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# *Eucyclops pacificus* and *E. ohtakai*, Two New Cyclopoid Copepods (Crustacea) from Japan

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**Abstract.** Two new cyclopoid copepods of the genus *Eucyclops* are described from Japan: *E. pacificus* and *E. ohtakai*. The former was mentioned as an "*E. speratus*-like species", and the latter as Eucyclops sp., in my earlier work. They are discriminated from congeners by several minor but clearcut micro-characters. Both species are distributed from Hokkaido in the north to Iriomote I. (24° N) in the south. Their main habitats are hillside cool waters for *E. pacificus* and floodplain warm waters for *E. ohtakai*.

**Key words:** taxonomy, copepod, *Eucyclops*, Japan.

## Introduction

The recognition of *Eucyclops roseus* Ishida, 1997 partly solved the confusing taxonomic picture of the genus *Eucyclops* in Japan (Ishida, 1997). In that article I pointed out the existence of an *E. speratus*-like species and two other unidentified *Eucyclops* species in Japan. I have since examined specimens of these taxa from various localities and discovered minor but clearcut micro-characters that are useful for the discrimination of each taxon. These findings confirm that the *E. speratus*-like species and one of the other two species are new to science. [The second unidentified species of *Eucyclops* was called E. cf. *serrulatus* (Fischer, 1851) by Ueda, TI & JI (1996) and Ueda, SO & KK (1996).] I describe herein the two new species and present their distribution ranges and habitats.

## Material and Methods

All specimens of *Eucyclops* species in my collection were examined. The type specimens of the two new species were chosen from samples containing sufficient numbers of specimens in good condition. Drawings and measurements were done either in glycerin before dissection or in gum-chloral medium after dissection, with the aid of a drawing tube and either an objective micrometer or a handmade scale on the drawing table equivalent to the micrometer. Body lengths were measured from the anterior tip of the rostrum to the end of the caudal ramus. High magnification objective lenses used were mainly ×60 (dry) and ×40 (phase-contrast). Type specimens were deposited in the Department of Zoology, National Science Museum (Tokyo) (NSMT) and the National Museum of Natural History, Smithsonian Institution (USNM).

Abbreviations used are as follows: A1, antennule; A2, antenna; Mxl, Maxillule; Mx, maxilla; Mxp, maxilliped; P1-P6, first to sixth legs; exp1-exp3, first to 3rd articles of exopod; enp1-enp3, first to 3rd articles of endopod; L/W, ratio of length to maximum width; Sp/Sg, ratio of length of terminal spine to P4 exp3; saw, row of spinules on lateral margin of caudal ramus.

## Taxonomic accounts and distribution

### *Eucyclops pacificus* sp. nov. (Figs 1-3)

*Eucyclops speratus* (Lilljeborg, 1901): Ishida, 1995: 299.

*Eucyclops speratus*-like species. Ishida 1997: 356, fig. 4e-h.

*Material examined.* Holotype ♀, dissected on 1 slide, NSMT-Cr 13152. Paratypes, 1 ♂, dissected on 1 slide, NSMT-Cr 13153, 15 ♀ ♀ and 6 ♂ ♂, undissected specimens in 70% ethanol, USNM 298345, all from roadside ditch in Yoichi town, Hokkaido, 2 November 1996.

Other specimens dissected on slides: 1 ♀, small stream by Lake Akan, Hokkaido, 21 October 1989; 2 ♀ ♀, pond, Oiwake town, Hokkaido, 4 November 1987; 10 ♀ ♀, pond and ditch, Yoichi town, Hokkaido, April-November 1996; 1 ♀, stream, Ohma town, Aomori Pref., Honshu, 1 June 1987; 1 ♀, cress-field, Hirosaki city, Aomori Pref., 21 June 1998; 1 ♀, small stream, Yamagata town, Iwate Pref., 3 June 1987; 1 ♀, small pond on rock terrace of Ara River, Minano town, Saitama Pref., 1 April 1994; 15 ♀ ♀, spring streams, Kokubunji city, Tokyo, 11 December 1993; 4 ♀ ♀, hillside pond, Tamaki town, Mie Pref., 15 March 1986; 3 ♀ ♀, spring stream, Samegai, Maibara town, Shiga Pref., 5 December 1995; 2 ♀ ♀, inundated shore edge clumps of grass adjacent to Lake Biwa Museum, Lake Biwa (south basin), Kusatsu city, Shiga Pref., 25 November 1998; 2 ♀ ♀, Ohmiya Stream, Shimosakamoto, Otsu city, Shiga Pref., 6 March 1994; 2 ♀ ♀, pathside ditch near Fusenotame, Youkaichi city, Shiga Pref., 4 December 1995; 3 ♀ ♀, hillside pond, Yoshimi town, Yamaguchi Pref., 18 December 1996; 1 ♀, small stream, Kin town, Okinawa I., Okinawa Pref., 2 April 1987; 4 ♀ ♀, pathside seeps, Nakamagawa hiking path, Iriomote I., Okinawa Pref., 25 April 1993 and 12 May 1997.

