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Taxonomy on Freshwater Canthocamptid Harpacticoids from South Korea V. Genus *Bryocamptus*

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ABSTRACT

Five freshwater harpacticoid species of the genus *Bryocamptus* are identified as one of the serial taxonomic studies on the family Canthocamptidae in South Korea: *B. zschokkei caucasicus* (Borutzky, 1930), *B. nivalis* (Willey, 1925), *B. pacificus* Ishida, 1992, *B. vejdovskyi* (Mrazek, 1893) and *B. umiatensis* Wilson, 1958. *Bryocamptus pacificus*, *B. vedjovskyi* and *B. umiatensis* are newly known from Korea. A key to the species of the genus *Bryocamptus* in Korea is provided.

Key words: Taxonomy, *Bryocamptus*, Canthocamptidae, Harpacticoida, freshwater Copepoda, Korea

INTRODUCTION

Bryocamptus is the most representative and specious genus of the freshwater harpacticoid copepods. *Bryocamptus* copepods are commonly found from various freshwater bodies, mostly among detritus, fallen leaves or mosses submerged in streams, trickles, springs, cave waters and mountainous temporary pools. Total 118 species or subspecies are currently known in this genus (Boxshall and Halsey, 2004).

In Korea, three species have been recorded in the collection list of a few faunal researches (Miura, 1969; Kim and Chang, 1989; Chang, 1990) and in the "List of Animals in Korea" (The Korean Society of Systematic Zoology, 1997) under the name of *B. minutus* (Claus), *B. hiemalis yunnanensis* Borutzky, and *B. zschokkei* (Schmeil) [or *B. zschokkei caucasicus* (Borutzky)]. They all have been in need of taxonomic revision.

As the fifth report of the serial studies on the family Canthocamptidae in South Korea, this paper deals with the taxonomic accounts of the genus *Bryocamptus*.

MATERIALS AND METHODS

Samplings were made with a dipnet of no. 10 mesh aperture, and copepods were fixed and stored in 4% buffered formalin. All specimens were dissected, drawn, and measured in lactophenol on H-S slide, a recent variation of Cobb slide (Shirayama et al., 1993). Mounted specimens were observed under a differential interference contrast microscope with Nomarski optics. Figures were prepared by using a camera lucida.

Abbreviations are used in the text and figure legend: enp 1-3 or exp 1-3, first to third endopodal or exopodal segment of each leg; L/W, length to width ratio. Main collectors of the material examined are initialized as follows: Cheon Young Chang as CYC, Hyeon Soo Rho as HSR, Hyung Wook Lim as HWL, Ji Min Lee as JML, Jin Mo Jeon as JMJ, and Young Hee Song as YHS.

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TAXONOMIC ACCOUNTS

Family Canthocamptidae Sars, 1906
Genus *Bryocamptus* Brady, 1880

[1]***Bryocamptus zschokkei caucasicus* Borutzky, 1930 (Figs. 1, 2)**

Bryocamptus caucasicus Borutzky, 1930, p. 124, figs. 5-11.
Bryocamptus (*Rheocamptus*) *zschokkei caucasicus*: Borutzky, 1952, p. 176, fig. 64 (1-11); Tai and Song, 1979, p. 251, figs. 120-121; Kim and Chang, 1989, p. 165; Chang, 1990, p. 220.
Bryocamptus (*Bryocamptus*) *zschokkei*: Miura, 1969, p. 241.
Bryocamptus zschokkei: Ishida, 1987, p. 85, pl. 22; Ishida and Kikuchi, 2000, p. 31, fig. 47.

Material examined. 4♀♀, 1♂, Jinburyeong Hill, Seoraksan Mt., 24 Aug. 1996 (CYC, JML); 2♀♀, 1♂, Naerincheon stream, Seoraksan Mt., Inje, 6 Nov. 1999 (JML, YHS); 6♀♀, 1♂, Hugok spring, Yanggu, 6 Nov. 1999

[1]*코카삭이끼장수노벌레

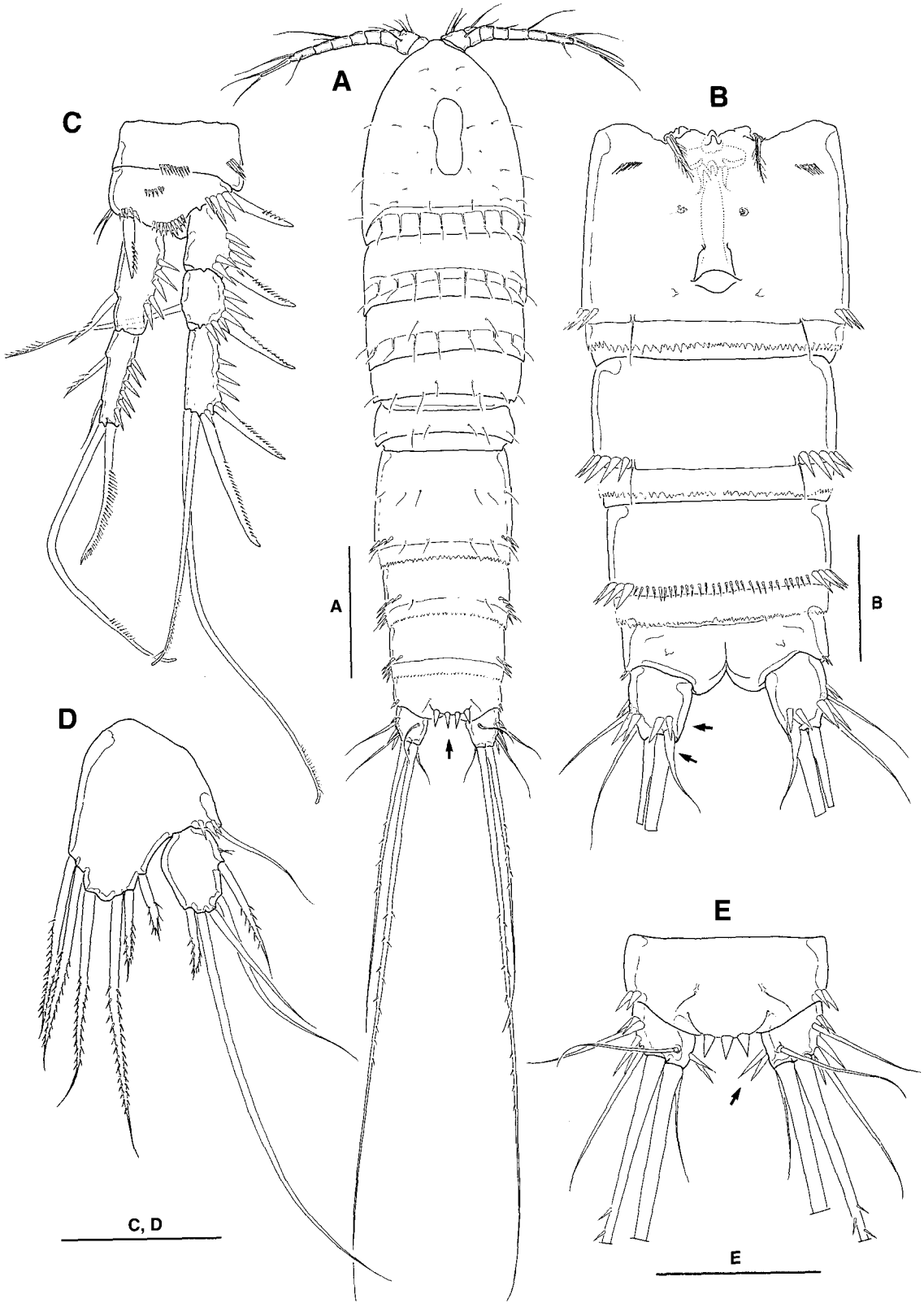

Fig. 1. *Bryocamptus zschokkei caucasicus*. A-D, female: A, habitus, dorsal; B, urosomites and caudal rami, ventral; C, leg 1; D, leg 5. E, male anal somite and caudal rami, dorsal. Scale bars=0.1 mm (A), 0.05 mm (B-E).

