Taxonomy on Freshwater Canthocamptid Harpacticoids from Korea II. Genus *Attheyella*

Cheon Young Chang* and Ji Min Lee

(Department of Biology, College of Natural Sciences, Daegu University, Gyeongsan 712-714, Korea)

ABSTRACT

A taxonomic study on the freshwater harpacticoids of the genus *Attheyella* has been accomplished as one of the serial researches on the family Canthocamptidae in South Korea. As a result, a total of seven species belonging to *Attheyella* are listed, three of which are new to Korean fauna: *A. crassa* (Sars), *A. nakaii* (Brehm), and *A. orientalis* Chappuis. A key to the species of the genus *Attheyella* known from Korea is prepared.

Key words: taxonomy, *Attheyella*, Canthocamptidae, Harpacticoida, freshwater Copepoda, Korea

INTRODUCTION

Attheyella harpacticoids are known as the typical mountainous copepods usually from trickles, springs, cave waters and temporary pools around mountain streams. Four species belonging to the genus Attheyella are currently recorded from South Korea: A. coreana Miura (Miura, 1969); A. paucisetosa Chang and Kim (Chang and Kim, 1992; Chang, 1993); A. byblis Chang and Kim (Chang and Kim, 1992); A. tetraspinosa Chang (Chang, 1993). All of them are restricted to the Far East, and A. tetraspinosa is tentatively endemic to Korea.

As the second report of the serial studies on the family Canthocamptidae in South Korea, this

Tel: 82-53-850-6454, Fax: 82-53-850-6459, E-mail: cychang@daegu.ac.kr

^{*} To whom correspondence should be addressed

paper deals with the taxonomic accounts of the genus Attheyella from Korea.

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 the specimens were dissected, drawn, and measured in lactophenol on H-S slide (Shirayama et al., 1993), a recent variation of Cobb slide. Mounted specimens were observed under a differential interference contrast microscope with Nomarski optics. Figures were prepared with the aid of a camera lucida.

Abbreviations are used in the text and figure legend: enp 1-3 or exp 1-3, the first to third endopodal or exopodal segment of each leg; L/W, length to width ratio.

SYSTEMATIC ACCOUNTS

Family Canthocamptidae Sars, 1906 Genus Atthevella Brady, 1880

1. *Attheyella (Attheyella) crassa (Sars, 1862) (Figs. 1, 2)

Canthocamptus crassus Sars, 1862, p. 232.

Canthocamptus (Attheyella) crassus: Gurney, 1932, p. 177, figs. 745-766.

Attheyella (Attheyella) crassa: Lang, 1948, p. 965; Borutskii, 1952, p. 257, figs. 75-76; Dussart, 1967, p. 263, figs. 107-108; Tai and Song, 1979, p. 232, fig. 125; Ishida, 1987, p. 82, pl. 9; Ishida and Kikuchi, 2000, p. 22, fig. 24.

Diagnosis. Body (Fig. 1A) hirsute, small and cylindrical, 0.62-0.76 mm long in females and 0.48-0.56 mm in males, excluding caudal setae; usually tinged with pale gray in alcohol or formalin; all thoracic and abdominal somites except anal somite with strongly serrated posterior margin; anal operculum a little convex with numerous fine setules along posterior margin; each ventromedial corner of anal somite furnished with 3 or 4 spines (Fig. 1B, left side), medialmost one shown apparently in a dorsal view (Fig. 1B, right side); caudal rami of both sexes (Figs. 1B, 2A) cylindrical, (L/W about 1.5 in female and about 1.8 in male), with spinule array along medial face (Figs. 1B, 2A, arrow), and a well-developed longitudinal ridge on dorsal surface, ending with a dorsal seta; antennule (Fig. 1A) 8-segmented; exopod of antenna 2-segmented, distal segment bearing 3 setae; leg 1 enp 1 (Fig. 1C) much shorter than whole exopod; female legs 2-4 (Fig. 1D-F) with typical pattern of *Attheyella*; female leg 5 (Fig. 1G) exopod furnished with 2-3 spinules along a little