*Description.*

*Female.* Length of holotype 1.53 mm; range of lengths of 15 paratypes 1.40-1.64 mm, mean 1.51 mm. Habitus (Fig. 1a) typical for genus. Pleurotergite of 4th thoracic somite (Fig. 1b) finely serrate posterolaterally and with several hairs at posterior margin. L/W of genital double-somite 1.0. Seminal receptacle as in Fig. 1c. Posterior edges of genital double-somite and of two subsequent urosomites with hyaline frills finely serrated dorsally and comb-like ventrally. Anal operculum (Fig. 1e) almost flat. Caudal rami (Fig. 1d, e) slightly divergent; L/W 5.7; lateral margins with fine saw; space between bases of lateralmost and next terminal seta narrow. Lengths of caudal terminal setae from medialmost to lateralmost in $\mu$m: 150, 710, 475, and 90.

A1 with 12 segments, reaching distal margin of 2nd thoracic somite; last 3 segments with minutely serrated hyaline membrane. Posterior surface of basis of A2 as in Fig. 1f, with spinules in distalmost portion; anterior surface (Fig. 1g) with hair-like long spinules in distal portion. Labrum (Fig. 1h) with 8 teeth and 2 + 2 minute processes between lateral protuberances. Mandible as in congeners. Lateral surface of proximal article of Mxl palp with group of spinules (Fig. 2a). Mx as in congeners; praecoxa with prominent spinules on lateral surface (Fig. 2b). Mxp as illustrated in Fig. 2c.

Spine-seta formula of P1-4 as in congeners. Basis of P1 with medial seta reaching middle of enp3. Ornamentation of posterior surfaces of couplers and coxae of P1-4 as in Fig. 2d-g. P4 exp3 (Fig. 2g) with short terminal spine (Sp/Sg = 0.71). Medial spine of P5 wide and depressed, with fine spinules densely on each side (Fig. 2h). P6 as in congeners (Fig. 2i).

*Male.* Range of lengths of 7 paratypes 0.99-1.13 mm, mean 1.04 mm. Anal operculum (Fig. 3c) almost flat. L/W of caudal rami 4.3. A1 with 16 articles and armed as in Fig. 3d. Armament of A2 basis and Mxl palp similar to those of female (Fig. 3e-g). P6 (Fig. 3b) with medial short spine half as long as succeeding somite.

*Etymology.* Named for its distribution range facing the Pacific Ocean.

*Variation.* Ranges of lengths varied as follows among localities: Hokkaido, 1.21-1.64 mm; Honshu, 1.10-1.38 mm; Iriomote I., 0.93-1.10 mm. L/W of