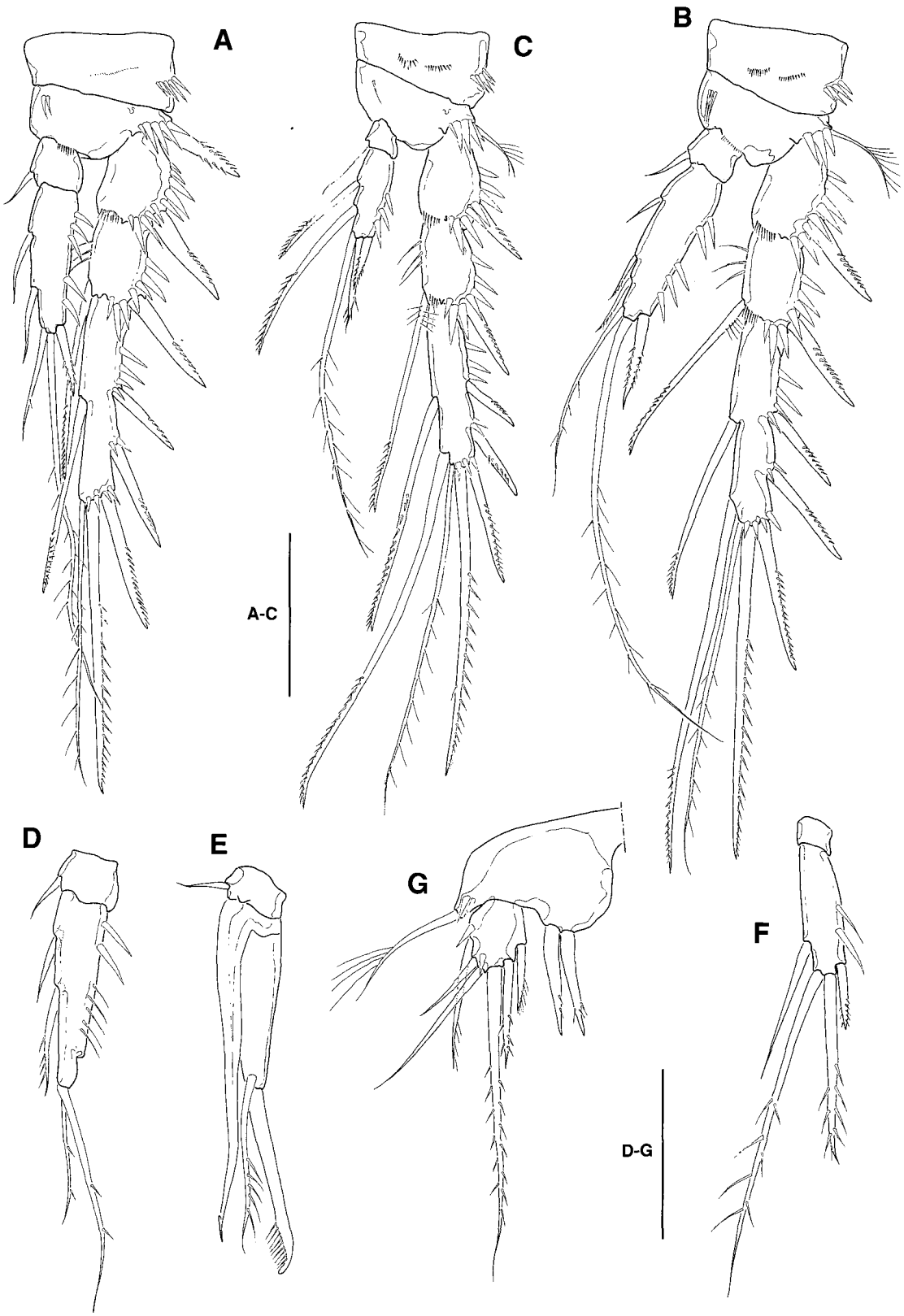

Fig. 2. *Bryocamptus zschokkei caucasicus*. A-C, female legs 2-4. D-F, endopods of male legs 2-4; G, male leg 5. Scale bars=0.05 mm (A-C), 0.03 mm (D-G).

(JML, YHS); 1♀ (ovi.), Weoljeongsa Valley, Odaesan Mt., 28 Jul. 1999 (CYC, JML); 1♀, 1♂, Eoseongjeon Valley, Odaesan Mt., Yangyang, 6 Nov. 1999 (CYC, JML); 1♀ (ovi.), 1♂, Gangneung (well), 8 May 1993 (CYC); 2♀♀, 2♂♂, Gangneung (spring), 21 Jul. 1995 (CYC, JML); 3♀♀, 2♂♂, Hujin Port (puddle), Samcheok, 25 Aug. 1996 (CYC, JML); 2♀♀, Surisan Mt., Gunpo, 8 Nov. 1999 (CYC); 1♂, Chiljangsa Temple, Anseong, 15 Oct. 1999 (CYC, JML); 6♀♀, 3♂♂, Donghaksa Temple, Gongju, 17 Jun. 1995 (CYC); 2♀♀, 1♂, Joryeong Hill, Mungyeong, 12 Feb. 1995 (HSR); 1♀, 1♂, Gimryongsa Temple, Mungyeong, 10 Nov. 1995 (HSR); 2♀♀, 1♂, Yongchu Valley, Mungyeong, 12 Mar. 1995 (HSR); 3♀♀ (ovi.), Gimryongsa Temple, Mungyeong, 11 Nov. 1996 (HSR); 2♀♀, 1♂, Nutjae Valley, Bonghwa, 9 Oct. 1999 (JML, YHS); 1♀, Jung-ri (streamlet), Sangju, 10 Jul. 1999 (JML, YHS); 2♀♀, Seongamsa Temple, Seongamsan Mt., Gyeongsan, 10 Jun. 1995 (CYC, JML, HSR); 1♀, Eunhaesa Temple, Yeongcheon, 8 Oct. 2004 (CYC); 1♀, 1♂, Geumsansa Temple, Moaksan Mt., Jeonju, 29 Oct. 1999 (CYC, JML); 1♀, Gogi-ri (spring), Jirisan Mt., Namwon, 28 Jan. 1991 (CYC); 1♀, Seoknamsa Temple, Gajisan Mt., Ulsan, 10 Jul. 1999 (CYC); 3♀♀, 1♂, Suryeom-ri (streamlet), Gyeongju, 18 Apr. 2005 (HWL, JMJ); 2♀♀, Seoknamsa Temple, Gajisan Mt., Ulsan, 13 Aug. 1996 (CYC); 1♀, Dongchuksa Temple, Ulsan, 4 Oct. 2004 (CYC, JML); 1♀, Okcheonsa Temple (streamlet), Yeonhwasan Mt., Goseong, 5 Jun. 1999 (CYC, JML); 2♀♀, 3♂♂, Dasolsa Temple (spring), Sacheon, Gyeongnam, 26 Oct. 1999 (CYC, JML); 12♀♀, 6♂, Weochulsan Mt., Yeongam, 28 May 1995 (CYC); 5♀♀, 3♂♂, Daejipo (spring), Changseon Is., Namhae, 27 Jul. 2004 (CYC, JML); 1♀ (ovi.), Ssangyesa Temple, Jindo Is., 29 Jun. 2004 (HWL, JMJ); 2♀♀, Oido-dong (spring), Jeju, Jejudo Is, 20 Mar. 2003 (CYC, JML); 2♀♀, 2♂♂, Gushimul spring, Jejudo Is, 6 Jun. 2004 (CYC, JML); 1♀ (ovi.), Cheonjeyeon Fall, Jejudo Is, 25 May 1993 (CYC); 13♀♀, 7♂♂, Cheonjeyeon Fall, Jejudo Is, 16 Jun. 1999 (CYC, JML).