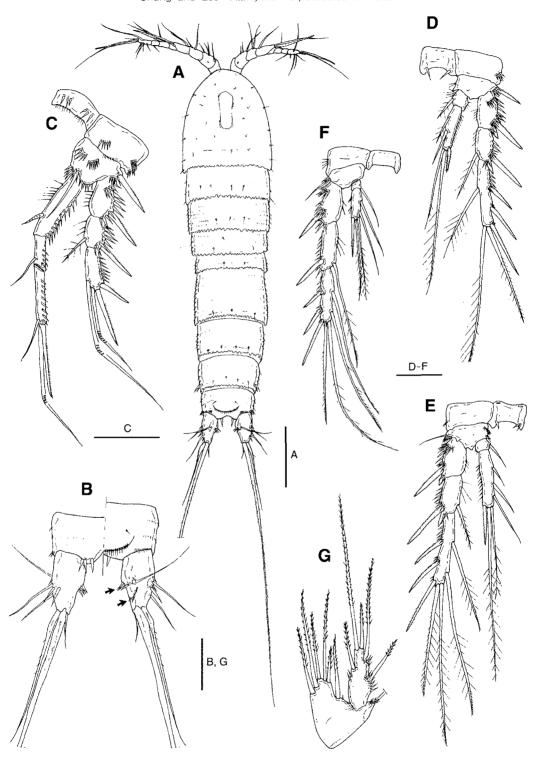


Fig. 1. Attheyella crassa, female. A, habitus, dorsal; B, anal somite and caudal rami, ventral (left) and dorsal (right); C-G, legs 1-5. Scale bars = $0.05 \, \text{mm}$ (B-G), $0.1 \, \text{mm}$ (A).

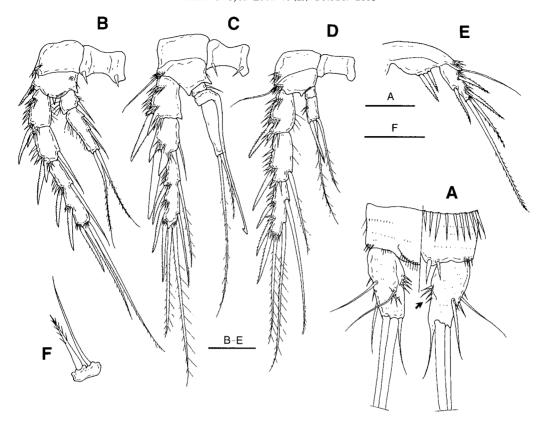


Fig. 2. Attheyella crassa, male. A, anal somite and caudal rami, dorsal (left) and ventral (right); B-F, legs 2-6. Scale bars = $0.02 \, \text{mm}$ (F), $0.03 \, \text{mm}$ (A-E).

expanded medioproximal margin, and strong spinule arrays along bases of lateral spines; exopod L/W about 2.0-2.3, narrowing distally, bearing 5 setae in total; baseoendopod nearly reaching middle of exopod, equipped with 6 spiniform setae, lateral second of which shortest; male leg 2 enp 2 (Fig. 2B) bearing 2 medial and 2 apical setae; male leg 3 enp 2 (Fig. 2C) armed with a slender, tapering process (apophysis) with strong barb at its tip; enp 3 with 2 distal setae; exp 2 armed with a stout distolateral spinous process, not reaching distal end of exp 3; male leg 4 (Fig. 2D) enp 1 without medial seta, enp 2 with 2 apical setae and 1 spine; male leg 5 (Fig. 2E) baseoendopod with 2 spiniform setae, lateral one a little shorter than medial one; leg 5 exopod with 5 setae in total including 1 longest apical seta; leg 6 (Fig. 2F) represented by a small plate bearing 1 inner spine and 1 slender outer seta.

Remarks. Asian specimens including Chinese (Tai and Song, 1979), Japanese (Ishida and Kikuchi, 2000) and Korean specimens of *A. crassa* show the minor morphological discrepancies from the original description (Sars, 1862) and European specimens (Dussart, 1967): (1) male leg 3 enp 2 armed with a relatively longer apophysis with an apparent barb (Fig. 2C); (2) female leg 5 baseoendopod bearing the relatively shorter setae (Fig. 1G).

In South Korea, the present species occurred from mountain streamlets not far from the village

locating at foothills.

