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The Genus *Kamaka* (Crustacea, Amphipoda, Kamakidae) from Korean Brackish Waters, with Description of Newly Recorded Species, *Kamaka morinoi*

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ABSTRACT

Three species of the genus *Kamaka* have been reported from Korean brackish waters. Among them, *Kamaka morinoi* is identified as a newly recorded species in Korea. Previously, two species, *K. excavata* and *K. rostra*, were reported from the intertidal zone of Korea. However, this study confirms that these species also inhabit brackish water areas in Korea. The newly recorded species, *Kamaka morinoi*, is morphologically similar to *K. biwae* and *K. rostra*, but can be distinguished from its congeners by the shape of the propodus of gnathopod 2, the absence of protuberances on the posteroventral margin of peduncular articles 4–5, and differences in the number of plumose setae on the posterior margin of the basis of pereopod 7. This newly recorded species is described and fully illustrated in the present study. A key to the Korean *Kamaka* species is provided.

Keywords: kamakid, key, Korea, Peracarida, Senticaudata, taxonomy

INTRODUCTION

Brackish water areas, where freshwater and seawater intersect, form ecological transition zones known as brackish water ecosystems. These regions are characterized by a unique combination of physical, chemical, and biological elements and are recognized as some of the most productive ecosystems on Earth (Lim and Kim, 2018). The amount of freshwater fluctuates irregularly depending on rainfall in the catchment area, while seawater undergoes regular vertical movements. This results in salinity levels that can vary widely, ranging from 0.5 to 30.0 psu, and changes significantly with seasonal variations and rainfall (Han et al., 2021). Consequently, organisms capable of adapting to a broad range of salinity levels are commonly found in these areas (Lim and Kim, 2018). Although the number of taxa in brackish water ecosystems is smaller than that of pure marine or freshwater ecosystems, most of the species present are marine with freshwater species representing only a small fraction (Lee et al., 2018).

In Korea, several studies have focused on brackish water invertebrates. Lim et al. (2012) and Lim and Kim (2018) analyzed the biodiversity and ecological characteristics of brackish ecosystems. Kim (1991) examined the relationship between benthic environments and the organisms living within them. Hong and Lim (2002) and Hong et al. (2000, 2004) investigated the habitat characteristics of large benthic animals distributed in the brackish waters of Yangyangnamdae Stream. Moon et al. (2011a) studied seasonal changes downstream of the estuary, which is the sphere of influence of seawater. Kim et al. (2000) and Moon et al. (2011b) also conducted studies on the ecology of copepods in brackish waters. Lee et al. (2018) and Han et al. (2021) researched the distribution and ecology of *Clithon retropictum* (E. von Martens, 1878) in brackish waters. Regarding amphipods, only 10 species (3.3%), including *Grandidierella japonica* Stephensen, 1938, *Jesogammarus* (*Jesogammarus*) *hinumensis* Morino, 1993, *Melita aestuarina* Choi and Kim, 2024, *M. setiflagella* Yamato, 1988, *M. shimizui* (Ueno, 1940), *Monoculodes dentimanus* Jo, 1990, *Monocorophium insidiosum* (Crawford, 1937), *Platorchestia japonica* (Tattersall, 1922), *P. monodi* (Mateus, Mateus & Afonso, 1986), and *Sinocorophium hangangense* Kim, 2012 have been recorded in Korean brackish waters (Jo, 1990; Kim, 1991; Kim et al., 1992; Kim and Min, 2010, 2011; Kim, 2012; Song et al., 2017; Lee et al., 2019, Choi and Kim, 2024). This small number is relatively low

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compared to the 267 marine species (87.5%) and 28 freshwater species (9.2%) in Korea. It is expected that further research on brackish water amphipods will reveal more species inhabiting these environments.

The family Kamakidae, as described by Myers and Lowry (2003), comprises a group of photoid amphipods, that includes two subfamilies, ten genera, and 43 species (Horton et al., 2025). This family was originally classified under the family Corophiidae until 2003. Later, Myers and Lowry elevated it to the rank of a separate family, Kamakidae, with *Kamaka* as the type genus. They also introduced two new subfamilies: Aorchinae and Kamakinae (Myers and Lowry, 2003). The subfamily Kamakinae consists of seven genera: *Aorchoides* Ledoyer, 1972, *Cerapopsis* Della Valle, 1893, *Gammaropsella* Myers, 1995, *Heterokamaka* Ariyama, 2008, *Kamaka* Derzhavin, 1923, *Ledoyerella* Myers, 1973, and *Paraloiloi* Myers, 1995. Among these genera, *Kamaka* was established by Derzhavin (1923), with *K. kuthae* Derzhavin, 1923 as its type species (Derzhavin, 1923; Ariyama, 2007a). This genus can be easily distinguished from others by the following features: (1) urosomites 1 and 2 are coalesced; (2) urosomite 3 is also coalesced with the telson (Barnard and Karaman, 1991; Morino, 2012; Jung and Yoon, 2015). This genus is known to inhabit a broad range of salinities from freshwater to seawater and generally exhibits a tube-dwelling life cycle (Ariyama, 2007a, 2007b; Lowry and Myers, 2009). To date, 19 described species of the genus *Kamaka* are known, of which eight kamakid species have been reported from East Asian waters: *Kamaka biwae*, *K. corophina*, *K. excavata*, *K. foliacea*, and *K. littoralis* from China (Ren, 2006; Ren and Sha, 2013); *K. poppi* from Hong Kong (Bamber, 2003); and *K. biwae*, *K. excavata*, *K. kuthae*, and *K. morinoi* from Japan (Ariyama, 2007a, 2007b). To date, two species, *Kamaka excavata* and *K. rostra*, have been recorded in Korea (Jung and Yoon, 2015). These species have been found in the tidal mudflats of seawater. In this paper, we report a newly recorded species, *K. morinoi*, thereby adding it to the kamakid amphipod fauna and presenting the first record of kamakid species in Korean brackish waters. Molecular analysis, utilizing the mitochondrial cytochrome *c* oxidase subunit I (COI) gene, has confirmed these specimens as representing distinct newly recorded species in Korea. Additionally, a key to *Kamaka* species in Korean waters is provided.

