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Macrocyclops monticola and *Diacyclops dispinosus*, New Cyclopoid Copepods (Crustacea) from Mountain Waters of Japan

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ABSTRACT *Macrocyclops monticola* n. sp. from Honshu and Kyushu, and *Diacyclops dispinosus* n. sp. from Hokkaido are described. They are common cyclopoids in the mountain waters of their ranges. *M. monticola* shows disappearance of the outer lateral spine of leg 5 article 2, as a variation occurring frequently in most populations. *D. dispinosus* has an extra outer lateral spine of leg 5 article 2 without exception.

During my faunistic studies on the fresh water copepods in Japan, *Macrocyclops* sp. (from Honshu and Kyushu: ISHIDA, 1989, 1990), and *Diacyclops* sp. (from Hokkaido: ISHIDA, 1984, as *Acanthocyclops venustoides bispinosus* YEATMAN) were reported from waters in mountain regions.

In the present paper *Macrocyclops monticola* n. sp. and *Diacyclops dispinosus* n. sp. are described on the basis of the above and some new material.

For description, specimens were mounted in gum-chloral medium: drawings and measurements were made from the mounted specimens. Specimens were deposited in the collection of the Department of Zoology, National Science Museum, Tokyo (NSMT) and the U.S. National Museum of Natural History, Smithsonian Institution (USNM).

Family Cyclopidae G. O. SARS, 1913

Genus ***Macrocyclops*** CLAUS, 1893

Macrocyclops monticola n. sp.

(Fig. 1)

Macrocyclops sp. ISHIDA, 1989, p. 7, Plate 1; ISHIDA, 1990, p. 39.

Types. *Holotype*: female, dissected on 1 slide (NSMT-Cr 11289). *Paratypes*: 1♂, dissected on 1 slide (NSMT-Cr 11290); 5♀♀ and 1♂, habitus, on 1 slide (NSMT-Cr 11291). All from trickle, Mt. Yamizo, Ibaraki Prefecture, 36°53′N 140;17′E, 9 February 1988, col. T. ISHIDA. 4♀♀ and 2♂♂, in 70% ethanol (USNM 259551), from small stream, Ôhe, Kyôto Prefecture, 35°26′N 135°09′E, 22 May 1988, col. T. ISHIDA.

Description. Female: Length of holotype excluding caudal setae 0.93 mm; range of 5 paratypes 0.93–1.00 mm (mean=0.95 mm). Body (Fig. 1a) widest at prosomite 1, posterior margins of prosomites smoothly rounded. Prosomite 5 (Fig. 1n) with spinules on lateral posterior margin. Genital segment (Fig. 1b) broad anteriorly, tapering posteriorly; seminal receptacle with oval anterior section