Distribution. Europe, North Africa, Central Asia, China, Japan, Korea.

2. *Attheyella (Attheyella) nakaii (Brehm, 1927) (Figs. 3, 4)

Canthocamptus nakaii Brehm, 1927, p. 138.

Attheyella nakaii: Lang, 1948, p. 972; Borutskii, 1952, p. 260; Ishida, 1987, p. 82, pl. 8; Ishida, 1990, p. 44; Ishida, 1994a, p. 53, figs. 2-20; Ishida and Kikuchi, 2000, p. 20, fig. 20. Attheyella morimotoi Miura, 1962, p. 271, figs. 32-50.

Material examined. One $\[mu]$, $1\[mu]$, Daegwanryeong Hill (Sorak Mt.) 28 Jul. 1999 (J. M. Lee); $1\[mu]$, Jinburyeong Hill (Seorak Mt.) 24 Aug. 1996 (C. Y. Chang and J. M. Lee); $1\[mu]$, Yongmunsa Temple (Yongmunsan Mt., Yangpyeong) 15 Oct. 1999 (C. Y. Chang and J. M. Lee); $5\[mu]$ $\[mu]$ (Quiv.), Geomryongso (Taebaek) 7 Oct. 2000 (C. Y. Chang and J. M. Lee); $1\[mu]$, Guryongsa Temple (Chiaksan Mt., Weonju) 27 Jul. 1999 (J. M. Lee and Y. H. Song); $1\[mu]$, Yeongweol (trickle), 29 Jul. 1999 (J. M. Lee and Y. H. Song); $1\[mu]$ (Ovi.), Mungyeongsaejae, 10 Nov. 1995 (H. S. Rho); $1\[mu]$ $\[mu]$, Yongheungsa Temple (Gapjangsan Mt., Sangju) 26 Jul. 1999 (J. M. Lee and Y. H. Song); $1\[mu]$ $\[mu]$, Seoknamsa Temple (Gajisan Mt.) 13 Aug. 1996 (C. Y. Chang); $1\[mu]$ (Ovi.), $1\[mu]$, Seoknamsa Temple (Gajisan Mt.) 10 Jul. 1999 (C. Y. Chang); $1\[mu]$, Okcheonsa Temple (Yeonhwasan Mt., Goseong) 8 May 1999 (C. Y. Chang and J. M. Lee); $8\[mu]$ $\[mu]$, Weolchul Mt., 28 May 1995 (C. Y. Chang); $1\[mu]$, Daeheungsa Temple (Haenam) 8 Feb. 2003 (C. Y. Chang and J. M. Lee); $3\[mu]$ $\[mu]$, Songgwangam Temple (Geogeumdo Is.) 1 Aug. 2002 (J. M. Lee).

Diagnosis. Body (Fig. 3A) hirsute and shown as armored, usually tinged with dark brown, very similar in overall appearance with A. coreana, but relatively smaller than A. coreana, 0.78-0.89 mm long in females and 0.72-0.80 mm in males, excluding rostrum and caudal setae; anal operculum (Fig. 3B, H) with rather flattened posterior margin; caudal rami sexually dimorphic, in female suboval or ellipsoidal (L/W about 1.6-1.8) and a little divergent, with a chitinous protrusion on laterodorsal side and smooth medioventral face (Fig. 1B, arrows), in male (Fig. 1H) caudal rami much elongated, narrowing posteriorly, with smooth medioventral face; female antennule, antenna, legs 1-4 with typical segmentation and setal/spine ornamentation of subgenus Attheyella; female leg 5 (Fig. 3G) baseoendopod protruding and reaching distal end of exopod, bearing 6 spiniform setae; exopod L/W about 1.7-2.3, with 5 setae; male leg 2 enp 2 (Fig. 4A) bearing 2 apical setae with spinules along lateral margin; male leg 3 enp 2 (Fig. 4B) armed with a barbed process (apophysis), enp 3 with 2 slender apical setae, exp 1-2 each armed with a huge and thickened spine on distolateral corner, spine on exp 2 much exceeding beyond exp 3; male leg 4 enp 2 (Fig. 4C) with 2 short apical setae and 1 stout spine; male leg 5 (Fig. 3I) baseoendopod with 2 spiniform setae, medial one of which about 1.7 times longer than lateral one; exopod rather suboval, L/W about 1.3-1.6, bearing 4 spiniform setae.