MATERIALS AND METHODS

Sample collection and morphological examination

Specimens were collected from brackish waters in Korea using a dredge during the period 2017–2024 (Table 1, Fig. 1). The specimens were fixed in 95% ethanol and dissected in glycerol on Cobb's aluminum hole slides. The materials were examined using stereoscope (Olympus SZX 10, Japan) and compound microscopes (Olympus BX 51), and drawings and measurements were performed with the aid of a drawing tube. Line drawings were produced using the program Clip Studio Paint (Celsys, Japan). Body length was measured from the tip of the rostrum to the posterior end of the urosome, along the dorsal parabolic line of the body. The examined specimens are deposited at the National Institute of Biological Resources (NIBR), Incheon, Korea, Chungcheongnam-do, Korea, and the Department of Biological Science, Dankook University (DKU), Cheonan, Korea.

Molecular analysis

Genomic DNA was extracted from the muscles of the appendages of three Korean *Kamaka* specimens (Table 2) using DNeasy Blood & Tissue Kit (Qiagen, Germany), following the manufacturer's instructions. The COI gene was amplified using the LCO1490 and HCO2198 primer set (Folmer et al., 1994). PCR reactions were performed using the SimpliAmp thermal cycler (Thermo Fisher Scientific) using KOD One PCR master Mix (Toyobo STC Co., Japan), with cycling conditions of 35 cycles at 98°C for 10 s, 50°C for 5 s, and 68°C for 1 s. Molecular analyses were performed using COI sequences aligned by Geneious Prime (Biomatters, New Zealand). Nucleotide sequence divergence was calculated using the Kimura-two-parameter model (Kimura, 1980). Phylogenetic tree was constructed using maximum likelihood by MEGA 11 (Tamura et al., 2021) and the resulting relationships were assessed for confidence using a bootstrap procedure with 1,000 replications.

SYSTEMATIC ACCOUNTS

Order Amphipoda Latreille, 1816
Family Kamakidae Myers and Lowry, 2003
Genus *Kamaka* Derzhavin, 1923

1. *Kamaka excavata* Ariyama, 2007 (Fig. 2A)

Kamaka excavata Ariyama, 2007b: 256, figs. 1–4; Ren and Sha, 2013: 392, fig. 1; Jung and Yoon, 2015: 357, figs. 1–4.

Material examined. Korea: 1♂, 1♀, Jeollanam-do, Gwangyang-si, Jinwol-myeon, Seonso-ri, Seomjin River, 34°58′39″N, 127°45′40″E, 16 Apr 2024; 2♀♀, Gwangyang-si, Okgok-myeon, Singeum-ri, Sueo Stream, 34°58′26″N, 127°43′32″E, 19 Apr 2024, Im SH.
Previous Korean record. Korea: 1♂, 1♀, Jeollanam-do:

Table 1. Details of sampling localities information of the genus *Kamaka* from Korean brackish waters

