한국동물분류학회지 제9권 제2호
The Korean Journal of Systematic Zoology
Vol. 9, No. 2: 181-190 (December 1, 1993)

Harpacticoid Copepods of Genus *Attheyella* (Harpacticoida: Canthocamptidae) in Korea

Chang, Cheon Young
(Department of Biology, College of Natural Sciences, Taegu University, Kyongsan-kun 713-714, Republic of Korea)

Attheyella 속의 한국산 하르팍티쿠스류

장 천 영
(대구대학교 자연과학대학 생물학과)

적 요

Attheyella 속의 한국산 하르팍티쿠스류 4종을 보고한다. 4종 중 아직 기재 안 된 *Attheyella* (*Attheyella*) *paucisetosa*의 수컷과 신종인 *Attheyella* (*Mrazekiella*) *tetraspinosa*를 기재한다.

Key words: Taxonomy, Copepoda, Harpacticoida, *Attheyella*, New species, Korea.

Three harpacticoid species of genus *Attheyella* have been known from Korea. *A.* (*A.*) *coreana* Miura was described from 4 caves (Miura, 1969), and once reported from a faunal study on Mt. Wolch'ul (Kim and Chang, 1989). Recently, two species of *Attheyella* were described by Chang and Kim (1992) with the name of *A.* (*A.*) *paucisetosa* (female only) and *A.* (*Mrazekiella*) *byblis* from two springs, each of Mt. Hambak and Mt. Halla.

As a result of examining my collection of the freshwater harpacticoids collected from 120 localities

*This is a part of study that was supported by a grant from the Ministry of Education of Korea in 1990.

or more in South Korea since 1985, I confirmed one more new species belonging to the subgenus *Mrazekiella*. In this report, I shall sum up the results on the four species of *Attheyella* in Korea, with the description of the new species and the male of *A.* (*A.*) *paucisetosa* which has not been described yet.

Materials were collected mostly from springs with diprets. All the specimens were dissected, drawn and measured in lactic acid, later mounted in lactophenol. Figures were made with the aid of a camera lucida. Type specimens of *A. tetraspinosa*, n. sp., *A. paucisetosa* Chang and Kim, *A. byblis* Chang and Kim, and 5 individuals of *A. coreana* Miura are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Family Canthocamptidae Sars, 1906
Genus *Attheyella* Brady, 1880
Subgenus *Attheyella* Chappuis, 1929

1. *Attheyella (Attheyella) coreana* Miura, 1969

Attheyella coreana Miura, 1969 (p. 246, figs. 16-31); Kim and Chang, 1989 (p. 165); Ishida and Ito, 1991 (p. 80, figs. 4-18).

Material examined. 1♀, Samsan-ri, Y ŏngok, Kangw ŏndo, May 31, 1987 (I.H. Kim); 5♀♀ and 3♂♂, Mt. Noch'u, Kuj ŏl-ri, Ch ŏngs ŏn, May 3, 1987; 2♀♀, 1♂, Y ŏnhwaam Temple, Mt. Odae, Sep. 5, 1991; 1♀, a cave at Hwaj ŏn-dong, Taebaek-shi, May 4, 1987; 2♂♂, Changs ŏng, May 4, 1987; 2♀♀, 3♂♂, Chikjisa Temple, June 21, 1991; 1♀, 1♂, a well near Changgoksa Temple, Ch' ŏngyang, Mar. 4, 1991; 1♂, Magoksa Temple, Kongju, July 5, 1987; 1♀, Ch'unyang, May 5, 1987; 5♀♀, 2♂♂, a well at Ungok-ri, K ŭmr ŭng-kun, Aug. 11, 1990; 4♀♀, 2♂♂, Kuch ŏn-ri, Andong-kun, Oct. 3, 1991; 2♀♀, Mt. Namd ŏkyu, Aug. 15, 1987 (J.H. Park); 8♀♀, 2♂♂, Mt. Chiri, July 29, 1991; 1♀, 1♂, Ssanggyesa Temple, Jan. 21, 1987; 2♀♀, 2♂♂, Mt. Hambak, July 22, 1987; 1♀, 1♂, Ch ŏgu-ri, K ŏje, Aug. 18, 1987; 2♀♀, 5♂♂, Tadae-ri, K ŏje-kun, Sep. 25, 1990; 2♀♀, 1♂, 1100 Hill of Mt. Halla, Feb. 19, 1987; 1♀, Ch' ŏnjey ŏn Fall, Cheju I., Feb. 5, 1987; 1♀, Ch' ŏnjey ŏn Fall, Cheju I., May 25, 1993.