Remarks. Attheyella nakaii was collected from the various mountainous water bodies in Korea, frequently with Canthocamptus mirabilis group and A. coreana. Attheyella nakaii most resembles A. coreana in general appearance, but the former is easily differentiated from the latter

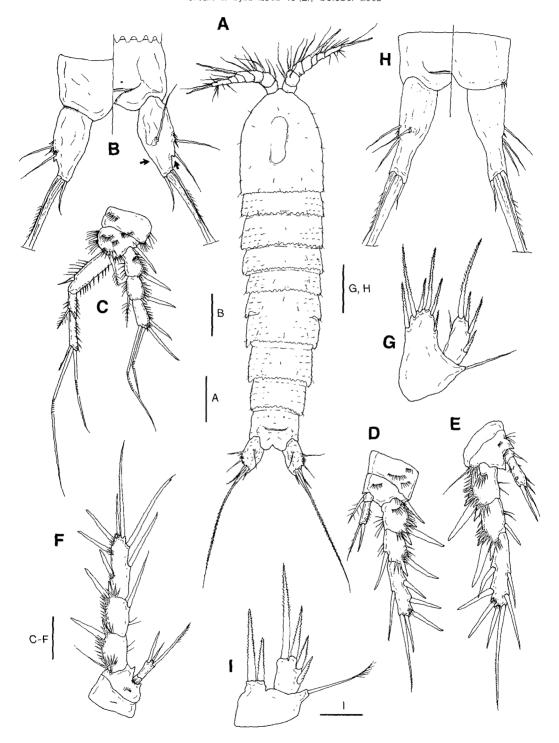


Fig. 3. Attheyella nakaii. Female: A, habitus, dorsal; B, anal somite and caudal rami, ventral (left) and dorsal (right); C-G, legs 1-5. Male: H, anal somite and caudal rami, dorsal (left) and ventral (right); I. leg 5. Scale bars $\approx 0.03 \, \text{mm}$ (I), $0.05 \, \text{mm}$ (B-H), $0.1 \, \text{mm}$ (A).

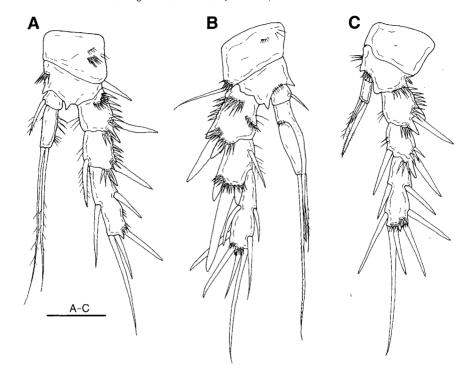


Fig. 4. Attheyella nakaii, male. A-C, legs 2-4. Scale bar = 0.05 mm.

by the laterodorsal protrusion of caudal rami and the not-protruding leg 5 exopod in female. Moreover, it has much smaller body (about 80%) than in *A. coreana*.

As in *A. coreana*, this species shows the wide variation range in the shapes and setal ornamentations of legs 2-4 endopods according to the regional populations. Korean specimens were well coincided with Japanese ones including the type specimens except for the slightly swollen medial margin of female caudal rami, not-protruding leg 5 exopod in female, and the huge and thickened spine on distolateral corner of male leg 3 exp 2 (beyond the leg 3 exp 3).

Distribution. Japan, Korea.

3. *Attheyella (Attheyella) orientalis Chappuis, 1929 (Fig. 5)

Attheyella orientalis Chappuis, 1929, p. 97; Lang, 1948, p. 970; Ishida, 1982, p. 76; Ishida, 1987, p. 82, pl. 10; Ishida, 1989, p. 2; Ishida, 1994b, p. 126; Ishida and Kikuchi, 2000, p. 23, fig. 26.

Material examined. One ♂, Seonsan Village (spring) (Oido-dong, Jeju Is.) 22 Jan. 2003 (C. Y. Chang and J. M. Lee).