Diagnosis. Body (Fig. 1A) hirsute, small and cylindrical, 0.43-0.61 mm long in females and 0.4-0.47 mm in males, excluding caudal setae; usually tinged with pale gray in alcohol or formalin. Urosomites with spinule row along posterolateral margin; ventral spinulation restricted to third urosomite (Fig. 1B). Anal operculum convex with 3-5 strong spines along posterior margin (Fig. 1A, E). Caudal rami of both sexes (Fig. 1B, E) cylindrical, (L/W about 1.3 in female and about 1.2 in male), a little divergent posteriorly; posteromedial face of caudal rami smooth in female (Fig. 1B, arrow), while with 2-3 spinules in male (Fig. 1E, arrow); inner caudal seta issuing below median terminal caudal seta (Fig. 1B, arrow). Antennule 8-segmented; exopod of antenna 2-segmented, distal segment bearing 3 setae. Leg 1 (Fig. 1C) endopod 2-segmented, slightly longer than exopod. Legs 2-4 endopods of female (Fig. 2A-C) 2-segmented; enp 1 with 1 distomedial seta. Male endopods modified, as in Fig. 2D-F. Female leg 5 (Fig. 1D) exopod small, a little longer than wide, with 5 setae; baseoendopod with 6 setae, including 2 short lateralmost setae. Male leg (Fig. 2G) with 6 setae on exopod and 2 stout spiniform setae on baseoendopod.

Remarks. More than nine subspecies and many varieties have been known in *B. zschokkei* (Schmeil) (Dussart and Defaye, 1990). Among them, Korean specimens coincide with *B. zschokkei caucasicus*. Borutzky (1952) regarded *B. zschokkei himalayensis* Chappuis from the Himalayas and *B. zschokkei orientalis* Chappuis from southern China as the varieties of *B. zschokkei caucasicus*, and differentiated *B. zschokkei caucasicus* from the nominate subspecies, *B. zschokkei zschokkei* by the position of the inner apical caudal seta, "situated in the subspecies below the median apical seta". Authors think that this character deserves to be a significant and diagnostic one for the classification of canthocamptid harpacticoids, because males usually perceive their mating partner through the shape of caudal rami and caudal setae when males try to seize the caudal setae of females by their geniculated antennules (cf. Chang and Ishida, 2001). And so we admit *B. zschokkei caucasicus* as an independent taxon, and regard the records from East Asia, that is, '*B. zschokkei caucasicus*' *sensu* Tai and Song, 1979 from China, *B. zschokkei sensu* Ishida and Kikuchi, 2000 from Japan (Ishida and Kikuchi, 2000) and the present data from Korea as the same subspecies, *B. zschokkei caucasicus*.

In South Korea, this species occurred from various mountainous waters, especially from the submerged mosses or fallen leaves in cold springs and trickles. This is the most frequent species among the mountain-water copepods, occurred from 32 of total 56 samples examined (frequency 57%). *Bryocamptus zschokkei caucasicus* is smallest (0.4-0.61 mm in body length) in the *Bryocamptus* species from Korea, and easily distinguished from the others by 2-segmented endopods of first leg, 3-5 strong projections of anal operculum and the shape of caudal rami.

Distribution. Korea, Japan, China, Central Asia, North America.

[1]*Bryocamptus nivalis* (Willey, 1925) (Figs. 3, 4)

Attheyella nivalis Willey, 1925, p. 153, figs. 25-26.

[1]*이끼장수노벌레 (신칭)

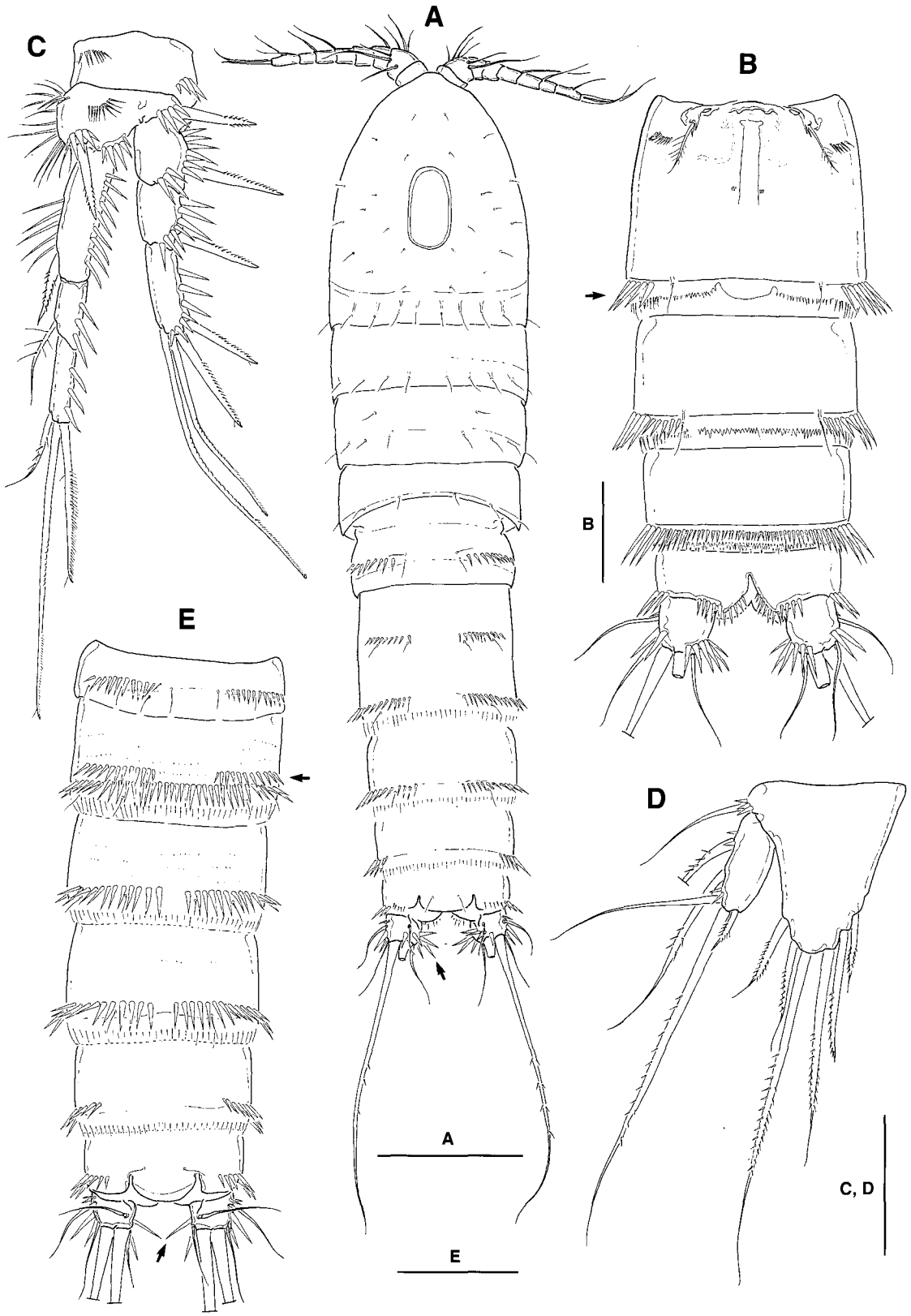

Fig. 3. *Bryocamptus nivalis*. A-D, female: A, habitus, dorsal; B, urosomites and caudal rami, ventral; C, leg 1; D, leg 5. E, male urosomites and caudal rami, dorsal. Scale bars=0.1 mm (A), 0.05 mm (B-E).

