

***Eucyclops roseus*, a New Eurasian Copepod, and the *E. serrulatus-speratus* Problem in Japan**

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ABSTRACT

A new *Eucyclops* species similar to *E. serrulatus* and *E. speratus* is described as *Eucyclops roseus*. The species seems to be distributed widely in Europe and Asia. The confusing taxonomical status of *E. serrulatus* and *E. speratus* in Japanese waters has been partly solved by the recognition of this new species. *Eucyclops speratus* s. str. does not occur in Japan, while *E. roseus*, *E. serrulatus*, and the *speratus*-like species complex are distributed from the Ryukyu Islands to Hokkaido. This species complex may be divided into several taxa ; one is distributed mainly in the northern half of Japan, and the others mainly in the southern half. The habitats of *E. roseus* and the *E. speratus*-like species complex in Japan are ponds, lakes, and the middle and lower reaches of rivers and streams, while *E. serrulatus* is generally restricted to mountain waters and springs.

Key words : Faunistics, freshwater copepod, *Eucyclops*, Japan

INTRODUCTION

During the Sixth International Conference on Copepoda at Oldenburg, Germany, in the summer of 1996, I sampled at a stream near Oldenburg University. The sample included four *Eucyclops* species, i.e., *Eucyclops serrulatus* (FISCHER, 1851), *E. speratus* (LILLJEBORG, 1901), *E. macruroides* (LILLJEBORG, 1901), and a conspicuously colored species seemingly new to science. Examination of the unnamed species led me to the conclusion that it was identical to one of the *speratus*-like species collected from Japan and neighboring areas. The species is described as *Eucyclops roseus* sp. nov. I examined the *Eucyclops* specimens in my personal collection to clarify the taxonomic characteristics and distribution range of each taxon in Japan and neighboring areas. The result is reported in the present paper.

MATERIAL AND METHODS

Type series specimens of *Eucyclops roseus* were chosen from a sample collected in Hiji Creek, Okinawa I., the Ryukyu Islands, in 1989. About 400 individuals of dissected or whole *Eucyclops* species specimens on slides in ISHIDA's collection were examined thoroughly. The specimens were fixed and preserved in formalin solution until mounted on slides. Drawings and

measurement were made before dissection in glycerine, and after dissection in gum-chloral medium. High magnification objective lenses mainly used were $\times 60$ (dry) and $\times 40$ (phase-contrast); occasionally a differential interference apparatus at a magnification of $\times 500$ was used. Specimens are deposited in the National Science Museum (Tokyo) (NSMT), and the United States National Museum of Natural History (USNM).

Abbreviations used are as follows: A1, antennule; A2, antenna; P1-P6, first to sixth leg; exp1-exp3, first to third article of exopodite; enp1-enp3, first to third article of endopodite; L/W, ratio of length to maximum width; saw, row of spinules on lateral margin of caudal ramus.

DISTRIBUTION AND TAXONOMIC ACCOUNT

Family Cyclopidae G. O. Sars, 1913

Genus *Eucyclops* CLAUS, 1893; KIEFER, 1927

Eucyclops roseus sp. nov.

Figs. 1-3

Major synonymy:

Eucyclops speratus (LILLJEBORG, 1901). — TAI and CHEN 1979: 325-326, fig. 184. — ISHIDA 1994: 127-128, fig. 2c.

Eucyclops cf. *serrulatus* (FISCHER 1851). — KAWABATA and DEFAYE, 1994: 144-145, fig. 1.

Eucyclops cf. *speratus*. — UEDA *et al.*, 1996a: 51-53, figs. 31-39. — UEDA *et al.*, 1996b: 308-309, fig. 3.

Material: Holotype ♀, dissected on 1 slide, NSMT-Cr 12029. Paratypes, 1 ♂, dissected on 1 slide, NSMT-Cr 12030; 2 ♀♀, dissected on 1 slide, NSMT-Cr 12031; 20 ♀♀, undissected specimens in 70% ethanol, USNM 284147, all from middle reaches of Hiji Creek, Kunigami-son, Okinawa I., the Ryukyu Islands, 10 January 1989. Other specimens, 9 ♀♀, dissected on 3 slides, and 3 ♂♂, dissected on 1 slide, stream near Oldenburg University, Oldenburg, Germany, 2 August 1996; 8 ♀♀, dissected on 6 slides, Kedvovaya River, Primorye, Russia, 1991-1992, coll. Tomiko ITO; 2 ♀♀, dissected on 1 slide, Iriomote I., the Ryukyu Islands, 13 May 1996; 3 ♀♀, dissected on 2 slides, Mooka, Tochigi Pref., Honshu, 4 June 1995; 4 ♀♀, dissected on 2 slides, Lake Kussharo, Hokkaido, 28 April 1992, coll. S. HASHIMOTO.