Diagnosis. Body cylindrical and rather slender, 0.53 mm long in an examined male, excluding rostrum and caudal setae; anal operculum (Fig. 5A, arrow) with triangular hyaline protrusion; caudal rami (Fig. 5A) truncate, a little elongate (L/W about 2.0-2.3) and slightly divergent

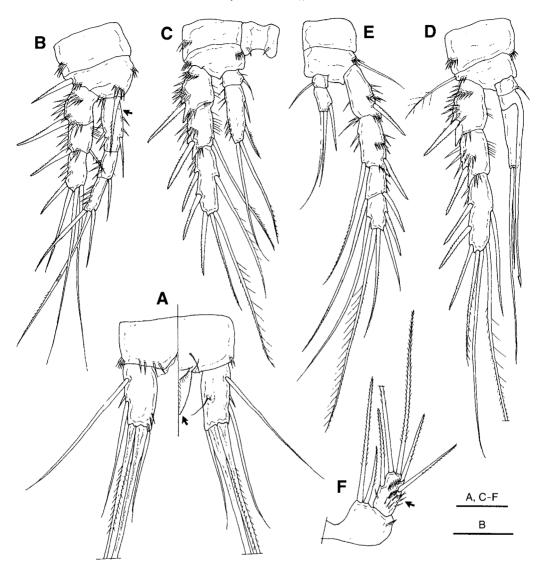


Fig. 5. Attheyella orientalis, male. A, anal somite and caudal rami, ventral (left) and dorsal (right); B-F, legs 2-5. Scale bars = 0.03 mm.

posteriorly, with smooth medial surface; legs 1-4 with typical segmentation and setal/spine ornamentation of subgenus *Attheyella*; leg 1 enp 1 (Fig. 5B, arrow) much shorter than exopod; male leg 2 enp 2 (Fig. 5C) bearing 2 short medial and 2 long apical setae with spinules along lateral margin; male leg 3 enp 2 (Fig. 3D) armed with a barbed process (apophysis), leg 3 enp 3 elongated with 2 slender apical setae, exp 2 with rather normal distolateral spine, not a huge spinous process; male leg 4 enp 2 (Fig. 5E) with 2 long apical setae and 1 sharp spine; male leg 5 (Fig. 5F) baseoendopod with 2 spiniform setae, medial one of which a little more than 2 times longer than lateral one; exopod rather oval, L/W about 1.6-1.8, bearing 1 medial, 2 very long apical and 2

lateral setae, with 3-4 diagonal setule rows on ventral surface (Fig. 5F, arrow).

Remarks. Attheyella orientalis is known to be abundant among plant materials in the various stagnant waters or streams running slowly (Ishida and Kikuchi, 2000). In Korea, we found it from a small fountain at Jeju Is., upwelling not far from the seashore, co-occurred with cyclopoid copepods (Macrocyclops fuscus and Eucyclops ohtakai).

This species is most characteristic in having the triangular hyaline protrusion on the anal operculum. Except that, *A. orientalis* is much similar to *A. crassa* especially in having the long setae on leg 5 exopod and baseoendopod, and somewhat truncate and sexually isomorphic caudal rami. However, it is discernible from *A. crassa* in having much longer caudal rami with its smooth medial face and the setal arrangement of leg 5 baseoendopod in both sexes.

The hyaline membrane protrusion on anal operculum in our male specimen reaches the distal quarter of caudal rami, while described as about two thirds in the original description, and nearly as long as caudal rami in *A. orientalis heterospina* Shen and Tai from Yunnan Province and Tibet (Shen and Tai, 1964; Tai and Song, 1979). As the length differences among them are rather subtle, especially depending on the preparation condition, so the subspecies might not be valid. In any case, the protrusion in our specimen is apparently much shorter than caudal rami, so it should be identified as *A. orientalis*.

Distribution. Europe, North Africa, Asia (Turkey, Iran, Central Asia, China, Japan and South Korea).

4. Attheyella (Attheyella) coreana Miura, 1969

Attheyella coreana Miura, 1969, p. 246, figs. 16-31; Ishida and Ito, 1991, p. 80, figs. 10-18; Chang, 1993, p. 182.

Attheyella coiffaitti: Ishida, 1990, p. 40.