Remarks. As well-pointed out by Ishida and Ito (1991) from Japanese and Primorye populations, nearly all the specimens examined in this report showed the conspicuous sexual dimorphism in caudal rami, which makes this species distinguished from its relatives, such as *A. coiffaiti* Chappuis, *A. nakaii* (Brehm), *A. idahoensis* (Marsh), and *A. gladkovi* Borutzky. In his original description for *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; Dussart and Defaye, 1990), and enumerated three morphological differences between them, one of which was the armature of distal endopodal segments. But the specimens examined in this report often showed a variation in the armature of leg 2, for instances, bearing no inner seta on one distal endopodal segment and 1 seta on the other, or even 1 seta on one and 2 on the other.

Since *A. coreana* had been described from 4 caves of Korea in 1969 (Miura, 1969), it was reported from Mt. W ŏlch'ul of Korea (Kim and Chang, 1989), from Kyushu and Tsushima Is. of Japan (Ishida, 1990), and from South Primorye of Russia (Ishida and Ito, 1991). In Korea, this species was turned out to be the most abundantly and frequently occurred species of *Attheyella* in

mountain waters, especially in the springs.

2. *Attheyella (Attheyella) paucisetosa* Chang and Kim, 1992 (Fig. 1)

Attheyella sp. M Ishida, 1987 (p. 82, pl.1); Ishida, 1990 (p. 44).

Attheyella paucisetosa Chang and Kim, 1992 (p. 58, figs. 1-2).

Material examined. 8♀♀, 2♂♂, collected at a spring of Mt. Chiri, in Kogi-ri, Namwŏn (35° 22′ 83″N, 127°30′ 40″E, about 680m in altitude) on July 29, 1991, C.Y. Chang *leg*. 4♀♀ and 1♂ deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Male. Body fairly minute, about 0.47mm long, excluding rostrum and caudal setae. Rostrum minute and pointed downward. Cephalothorax protruded anteriorly with some scattering hairs on dorsal surface and along lateral margin. Posterior margins of all thoracic and abdominal segments serrated. Anal operculum (Fig. 1a) rounded with minute setules on its hind edge.

