

# Redescription of *Canthocamptus morimotoi* Miura, a Stygobiontic Harpacticoid Species from Korea, with a Brief Review on *C. mirabilis* Group

Cheon Young Chang

Department of Biology, College of Natural Sciences, Taegu University, Kyungsan 712-714, Korea

Key Words:

Redescription

*Canthocamptus morimotoi*  
*mirabilis*-group

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***Canthocamptus morimotoi* Miura, a cave-dwelling harpacticoid species belonging to *C. mirabilis* species group, is fully redescribed and illustrated on the basis of the material newly collected from the type locality, Simpigul Cave, South Korea. *C. morimotoi* is the only genuine subterranean species in the *C. mirabilis* group, and claimed to be a relict species restricted to its type locality. The sexually isomorphic ornamentation of the outer terminal seta on the distal exopodal segment of male leg 4 and the well-developed spines on the disteromedial corner of anal somite are the most significant features differentiating this species from other members of the *mirabilis*-group.**

After Štěrba (1968) had recorded *Canthocamptus mirabilis*, based upon only three females from a mountain streamlet located at 100 km southwest of Peking, China, it had not been paid attention to until Ito and Takashio (1980) redescribed it on basis of the materials from Hokkaido, Japan, and mentioned some of its own features characterizing it against its congeners. Recently, throughout the serial, faunistic studies on mountainous harpacticoids in Japan (Ishida, 1987, 1989, 1990, 1991; Kikuchi and Ishida, 1988), it was turned out to be composed of several closely related species, the *mirabilis*-group (Kikuchi and Ishida, 1994).

In Korea, Miura (1969) described a cave-dwelling species, *Canthocamptus morimotoi*, which had been collected from Simpigul Cave, Kumdae village, Koesangun, Chungchongbuk-do Province during a speleological survey of 21 limestone caves of South Korea in the spring of 1966. Although this species evidently resembled *C. mirabilis* Štěrba which had been described just one year before, considering that Dr. Miura did not refer to it, he must have been unaware of *C. mirabilis*, and treated with inadequacy many significant characters of the *mirabilis*-group in his description.

Thereafter, the study on the *mirabilis*-group in Korea is entirely lacking, in spite of its great abundance and frequent occurrences in various mountain water bodies. Since the year 1986, the author gathered many specimens belonging to *C. mirabilis* group from 71 localities of South Korea, and several species of *C. mirabilis* group including three or four candidating new species, which are in need of more explicit study later on with the confirmation of the identity of *C. mirabilis* from

China. In this paper, redescription of *C. morimotoi* is dealt according to new material from the type locality with a brief review on the species group, which would be the prerequisites to clarify the taxonomy and zoogeography of the *mirabilis*-group in detail.

Collections were made with a dipnet of no. 10 mesh aperture. All specimens were dissected, drawn, and measured in lactophenol on Cobb's hole slide. Figures were supplied with the aid of a camera lucida.

Type specimens did not remain, so neotype newly collected from the type locality is established. Neotype is deposited in the Natural History Museum of Ewha Womans University.

Abbreviations used in the redescription below, enp 1-3 or exp 1-3 indicate the first to third endopodal or exopodal segment of each leg.

Family Canthocamptidae Sars, 1906  
Subfamily Canthocamptinae Chappuis, 1929  
Genus *Canthocamptus* Westwood, 1836

*Canthocamptus morimotoi* Miura, 1969  
(Figs. 1-5)

*Canthocamptus morimotoi* Miura, 1969 (p. 243, figs. 1-15).

Material examined: 5 ♀ ♀, 5 ♂ ♂, Simpigul Cave (33° 14' 21" N, 126° 25' 12" E), Aug. 1, 1996, H. S. Rho. An undissected male is designated as neotype, and deposited in the Natural History Museum, Ewha Womans University under registration number EWNHM 60209, with an undissected female. Other dissected (4 ♀ ♀, 4 ♂ ♂) specimens are deposited in the collection of the author.