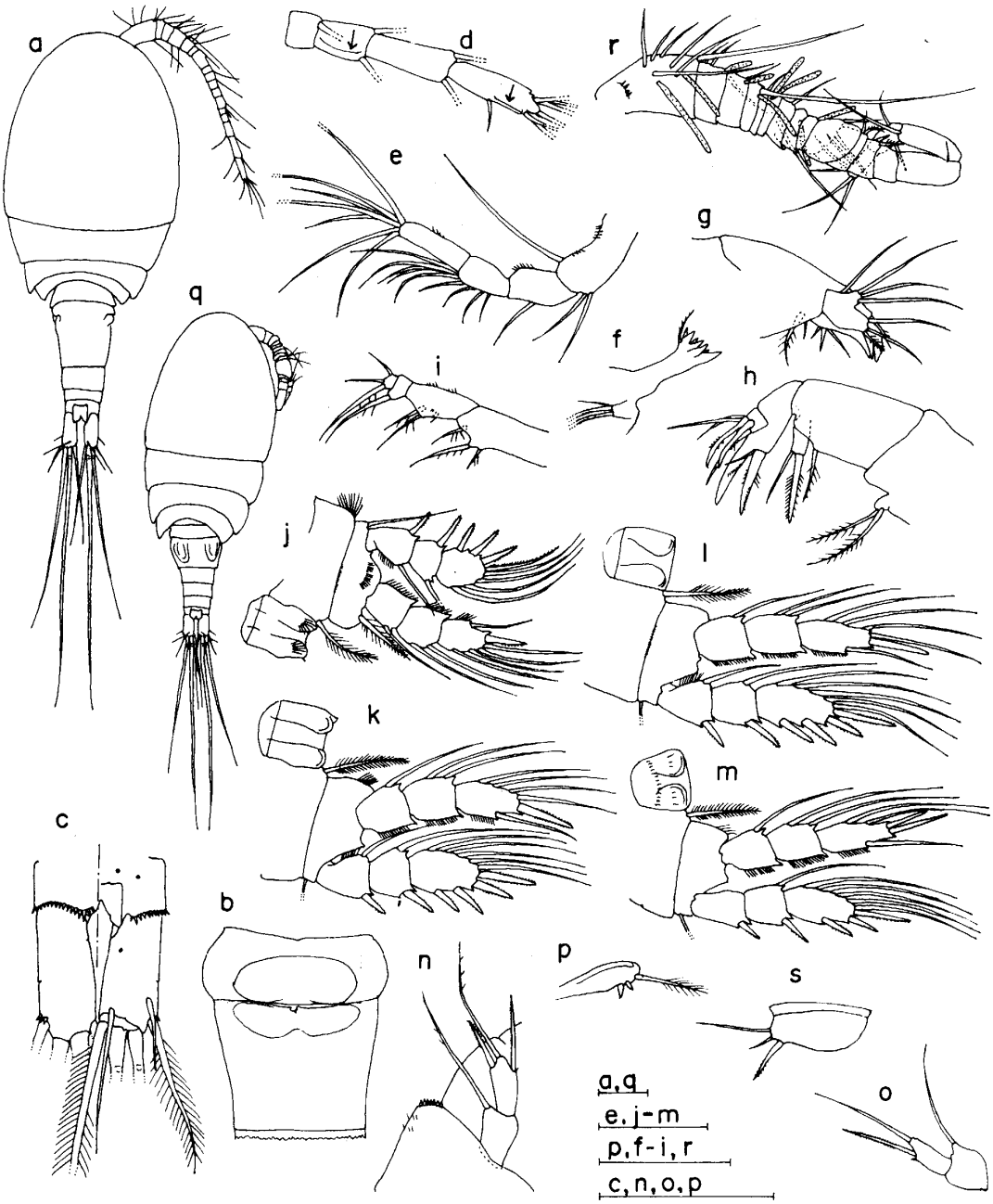

Fig. 1. *Macrocyclops monticola* n. sp., female, holotype: a, Habitus, dorsal; b, Genital segment, ventral; c, Anal somite and caudal ramus; d, Antennule articles 14–17 (arrows indicating hyaline ridges); e, Antenna; f, Mandible; g, Maxillule; h, Maxilla; i, Maxilliped; j, Leg 1 and coupler, anterior; k, Leg 2 and coupler, anterior; l, Leg 3 and coupler, anterior; m, Leg 4 and coupler, anterior; n, Leg 5 and part of prosomite 5; o, Leg 5, anomaly, of another specimen; p. Leg 6. Male, paratype (NSMT-Cr 11290): q, Habitus, dorsal; r, Antennule, of another specimen; s, Leg 6. Scales=100 μm.

and compressed posterior section. Hyaline fringes of urosomites finely serrate (Fig. 1b). Anal somite (Fig. 1c) with spinules on dorsal to ventral posterior margin above caudal rami; anal operculum narrow, with irregular indentations. Caudal ramus

(Fig. 1c) about 2.4 times longer than broad; lateral seta inserted dorsolaterally on posterior 1/3.5 of ramus; no hair on medial surface; caudal terminal setae homonomously plumed; lengths of caudal setae of holotype in μm: lateral 33, dorsal 80, outermost to innermost terminal 95, 430, 670, 280.

Antennule of 17 articles, hardly reaching posterior margin of cephalosome; article 12 with esthetasc reaching midlength of article 14; 15th and apical half of terminal articles (Fig. 1d) with hardly visible thin, smooth hyaline ridges. Antenna (Fig. 1e) similar to that of congeners. Labrum pointed at each end, with ten teeth. Mandible (Fig. 1f) with palp bearing two long plumose setae and one short seta. Maxillule (Fig. 1g) with basis of palp furnished apically with one spine bearing two rows of spinules and with two setae, and proximally with one seta; endopod with three setae. Claw of maxilla (Fig. 1h) with fine comb on inner margin consisting about 30 short spinules. Maxilliped (Fig. 1i) article 2 with 1 group of spinules.