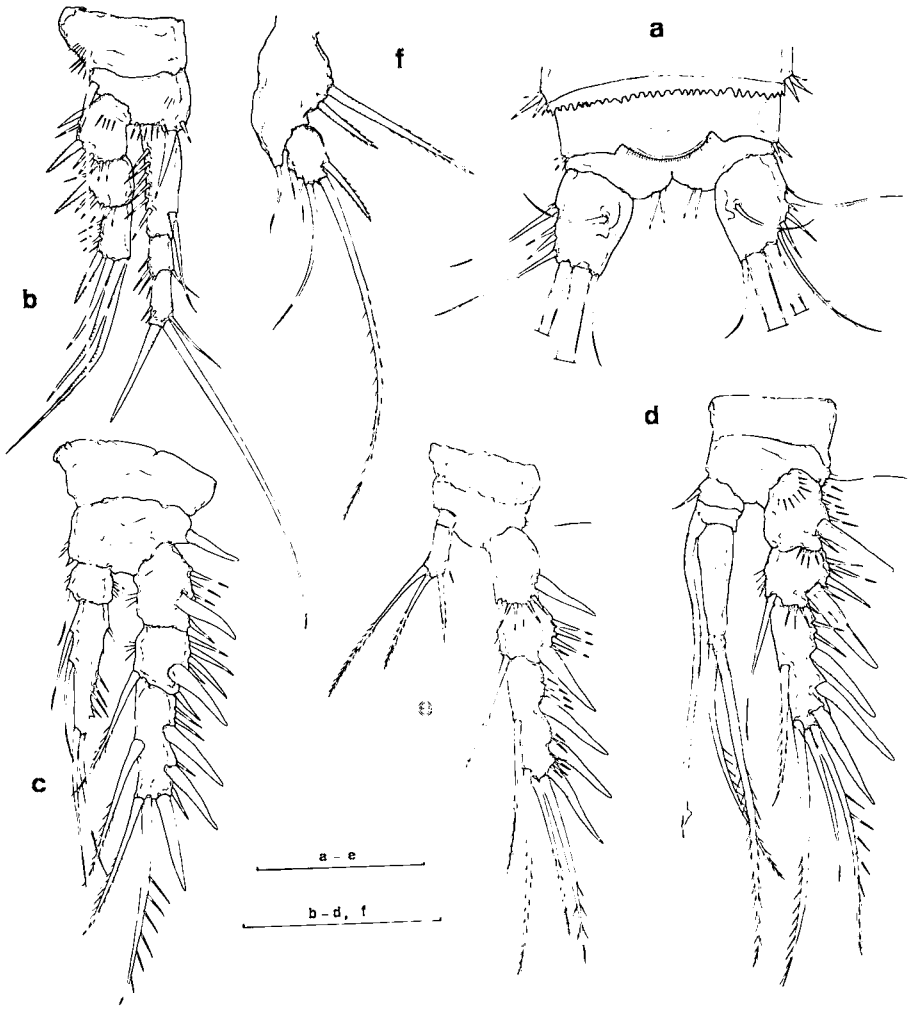

Fig. 1. *Attheyella (Attheyella) paucisetosa*, male: a, anal segment and caudal rami, dorsal; b, leg 1; c, leg 2; d, leg 3; e, leg 4; f, leg 5. (Scales: 0.05mm)

Caudal rami (Fig. 1a) somewhat different from female's; divergent and tapering posteriorly, 1.25 times as long as broad. Dorsal seta located near middle of ramus. Chitinous tubercle running longitudinally inside dorsal seta. Inner side of caudal rami smooth. Outer terminal seta slender and very long. Outer median apical seta much longer than in female's.

Antennule geniculate, with slender aesthetasc on articles 4 and 8. Antenna, mandible, maxillula, maxilla, and maxilliped similiar to those of female.

Both endopod and exopod of leg 1 (Fig. 1b) 3-segmented; first endopodal segment much shorter than entire exopod (slightly beyond half of distal exopodal segment). Endopod of leg 2 (Fig. 1c) 2-segmented; distal endopodal segment elongate, bearing 2 apical and 2 inner setae with several sharp spinules along outer margin. Endopod of leg 3 (Fig. 1d) 3-segmented; endopod 1 with 1 short inner spine; process (apophysis) on inner margin of second endopodal segment far beyond tip of distal segment of exopod, possessing terminal barb; last endopodal segment very elongate, over 2 times as long as sum of two preceding ones, and nearly reaching middle of last exopodal segment, ending with 2 long setae. Lateral spine on article 2 of leg 3 exopod not so much enlarged. Proximal segment of leg 4 (Fig. 1e) without inner seta; distal one bearing 2 apical or subapical setae and 1 sharp spine with 1 minute spinnule on outer margin. Basipod of leg 5 (Fig. 1f) bearing 2 spines, inner one more than two times longer; exopod 1.24 times as long as broad, bearing total 5 elements, of which innermost one spiniform and next apical seta strikingly long. Leg 6 represented by one inner spine and 2 outer setae.

Collected with *Attheyella coreana* Miura and *Canthocamptus* sp.