\* Tel: 82-53-850-6454, Fax: 82-2-850-6459  
E-mail: cychang@biho.taegu.ac.kr

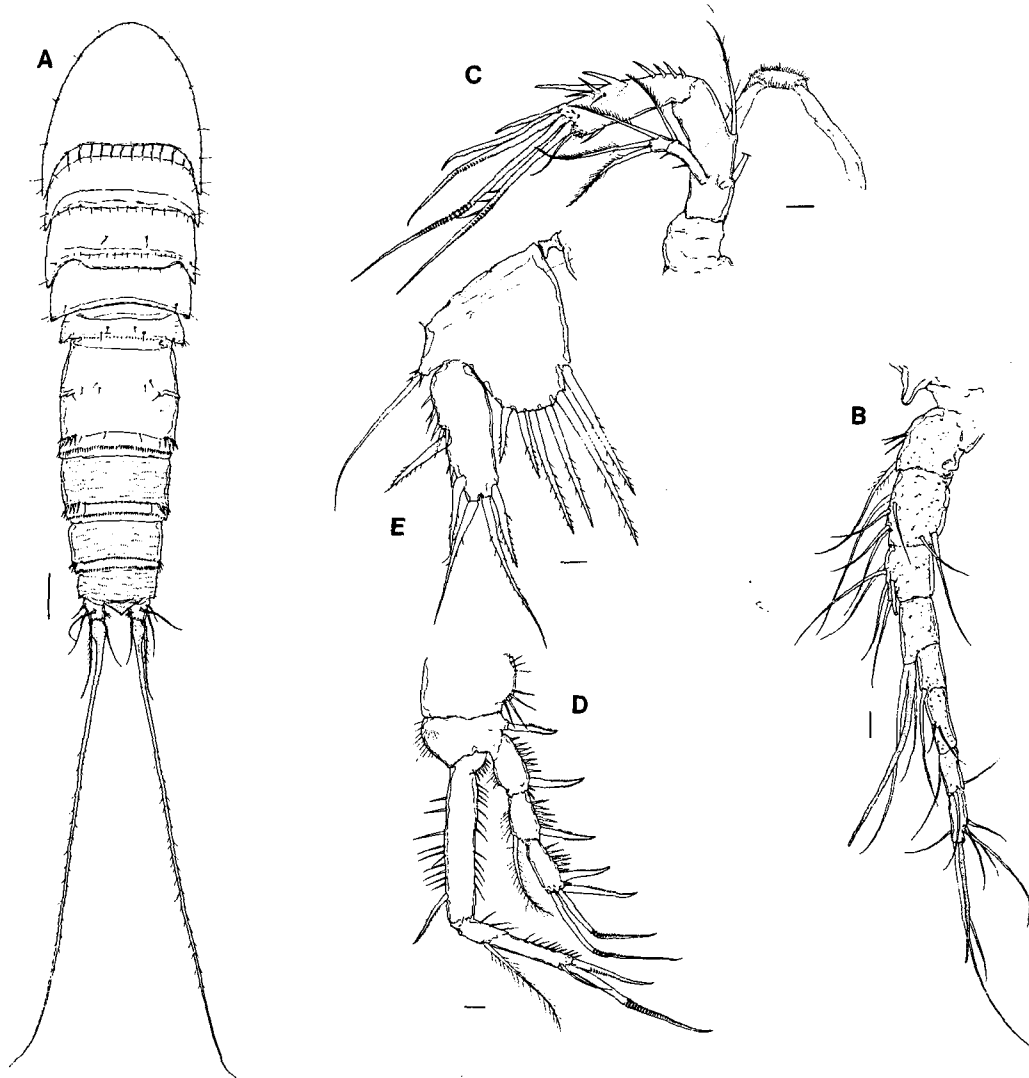


Fig. 1. *Canthocamptus morimotoi* Miura, Female. A, Habitus (dorsal). B, Antennule. C, Labrum and antenna. D, Leg 1. E, Leg 5. Scale bars=0.01 mm (B-E) and 0.05 mm (A).

Female: Body (Fig. 1A) 0.64-0.69 mm long ( $0.66 \pm 0.04$  mm,  $N=5$ ), excluding rostrum and caudal setae; broadest near posterior margin of cephalothorax, tapering behind. Prosoma bullet-formed. Cephalothorax a little protruding, as long as succeeding 3 thoracic somites combined. Dorsal and lateral surface of thoracic somites sparsely haired; posterior part of cephalothorax with 12-14 longitudinal folds along its margin, each bearing a setule at its tip (Figs. 1A, 2A); posterior margins of next somites furnished with a row of setules. Genital double somite a little wider than long, subdivided by a pair of lateral suture at about half of lateral margin, each with a seta near its dorso-medial end. Genital area (Fig. 2G) 'T'-shaped; flanks rather short. Each abdominal somite bearing a row of spinules on outero-distal corner, and hyaline frill with posterior margin serrated. Posteromedial corner of ventral side of anal segment bearing 2 prominent and sharp spines (Fig.

2B). Anal operculum convex with minute setules on its hind edge. Hyaline membrane (Figs. 1A, 2B) triangular, its tip reaching the posterior margin of caudal rami. Specimens examined without egg sac.

Caudal ramus (Fig. 2B) about 1.2 times as long as wide, with a row of slender spinules on medial margin; outer caudal seta armed with sharp secondary spinules and setae from proximal one fifth to middle; terminal seta stout, strikingly swollen at its base, lacking proximal breaking plane; inner caudal seta bare.