Station No.	Species	Date	Locality	Latitude, longitude	No. of specimens
1	*Kamaka morinoi*	30 Aug 2023	Galdu Stream, Cheongsan-ri, Taean-gun	36°48′47″N, 126°16′29″E	1
2	*Kamaka rostra*	18 Apr 2019	Bulgap Stream, Shinseong-ri, Yeonggwang-gun	35°15′26″N, 126°23′04″E	20
3	*Kamaka morinoi*	19 Apr 2018 16 May 2022	Maryang Stream, Wonpo-ri, Gangjin-gun	34°27′27″N, 126°49′58″E	20 55
4	*Kamaka morinoi*	21 Apr 2020	Honggeo Stream, Jicheon-ri, Jangheung-gun	34°38′03″N, 126°58′18″E	83
5	*Kamaka morinoi*	04 Oct 2018 18 Apr 2019 18 Apr 2022	Ssangbong Stream, Hwachi-dong, Yeosu-si	34°49′29″N, 127°38′12″E	20 30 25
6	*Kamaka morinoi*	26 Apr 2018 22 Apr 2021	Yulchon Stream, Jojo-ri, Yeosu-si	34°52′47″N, 127°35′27″E	290 75
7	*Kamaka morinoi*	27 Apr 2018	Gwangyangseo Stream, Dowol-ri, Gwangyang-si	34°57′30″N, 127°35′52″E	28
8	*Kamaka excavata*	19 Apr 2024	Sueo Stream, Singeum-ri, Gwangyang-si	34°58′26″N, 127°43′32″E	2
9	*Kamaka excavata*	16 Apr 2024	Seomjin River, Seonso-ri, Gwangyang-si	34°58′39″N, 127°45′40″E	2
10	*Kamaka morinoi*	18 Apr 2023	Daesa Stream, Posang-ri, Namhae-gun	34°54′04″N, 127°51′44″E	4
11	*Kamaka morinoi*	20 Apr 2021 17 Apr 2024	Buyun Stream, Oyong-ri, Namhae-gun	34°51′57″N, 128°01′29″E	98 26
12	*Kamaka morinoi*	06 May 2020 14 Sep 2023	Changseon Stream, Sangjuk-ri, Namhae-gun	34°51′57″N, 128°00′59″E	150 10
13	*Kamaka morinoi*	17 Apr 2023	Mukgok Stream, Hwandeok-ri, Sacheon-si	35°03′24″N, 128°00′59″E	54
14	*Kamaka morinoi*	18 Apr 2019	Daedok Stream, Daedok-ri, Goseong-gun	34°57′58″N, 128°18′55″E	10
15	*Kamaka morinoi*	22 Apr 2021	Geumbongsan Stream, Bongdong-ri, Goseong-gun	35°03′40″N, 128°23′51″E	4
16	*Kamaka morinoi*	10 Sep 2019	Gandeok Stream, Oegan-ri, Geoje-si	34°51′14″N, 128°34′40″E	10
17	*Kamaka morinoi*	21 Apr 2021	Yeoncho Stream, Yeonsa-ri, Geoje-si	34°54′12″N, 128°38′44″E	20
18	*Kamaka morinoi*	18 Apr 2019	Gohyeon Stream, Gohyeon-dong, Geoje-si	34°53′30″N, 128°37′29″E	25
19	*Kamaka morinoi*	22 Apr 2021	Imgok Stream, Yultiri, Masanhappo-gu, Changwon-si	35°06′22″N, 128°27′02″E,	4
20	*Kamaka morinoi*	18 Apr 2024	Seokgok Stream, Sujeong-ri, Masanhappo-gu, Changwon-si	35°07′01″N, 128°34′54″E	1
21	*Kamaka morinoi*	20 Apr 2021	Jangan Stream, Gilcheon-ri, Gijang-gun	35°20′02″N, 129°16′37″E	1
22	*Kamaka morinoi*	30 Mar 223	Hoeya River, Sampyeong-ri, Ulju-gun	35°23′55″N, 129°19′20″E	1
23	*Kamaka morinoi*	17 Apr 2019	Cheongnyang Stream, Sangnam-ri, Ulju-gun	35°29′02″N, 129°19′15″E	20
24	*Kamaka morinoi*	25 Apr 2017 20 Apr 2021 26 Aug 221	Taehwa River, Myeongchon-dong, Buk-gu	35°32′32″N, 129°21′37″E	3 1 1
25	*Kamaka morinoi*	18 Apr 2018	Song Stream, Goesi-ri, Yeongdeok-gun	36°33′21″N, 129°25′12″E	2
26	*Kamaka morinoi*	18 Apr 2018 28 Aug 2019 30 Aug 2022	Baekrok Stream, Yeong-ri, Yeongdeok-gun	36°35′42″N, 129°24′32″E	6 38 9
27	*Kamaka morinoi*	17 Apr 2024	Chu Stream, Maewon-ri, Samcheok-si	37°19′23″N, 129°16´05″E	1
28	*Kamaka morinoi*	20 Apr 2022	Yeongok Stream, Yeongjin-ri, Gangneung-si	37°51′57″N, 128°50′52″E	23
29	*Kamaka morinoi*	10 Apr 2017 17 Apr 2019 19 Apr 2022	Dongmyeong Steram, Osan-ri, Yangyang-gun	38°05′13″N, 128°39′37″E	46 103 20