Swimming legs 1–4 (Figs. 1j–m) each with rami of 3 articles; number of spines on article 3 of exopodites 3, 4, 4, 3, number of setae 5, 5, 5, 5; setae of all legs finely plumose, except terminal seta of leg 1 exopodite article 3, which has spinules on lateral margin. Leg 1 with inner margin of basipodite little expanded, bearing spine reaching midlength of endopodite article 2. Couplers anteriorly without ornament except for blunt protrusions each side, and row of setules on each protrusion on leg 1; posteriorly with 2 rows of setules on leg 4.

Setation of leg 5 (Fig. 1n) normal for genus; surface of articles 1 and 2 without ornament. Some specimens without outer spine of article 2 (Fig. 1o). Leg 6 (Fig. 1p) with short inner and middle spine, and long, plumed dorsal seta.

Male: Range of lengths of paratypes 0.73–0.74 mm. Body in dorsal view (Fig. 1q) more slender than that of female. Proportions of caudal ramus and length of caudal setae much as in female. Antennule (Fig. 1r) geniculate, of 17 articles; articles 1 and 6 each with 2 esthetascs, articles 2, 3, 4, 8 and 9 each with 1 esthetasc.

Legs 1–5 similar to those of female; leg 6 (Fig. 1s) consisting of semicircular flap bearing stout inner spine reaching approximately to posterior margin of succeeding urosomite, small middle seta, and longer outer seta.

Etymology. Named for the inhabitant of mountain waters.

Remarks. The distribution range of this species extends in the north to Fukushima Prefecture (37°N), Honshu, and south to Miyazaki Prefecture (33°N), Kyushu (Fig. 2).

The species commonly inhabits trickles and small streams in mountainous regions. Observed co-occurring cyclopoid copepods were *Macrocyclops fuscus* (JURINE), *Macrocyclops albidus* (JURINE), *Eucyclops serrulatus* (FISHER), *Tropocyclops prasinus* (FISCHER), *Paracyclops fimbriatus* (FISCHER), *Paracyclops affinis* (SARS), and *Diacyclops yezoensis* (ITO).

Variation occurs on the outer lateral spine of leg 5 article 2. Some specimens lack the spine on one or both legs. The frequency of this lack in 18 specimens from various localities was normal 10, on one leg 6, and on both legs 2.

Affinities. The body length of *Macrocyclops monticola* n. sp., less than 1 mm, is strikingly smaller than those of congeners, viz. *Macrocyclops neuter* KIEFER, 1.2–1.3 mm; *Macrocyclops albidus* (JURINE), 1.5–2.5 mm; *Macrocyclops fuscus* (JURINE), 1.8–4.0 mm; *Macrocyclops distinctus* (RICHARD), 1.5–2.25 mm (KIEFER, 1931; RYLOV, 1948). As opposed to the prominent hyaline plates on the 15th–17th articles of