Rostrum (Fig. 1B) not prominent, protruding antero-ventrally, not defined at its base, constricted secondarily at its distal half, but ended into round tip. Antennule (Fig. 1B) with typical characteristics of genus *Canthocamptus*, of 8-articulated, bearing 1 aesthetasc on anterodistal edge of fourth article, its tip slightly beyond distal end of antennule. Labrum (Fig. 1C) triangular with blunt and hirsute tip. Allobasis of antenna (Fig.

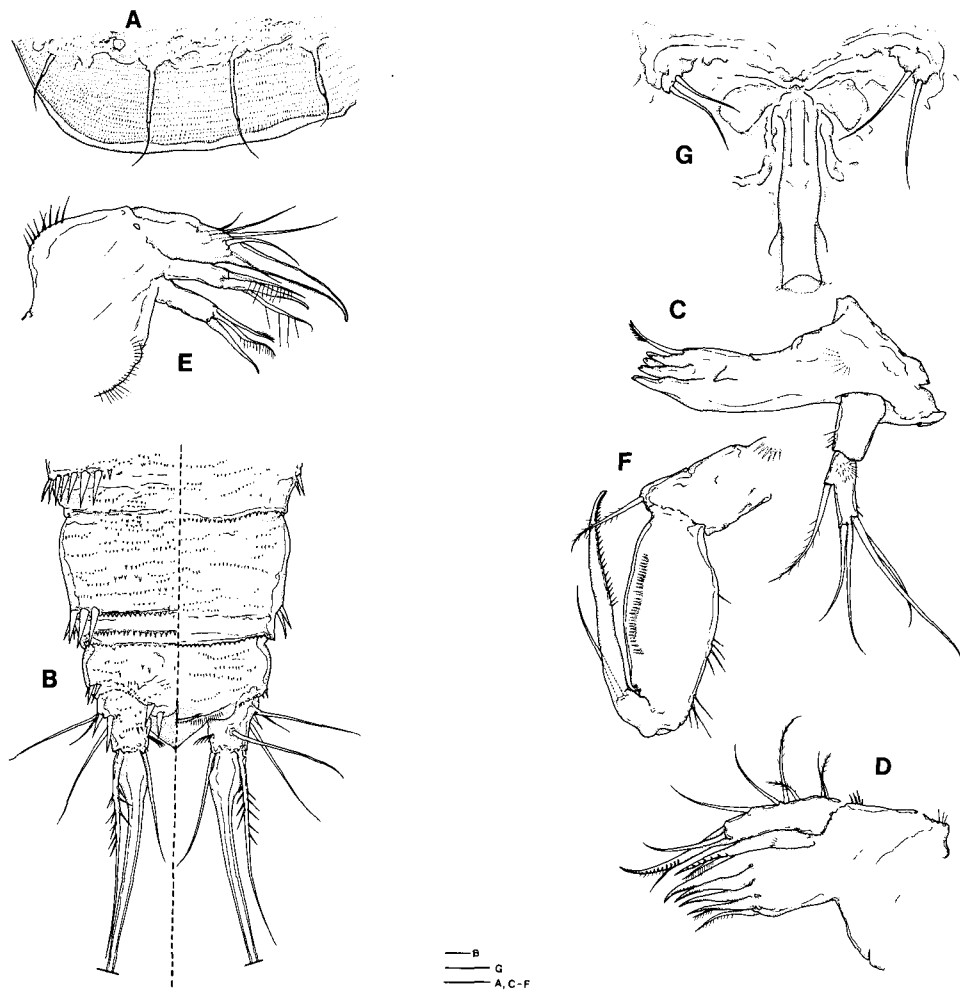


Fig. 2. *Canthocamptus morimotoi* Miura, Female. A, Part of left posterior margin of cephalothorax. B, Posterior part of urosome showing both ventral (left) and dorsal (right) sides. C, Mandible. D, Maxillule. E, Maxilla. F, Maxilliped. G, Genital area. Scale bars=0.01 mm.