Additional material examined. One ♂, 1♀, Jinburyeong Hill (Seorak Mt.) 24 Aug. 1996 (C. Y. Chang and J. M. Lee); 1♀, Naerincheon Stream (Seorak Mt.) 6 Nov. 1999 (J. M. Lee and Y. H. Song); 13♀♀, 11♂♂, Sujeongsa Temple (Namyangju) 16 Oct. 1999 (C. Y. Chang, J. M. Lee and H. S. Ahn); 6 ♀ ♀ , 5 ♂ ♂ , Chodanggul Cave (Samcheok) 12 May 1995 (H. S. Rho); 5 ♀ ♀ , 4 ♂♂, Surisan Mt., 4 May 1995 (C. Y. Chang); 4우우, 2♂♂, Chiljangsa Temple (streamlet) (Anseong) 15 Oct. 1999 (C. Y. Chang, J. M. Lee and H. S. Ahn); 1 ♀, Yeongweol, 29 Jul. 1999 (J. M. Lee and Y. H. Song); 3♂♂, 11♀♀, Simpigul Cave (Goisan) 1 Aug. 1996 (H. S. Rho); 5♀ 우, 3 ð ð, Bongjeongsa Temple (Andong) 13 Nov. 1999 (C. Y. Chang); 12 우우, 17 ð ð, Myeongdae Valley (spring) (Oseosan Mt., Boryeong) 14 Jul. 2003 (C. Y. Chang); 5♀♀, Seoknamsa Temple (Gajisan Mt.) 13 Aug. 1996 (C. Y. Chang); 3♀♀, 1♂, Gogori (spring) (Jirisan Mt.) 29 Jan. 1991 (C. Y. Chang, S. J. Song and J. H. Choi); 1 ♂, Jirisan Mt. (Sancheong) 26 Oct. 1999 (C. Y. Chang and J. M. Lee); $12 \stackrel{\wedge}{+} \stackrel{\wedge}{+}$, $3 \stackrel{\rightarrow}{-} \stackrel{\rightarrow}{+}$, Ssanggyesa Temple (Jirisan Mt.) 21 Jan. 1987 (C. Y. Chang); 3♀♀, 1♂, Muhaksan Mt. (spring) (Masan) 30 May 1999 (C. Y. Chang and J. M. Lee); 6우우, 5광광, Tongyeong, 9 May 1995 (C. Y. Chang); 17우우, 7광광, Daeheungsa Temple (Haenam) 8 Feb. 2003 (C. Y. Chang and J. M. Lee); 12 + ?, 3 - ?, Ssanggyesa Temple (Jindo Is.) 23 Jul. 1994 (C. Y. Chang, S. J. Song and J. M. Lee); 3♀♀, 2♂♂, Songgwangam Temple (Geogeumdo Is.) 1 Aug. 2002 (J. M. Lee); 10 ♀ ♀, 8♂♂, Seonsan Village (spring) (Oido-dong, Jeju Is.) 22 Jan. 2003 (C. Y. Chang and J. M. Lee); 1♂, Andeok Valley (Jeju Is.) 8 Jul. 1996 (C. Y. Chang and J. M. Lee).

Remarks. Since described from four caves of South Korea by Miura (1969), this species has occurred most abundantly and frequently, especially from mountain springs and trickles, among *Attheyella* species in South Korea. This species shows the conspicuous sexual dimorphism in caudal rami, as in *A. coiffaiti* Chappuis and *A. nakaii* (Brehm), which are easily distinguished each other by the shape of female caudal rami. In his original description of *A. coreana*, Miura (1969) mentioned the resemblance between this species and *A. morimotoi* Miura, which was later regarded as a junior synonym of *A. nakaii* (Ishida, 1987; Ishida and Kikuchi, 2000).

Distribution. South Korea, Japan (Yamaguchi-ken, Fukuoka-ken), Far East Russia (South Primorye).

5. Attheyella (Attheyella) paucisetosa Chang and Kim, 1992

Attheyella (Attheyella) paucisetosa Chang and Kim, 1992, p. 68, figs. 1-2; Chang, 1993, p. 183, fig. 1; Ishida, 1994b, p. 126; Ishida and Kikuchi, 2000, p. 21, fig. 23.