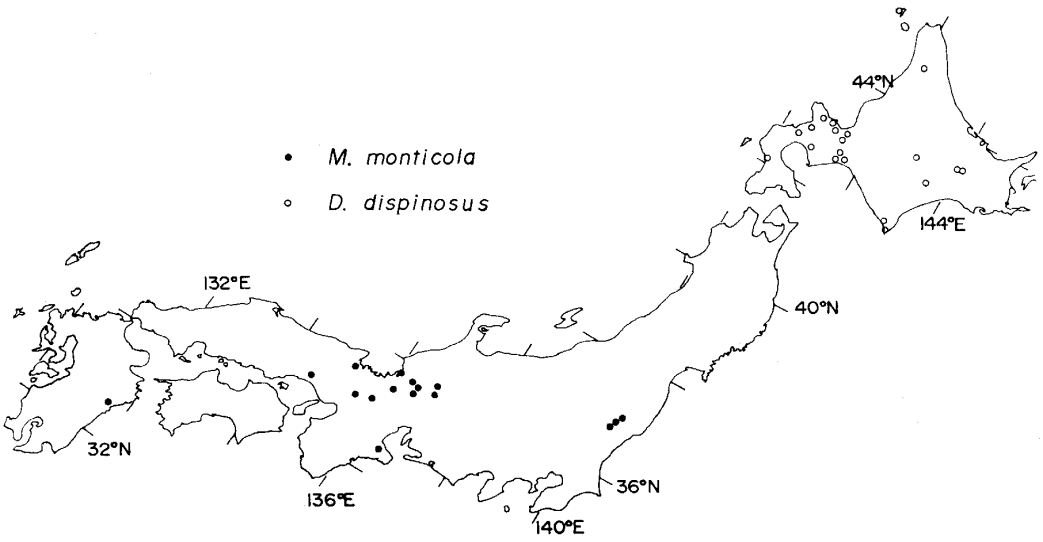

Fig. 2. Collection localities of *Macrocyclops monticola* n. sp. and *Diacyclops dispinosus* n. sp.

congeners, the species has only barely visible thin hyaline ridges on the corresponding articles. Degeneration of the outer subterminal spine of leg 5 article 2 may be not a mere anomaly, but essential. From these morphological characteristics, the systematic position of *M. monticola* may differ considerably from its congeners.

Family Cyclopidae G. O. Sars, 1913

Genus ***Diacyclops*** Kiefer, 1927

Diacyclops dispinosus n. sp.

(Fig. 3)

Acanthocyclops venustoides bispinosus (Yeatman, 1951). Ishida, 1984, p. 51.

Types. Holotype, female, dissected on 1 slide (NSMT-Cr 11292). *Paratypes*: 1♂, dissected on 1 slide (NSMT-Cr 11293); 4♀♀ and 2♂♂, habitus, on 2 slides (NSMT-Cr 11294-5); 12♀♀, in 70% ethanol (USNM 259552), all from spring seepage on roadside of Route 5, Hirafu, Hokkaido, 42°52.0′N 140;45.3′E, 11 May 1987, col. T. Ishida.

Description. Female: Length of holotype excluding caudal setae 1.08 mm; range of lengths of 4 paratypes 0.98–1.02 mm (mean=1.00 mm). Habitus as in Fig. 3a; posterior angles of prosomite 5 considerably protruding laterally. Genital segment (Fig. 3b) broad anteriorly, narrower posteriorly; seminal receptacle constricted at midlength. Posterior hyaline fringes of urosomites finely serrated (Fig. 3b), except anal somite (Fig. 3c) which bears spinules ventrally. Anal operculum (Fig. 3c) narrow, irregularly crenate. Caudal rami (Fig. 3c) about 2.7 times longer than broad; each ramus bearing dorsolateral row of hardly visible setules on anterior two-thirds of medial surface, and sparse hairs on middle of medial surface; lateral setae inserted at distal third of rami: caudal terminal setae homonomously plumed; lengths of caudal setae of holotype in μm: lateral 40, dorsal 83, outermost