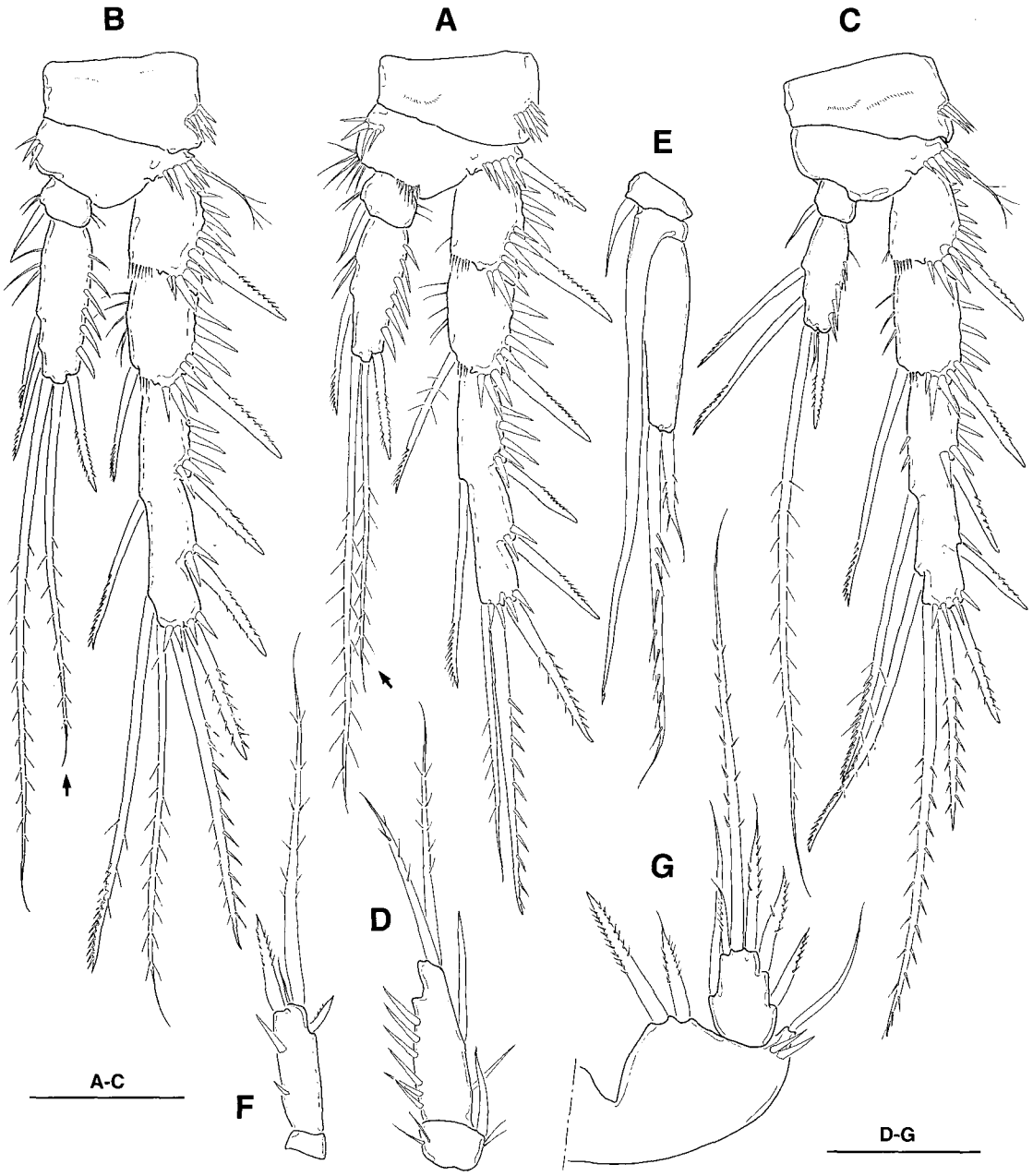

Fig. 4. *Bryocamptus nivalis*. A-C, female legs 2-4; D-F, endopods of male legs 2-4; G, male leg 5. Scale bars=0.05 mm (A-C), 0.03 mm (D-G).

Echinocamptus (*Limocamptus*) *nivalis*: Chappuis, 1931, p. 358.

Echinocamptus (*Limocamptus*) *hiemalis nivalis*: Coker, 1934, p. 105.

Bryocamptus (*Limocamptus*) *hiemalis* var. *nivalis*: Lang, 1948, p. 972; Dussart and Defaye, 1990, p. 173.

Echinocamptus (*Limocamptus*) *hiemalis* var. *nivalis*: Borutzky, 1952, p. 238.

Canthocamptus calvus Brehm, 1927, p. 143, figs. 17-22.

Bryocamptus calvus Miura, 1962, p. 271, figs. 32-50; Ishida, 1987, p. 86, pl. 26; 1989 (part.), p. 2; 1990, p. 41.

Bryocamptus nivalis: Miura, 1962, p. 267; Ishida and Kikuchi, 2000, p. 31, fig. 49.

Bryocamptus hiemalis yunnanensis (non Borutzky): Kim and Chang, 1989, p. 165; Chang, 1990, p. 220.

Material examined. 4♀♀ (2 ovi.), 2♂♂, Jinburyeong Hill, Seoraksan Mt., 24 Aug. 1996 (CYC, JML); 2♀♀, 1♂, Naerincheon Str., Seoraksan Mt., Inje, 6 Nov. 1999 (JML, YHS); 3♀♀, 1♂, Hugok spring, Yanggu, 6 Nov. 1999 (JML, YHS); 2♀♀, Weoljeongsa Valley, Odaesan Mt., 28 Jul. 1999 (CYC, JML); 1♀, Anhyeon-dong (trickle), Gangneung, 20 Jun. 2004 (CYC, JML); 2♂♂, Hujin Port (puddle), Samcheok, 25 Aug. 1996 (CYC, JML); 2♀♀, Chiljangsa Temple, Anseong, 15 Oct. 1999 (CYC, JML); 3♀♀, 2♂♂, Cheonunsa Temple (spring), Chungju, 31 May 1991 (S.H. Kim); 5♀♀, 3♂♂, Songgye Valley, Weolaksan Mt., Chungju, 2 Jun. 2000 (CYC, JML); 3♂♂, 11♀♀, Simpigul Cave, Goisan, 1 Aug. 1996 (HSR); 2♀♀, 1♂, Sutgul cave, Mungyeong, 1 Aug. 1996 (HSR); 3♀♀ (1 ovi.), Gimryongsa Temple, Mungyeong, 11 Nov. 1996 (HSR); 1♀, 1♂, Nutjae Valley, Bonghwa, 9 Oct. 1999 (JML, YHS); 1♀, Jung-ri (streamlet), Sangju, 10 Jul. 1999 (JML, YHS); 6♀♀, 5♂♂, Jikjisa Temple, Gimcheon, 21 Jun. 1991 (CYC); 1♀, Tongjeom (streamlet), Cheongdo, 10 Jul. 1998 (JML); 3♀♀, 1♂, Bammeorijae Hill (trickle), Sancheong, 26 Oct. 1999 (CYC, JML); 2♀♀, 3♂♂, Jeungsimsa Temple, Mudeungsan Mt., Gwangju, 10 Oct. 2004 (CYC); 1♀, Hwawangsan Mt. (trickle), Changnyeong, 14 Mar. 1999 (CYC, JML); 1♀, Seoknamsa Temple, Gajisan Mt., Ulsan, 10 Jul. 1999 (CYC); 1♀ (ovi.), Gosan coast off Chagwido Is. (spring), Jejudo Is, 21 Mar. 2003 (CYC, JML); 1♀, Cheonjeyeon Fall, Jejudo Is, 25 May 1993 (CYC).