Female. Length of holotype 1.02 mm; range of lengths of 22 paratypes 0.89-1.08 mm, mean 1.00 mm. Posterior edges of all thoracic somites with finely serrated hyaline frill. Margin of 4th thoracic somite (Fig. 1c) markedly serrate laterally, and with 2-3 hairs dorsolaterally. Genital double-somite (Fig. 1b, d) about 1.2 times broader than long. Distal edges of genital double-somite and of two subsequent urosomites with hyaline frills irregularly serrated (Fig. 1b, d, e), fine dorsally, and coarse ventrally. Seminal receptacle with anterior part larger than posterior; posterior margin with

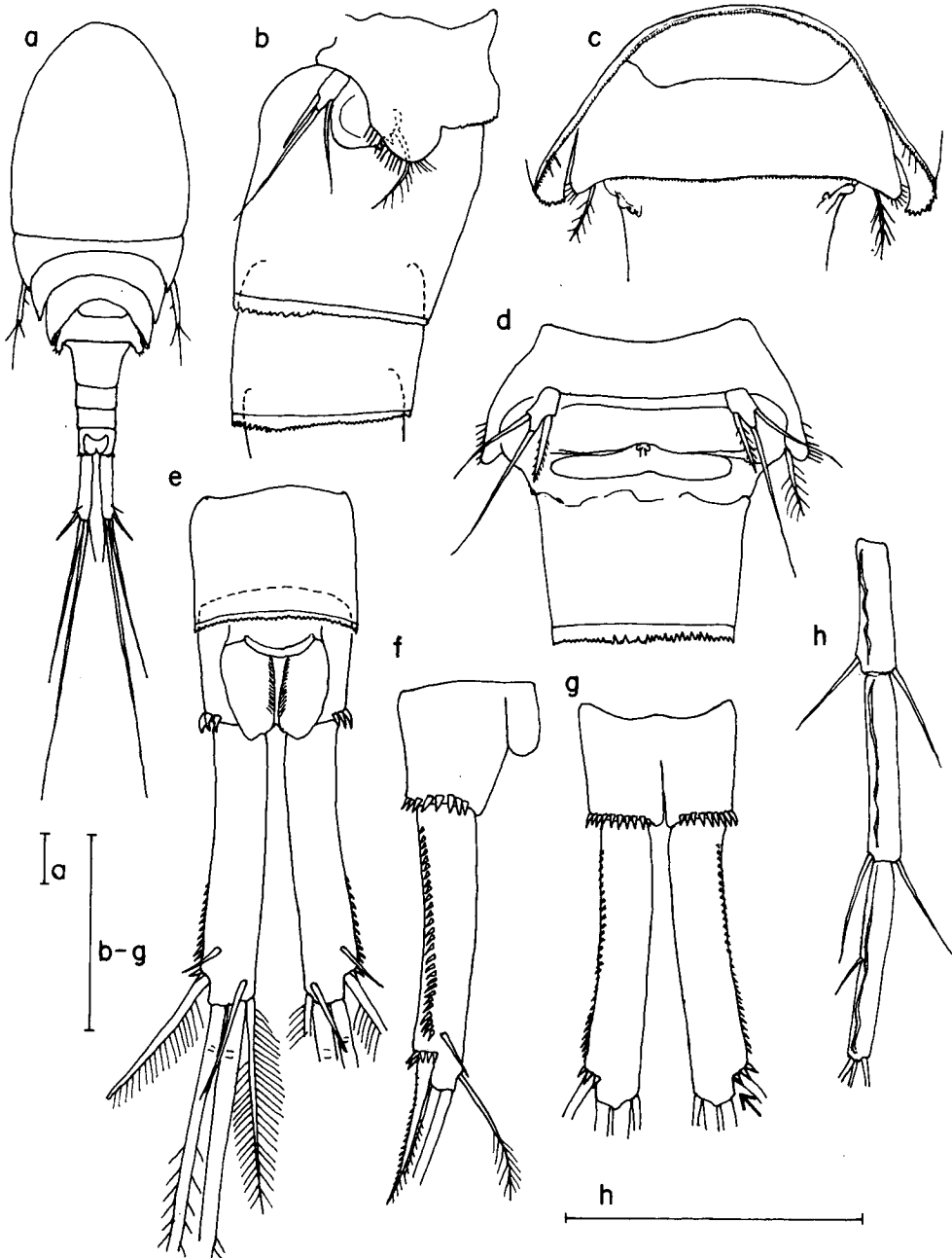


Fig. 1. *Eucyclops roseus*, sp. nov., holotype female : a, habitus, dorsal ; b, 5th thoracic somite to 1st abdominal somite, lateral ; c, posterior margin of 4th thoracic somite and 5th thoracic somite, dorsal ; d, 5th thoracic somite and genital double somite, ventral ; e, 2nd abdominal somite to caudal rami, dorsal ; f, anal somite and caudal ramus, lateral ; g, same, ventral ; h, distal three articles of A1. Scales = 100 μ m.