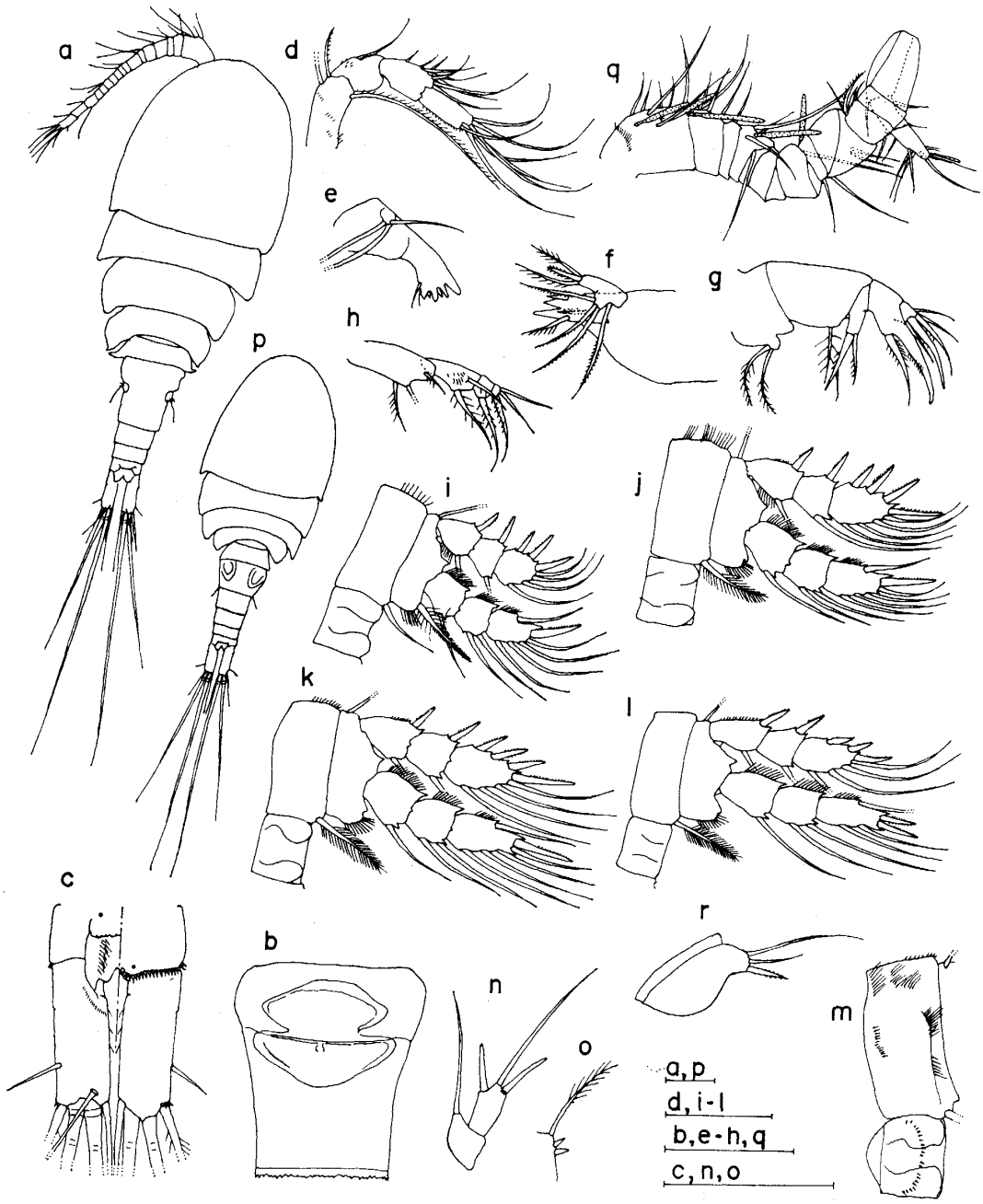

Fig. 3. *Diacyclops dispinosus* n. sp., female, holotype: a, Habitus, dorsal; b, Genital segment, ventral; c, Anal somite and caudal ramus; d, Antenna; e, Mandible; f, Maxillule; g, Maxilla; h, Maxilliped; i, Leg 1 and coupler, anterior; j, Leg 2 and coupler, anterior; k, Leg 3 and coupler, anterior; l, Leg 4 and coupler, anterior; m, Leg 4 coxa and coupler, posterior; n, Leg 5; o, Leg 6. Male, paratype (NSMT-Cr 11293): p, Habitus, dorsal; q, Antennule, of another specimen; r, Leg 6. Scales = 100 μm.

to innermost terminal 100, 370, 580, 148.

Antennule of 17 articles, not reaching past posterior margin of cephalosome; article 12 with esthetasc reaching midlength of article 15. Antenna (Fig. 3d) of 4

articles, article 1 with few groups of spinules on ventral surface, article 2 with 1 group of spinules on frontal surface. Labrum with ten teeth. Mandible (Fig. 3e) with palp bearing 2 long plumose setae and 1 short seta. Maxillula (Fig. 3f) with basis of palp furnished apically with 1 stout plumed spine and 2 plumed setae, and proximally with 1 seta; endopod with 3 plumed setae. Claw of maxilla (Fig. 3g) with comb on inner margin. Maxilliped (Fig. 3h) article 2 with several groups of spinules on dorsal and ventral surfaces.