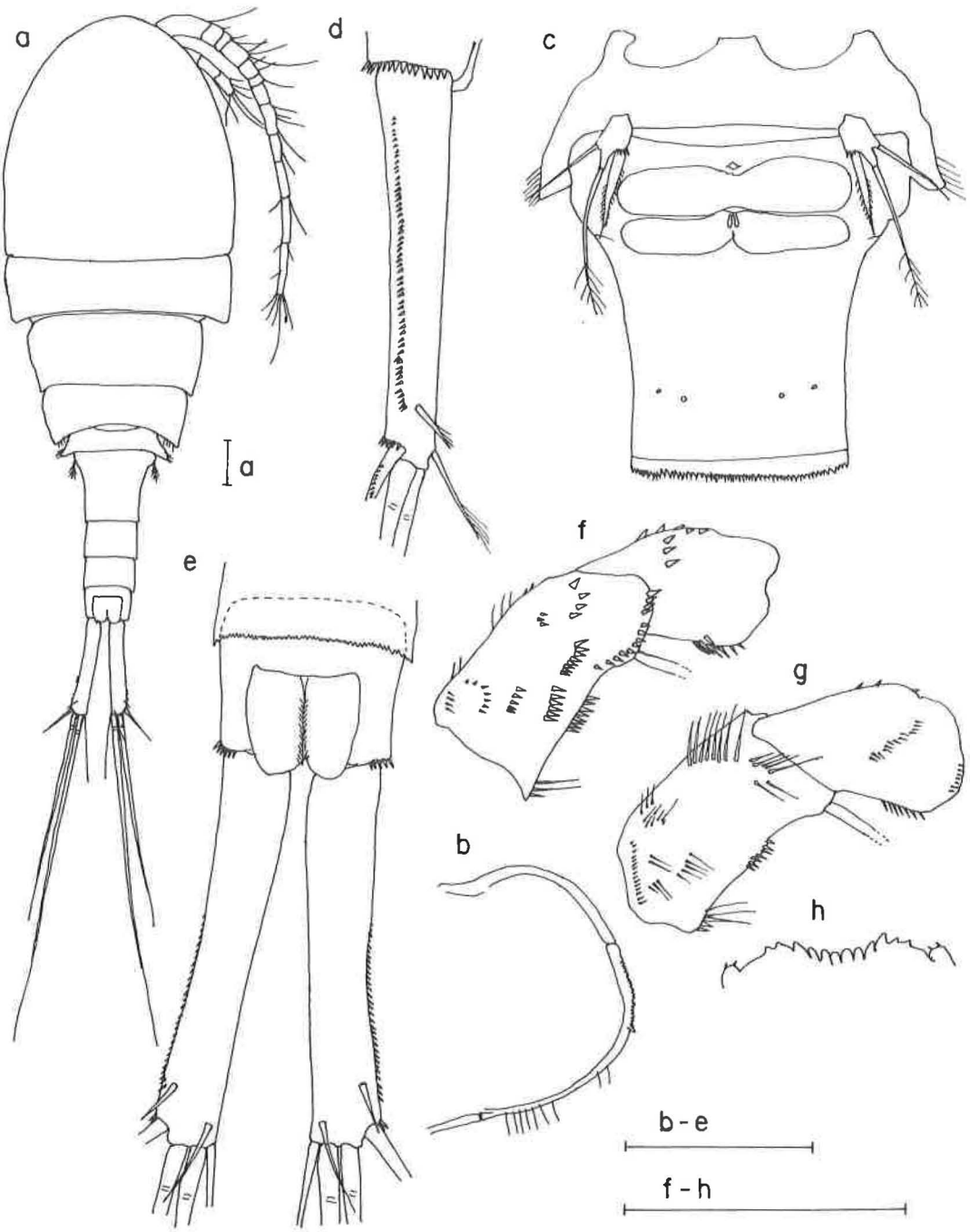


Fig. 1. *Eucyclops pacificus* sp. nov., holotype female: a, habitus, dorsal; b, pleurotergite of prosomite 4; c, prosomite 5 and genital double-somite, ventral; d, caudal ramus, lateral; e, anal somite and caudal rami, dorsal; f, A2 basis and enp1, posterior; g, A2 basis and enp1, anterior; h, labrum. Scales = 100 $\mu$m.