Remarks. As mentioned in Chang and Kim (1991), this species is closely related to *A. crassa* (Sars) or *A. orientalis* Chappuis, because the structure and armature of leg 5 in *A. paucisetosa* resembles those of the two species, and so does the caudal ramus. However, *A. paucisetosa* is readily distinguished from them by having fewer setae on distal endopodal segments of legs 3-4, as indicated in the specific name, and 7-articulated antennules in female. As far as male is concerned, this species is different from *A. crassa* in the following: (1) laterodistal spine of second exopodal segment of leg 3 is normal, and not swollen; (2) exopod of leg 5 is a little shorter than in *A. crassa*; (3) inner seta on basipod of leg 5 is more than 2 times longer than outer one. On the other hand, males of *A. paucisetosa* are discernable from those of *A. orientalis* by the following features: (1) posterior margins of all thoracic or abdominal segments are serrated; (2) anal operculun is rounded and not so much protruded; (3) first endopodal segment of leg 4 does not bear an inner seta.

Subgenus *Mrazekiella* Chappuis, 1929

3. *Attheyella (Mrazekiella) byblis* Chang and Kim, 1992

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

Attheyella (Mrazekiella) byblis Chang and Kim, 1992 (p. 71, figs. 3-5).

Material examined. 2♀♀, 1♂, 1100 Hill of Mt. Halla, Feb. 19, 1987, C.Y. Chang *leg.*

Distribution. Korea, Japan.

4. *Attheyella (Mrazekiella) tetraspinosa*, n. sp. (Figs. 2-3)

Type material. 15♀♀ and 8♂♂, collected at a spring of Mt. Noch'u in Kuj ŏl-ri, Ch ŏngs ŏn (37°

30′ 00″N, 128°44′ 30″E) on May 3, 1987, C.Y. Chang *leg.* Holotype female, allotype and 7 paratypes (5♀♀, 2♂♂) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.; the remaining paratypes in the collection of the author.

Additional material examined. 1♀ (ovi.), a brooklet at Mt. W ŏlch'ul (34°45′ 34″N, 126°39′ 35″E), Jul. 27, 1988, C.Y. Chang *leg.*

Female. Body (Fig. 2a) rather cylindrical, 0.51mm long, excluding rostrum and caudal setae, tinged dark gray. Rostrum minute and a little protruded. Cephalothorax with some scattering hairs on dorsal surface and along lateral margin. Thoracic and abdominal segments with rows of innumerable minute setules. Hind edges of dorsal surfaces strongly serrated. Genital segment much wider than long, subdivided by a lateral surture at about proximal two fifth of lateral margin. Anal operculum (Fig. 2b) convexed with minute setules on its hind edge.

Caudal ramus (Fig. 2b) barrel-shaped, or columnar; 1.35 times as long as broad. Proximal part of outer median apical seta swollen, covering distal part of dorsal surface of ramus. A row of spinules around dorsal seta located at proximal quarter to third of ramus. Inner side of caudal ramus with obliquely arranged spinules. Inner median apical seta about 3.5 times longer than outer one.

Antennule (Fig. 2c) of 8 articles, its tip not reaching distal quarter of cephalothorax. Aesthetasc on article 4 far exceeding posterior margin of distal joint; aesthetasc on distal joint nearly as long as sum of distal 4 articles. Exopod of antennae (Fig. 2d) 1-segmented, with total 4 setae. Precoxa of mandible (Fig. 2e) armed with a few rather stout spinules and comb-like projections; endopodite with 1 inner seta and 3 apical setae; exopodite absent. Maxillula (Fig. 2f) with 7 warped claw-like spines and 1 seta on cutting edge of precoxa; inner process of coxa bearing 2 apical setae; basis with 3 apical setae and 6 setae on ventral edge. Basis of maxilliped (Fig. 2h) bearing 1 long seta on subapical inner edge; endopod slender (2.1 times longer than wide), armed with 2 longitudinal rows of spinules; claw somewhat longer than preceding segment.