Attheyella sp. M Ishida, 1987, p. 82, pl. 11; Ishida, 1989, p. 3: Ishida, 1990, p. 40.

Additional material examined. One \cite{P} (ovi.), Seoknamsa Temple (Gajisan Mt., Eonyang) 13 Aug. 1996 (C. Y. Chang).

Distribution. Japan, South Korea.

6. Attheyella (Mrazekiella) byblis Chang and Kim, 1992

Attheyella (Mrazekiella) byblis Chang and Kim, 1992, p. 71, figs. 3-5; Chang, 1993, p. 184, fig. 1; Ishida, 1995, p. 301, fig. 3.

Attheyella sp. T Ishida, 1989, p. 11, pl. 7.

Distribution. Japan, South Korea.

7. Atthevella (Mrazekiella) tetraspinosa Chang, 1993

Attheyella (Mrazekiella) tetraspinosa Chang, 1993, p. 184, figs. 2-3.

Additional material examined. Five $\begin{array}{l} \begin{array}{l} \$

Remarks. Attheyella (Mrazekiella) tetraspinosa is the smallest (0.42-0.53 mm in body length) in the Korean Attheyella species. This species is tentatively endemic to Korea, and sporadically occurred from the various habitats like mountainous spring (Jeongseon, type locality), trickles and well near streamlet.

Distribution. South Korea.

A key to the species of genus Attheyella from Korea

1. Leg 1 enp 1 much shorter than the whole exopod 2 (subgenus Attheyella) Leg 1 enp 1 longer than the whole exopod 6 (subgenus Mrazekiella) 2. Caudal rami short and suboval, not showing sexual dimorphism; female leg 5 not elongated posteriorly 3 Caudal rami usually elongated and ellipsoidal, showing sexual dimorphism; female leg 5 much elongated posteriorly 5
3. Antennule 8-segmented; female leg 3 enp 2 and leg 4 enp 2 with 5 and 4 setae, respectively
Antennule 7-segmented; female leg 3 enp 2 and leg 4 enp 2 with 4 and 3 setae, respectively
4. Anal operculum with round and convexed posterior margin
Anal operculum protruding and pointed
5. Body huge (usu. more than $1.2 \ \text{mm}$ in length); medial margin of female caudal rami much
swollen with a setule row, and lateral margin without protrusion
Body relatively not so big (usu. less than 1 mm in length); medial margin of female caudal rami
nearly straight without setule row, and lateral margin with a blunt protrusion
6. Female leg 5 baseoendopod with 6 spiniform setae; male leg 5 baseoendopod with 2 spiniform
setae
Female leg 5 baseoendopod with 4 spiniform setae; male leg 5 baseoendopod with 1 spiniform
seta ————————————————————————————————————

ACKNOWLEDGEMENTS

We thank Eun Hee Kwon for her support in preparing the illustrations and collecting samples. Senior author (CYC) is grateful to Dr. Teruo Ishida who kindly sent his Japanese specimens with the valuable suggestion on freshwater harpacticoids. We appreciate three anonymous reviewers for their helpful comments that greatly improved the manuscript. This work was partly supported by Korea Research Foundation Grant (KRF-2001-002-D00246).

REFERENCES

Borutskii, E. V., 1952. Freshwater Harpacticoida. Fauna of the U.S.S.R. Crustacea, 3(4): 1-424.

Brehm, V., 1927. Über die Tiefenfauna japanischer Seen. Arch. Hydrobiol., 18: 135-150.

Chang, C. Y., 1993. Harpacticoid copepods of genus *Attheyella* (Harpacticoida: Canthocamptidae) in Korea. Korean J. Syst. Zool., **9**(2): 181-190.

Chang, C. Y. and H. S. Kim, 1992. Two new species of genus *Attheyella* (Harpacticoida: Canthocamptidae) from springs of Korea. Korean J. Syst. Zool., Special Issue No. **3**: 67-76.

Chappuis. P. A., 1929. Notes sur les copépodes. Bull. Soc. Stiint. Cluj., 4(2): 97-106.