1C) about 3 times as long as broad, with 2 big plumose setae on medial face. Exopod distinctly 2-segmented; proximal segment markedly slender, bearing 1 seta on inner distal edge with 2 spinules on outer margin; distal segment bearing 2+1 setae. Endopod nearly as long as allobasis, swollen distally; furnished with 2 stout spines on distal half of anterior face, accompanied by several spines; bearing 2 simple, 3 geniculate spines, and 1 seta on distal end. Basis and endopodite of mandible (Fig. 2C) well-developed and cylindrical; basis with a bundle of setules on anterodistal edge; endopodite about 2.6 times as long as broad, bearing 1 plumose seta on proximal third of anterior margin and 4 bare setae on distal margin; proximal part of dorsal surface hirsute; gnathobase armed with 4 blunt teeth and 1 pectinate seta on posteromedial corner. Praecoxal arthrite of maxillule (Fig. 2D) armed with several unguiform terminal spines and plumose setae; coxa

bearing 1 geniculate spine and 1 seta distally; basis forming a cylindrical segment equipped with a stout geniculate spine and 2 bare setae apically, and 6 setae along outer margin. Syncoxa of maxilla (Fig. 2E) bearing 2 endites of similar lengths, each furnished with 3 setae apically; allobasis with 1 basal endite transformed into a long claw with 2 bare setae; endopod represented by only small protrusion with 3 terminal bare setae. Maxilliped (Fig. 2F) chelate; basis bearing a long plumose seta on disteromedial corner; first endopodite oblong, about two times longer than wide, bearing a row of spinules near inner margin, with several spinules on outer edge; second endopodite forming a claw, a little longer than preceding segment, with a long slender seta proximally.

Both exopod and endopod of legs 1-4 consisting of 3 segments except endopod of leg 4 with 2 segments. Leg 1 enp 1 (Fig. 1D) a little shorter than exopod, with

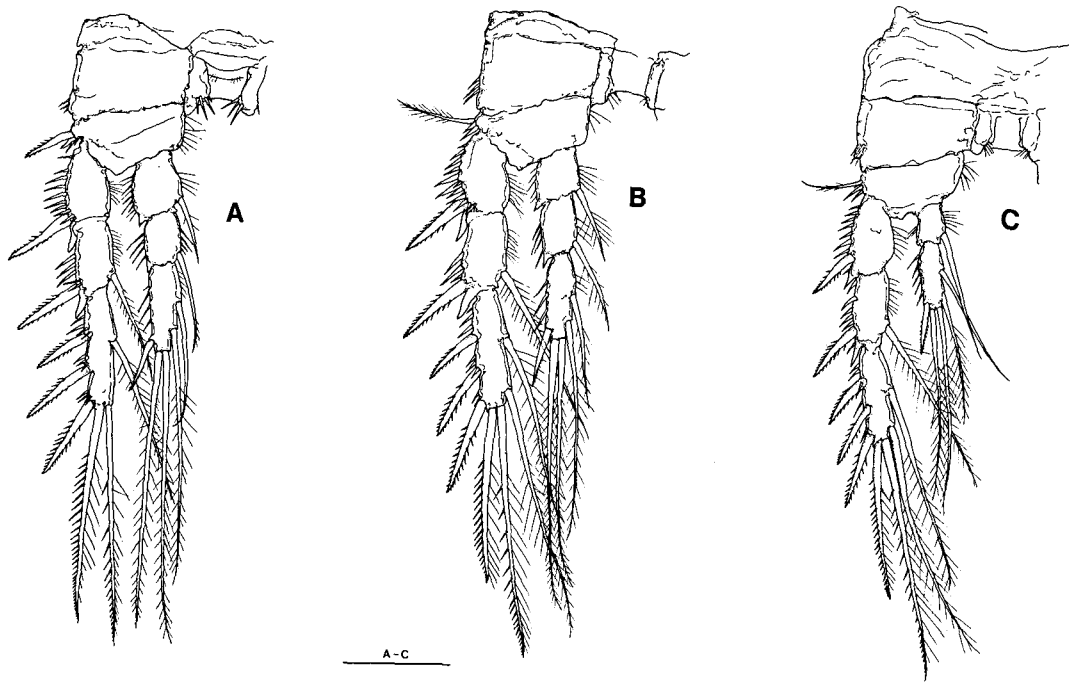


Fig. 3. *Canthocamptus morimotoi* Miura, Female. A-C, Legs 2-4. Scale bar=0.05 mm.

1 stout plumose seta on distal fifth of inner margin; enp 2 with 1 plumose seta on innerdistal corner and 3 sharp spinules on outer edge; enp 3 slender bearing 2 geniculate spines and 1 seta. Exopodal segments with similar length each other; exp 2 with 1 inner seta; exp 3 bearing 2 outer and 2 geniculate spines. Distal edge of intercoxal sclerites of legs 2-4 (Figs. 3A-C) with several spinules. Ornamentation of legs 2-4 as follows (Roman numerals indicating spines and Arabic numerals representing setae):

Leg 2	basis	I-0	exp	I-0; I-1; III, 2, 1
			enp	0-1; 0-1; I, 2, 2
Leg 3	basis	I-0	exp	I-0; I-1, III, 2, 2
			enp	0-1, 0-1, I, 2, 2
Leg 4	basis	I-0	exp	I-0, I-1, III, 2, 2
			enp	0-1, I, 2, 2

Distal end of leg 5 baseoendopod (Fig. 1E) reaching middle of exopod; baseoendopod not confluent at its base, connected by intercoxal sclerite; bearing 6 spiniform setae, of which outermost two smallest and second one from the inner longest. Exopod rather oblong, a little tapering distally, about 2.6 times as long as broad; inner margin slightly swollen; armed with 5 'awn-type' setae, of which inner distal one much longer than exopod; inner seta located distally.