Exopods of legs 1-4 and endopod of leg 1 3-segmented; endopods of legs 2-4 2-segmented. First endopodal segment of leg 1 (Fig. 2i) much longer than whole exopod, with 1 seta on distal quarter of inner margin. Endopods of leg 2 (Fig. 3a) and leg 3 (Fig. 3b) reaching proximal quarter to third of distal exopodal segment. Proximal segment of leg 4 (Fig. 3c) endopod bearing 1 seta on its distal corner; distal segment with only 1 seta and 1 spine on its tip. The armature of legs 2-4 in female as follows:

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

Basipod of leg 5 (Fig. 3d) bearing 4 terminal spines of similiar length. Distal segment exceedingly elongate, about 3.73 times longer than wide, bearing total 5 spines of 3 apical and 2 ventrolateral ones, with several rows of spinules and hairs on ventral surface.

Egg sac contains 12 eggs.

Male. Body shape (Fig. 3e) similiar to female, about 0.42mm long. Triangled rostrum protruding

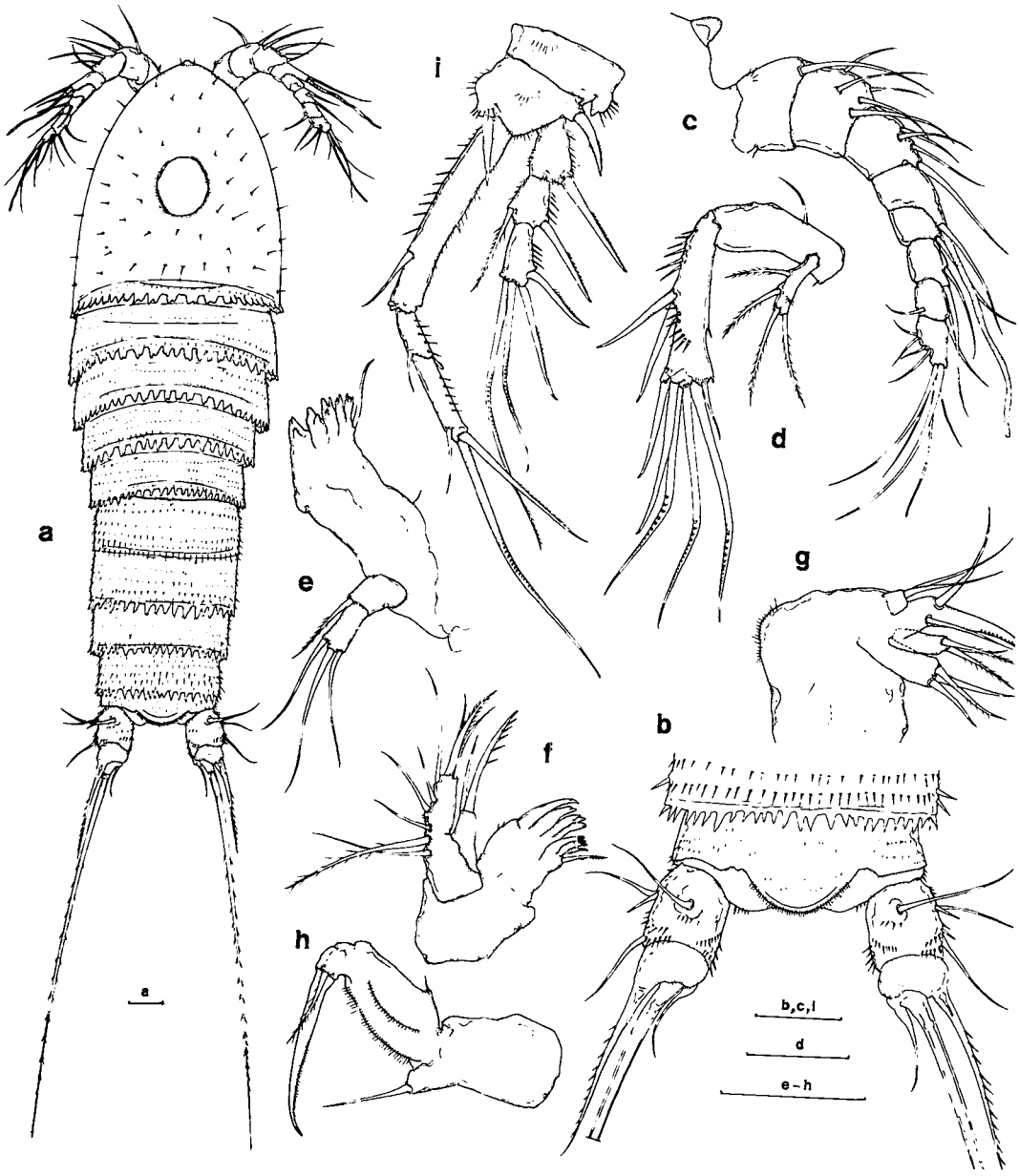

Fig. 2. *Attheyella (Mrazekiella) tetraspinosa*, n. sp., female: a, habitus, dorsal; b, anal segment and caudal rami; c, rostrum and antennule; d, antenna; e, mandible; f, maxillula; g, maxilla; h, maxilliped; i, leg 1. (scales: 0.025mm)

downward. Anal operculum semicircular and a little convexed, but not reaching horizontal line connecting dorsal setae, with fine hairs on its hind edge. Caudal rami a little divergent and columnar, 1.4 times longer than wide. Proximal part of outer median apical seta not swollen.

Antennule of 8 articles, geniculate, with slender aesthetasc on article 4 and 8; long aesthetasc on article 4 nearly reaching middle of last article.