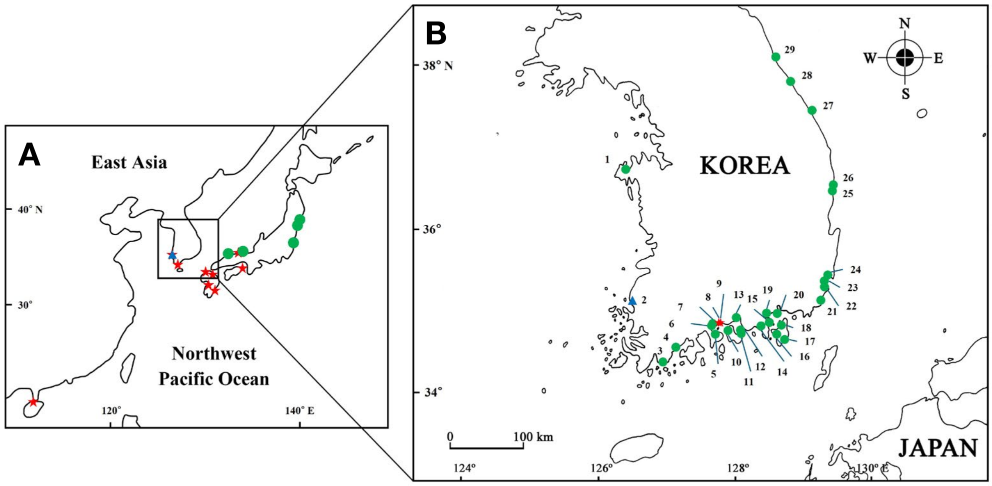

Fig. 1. Map showing collecting locations for *Kamaka* species from East Asia (●: *Kamaka morinoi* Ariyama, 2007; ★: *Kamaka excavata* Ariyama, 2007; ▲: *Kamaka rostra* Jung & Yoon, 2015). A, Previous record of *Kamaka* species from East Asian waters; B, Present study of *Kamaka* species from Korean brackish waters (see Table 1 for station details).

Hampyeong-gun, Hyeongyeong-myeon, Yongjeong-ri, 35°04′32″N, 126°23′20″E, 20 Apr 2011; 10♂♂, 15♀♀, Wando-gun, Sinji-myeon, Daegok-ri, 32°20′26″N, 126°49′07″E, 23 Jun 2011, Jung TW (Jung and Yoon, 2015).

Distribution. China, Japan, Korea (Jeollanam-do). This species was previously known to inhabit intertidal zones in Korea, however, this study confirmed its presence in brackish water areas, demonstrating that it inhabits both brackish and marine environments. Additionally, this species is found in the brackish water zones of China and Japan.

Molecular data. Unfortunately, due to the limited number of *Kamaka excavata* specimens and the inconclusive results of the sequencing analysis, we were unable to obtain reliable sequence data.

Salinity range. 20.1–26.5 psu.

2.[1]*_Kamaka morinoi_ Ariyama, 2007 (Figs. 2B, C, 3, 4)

Kamaka sp. Matsumasa and Kurihara, 1988: 36 (cited from Ariyama, 2007a); Ishimaru, 1994: 38.

Kamaka morinoi Ariyama, 2007a: 148, figs. 5B, 7–10.

Material examined. Korea: 63♂♂, 87♀♀ (cat. No. NIBRIV0000924477), Gyeongsangnam-do, Namhae-gun, Changseon-myeon, Sangjuk-ri, Changseon Stream, 34°51′57″N, 128°00′59″E, 6 May 2020, Im SH.

Additional material examined. See Table 1 and Fig. 1 for station details.

Description. Adult male (cat. No. NIBRIV0000924477): Body (Figs. 2B, 3A) smooth, 3.5 mm long. Head subequal to pereonites 1 and 2 combined; cephalic lobe rounded, conspicuously protruded anteriorly; eye black, subround, located in cephalic lobe; urosomites 1 and 2 coalesced.

Antenna 1 (Fig. 3B) short, less setose; peduncular article 1 stout, with 2 simple setae on dorsal margin, 3 simple setae on ventral margin; peduncular articles 2 and 3 subrectangular and slender; length ratio of peduncular articles 1–3 = 1.00 : 0.83 : 0.83; flagellum 8-articulate, subequal to peduncle, distal article minute; accessory flagellum absent.

Antenna 2 (Fig. 3C) elongated, less setose, longer than antenna 1; peduncular article 3 short, subrectangular, with 3 simple setae distally; peduncular articles 4 and 5 elongate, rectangular; length ratio of peduncular articles 3–5 = 1.00 : 1.63 : 1.81; flagellum 5-articulate, distal article minute.

Gnathopod 1 (Fig. 3D), coxa subtrapezoid, with rounded corners, a row of 13 simple setae ventrally and 1 robust seta posteriorly; basis subrectangular, with 5 long simple setae posteriorly; carpus elongate, proximally narrow, with row of 5 pectinate setae posterodistally; propodus elongate ovate; palm oblique, with a row of short setae; dactylus falcate, overreaching palm, with 1 simple seta anteroproximally; length ratio of basis to dactylus = 1.00 : 0.40 : 0.53 : 1.07 : 0.80 : 0.60.

Gnathopod 2 (Fig. 3E) large, massive; coxa subrectangular, smaller than that of gnathopod 1, with 4 simple setae ventrally; basis subrectangular, narrowed posteroproximally, unarmed; carpus subtriangular, with 2 anterodistal and 1 posterior setae; propodus characteristic in form, enlarged, subtriangular, with 4 simple setae posterodistally, postero-

Korean name: [1]*기수카마카옆새우 (신칭)

Fig. 2. A, *Kamaka excavata* Ariyama, 2007, adult male, 3.1 mm; B, *Kamaka morinoi* Ariyama, 2007, adult male, 3.5 mm; C, *Kamaka morinoi* Ariyama, 2007, adult female, 2.3 mm; D, *Kamaka rostra* Jung & Yoon, 2015, adult male, 4.2 mm. Scale bars: A–D = 1.0 mm.

proximal portion features long, acute process accompanied by 2 simple setae; dactylus elongate, deeply curved inward, with 2 simple setae on anterior margin and 3 simple setae on posterior margin; length ratio of basis to dactylus = 1.00 : 0.33 : 0.44 : 0.56 : 1.52 : 1.85.