Male: Body (Fig. 4A) 0.53-0.61 mm long ( $0.57 \pm 0.07$  mm, N=5). Overall appearance rather similar to female's, except slender caudal rami and basal part of terminal caudal seta (Fig. 4B). Hyaline membrane

triangular, its tip extending as far as posterior margin of caudal rami in a lateral view (Fig. 4C). Antennule as shown in Fig. 4D. Leg 2 (Fig. 5A), enp 1 with 1 inner seta; enp 2 bearing 3 inner, 2 long distal setae, with outer spinules; exp 3 with 1 inner seta, distal part of which is modified. Leg 3 (Fig. 5B), enp 2 armed with 1 sharp spine and 1 process (apophysis) slightly exceeding exp 3, possessing terminal barb; enp 3 much elongate, a little longer than sum of two preceding ones, tapering terminally, ending with 2 plumose setae; exp 2 armed with a stout spinal process on outero-distal corner, its tip not reaching distal edge of exp 3; exp 3 ornamented with 2 inner plumose setae, distal part of which is modified (with a row of minute spinules on inner tip). Leg 4 (Fig. 5C) nearly same in shape with female's, including outer terminal seta on exp 3 armed with more than 18 spinules on outer margin of seta; inner proximal seta on exp 3 normally plumosed, while distal one modified on its distal part; upper seta on enp 2 much weaker than female's. Baseoendopod of leg 5 (Fig. 4E) confluent; endopodal lobe protruding, but not reaching middle of exopod; bearing 2 terminal spiniform setae, inner one about 1.3 times longer than outer one; inner margin bare. Exopod 1.8 times longer than broad, armed with 6 setae in total, consisting of 1 weak plumose seta on inner middle, 1 inner distal, 2 distal, and 2 outer awn-type setae. Leg 6 represented by a small plate bearing 1 spine and 2 slender setae.

Variability: Not observed were the females with male-type caudal rami, and all of them had the caudal