Diagnosis. Body (Fig. 3A) hirsute and cylindrical, usually tinged with milky gray, very similar in alcohol or formalin, relatively larger than *B. zschokkei caucasicus* and *B. pacificus*, 0.52-0.65 mm long in females and 0.41-0.48 mm in males, excluding rostrum and caudal setae. Anal operculum (Fig. 3A, E) convex with smooth posterior margin. Caudal rami nearly as long as wide in ventral view (L/W about 0.9-1), nearly parallel, with 6-8 spinules along distomedial face in female (Fig. 3A, arrows), with 4-6 spinules in male (Fig. 3E, arrow). Female antennule, antenna with typical segmentation and seta/spine ornamentation of genus *Bryocamptus*. Leg 1 (Fig. 3C) endopod 3-segmented; enp 1 exceeding exp 2, with 1 distomedial seta. Endopods of legs 2-4 in female (Fig. 4A-C) 2-segmented; enp 1 each with 1 distomedial seta; length ratio of two apical setae on enp 2 of legs 2-3 about 0.7-0.8 (Fig. 4A, B, arrow). Female leg 5 (Fig. 3D) baseoendopod protruding and far exceeding distal end of exopod, bearing 6 setae; exopod L/W about 2-2.1, with 5 setae including very short innermost seta. Male endopods modified, as in Fig. 4D-F; leg 3 enp 2 (Fig. 4E) armed with a long barbed process (apophysis). Male leg 5 (Fig. 4G) baseoendopod with 2 spiniform setae, medial one of which about 1.3 times longer than lateral one; exopod rather suboval, L/W about 1.5, bearing 6 setae.

Remarks. Bryocamptus nivalis described from Canada and *B. calvus* from Aoki Lake, Japan have been confused to each other so long time in many faunistic studies in Japan (*e.g.* Miura, 1962; Ishida, 1987; 1990) before Dr. Ishida collected the specimens of *B. nivalis* at Washington, U.S.A. and confirmed that they are synonymous (cf. Ishida and Kikuchi, 2000). Authors compared Korean specimens with the specimens of *B. nivalis* from Japan, and found out that they are identical to each other.

Bryocamptus hiemalis s. str. is different from *B. nivalis* by the relative length of caudal rami (in a ventral view, as long as wide or slightly shorter than wide in *B. nivalis*, while much longer than wide in *B. hiemalis*) and by the seta of leg 4 enp 1 (an distomedial seta present in *B. nivalis*, while lacking in *B. hiemalis*) according to Borutzky (1952)'s criteria. However, the character of length ratios in caudal rami might be rather subtle. The caudal rami of *B. nivalis* is nearly as long as wide, and some individual variations exist. Moreover, the length to width ratio can be variable depending on the preparation condition. Ishida and Kikuchi (2000) proposed that the decisive discrepancy between two species lies in the spinulation pattern of urosomites. In Korea, *Bryocamptus hiemalis s. str.* has not been found yet.

Kim and Chang (1989) and Chang (1990) reported *B. hiemalis yunnanensis* from Songnisan Mt. and Wolchulsan Mt., respectively. As the result of re-examining, both of them turned out to be the typical *B. nivalis*, considering that *B. nivalis* specimens from Korea have 2 setae on medial margin of female leg 3 enp 2, while 3 setae in *B. hiemalis yunnanensis*, described from Yunnan Province, southern China by Borutzky (1952). Furthermore, *B. nivalis* specimens from Korea showed the consistent discrepancies from *B. hiemalis yunnanensis* in the length ratio of caudal rami (conspicuously shorter than wide in *B. hiemalis yunnanensis*) and the distomedial seta on leg 4 enp 1 (lacking the seta in *B. hiemalis yunnanensis*).

Bryocamptus nivalis was collected from the various mountainous water bodies in Korea, frequently with *Canthocamptus mirabilis* group and *B. zschokkei caucasicus*.

Distribution. Korea, Japan, North America.

[1]******Bryocamptus pacificus* **Ishida, 1992 (Fig. 5)**

Bryocamptus nivalis (not Willey, 1925): Ishida, 1987, p. 82, pl. 10; 1990, p. 40; Ishida and Ito, 1991, p. 80, figs. 23-26.

Bryocamptus pacificus Ishida, 1992, p. 77, figs. 1-15, 18b; Ishida and Kikuchi, 2000, p. 32, fig. 50.

[1]*****태평이끼장수노벌레 (신칭)