Pereopod 3 (Fig. 3F), coxa subquadrate with rounded corners, with 1 ventral simple and 1 posterior robust setae; basis subrectangular, slightly curved posteriorly, with 1 simple seta on posterodistal corner; merus proximally narrow, but broadened distally, with cluster of simple setae anterodistally; carpus subrectangular, with cluster of 4 simple setae anterodistally and 2 simple setae posteriorly; propodus slender, subrectangular, with 2 simple setae on posterior margin; dactylus falcate; length ratio of basis to dactylus = 1.00 : 0.21 : 0.42 : 0.42 : 0.54 : 0.21.

Pereopod 4 (Fig. 3G) similar to pereopod 3, but coxa slightly larger and each article shorter; length ratio of basis to dactylus = 1.00 : 0.20 : 0.44 : 0.48 : 0.56 : 0.24.

Pereopod 5 (Fig. 3H), coxa bilobate, anterior lobe strongly protruding downward, with 4 simple setae ventrally, posterior lobe with 1 plumose seta; basis slightly concave posteriorly, with 2 plumose and 1 short setae anteriorly, 4 plumose and 2 short setae posteriorly; merus gradually widening, with 3 robust setae anteriorly and 1 robust seta on posterior corner; carpus subrectangular, with group of robust setae anterodistally and 1 robust seta posterodistally; propodus subrectangular, with 2 robust and 1 plumose setae anterodistally, and 2 robust setae posterodistally; dactylus falcate; length ratio of basis to dactylus = 1.00 : 0.15 : 0.40 : 0.25 : 0.45 : 0.20.

Pereopod 6 (Fig. 4A), coxa bilobate, anterior lobe protruding downward, with 1 robust seta, posterior lobe with 1 plumose seta; basis subovate, anterior margin convex, with 11 plumose setae on anterior margin and 8 plumose setae on posterior margin; merus subrectangular, with 1 robust seta anterodistally and 3 simple setae on posterior margin; propodus subrectangular, with 4 simple and 1 plumose setae on anterior corner and 1 robust seta on posterior corner; dactylus falcate; length ratio of basis to dactylus = 1.00 : 0.19 : 0.59 : 0.55 : 0.77 : 0.36.

Pereopod 7 (Fig. 4B) similar to pereopod 6, but coxa unilobate, with 1 robust seta anteriorly and 1 short seta posteriorly; basis with 9 plumose setae on anterior margin and 10 plumose and 5 robust setae on posteriorly; length ratio of basis to dactylus = 1.00 : 0.23 : 0.59 : 0.48 : 0.63 : 0.41.

Uropod 1 (Fig. 4C), peduncle subrectangular, length 0.91 times as long as inner ramus, with 2 dorsolateral and 1 api-