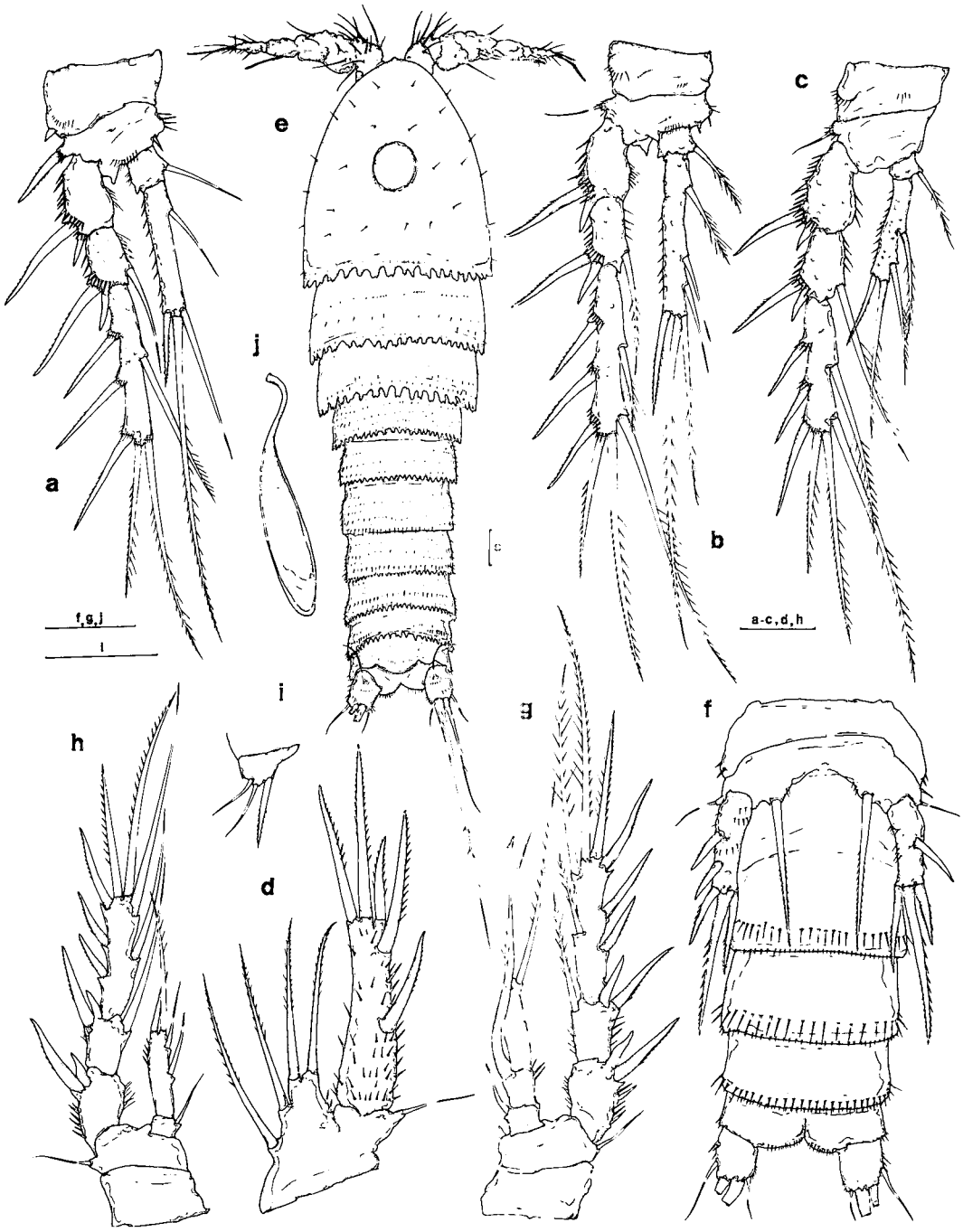

Fig. 3. *Attheyella (Mrazekiella) tetraspinosa*, n. sp., female: a-d, leg 2-5. male: e, habitus, dorsal; f, leg 5 and urosome, ventral; g, leg 3; h, leg 4; i, leg 6; j. spermatophore. (scales: 0.025mm)

Leg 2 nearly same as in female. Endopod of leg 3 (Fig. 3g) 3-segmented; proximal endopodal segment with a sharp inner spine; process (apophysis) on inner margin of second endopodal segment slightly exceeding tip of distal exopodal segment, possessing terminal barb; distal segment of

endopod much elongated, nearly 1.5 times as long as sum of the two preceding ones, and beyond second exopodal segment, ending with 2 slender setae, outer one of which much longer than inner one. Lateral spine on article 2 of leg 3 exopod not enlarged. Leg 4 (Fig. 3h) similar to that of female. Basipod of leg 5 (Fig. 3f) with only 1 long and stout spine, its tip far exceeding exopod; exopod 3.04 times as long as broad, bearing 2 terminal, 1 subapical and 2 (or 1) ventrolateral spine(s), with several rows of spinules on its ventral surface and lateral margin. Leg 6 (Fig. 3i) represented by 1 inner spine and 2 outer setae, all similiar in length. Spermatophore (Fig. 3j) conspicuously elongated, 4.62 times longer than broad (its length measured from neck to posterior end).

Type specimens collected with *Attheyella coreana* Miura and *Acanthocyclops* sp.