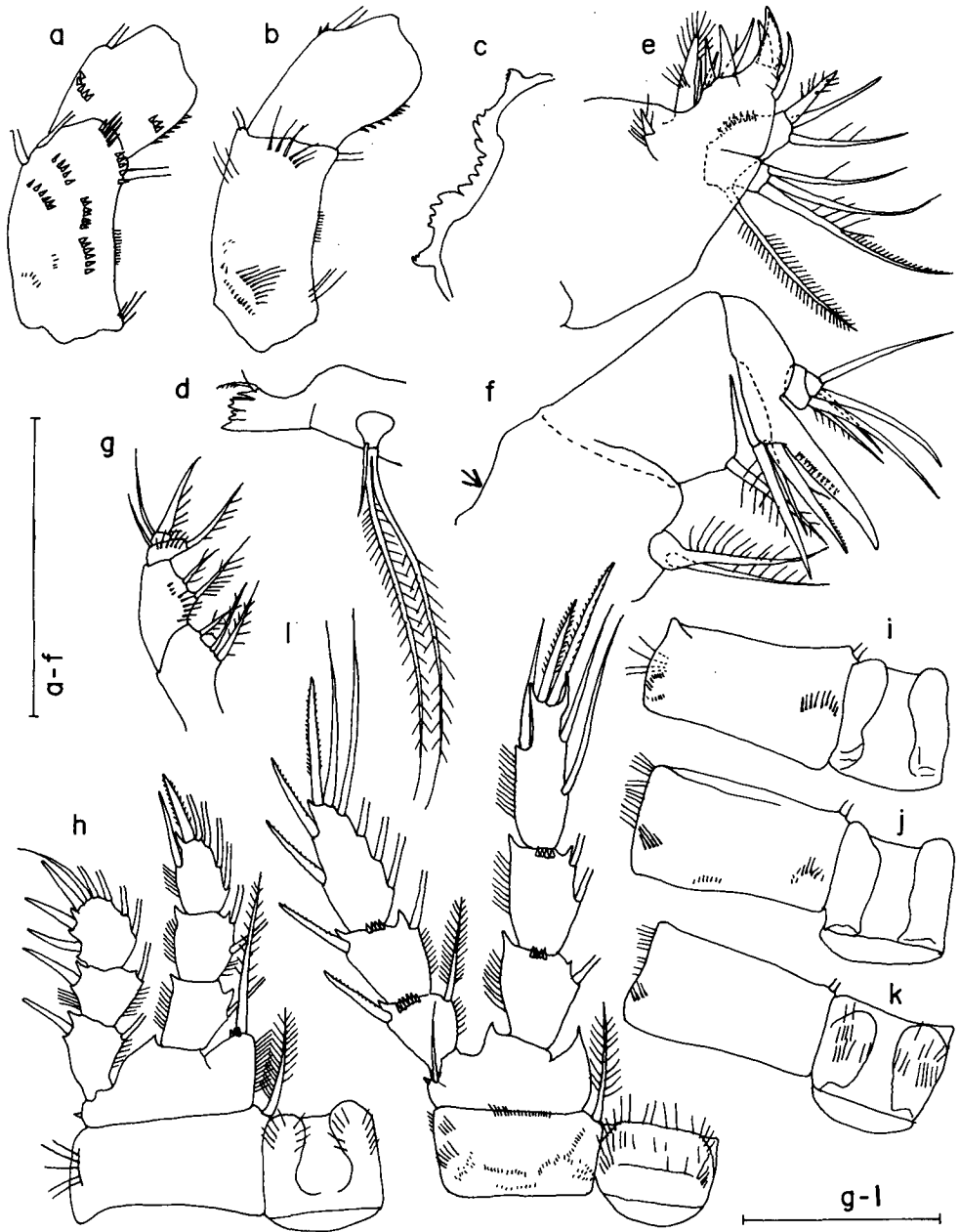


Fig. 2. *Eucyclops roseus*, sp. nov., holotype female: a, right A2 basis and enp1, posterior; b, left A2 basis and enp1, anterior; c, labrum; d, mandible; e, maxillule; f, maxilla; g, maxilliped; h, P1 and coupler, anterior; i-k, coxae and couplers of P1-3, posterior; l, P4 and coupler, posterior. Scales = 100 μ m.

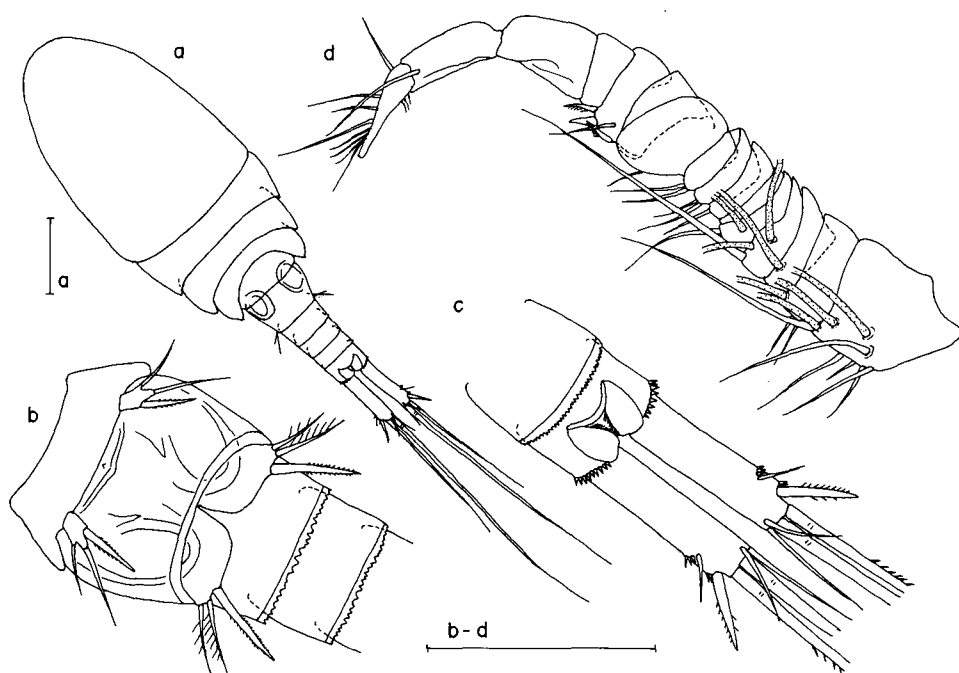


Fig. 3. *Eucyclops roseus*, sp. nov., paratype male : a, habitus, dorsal ; b, 5th thoracic somite to 2nd abdominal somite, ventral ; c, 3rd abdominal somite to caudal rami, dorsal ; d, left A1, ventral. Scales = 100 μ m.

shallow median concavity (Fig. 1d). Anal operculum (Fig. 1e) convex. Caudal rami (Fig. 1e-g) slightly divergent, L/W 5.0 ; lateral margin with saw extending along most of margin. Lengths of caudal setae of holotype in μ m : dorsal 70, lateral 35, medialmost to lateralmost terminal 102, 600, 460, and 75, respectively. Marked space between bases of lateralmost and next terminal seta (Fig. 1e, g : arrow).