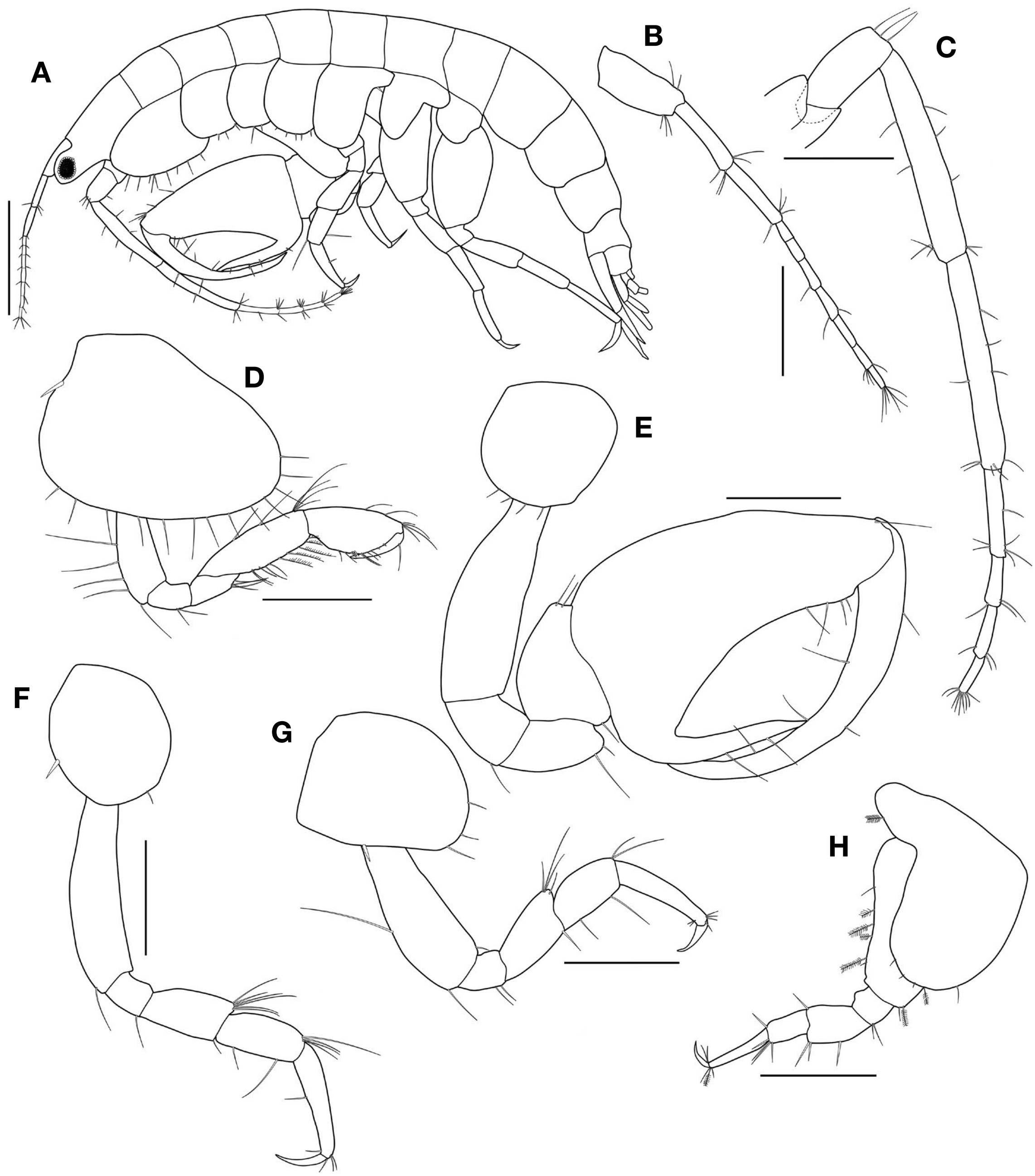

Fig. 3. *Kamaka morinoi* Ariyama, 2007, adult male, 3.5 mm. A, Habitus; B, Antenna 1; C, Antenna 2; D, Gnathopod 1; E, Gnathopod 2; F, Pereopod 3; G, Pereopod 4; H, Pereopod 5. Scale bars: A = 0.5 mm, B–H = 0.2 mm.

colateral robust setae, inter-ramal peduncular process distally; outer ramus 0.75 times as long as inner ramus, with 1 dorsal and 3 apical robust setae; inner ramus with 1 ventral and 5 apical robust setae.

Uropod 2 (Fig. 4D), peduncle short, with 1 dorsolateral robust seta; outer ramus 0.63 times as long as inner ramus; both rami with 1 dorsal and several apical robust setae.

Uropod 3 (Fig. 4E) uniramus; peduncle short, subrectangular, 0.88 times as long as ramus, with 2 robust setae medially; ramus short, uniarticulate, with 6 long simple setae apically.

Telson (Fig. 4F) entire, round apically, with 2 groups of 2 dorsal and 2 lateral setae.

Female (DKUAMP202501), Body (Figs. 2C, 4G) 2.3 mm long, morphologically similar to male in shape, except for the shape of gnathopods and presence of oostegites.