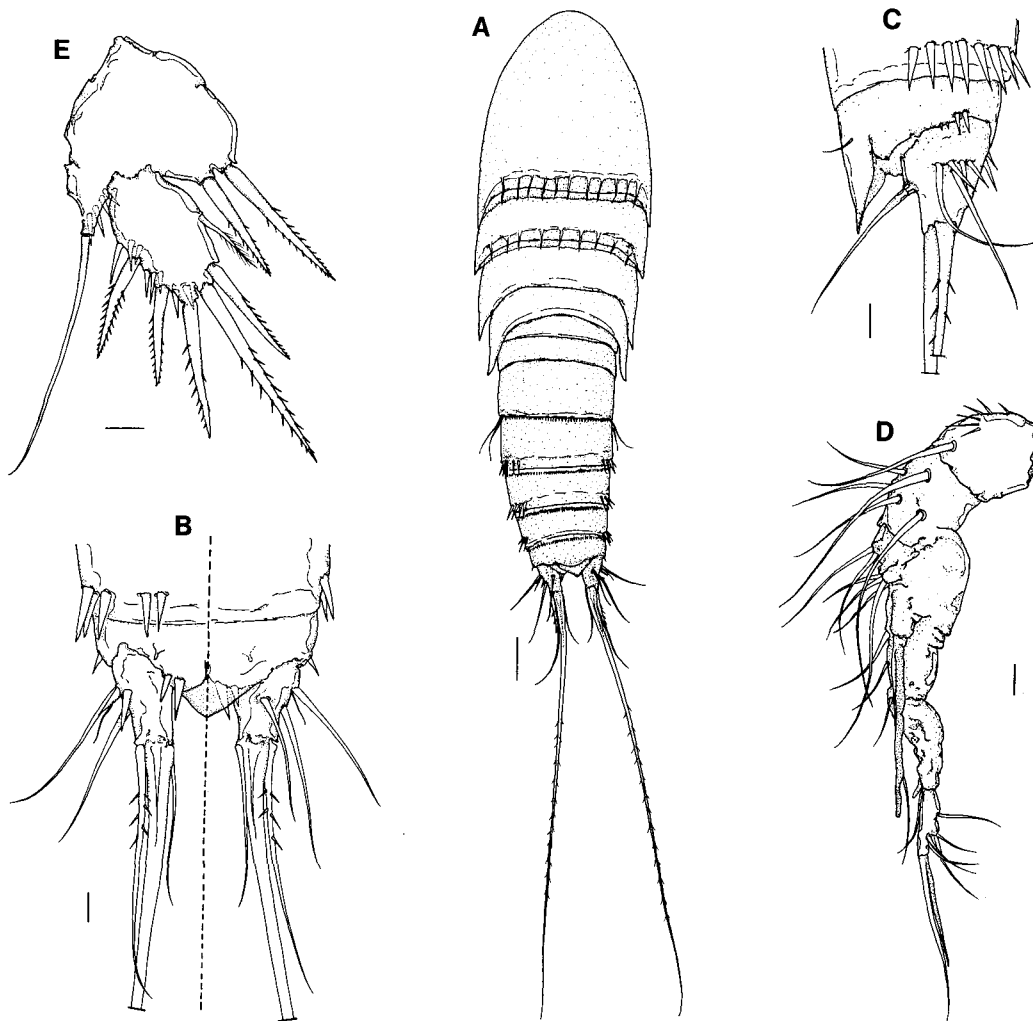


Fig. 4. *Canthocamptus morimotoi* Miura, Male. A, Habitus (dorsal). B, Posterior part of urosome showing both ventral (left) and dorsal (right) sides. C, Posterior part of urosome (lateral). D, Antennule. E, Leg 5. Scale bars=0.01 mm (B-E) and 0.05 mm (A).

terminal seta swollen at its base. All the examined specimens showed awn-type setae on exopods of leg 5 in both males and females. No particular difference in the principal ornamentation was detected among the specimens.

*Affinities and a brief review on the mirabilis-group*

*Canthocamptus mirabilis* group alludes to the species group which commonly inhabits the mountain streamlet and its related habitats in the Far East Asia, and possesses some characters reminiscent of those of the genus *Attheyella*, especially of the subgenera *Mrazekiella* and *Brehmiella* of the genus, viz. spindle-like body, convex anal operculum often with hyaline membrane protruding posteriorly, caudal rami of not cylindrical but ovoidal or conical form, the characsetal or spinal armatures especially in male leg 3 and leg 4 (Ito and Takashio, 1980; Kikuchi and Ishida, 1993).

segmentation and shape of legs with modified 1994). Six species are currently recognized in this species group: *C. mirabilis* Štěrba, 1968, *C. morimotoi* Miura, 1969, *C. prominulus* Kikuchi, 1993, *C. semicirculus* Kikuchi, 1993, *C. resupinatus* Ishida, 1993, *C. tomikoeae* Ishida, 1993. They are compared to each other in Table 1 together with the other two taxa, *Attheyella* (*Mrazekiella*) *amurensis* Borutzki, 1953 (sensu Shen and Sung, 1973) and *C. mirabilis* (sensu Ito and Takashio, 1980), suspected as the additional, separate species.

*C. mirabilis* was described from a streamlet near Peking on the basis of only three females in 1968. Although the original description of it was so poorly prepared, especially with the deficiency of male characters (see Štěrba, 1968), it must have belonged to the *mirabilis*-group, judging from the peculiar shape of the caudal rami and leg 5 as mentioned by Ito and Takashio (1980). Nevertheless, this species seems to