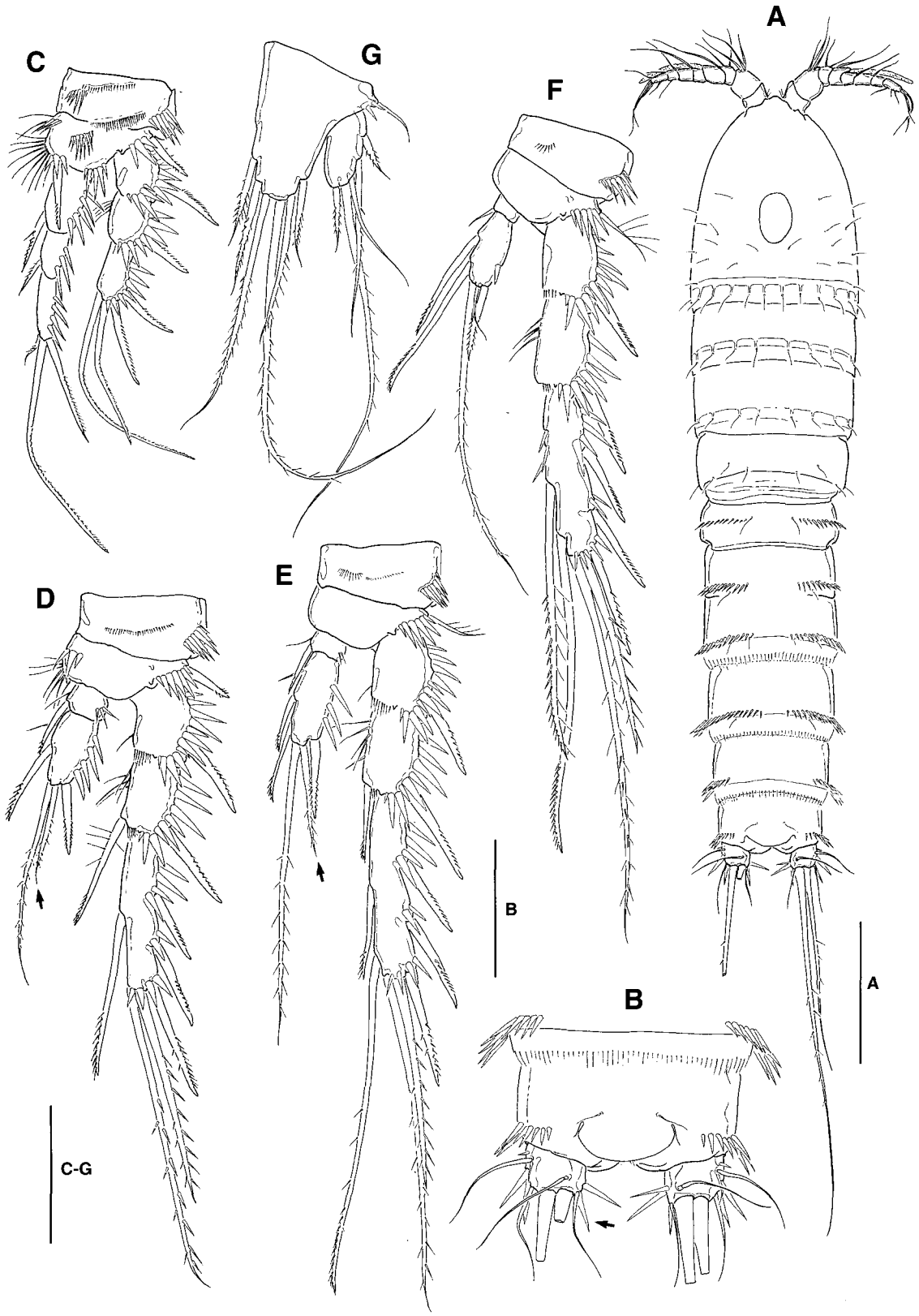

Fig. 5. *Bryocamptus pacificus*, female. A, habitus, dorsal; B, anal somite and caudal rami, dorsal; C-G, legs 1-5. Scale bars=0.01 mm (A), 0.05 mm (B-G).

Material examined. 1♀, 2♂♂, well, Gucheon-ri, Andong, 3 Oct. 1991 (CYC); 2♀♀, spring, Myeongdae Valley, Oseosan Mt., Boryeong, 14 Jul. 2003 (CYC); 2♀♀, trickle, Myosan Mt., Hapcheon, 3 May 2004 (CYC, JML); 7♀♀, 3♂♂, spring, Yaksuam Temple, Hadong, 26 Oct. 1999 (JML); 1♂, Seonsan Village (spring), Oido-dong, Jejudo Is., 22 Jan. 2003 (CYC, JML).

Diagnosis. Body (Fig. 5A) cylindrical and rather slender, 0.51-0.56 mm long, excluding rostrum and caudal setae. Anal operculum (Fig. 5B) with finely haired posterior margin. Caudal rami truncate, a little shorter than wide (L/W about 0.8) and nearly parallel, with 2-3 spinules along distomedial face (Fig. 5B, arrow). Female antennule, antenna with typical segmentation and seta/spine ornamentation of genus *Bryocamptus*. Leg 1 (Fig. 5C) endopod 3-segmented; endopod a little longer than exopod. Endopods of legs 2-4 in female (Fig. 5D-F) 2-segmented; enp 1 each with 1 distomedial seta; length ratio of two apical setae on enp 2 of legs 2-3 about 0.4-0.5 (Fig. 5D, E, arrows). Female leg 5 (Fig. 5G) baseoendopod protruding and exceeding distal end of exopod, bearing 6 setae; L/W ratio of exopod about 1.8, with 5 setae including very short innermost and outermost seta. Male legs 2-5 nearly similar to those in *B. nivalis*.

Remarks. *Bryocamptus pacificus* is a relatively rare species (5 of 56 samples examined), and has occurred mostly from springs in Korea. It often occurred with *Attheyella coreana* Miura.

This species mostly resembles *B. nivalis* in general appearance, but the former is easily differentiated from the latter by having fewer spinules along the distomedial face of caudal rami (2-4 spinules in *B. pacificus*, while 6-8 spinules in *B. nivalis*), and the length ratio of two distal setae on the last endopodal segments of legs 2 and 3 (about 0.4-0.5 in *B. pacificus*, while 0.7-0.8 in *B. nivalis*). Ishida and Kikuchi (2000) mentioned that this species generally lacks the spinule row in the middle of dorsal surface of female genital somite in contrast with *B. nivalis*, however, Korean specimens always showed the spinule row.

Distribution. Korea, Japan, Sakhalin, The Maritime Territory of Russia, Taiwan.

[1]*Bryocamptus vejdovskyi* (Mrazek, 1893) (Fig. 6)

Canthocamptus vejdovskyi Mrazek, 1893, p. 38, pl. 7, figs. 2-4.

Bryocamptus (*Bryocamptus*) *vejdovskyi*: Chappuis, 1928, p. 44; Lang, 1948, p. 1074, fig. 427; Borutzky, 1952, p. 178, fig. 61(6); Dussart, 1967, fig. 332; Tai and Song, 1979, p. 245, figs. 116-117.

Bryocamptus vejdovskyi: Ishida, 1987, p. 86, pl. 23; Ishida and Kikuchi, 2000, p. 32, fig. 51.

Material examined. 2♀♀, Gomgol Valley (bog), Seoraksan Mt., 3 May 1998 (S.M. Yoon).

Diagnosis. Body (Fig. 6A) hirsute, small and cylindrical, 0.59 mm long in females excluding caudal setae; tinged with pale brown in alcohol or formalin; all urosomites with spinule array along lateral margin. Anal operculum a little convex with 8-12 spines along posterior margin (Fig. 6A, arrow). Caudal rami (Fig. 6B) cylindrical, much longer than wide (L/W about 1.5), with 5-6 spinules along distomedial face (Fig. 6B, arrow); inner margin gently curved inward; outer terminal caudal seta represented by a small process (Fig. 6B, arrow). Leg 1 (Fig. 6C) endopod a little longer than exopod; exp 2 with 1 stout, modified medial seta, producing medially as in *B. zschokkei caucasicus*. Female legs 2-3 (Fig. 6D-E) 3-segmented; legs 2-4 endopods each with 1 short distomedial seta; nearly all medial setae of both endopods and exopods modified. Female leg 5 (Fig. 6G) exopod oval, L/W about 1.4, bearing 5 setae in total; baseoendopod nearly reaching middle of exopod, equipped with 6 spiniform setae, lateralmost two shortest.

Remarks. In having 3-segmented endopods of legs 2-3, this species is allied with *B. minutus*, which is known as a boreal species and widely distributed in Palearctic region. In Korea, since Miura (1969) reported *B. minutus* at five caves in process of a speleological survey to 21 limestone caves of South Korea in 1966, no additional report has been presented. *Bryocamptus vejdovskyi* is easily distinguished from *B. minutus* by the shape of caudal rami (much longer than wide and rather pyriform in *B. vejdovskyi*, while shorter than wide and cylindrical form in *B. minutus*), and the outer terminal caudal seta (diminished into a small process in *B. vejdovskyi*, while normal in *B. minutus*).

This species is known as inhabiting various freshwaters like ponds, lakes, highland sphagnous swamps, and snow puddles (Borutzky, 1952; Ishida and Kikuchi, 2000). In Korea, it occurred from a bog at Seoraksan Mt. with *Canthocamptus incurvisetosus* Chang and Ishida, *Attheyella byblis* Chang and Kim, and *Eucyclops roseus* Ishida.

Distribution. Korea, Japan (Hokkaido), China, Russia, Europe.

[2]*Bryocamptus umiatensis* Wilson, 1958 (Figs. 7, 8)

Bryocamptus umiatensis Wilson, 1958, p. 45; Ishida and Kobayashi, 1992, p. 205, figs. 1-7.