Measurements and variations. Measurements from 6 females and 4 males examined are shown in Table 1. All females and males examined had completely biarticulated leg 2 endopod, while 3 of 6 females had the indented lateral margin of leg 3 endopod (Fig. 3b) showing the fusion of proximal two articles. In leg 5, 1 of 4 males possessed 1 spines on one basipod and 2 spines on other; 1 of 6 females and 1 of 4 males had 5 spines on one exopod and 4 on other (Fig. 3f). Other characteristics showed no significant variations.

Etymology. The specific name *tetraspinosa* is taken from basipod of leg 5 in female beaing 4 spines, the most important feature of this species.

Remarks. The present new species is typified by the combination of the following charateristics: (1) the elongate caudal ramus, not showing sexual dimorphism; (2) the elongate leg 5 exopod densely armed with rows of setules on its surface, and the number of spines on both basipod and exopod reduced; (3) the conspicuous reduction of the number of setae on distal segment of legs 2-4 endopods; (4) exopod of antenna one-jointed, bearing 4 setae.

Judging from the above-mentioned characeristics, the present new species most resembles *A. baikalensis* Borutzky, for which Borutzky established the subgenus *Ryloviella* (Borutzky, 1931), and later accomodated to it two American species -*A. pilosa* Chappuis, 1929 and *A. carolinensis* Chappuis, 1932 (Borutzky, 1952). But the validity of subgenus *Ryloviella* was doubted by Lang

Table 1. Measurements of *Attheyella (Mrazekiella) tetraspinosa*, new species.