- Dussart, B., 1967. Les copépodes des eaux continentales d'Europe occidentale. Tome I. Calanoïdes et Harpacticoïdes. Ed. Boubée, Paris, pp. 1-500.
- Gurney, R., 1932. The British fresh-water Copepoda. Vol. 2, Harpacticoida. Ray Society, London, pp. 1-336.
- Ishida, T., 1982. On the benthic Cladocera and Copepoda of Lake Shikotsu, Hokkaido, northern Japan. Sci. Rep. Hokkaido Salmon Hatchery, **36**: 75-78.
- Ishida, T., 1987. Freshwater harpacticoid copepods of Hokkaido, northern Japan. Sci. Rep. Hokkaido Salmon Hatchery, **41**: 77-119.
- Ishida, T., 1989. Copepods in the mountain waters of Honshu, Japan. Sci. Rep. Hokkaido Salmon Hatchery, 43: 1-21.
- Ishida, T., 1990. Copepods in the mountain waters of Kyushu, Tsushima and Ryukyu Islands, southwestern Japan. Sci. Rep. Hokkaido Salmon Hatchery, **44**: 39-51.
- Ishida, T., 1994a. Variation in the species of freshwater harpacticoid copepods in Japan. Il. *Attheyella nakaii* (Brehm). Hydrobiologia, **292/293**: 53-57.
- Ishida, T., 1994b. Copepods in the upper reaches of the Tama River, Tokyo, Japan. Jpn. J. Limnol., **55**: 125-129.
- Ishida, T., 1995. Copepods in the floodplain waters of Japan. I. Shiribetsu River Basin, Hokkaido, northern Japan. Jpn. J. Limnol., **56**: 297-302.
- Ishida, T. and T. Ito, 1991. Freshwater harpacticoid copepods (Crustacea) from South Primorye, the Soviet Far East. Bull. Biogeogr. Soc. Japan, **46**: 77-82.
- Ishida, T. and Y. Kikuchi, 2000. Illustrated fauna of the freshwater harpacticoid copepods of Japan. Bull. Biogeogr. Soc. Jpn., **55**: 7-94.
- Lang, K., 1948. Monographie der Harpacticiden. Nordiska-Bokhandeln, Stockholm, 2 vols., pp. 1-1682.
- Miura, Y., 1962. Three new harpacticoid copepods from the subterranean waters of Shikoku in Japan. Jap. J. Zool., 13: 267-274.
- Miura, Y., 1969. Results of the speleological survey in South Korea 1966 XIV. Subterranean harpacticoid copepods of South Korea. Bull. Nat. Sci. Mus. Tokyo, **12**: 241-254.
- Sars, G. O., 1862. Oversigt af de indenlandske ferskvandscopepoder. Forh. Vidensk-Selsk. Christiania, **1862**: 212-262.
- Shen, C.-J. and A.-Y. Tai, 1964. On the freshwater copepods of Yunnan Province. Acta Zool. Sin., **16**(4): 611-642.
- Shirayama, Y., T. Kaku, and R. P. Higgins. 1993. Double-sided microscopic observation of meiofauna using an HS-slide. Benthos Research, **44**: 41-44.
- Tai, A.-Y. and Y.-Z. Song, 1979. Harpacticoida Sars, 1903. *In Shen*, C. J., ed., Fauna Sinica, Crustacea, Freshwater Copepoda. Science Press, Peking, pp. 164-300.

RECEIVED: 25 August 2003 ACCEPTED: 3 October 2003

한국 담수산 딱정장수노벌레과 갈고리노벌레류의 분류 II. 털보딱정장수노벌레(Attheyella)속

장 천 영*·이 지 민 (대구대학교 자연과학대학 생명과학부)

요 약

한국 담수산 딱정장수노벌레과(Canthocamptidae)의 요각류에 대한 분류학적 연구의 일환으로, 털보딱정장수노벌레속에 속하는 7종을 보고한다. 이중에는 3 한국미기록종, 안가시털보딱정장수노벌레(A. crassa), 돌출털보딱정장수노벌레(A. nakaii) 및 동방털보딱정장수노벌레(A. orientalis)가 포함되어 있다. 현재까지 한국에서 기록된 털보딱정장수노벌레속의 종 검색표를 작성하였다.