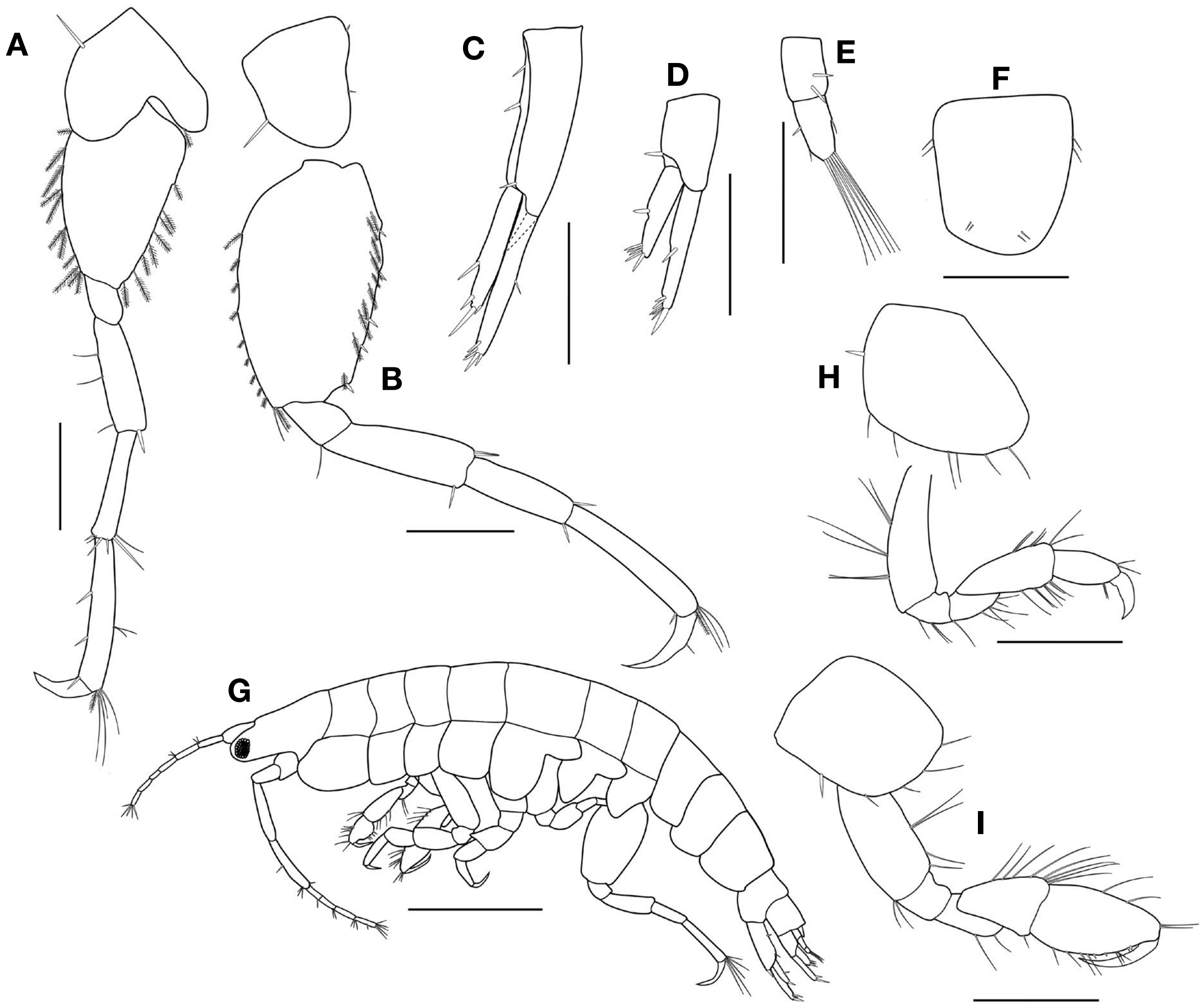

Fig. 4. *Kamaka morinoi* Ariyama, 2007, adult male, 3.5 mm; A, Pereopod 6; B, Pereopod 7; C, Uropod 1; D, Uropod 2; E, Uropod 3; F, Telson. *Kamaka morinoi* Ariyama, 2007, adult female, 2.3 mm; G, Habitus; H, Gnathopod 1; I, Gnathopod 2. Scale bars: A–E, H, I = 0.2 mm, F = 0.1 mm, G = 0.5 mm.

Gnathopod 1 (Fig. 4H) similar to male, but each article smaller.

Gnathopod 2 (Fig. 4I) subchelate; coxa broader than that of male; carpus widening distally; propodus smaller than that of male, without posteroproximal process, palm oblique.

Molecular data. CO1 gene sequences (GenBank accession Nos. PV476998, PV483415) were obtained from two *K. morinoi* specimens from Korea. The sequences were aligned and compared with sequences from *K. biwae* (LC763660–763662) in Japan and *K. rostra* (PV476999) from Korea (Table 2). Intraspecific variation of the CO1 gene sequence of *K. morinoi* ranged 2.3% while interspecific variation ranged from a low of 11.6% (*K. biwae* and *K. morinoi*) to a high of 17.6% (*K. rostra* and *K. morinoi*) (Table 3, Fig. 5).

Remarks. *Kamaka morinoi* is similar to *K. biwae* and *K. rostra* in the following features: (1) gnathopod 2, propodus triangular; (2) uropod 1, outer ramus with dorsal robust setae; and (3) uropod 2, both rami with dorsal robust setae. However, *K. morinoi* is easily distinguished from *K. biwae* and *K. rostra* by the following features (different characters of *K. biwae* and *K. rostra* in brackets): (1) cephalic lobe distally round (vs. acute in *K. rostra*); (2) eye subrounded (vs. reinform in *K. rostra*); (3) antenna 2, peduncular article 5 without protuberances (vs. with protuberances in *K. rostra*); (4) coxa 1, white color with right brown spots (vs. uniformly dark brown color in *K. biwae*); (5) gnathopod 2, dactylus with simple setae (vs. with plumose setae in *K. rostra*); and (6) pereopods 5–7, basis setose, posterior margin with 4-8-10 plumose setae (vs. sparse, with 2-4-9 plumose setae in *K. biwae* and densely setose, with 10-18-19 plumose setae in *K. rostra*). Our Korean specimens closely agree with the original description by Ariyama (2007a).

Table 2. Sampling localities information of *Kamaka* species from Korea and GenBank access numbers

No.	Species	Date	Locality	Latitude, longitude	GenBank accession No.
1	*Kamaka morinoi*	18 Apr 2019	Ssangbong Stream, Daepo-ri, Yeosu-si	34°49′29″N, 127°38′12″E	PV476998
2	*Kamaka morinoi*	17 Apr 2023	Mukgok Stream, Handeok-ri, Sacheon-si	35°02′57″N, 128°00′42″E	PV483415
3	*Kamaka rostra*	10 Apr 2019	Bulgap Stream, Chukdong-ri, Yeonggwang-gun	35°15′26″N, 126°23′04″E	PV476999
4	*Gammaropsis* sp.	27 Jun 2024	Ieodo Island, Mara-ri, Jeju-si	32°30′00″N, 124°30′00″E	PV522070

Table 3. The genetic distance in the *Kamaka* species based on mtDNA *COI* sequences

No.	Species	Site	1	2	3	4	5	6	7
1	*Kamaka biwae*	Lake biwa, Japan							
2	*Kamaka biwae*	Lake biwa, Japan	0.014						
3	*Kamaka biwae*	Lake biwa, Japan	0.012	0.012					
4	*Kamaka morinoi*	Mukgok Stream, Korea	0.127	0.125	0.131				
5	*Kamaka morinoi*	Ssangbong Stream, Korea	0.118	0.116	0.122	0.023			
6	*Kamaka rostra*	Bulgap Stream, Korea	0.160	0.164	0.166	0.176	0.165		
7	*Gammaropsis* sp.	Ieodo Island, Korea	0.247	0.251	0.251	0.238	0.231	0.230	

mtDNA, mitochondrial DNA; COI, cytochrome *c* oxidase subunit I.