Swimming legs 1–4 (Figs. 3i–l) each with rami of 3 articles; number of spines on article 3 of exopodites 3, 4, 4, 3, number of setae 4, 4, 4, 4; leg 3 similar to leg 2. Setae of all legs finely plumose. Leg 1 with inner part of basipodite little expanded, bearing stout spine reaching nearly to end of endopodite article 2. Anterior surfaces of couplers without ornament except for blunt protrusions each side. Ornamentation of posterior surface of coxa and coupler of leg 4 as in Fig. 3m.

Leg 5 (Fig. 3n) with article 2 about twice longer than broad, bearing slender median terminal seta 2.7 times longer than article, slightly curved medial subterminal spine equal to article length, and lateral spine 0.8 times shorter than article. Leg 6 (Fig. 3o) consisting of 1 seta and 2 spinules inserted dorsally on genital segment; ventralmost spinule blunt.

Male: Range of lengths of paratypes 0.72–0.86 mm. Habitus (Fig. 3p), proportions and armament of swimming legs, leg 5, caudal rami, and caudal setae similar to female, except posterior angles of prosomite 5 of male without protrusions. Antennule (Fig. 3q) geniculate, of 17 articles; article 1 with 3 sethetascs, articles 4 and 8 each with 1 esthetasc.

Leg 6 (Fig. 3r) consisting of semicircular flap with protrusion bearing ventral spine, plumose middle seta, and longer dorsal seta reaching past posterior margin of succeeding somite.

Etymology. Named for the two spines on leg 5 article 2.

Remarks. *D. dispinosus* is widely distributed in Hokkaido, including Rebun Island (Fig. 2).

The species is a common inhabitant of the pools, trickles and small streams in mountainous regions. Observed co-occurring cyclopoid copepods were *Macrocylops fuscus*, *M. albidus*, *Eucyclops serrulatus*, *Paracyclops fimbriatus*, *Megacyclops viridis* (JURINE), *Acanthocyclops vernalis* (FISCHER), *Diacyclops languidus* (SARS), *Diacyclops nanus* (SARS), *Microcyclops varicans* (SARS), and *Diacyclops yezoensis*. Although the habitat of the species coincides with that of *A. vernalis*, co-occurrence of both species was not observed, except in only one case (at spring stream, Ainuma: southernmost locality of Fig. 2, 31 May 1987).

The specimens collected from various localities showed no variations.

Affinities. As the allopatric distribution of *D. dispinosus* n. sp. and *A. vernalis* shows, both species may be closely related ecologically, possibly taxonomically. The similarity of *D. dispinosus* to *A. vernalis* in the setation formula for major armament of legs 1–4, and the shape of posterolateral corner of 5th prosomite suggests the close affinity between the two species. At present, *D. dispinosus* is attributed not to *Acanthocyclops* but to *Diacyclops*, by the long subterminal spine of leg 5 article 2. However, the length of the spine varies considerably among the populations of *A. vernalis*. Some of them in Hokkaido, Kamchatka, and Alaska possess a long spine being subequal to the length of article 2 (author's unpublished data). Such a situation suggests a possibility that *Diacyclops* might in the future come to be synonymiz-

ed again with *Acanthocyclops* s. str. REID *et al.* (1991) discussed the pattern of occurrence of an extra outer spine of leg 5 in some populations of *Acanthocyclops venustoides* (COKER) and *Acanthocyclops montana* REID & REED. *D. dispinosus* is furnished with the outer spine of leg 5 without exception. These facts suggest a hypothesis that the species is close to ancestral live form of the genera *Acanthocyclops* and *Diacyclops*.

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摘　　要

石田昭夫（北海道余市町入舟町 372）——日本の山地水体から得られたケンミジンコ（甲殻類）の新種 *Macrocyclops monticola* と *Diacyclops dispinosus*.

本州と九州から得られた新種 *Macrocyclops monticola* と．北海道から得られた新種 *Diacyclops dispinosus* を記載した．これら２種はそれぞれの分布域の山地水体に普通に分布している．*M. monticola* は第５脚２節外縁の棘の消失が殆どの個体群で変異として出現する．*D. dispinosus* は第５脚２節外縁に例外なく棘を具えている．

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