A1 with 12 segments, reaching distal margin of 3rd thoracic somite ; last three segments (Fig. 1h) with very finely serrated hyaline membrane. Posterior surface of basis of A2 as in Fig. 2a ; anterior surface with 2 rows of 3-5 long spinules in distal half, and 2 oblique rows of spinules in proximal half (Fig. 2b). Labrum (Fig. 2c) with 12 blunt teeth between lateral protuberances. Mandible (Fig. 2d) with reduced palp bearing 2 long plumose setae and short naked seta. Maxillule (Fig. 2e) comprised of well-developed praecoxa and 2-segmented palp. Praecoxal arthrite armature consisting of 11 spines and setae. Proximal article of palp derived from basis, armed with spinule row on lateral surface, 3 medial setae, and lateral remnant seta of exopod. Distal segment of palp representing endopod, armed with 3 setae. Maxilla (Fig. 2f) 5-segmented, comprised of praecoxa, coxa, basis and 2-segmented endopod. Praecoxa without spinules on lateral surface (arrow). Basis drawn out into claw with 10-11 medial teeth.

Maxilliped as illustrated in Fig. 2g.

Spine-seta formula of P1-4 as in congeners. Basis of P1 with medial seta reaching insertion of proximal inner seta of enp3 (Fig. 2h). Lengths of P4 exp3 and terminal spine subequal (Fig. 2l). Ornamentation of posterior surfaces of couplers and coxae of P1-P4 as in Fig. 2i-l. Spinule row on distal border of P4 coxa dense. P5 and P6 as in Fig. 1b, d.

Male. Length of paratype 0.68 mm. Caudal rami (Fig. 3c) almost parallel; L/W 3.6. A2 with 16 articles and armed as in Fig. 3d. P6 (Fig. 3b) with medial spine longer than two setae.

Etymology. The specific name refers to the body color, like that of rose wine.

Geographical distribution. This species was collected from Germany, South Primorye, and Japan (from Iriomote I., Okinawa to Lake Kussharo, Hokkaido). Its presence in China is apparent from the figures illustrated as *E. speratus* by TAI and CHEN (1979). Accordingly, the species seems to be distributed widely in Europe and Asia.

Range of habitats. The species inhabits ditches, ponds, lakes, and the middle and lower reaches of rivers and streams.

Variation. The species is morphologically stable all over its range, except that the L/W of the caudal rami varies between 4-6.5 among the populations.

Affinities. *Eucyclops roseus* is close to the North American species *E. elegans* (HERRICK, 1884) in having the long caudal rami with extensive saw, the wide gap between the lateralmost and next caudal setae, the convex anal operculum, etc. (EINSLE, 1992, fig. 6). This similarity of the two species was pointed out by Dr. Janet W. REID, who reviewed the manuscript, but she also informed me by examining her *elegans* specimens that they differ in the spinules on the P4 coupler, on the A2 basis, etc.

Eucyclops serrulatus (FISCHER, 1851)

Fig. 4a-d

Material: 9 ♀♀, dissected on 9 slides, The Long Water, Hyde Park, London, U.K., 16 August 1987; 10 ♀♀ and 1 ♂, dissected on 4 slides, Oldenburg, Germany, 2 August 1996; 2 ♀♀, dissected on 2 slides, from interstices of boulders of middle reaches of Hiji Stream, Kunigamison, Okinawa I., the Ryukyu Islands, 10 January 1989; 2 ♀♀, dissected on 1 slide, Otowa-ike, Mt. Hira, Shiga Prefecture, Honshu, 5 September 1995; many specimens from Yamanashi, Tokyo, Tochigi, Ibaraki, Iwate, and Aomori Prefs., and Hokkaido.

Except for the ornamentation of the P4 coupler, *E. serrulatus* in Japan is morphologically similar to the European populations described by GURNEY (1933), DUSSART (1960), and specimens I have newly examined from the U. K. and Germany. The distal edges of the P4 coupler of European populations are equipped with long hairly spinules in many cases, while those of the Japanese populations are furnished with short, uniform, medially directed spinules (Fig. 4d: arrow). The anal operculum is convex (Fig. 4a: arrow).