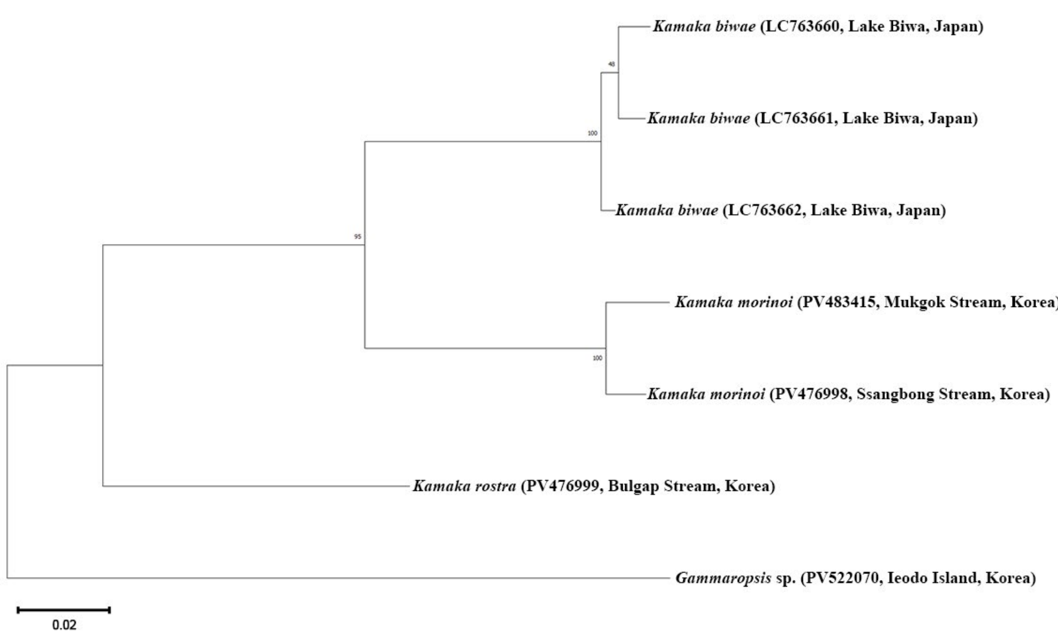

Fig. 5. Maximum-likelyhood (ML) tree based on the mitogenome sequence (COI) of *Kamaka biwae*, *K. morinoi*, and *K. rostra*.

Distribution. Japan, Korea (west, south, and east brackish waters). This species inhabits the brackish water zones of various rivers and streams in the eastern and southern regions of Korea. Additionally, this species is found in the fresh and brackish water zones of Japan.

Salinity range. 0.7–29.3 psu.

3. *Kamaka rostra* Jung and Yoon, 2015 (Fig. 2D)
Kamaka rostra Jung and Yoon, 2015: 364, figs. 5-8.

Material examined. Korea: 3♂♂, 18♀♀. Jeollanam-do, Yeonggwang-gun, Yeomsan-myeon, Shinseong-ri, Bulgap Stream, 35°15′26″N, 126°23′04″E, 18 Apr 2019, Im SH.
Previous Korean record. Korea: 3♂♂, 1♀, Jeollanam-do, Hampyeong-gun, Hyeongyeong-myeon, Yongjung-ri, 35°04′32″N, 126°23′20″E, 11 Apr 2012, Jung TW (Jung and Yoon, 2015).
Distribution. Korea (Jeollanam-do). This species was previously known to inhabit intertidal zones, but this study confirmed its presence in brackish water areas, demonstrating that it inhabits both brackish and marine environments.
Molecular data. CO1 gene sequences (GenBank accession No. PV476999) were obtained from one *K. rostra* specimen from Korea.
Salinity range. 18.7 psu.

Key to the species of *Kamaka* in Korean waters

1. Gnathopod 2, propodus subrectangular, ventral process thick, elongate, exceeding distal end of propodus ....*K. excavata* Ariyama, 2007
– Gnathopod 2, propodus subtriangular, ventral process slender, short, not exceeding distal end of propodus 2
2. Cephalic lobe triangular; antenna 1 setose; antenna 2, peduncular article 5 with protuberances; gnathopod 2, dactylus with plumose setae on posterior margin.. *K. rostra* Jung and Yoon, 2015
– Cephalic lobe rounded; antenna 1 less setose; antenna 2, peduncular article 5 without protuberances; gnathopod 2, dactylus with simple setae on posterior margin .... *K. morinoi* Ariyama, 2007

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CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

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