Material examined. 3♀♀ (1 ovi.), 2♂♂, 1,100 m Hill,

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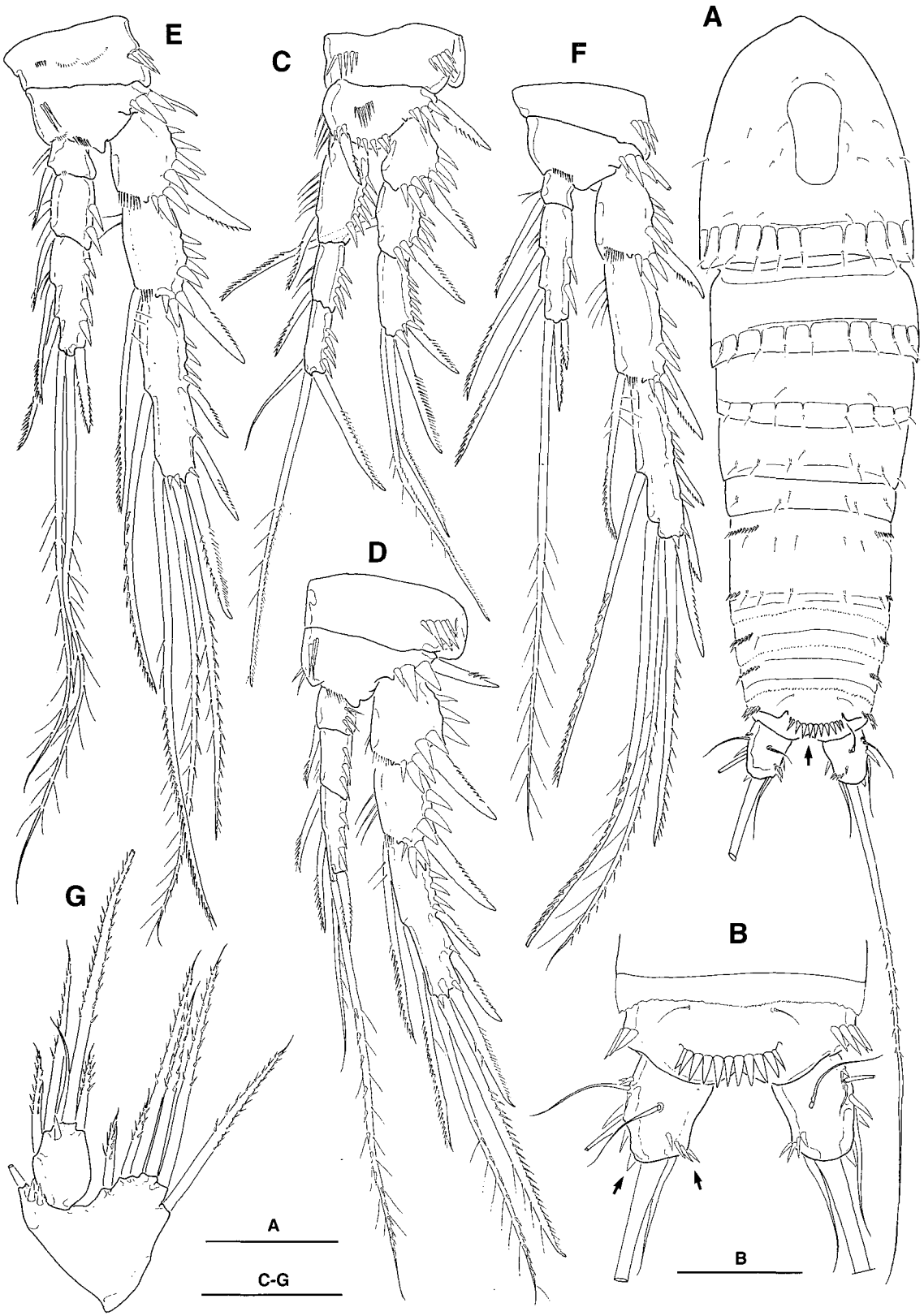

Fig. 6. *Bryocamptus vejdovskyi*, female. A, habitus, dorsal; B, anal somite and caudal rami, dorsal; C-G, legs 1-5. Scale bars=0.1 mm (A), 0.05 mm (B-G).

Hallasan Mt., Jejudo Is., 13 Feb. 1988 (C.Y. Chang).

Diagnosis. Body cylindrical and small, 0.45 mm long in females and 0.29 mm in males, excluding caudal setae; tinged with pale brown in alcohol or formalin; second and third urosomites with spinule array along lateroventral and ventral margins, respectively. Anal operculum (Fig. 7B, arrow) with smooth posterior margin. Caudal rami (Fig. 7A) truncate, a little longer than wide (L/W about 1.3-1.5), a little divergent posteriorly, with setule row along distomedial surface in female (Fig. 7B, arrow) or smooth in male (Fig. 7F). Leg 1 (Fig. 7C) enp 1 nearly reaching distal margin of exp 2, with 1 short distomedial seta. Female legs 2-4 (Figs. 7D, 8A, B) very similar to those of *B. vejdovskyi*. Female leg 5 (Fig. 7E) exopod nearly circular, inner margin

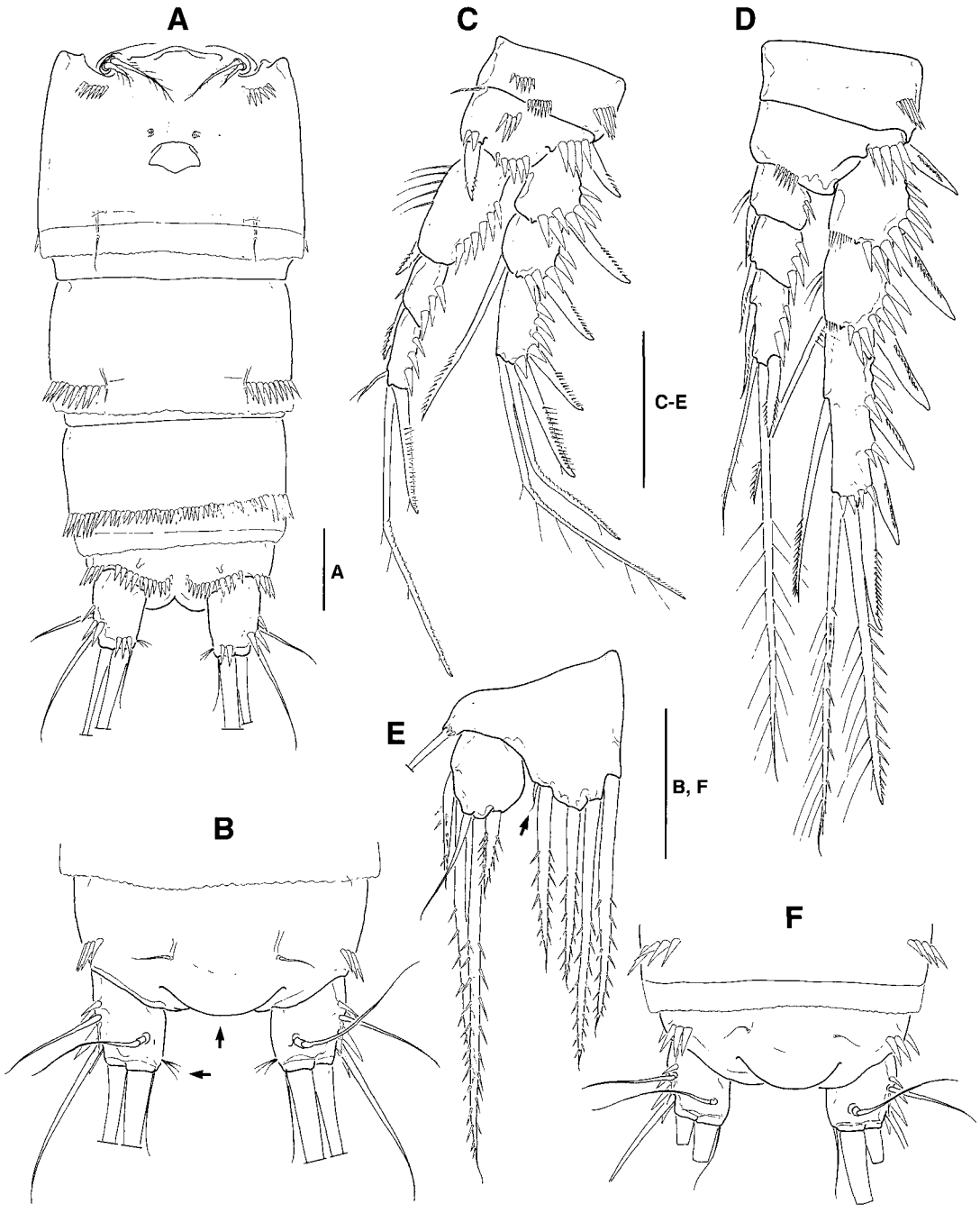

Fig. 7. *Bryocamptus umiatensis*. A-E, female: A, urosomites and caudal rami, ventral; B, anal somite and caudal rami, dorsal; C-D, legs 1-2; E, leg 5. F, male anal somite and caudal rami, dorsal. Scale bars=0.05 mm (A-F).