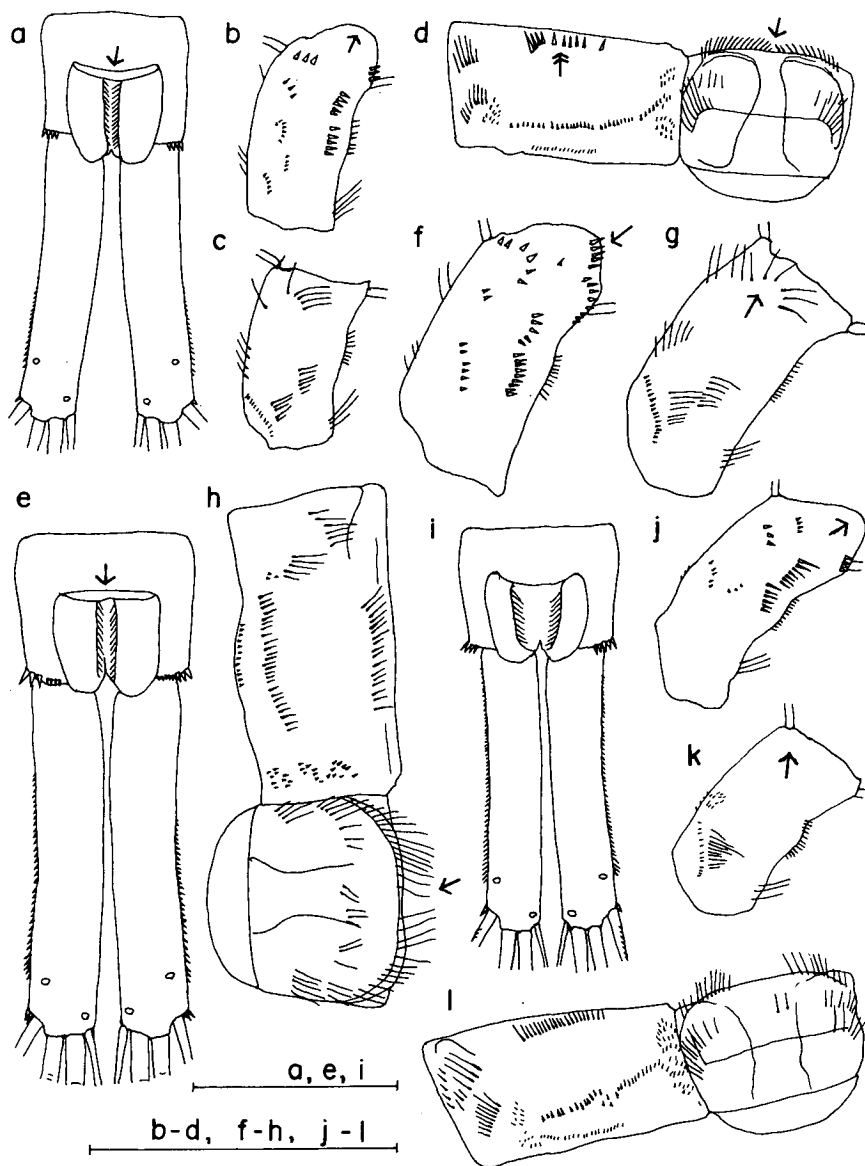


Fig. 4. *Eucyclops serrulatus* (FISCHER, 1851), female, from Tama River, Tokyo : a, anal somite and caudal rami, dorsal ; b, right A2 basis, posterior ; c, left A2 basis, anterior ; d, P4 coxa and coupler, posterior. *E. speratus*-like species, female, from Kokubunji, Tokyo : e, anal somite and caudal rami, dorsal ; f, A2 basis, posterior ; g, A2 basis, anterior ; h, P4 coxa and coupler, posterior. *Eucyclops* sp., female, from Kajiyana-tameike, Yoshimi, Yamaguchi : i, anal somite and caudal rami, dorsal ; j, A2 basis, posterior ; k, A2 basis, anterior ; l, P4 coxa and coupler, posterior. Scales = 100 μ m.

The L/W of the caudal rami is less than about 5.0. The space between the lateralmost and the next caudal setae is narrow (Fig. 4a). The distalmost posterior surface of the A2 basis is bare (Fig. 4b : arrow). The distal border of the posterior surface of the P4 coxa bears a coarse row of spinules (Fig. 4d : double, arrow).