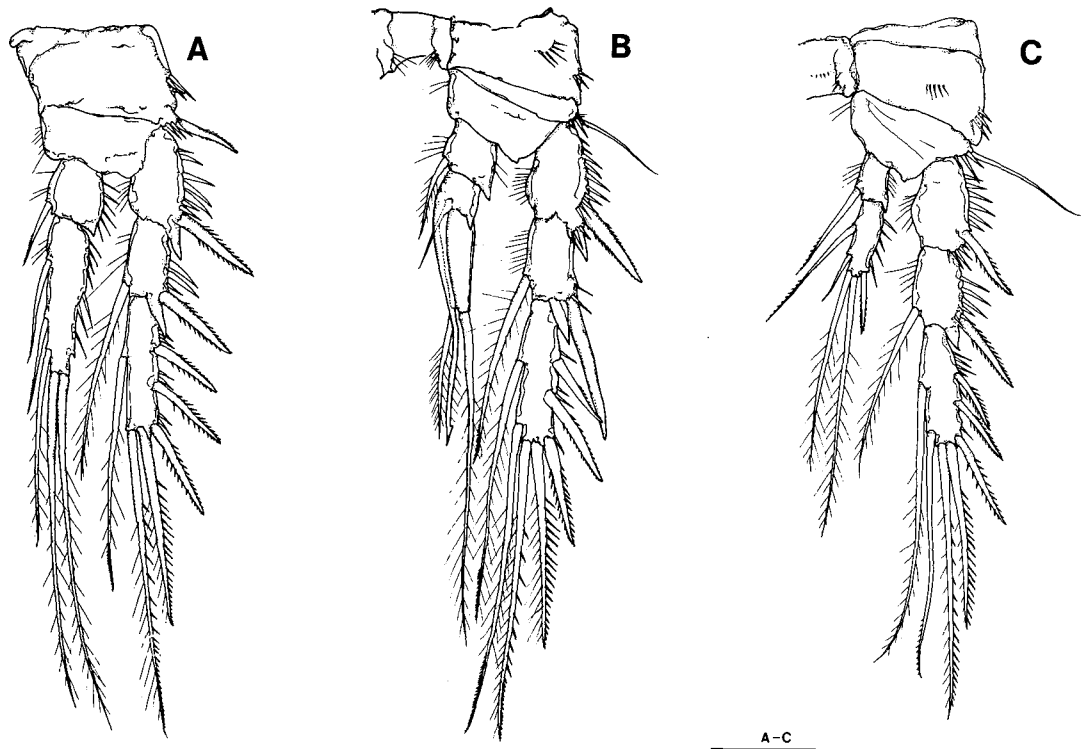


Fig. 5. *Canthocamptus morimotoi* Miura, Male. A-C, Legs 2-4. Scale bar=0.05 mm.

be characterized only by the (male-type) caudal rami furnished with spinules on the medial face and the elongate exopod of leg 5 not bearing setules on its inner edge, so the fair judgement on its identity must be reserved until the exact redescription on the topotypes including male characters.

Comparing the original description of *C. morimotoi* (see Miura, 1969) with the topotypes (the present materials) recollected from the type locality, Simpigul Cave in South Korea, it is ascertained that the original description was not adequate to fully characterize this relict species of the *mirabilis*-group, and is lacking in detail by modern standards: (1) the outer proximal spine on exopod of male leg 5 was omitted in his Fig. 11, (2) the ornamentation of outer terminal seta of male leg 4 exopod was not correctly figured, (3) the awn-type setae both of female and male leg 5 exopods, were illustrated as taper-type setae, (4) the spinal process on the outerodistal corner of male leg 3 exopod was too short, (5) the stout spines on the posteromedial corner of the anal somite and the ornamentation of female leg 5 exopod were not manifested, and so on.

The '*A. (M.) amurensis*' (sensu Shen and Sung, 1973), which was reported from Kirin, South Manchuria, must have been erroneously identified, and should be allocated to *C. mirabilis* group as once mentioned by Ito and Takashio (1980), considering the typical characteristics such as the conical caudal rami, the shape

and ornamentation of leg 5, and the modification of male leg 3 and leg 4. This species is suspected to be identical with the Chinese species, *C. mirabilis* of Štěrba (1968) in sharing the convex anal operculum without the hyaline membrane, the subconical caudal rami with plumose outer caudal seta and bare inner seta, and the female leg 5 exopod not furnished with setules on the inner edge. On the other hand, this species is similar to *C. morimotoi* Miura in having the short subconical caudal rami with setules on the medial face and the short spinal process on the second exopodal segment of male leg 3, but the former differs from the latter by the shape of the anal operculum and the ornamentation of the outer terminal seta of male leg 4 exopod.

*C. mirabilis* group from Japan consist of six species including *C. mirabilis* (sensu Ito and Takashio, 1980), which was fully (re)described with the mentions about the taxonomic characters of the *mirabilis*-group for the first time. This species, known to be distributed around Hokkaido and northern Honshu, is doubted whether it would be identical to the original species described by Štěrba (1968) from China. The '*C. mirabilis*' from Japan is clearly distinguished from *C. morimotoi* from Korea by the convex anal operculum, the presence of a spinule on the disteromedial corner on exopod of female leg 5, the long spinal process on the male leg 3 exopod, and the ornamentation of the outer terminal seta of the male leg 4 exopod.