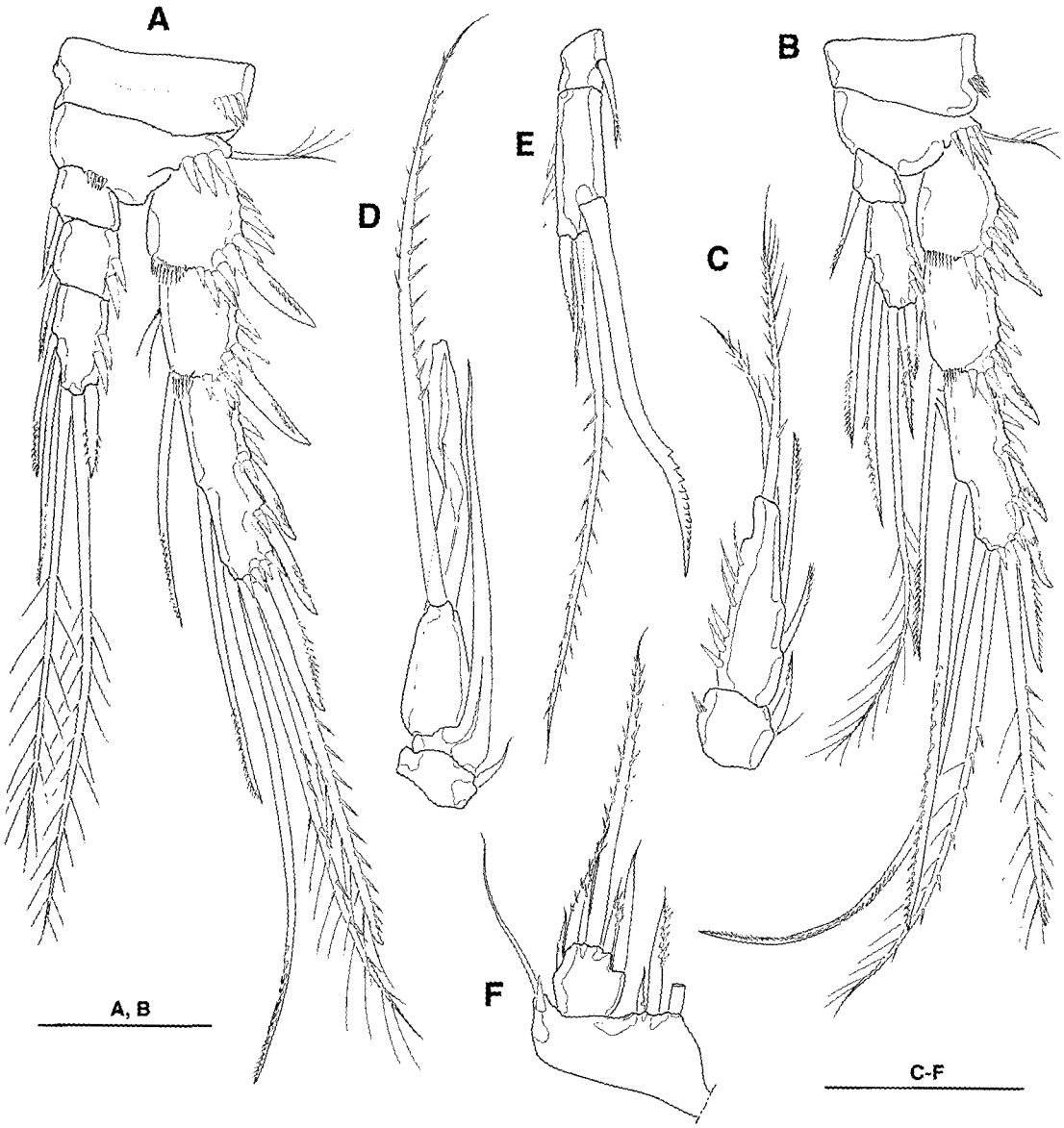

Fig. 8. *Bryocamptus umiatensis*. A-B, female legs 3-4; C-E, endopods of male legs 2-4; F, male leg 5. Scale bars=0.05 mm (A-F).

swollen, bearing 5 setae in total; baseoendopod nearly reaching end of exopod, equipped with 4 stout spiniform setae and 1 minute, slender seta laterally (Fig. 7E, arrow). Male leg 2 endopod (Fig. 8C) similar to those of other congeneric species, bearing 2 modified medial and 2 plumose apical setae with spinules along lateral margin; leg 3 (Fig. 8D) enp 2 armed with a apophysis, enp 3 ellipsoidal with 1 long plumose apical seta and 1 elongate modified process; leg 4 (Fig. 8E) enp 2 bearing 1 stout, curved modified distomedial setal with 3 apical setae. Male leg 5 (Fig. 8F) exopod wider than long, L/W about 0.8-0.9, bearing 6 setae in total.

Remarks. Bryocamptus umiatensis is evidently boreal and very rare species. Outside its type locality (Alaska), only a female specimen was reported from a trickle at Sakhalin by Ishida and Kobayashi (1992). In Korea, this species was found under thin ice of an alpine marsh at 1,100 m Hill, Hallasan Mt., Jejudo Is. in the winter season. This record suggests the southern limit of zoogeographical distribution of this species.

Korean specimens fit well with the original description, except the smooth margin of anal operculum as in the Japanese specimen (Ishida and Kobayashi, 1992) (while 3-4 spinules on the posterior margin of anal operculum in the

Alaskan specimens). The Asian specimens from Sakhalin and Korea perfectly coincide with each other.
Distribution. Korea (Jejudo Is.), Sakhalin, Alaska.

A key to the species of genus *Bryocamptus* from Korea

1. Leg 1 endopod 2-segmented; anal operculum with 3-5 stout spinules ..... *B. zschokkei caucasicus*
- Leg 1 endopod 3-segmented; anal operculum with more than 10 spinules along posterior margin or smooth 2
2. Legs 2-3 endopod 2-segmented 3
- Legs 2-3 endopod 3-segmented 4
3. Distomedial edge of caudal rami with more than 6-8 spinules; both apical setae of legs 2-3 enp 2 very long (outer seta about 3/4 times of the inner seta) ..... *B. nivalis*
- Distomedial edge of caudal rami with 2-3 spinules; outer apical setae of legs 2-3 enp 2 short (outer seta about half of the inner seta) ..... *B. pacificus*
4. Female leg 5 baseoendopod with 6 spiniform setae; anal operculum with spinules along posterior margin 5
- Female leg 5 baseoendopod with 4 spiniform and 1 slender setae; anal operculum with smooth posterior margin ..... *B. umiatensis*
5. Outer terminal caudal seta diminished into a small process ..... *B. vejdovskyi*
- Outer terminal caudal seta normal ..... *B. minutus*

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