The southernmost locality of *E. serrulatus* in Japan is the mountainous region of Okinawa I., where the species was collected from the interstices between boulders in a stream. The species was also found in a small pond, Otowa-ike, located at an altitude of 980 m on Mt. Hira, Shiga Prefecture, western Honshu. In central and northern Japan the species is very common in the upper reaches of streams. Terrace cliff springs on lowlands are also suitable habitats of the species. The species is principally allopatric with *E. roseus* and *E. speratus*-like species. Within a narrow area as well as several meters square they segregate their microhabitats.

Eucyclops speratus-like species

Fig. 4e-h

Material : *Eucyclops speratus* (LILLJEBORG), 1 ♀, dissected on 1 slide, The Long Water, Hyde Park, London, U. K., 16 August 1987 ; 2 ♀♀, dissected on 2 slides, Oldenburg, Germany, 2 August 1996. *Eucyclops speratus*-like species, 5 ♀♀, dissected on 3 slides, Kajiyahara-tameike, Yoshimi, Yamaguchi Pref., 18 December 1996 ; 2 ♀♀, dissected on 2 slides, Ohmiya Stream, Shiga Pref., 6 March 1994 ; 1 ♀ dissected on 1 slide, spring stream of Samegai, Shiga Pref., 5 December 1995 ; 6 ♀♀, dissected on 4 slides, hillside pond, Tamaki, Mie Pref., 15 March 1986 ; many specimens from Tokyo, Iwate, and Aomori Prefs., and Hokkaido.

E. speratus-like specimens from central and northern Japan are very similar to the European *E. speratus* described by GURNEY (1933), DUSSART (1960), and specimens that I examined from the U.K. and Germany, except for the ornamentation of the anterior surface of the A2 basis, *i.e.*, the former has rows of hair-like spinules at distal half (Fig. 4g : arrow), while the latter lacks them. At present, it is not certain that this discrepancy qualifies as a species-level characteristic. The anal operculum is sublinear or weakly convex (Fig. 4e : arrow). The L/W of the caudal rami is greater than about 5.0. There is a narrow space between the bases of the lateralmost and the next terminal seta (Fig. 4e). The distalmost posterior surface of the A2 basis is furnished with a spinule row (Fig. 4f : arrow). The spinule row on the distal border of the P4 coxa is dense. The distal edge of the P4 coupler is equipped with long hairs (Fig. 4h : arrow).

This taxon is distributed also in hill-side waters in western Japan.

Eucyclops spp. in western Japan

Specimens from the floodplain waters in western Japan seem to be composed of two taxa. One is *E. cf. serrulatus*, sensu UEDA *et al.* (1996a, b) from small ponds in Kyushu, and Akiyoshido, Yamaguchi Prefecture, Honshu. The other is very common in western Honshu, and found also from

Sanpoh-ike, Shakujii Park, Tokyo, and the southern part of the Ishikari Lowland, Hokkaido, *i.e.*, Bibi Creek, and ponds in Oiwake and Abira. The major characteristics are long caudal rami, the L/W greater than 5.0, and the lack of distal spinules on anterior and posterior surfaces of A2 basis (Fig. 4j-k, arrows).

These taxa will be examined thoroughly and reported on in the near future.

DISCUSSION

As the synonymy of the *E. roseus* shows, systematics of *Eucyclops* species in Japan has been problematic due to a confusion of *E. roseus* with *E. speratus* or *serrulatus*. It can now be said that the recognition of *roseus* eliminated part of the *E. serrulatus-speratus* complex problem in Japan.

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ユーラシア産カイアシ類の1新種, *Eucyclops roseus* と 日本における *E. serrulatus*-*speratus* の問題

石田昭夫

摘 要

Eucyclops serrulatus と *E. speratus* に類似する1新種 *Eucyclops roseus* を記載した。本種はヨーロッパからアジアに広く分布すると見られる。日本において混乱していた *E. serrulatus* と *E. speratus* の分類は本種の存在が知れたことで部分的に解決された。琉球列島から北海道まで *E. roseus*, *E. serrulatus* および *E. speratus*-like species が分布するが, *E. speratus* s. str. は出現しない。日本の *speratus*-like species complex は幾つかのタクサに分けられ, その一つは主に日本の北半分に, 他方は南半分に分布する。*E. roseus* と *E. speratus*-like species complex の日本における棲み場所は池, 湖沼, 河川の中・下流域で, *E. serrulatus* のそれは一般的に山地水体と泉流に限られる。