Parameter	Females (N=6) Range (Mean ± SD)	Males (N=4) Range (Mean ± SD)
Body length to width	3.40–3.50 (3.44 ± 0.040)	0.24–0.36 (0.28 ± 0.009)
Length to width ratio of caudal ramus	1.28–1.46 (1.35 ± 0.092)	1.42–1.56 (1.48 ± 0.058)
Length ratio of inner caudal seta to outer caudal seta	0.24–0.36 (0.28 ± 0.048)	0.30–0.36 (0.34 ± 0.029)
Length to width ratio of leg 5 exopod	3.44–4.05 (3.73 ± 0.256)	2.88–3.24 (3.04 ± 0.183)
Armature of leg 5 basipod	4 spines–4 spines	1 spine–1 (or 2) spine
Armature of leg 5 exopod	5 spines–5 (or 4) spines	5 spines–5 (or 4)spines

(1948), and it has not been firmly founded still yet. At any rate, it seems to be apparent that *A. tetraspinosa* n. sp. is closely related the above three species.

As far as the armature of the appendages, and the structure of caudal ramus and leg 5 are concerned, *A. tetraspinosa* is similiar to *A. baikalensis*, but the former distinctly differs from the latter in having 8-articulated antennule, bearing 4 spines on female leg 5 basipod, and having much longer (about 3.7 times as long as wide) leg 5 exopod. Furthermore, *A. tetraspinosa* is distinguished from *A. pilosa* by having much longer leg 5 exopod and showing different armature on leg 5 basipod (4 spines in female and 1 spine in male), on the other hand, from *A. carolinensis* by having 8-articulated antennule, the different armature in leg 2-4, and much longer leg 5 exopod.

ABSTRACT

Four harpacticoid species belonging to genus *Attheyella* were confirmed from South Korea: *Attheyella (Attheyella) coreana* Miura, *A. (A.) paucisetosa* Chang and Kim, *A. (Mrazekiella) byblis* Chang and Kim, and *A. (M.) tetraspinosa*, n. sp. The new species and the male of *A. (A.) paucisetosa* are described. *A. (M.) tetraspinosa*, n. sp. most resembles *A. baikalensis* Borutzky, but readily distinguished from it and its relatives by the extraordinarily elongated leg 5 exopod and the female leg 5 basipod bearing four spines on it.

REFERENCES

Borutzky, E.V., 1931. Harpacticoida of fresh and brackish waters of U.S.S.R. A./Presnovodnaya fauna, **3:** 1-246.

Borutzky, E.V., 1952. Freshwater Harpacticoida. Fauna of the U.S.S.R., Crustacea, vol. 3, no. 4, 424 pp.

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

Chappuis, P.A., 1929. Copépodes cavernicoles de l'Amérique du Nord. Bul. soc. stiint. Cluj., **4**(2): 51-58.

Chappuis, P.A., 1932. Eine neue *Attheyella* aus Nordamerika. *Attheyella (Brehmiella) carolinensis* n. sp. Zool. Anz., **98**(7/8): 226-229.

Dussart, B. and D. Defaye, 1990. Répertoire mondial des crustacés copépodes des eaux intérieures III. Harpacticoïdes. Crustaceana supplement **16,** E. J. Brill, Leiden.

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. and T. Ito, 1991. Freshwater harpacticoid copepods (Crustacea) from South Primorye, the Soviet Far East. Bull. Biogeogr. Soc. Japan, **46**(7): 77-82.

Kim, H.S. and C.Y. Chang, 1989. Freshwater invertebrates in Mt. W ŏlch'ul. Rep. KACN., **24:** 159-174.

Lang, K., 1948. Monographie der Harpacticiden. Nordiska-Bokhandeln, Stockholm, 2 vol., 1682 pp.

Miura, Y., 1969. Result of the speological survey in South Korea 1966. 14. Subterranean harpacticoid copepods of South Korea. Bull. Natn. Sci. Mus. Tokyo, **12:** 241-254, 51 figs.

RECEIVED: 4 October 1993
ACCEPTED: 20 October 1993