Table 1. Character comparison of the *Canthocamptus mirabilis* group

Character	<i>C. mirabilis</i> Sterba, 1968	<i>C. morimotoi</i> Miura, 1969	<i>Attheyella</i> <i>amurensis</i> sensu Shen & Sung, 1973	<i>C. mirabilis</i> sensu Ito & Takashio, 1980	<i>C.</i> <i>prominulus</i> Kikuchi, 1994	<i>C.</i> <i>semicirculatus</i> Kikuchi, 1994	<i>C.</i> <i>resupinatus</i> Ishida, 1994	<i>C. tomikoeae</i> Ishida, 1994
Body length ♀ (mm)	0.85	0.64-0.69	0.70-0.75	1.04	0.77-0.88	0.78-0.86	0.60-0.64	0.57-0.66
	♂: -	0.53-0.61	0.65-0.73	0.96	0.65-0.73	0.65-0.75	0.50-0.65	0.48-0.59
Anal operculum / hyaline membrane	convex / absent (?)	triangular / present	weakly convex / absent (?)	weakly convex / absent	triangular / present	semicircular / absent	triangular / present	straight / absent
Ventromedial spines of anal somite	-	well developed	not developed	a little developed	not developed	not developed	not developed	not developed
Caudal ramus (L/W ratio), ♀	subconical male-type	stubby (> 1.2)	subconical (> 1.5)	subconical (1.5)	subconical (1.8)	conical (2.0)	subovoidal (1.25)	subconical (1.5)
Setules on medial edge of caudal ramus	♀: present ♂: -	♀: present ♂: absent	♀: present ♂: present	♀: present ♂: present	♀: present ♂: absent (var. form present)	♀: present ♂: present	♀: present ♂: present	♀: present ♂: absent (var. form present)
Caudal setae (medial / outer)	bare (?) / bare (?)	bare / plumose	bare / bare (?)	bare / plumose	♀: fringed / bare (♂: vice versa)	bare / sparse setules	bare / fringed (incurved)	bare / fringed
Spinules on medial edge of leg 5 exp, ♀	absent	absent	absent	absent	absent	present	absent	present
Spines on disteromedial corner of leg 5 exp, ♀	absent (?)	absent	absent (?)	present	absent	absent	absent	absent
Terminal seta on leg 5 exp, ♀	longer (than exp)	longer	longer	nearly same	short	longer	longer	short
Spinal process of leg 3 exp 2, ♂	-	slightly not reaching tip of exp 3	not reaching tip of exp 3	over tip of exp 3	under tip of exp 3	reaching tip of exp 3	over tip of exp 3	over tip of exp 3
Spinules on outer terminal seta of leg 4 exp 3, ♂	-	15-16 (isomorphic to ♀)	4	5	4	3	6	3
Diminishment of medial setae on leg 4 exp 2, ♂	-	distal seta	distal seta	proximal seta	distal seta (var. form present)	distal seta (var. form present)	distal seta	proximal seta
Length to width ratio of P5 exp	♀: 2.9 ♂: -	♀: 2.6 ♂: 1.8	♀: 2.1 ♂: 1.8	♀: ≈2 ♂: 1.8	♀: ≈3 ♂: 2.4	♀: 3.2 ♂: 2.3	♀: 2.8 ♂: 1.5	♀: ≈2 ♂: 1.7
Distribution	China: near Peking	Korea: Simpigul Cave, (Koesan)	Kirin (S. Manchuria)	Japan: Hokkaido, N. Honshu	Japan: Hokkaido, E. Honshu	Japan: W. Honshu, Shikoku, Kyushu; Taiwan	Japan: Central Honshu	Japan: W. Honshu, Shikoku, Kyushu, Tsushima

Of the other four recognized Japanese species viz. *C. prominulus*, *C. resupinatus*, *C. semicirculatus* and *C. tomikoeae*, *C. morimotoi* resembles the first two species than the other two when considering the shape of anal operculum and female leg 5 exopod, but it is easily discernible from them by the well-developed spines on the disteromedial corner of the anal somite, the shape of caudal seta, and the number of spinules on the outer terminal seta of male leg 4 exp 3.

Ishida (1990) once reported '*C. morimotoi*' from the trickles of a streamside in Tsushima Island, Japan, however, it is considered to be another distinct species of *C. mirabilis* group. After examining his specimens that he kindly sent to me, it is apparently different from the Japanese members of the *mirabilis*-group as well as the Korean stygobiontic *C. morimotoi* by the ornamentation of the medial face of the caudal rami (setules absent in female's, whereas present in

male's), the armature of the outer terminal seta of male leg 4 exp 3, and the normal spine (not-modified as a spinal process) on the outerodistal edge of the male leg 3 exp 2.

At present, *Canthocamptus morimotoi* is the only genuine subterranean species in the *mirabilis*-group, and supposed to be a relict species, for its collection datum is restricted to its type locality, Simpigul cave, even though *Canthocamptus*-harpacticoid samples obtained from 71 localities in South Korea have been scrupulously examined. The most conspicuous and decisive features which characterizes this species from other members of this group are the ornamentation of the outer terminal seta on the distal exopodal segment of male leg 4 and the well-developed spines on the disteromedial corner of the anal somite. The former feature seems to be conserved and supposedly plesiomorphic, for it is sexually isomorphic and retained only in *C. morimotoi* in the *mirabilis*-group, while the latter

appears to be uniquely developed, as the apomorphic character. It still remains doubtful, however, that both characters resulted from its adaptation to groundwater habitation.

#### Acknowledgements

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