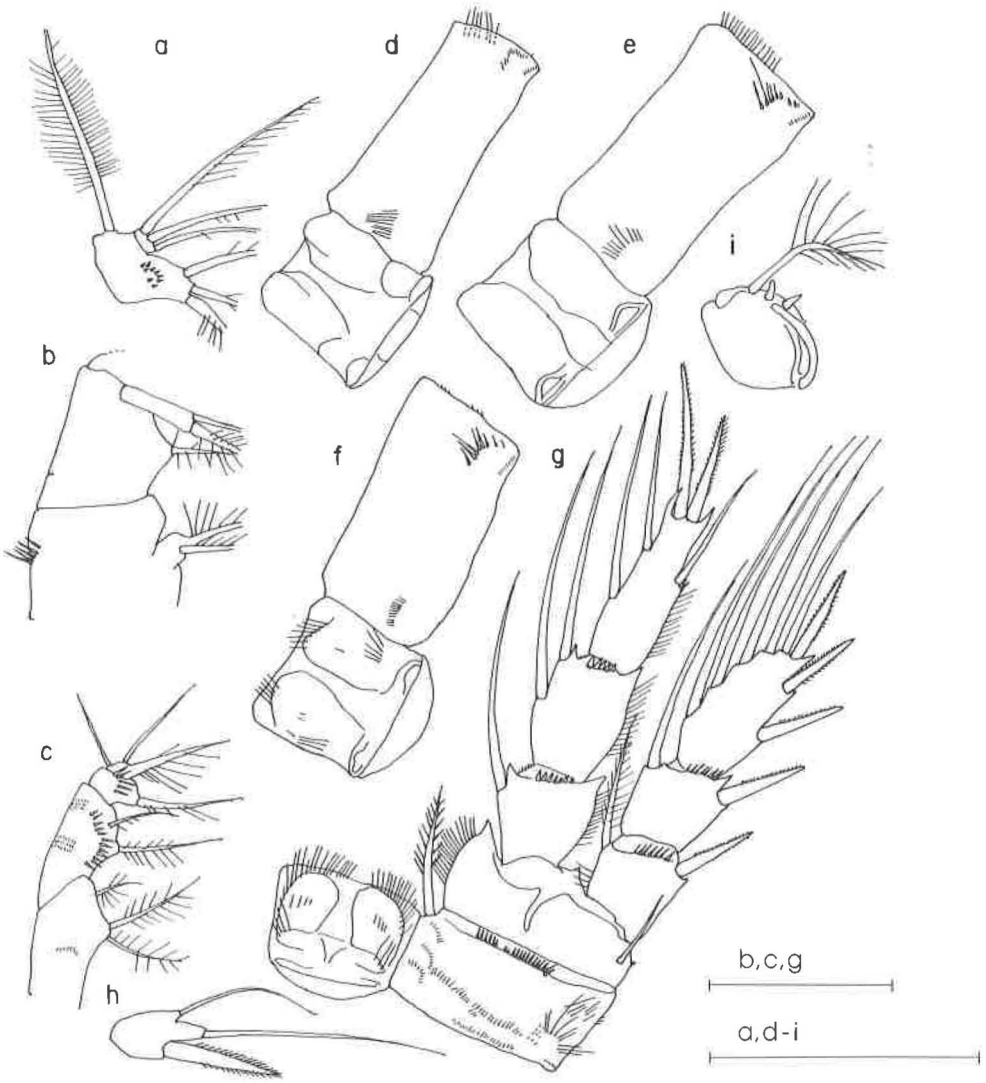


Fig. 2. *Eucyclops pacificus* sp. nov., holotype female: a, Mxl palp; b, praecoxa and basis of Mx; c, Mxp; d-f, coxae and couplers of P1-P3, posterior; g, P4 and coupler, posterior; h, P5; i, P6. Scales = 100 $\mu$m.

caudal rami: Hokkaido, 4.8-6.4; Honshu, 4.2-5.9; Iriomote I., 3.9-4.4. Sp/Sg: Hokkaido, 0.69-0.84; Honshu, 0.57-0.81; Iriomote I., 0.64-0.73.

*Affinities*. The new species is similar to *E. speratus* (Lilljeborg, 1901). However, as pointed by Ishida (1997), the distal anterior surface of the A2 basis is bare in *E. speratus*, whereas it bears hair-like spinules in *E. pacificus*. Differences exist also in Mx: the lateral surface of the praecoxa is bare or with small spinules in *E. speratus* ( *cf.* Ishida and Hiruta, 1999), *versus* it bears prominent spinules in *E. pacificus*.

*Geographical distribution and habitats*. The new species was collected from Hokkaido (45°N) in the north to Iriomote I. (24°N) in the south. In Hokkaido and northern Honshu, populations inhabit various kinds of waters except for spring streams and

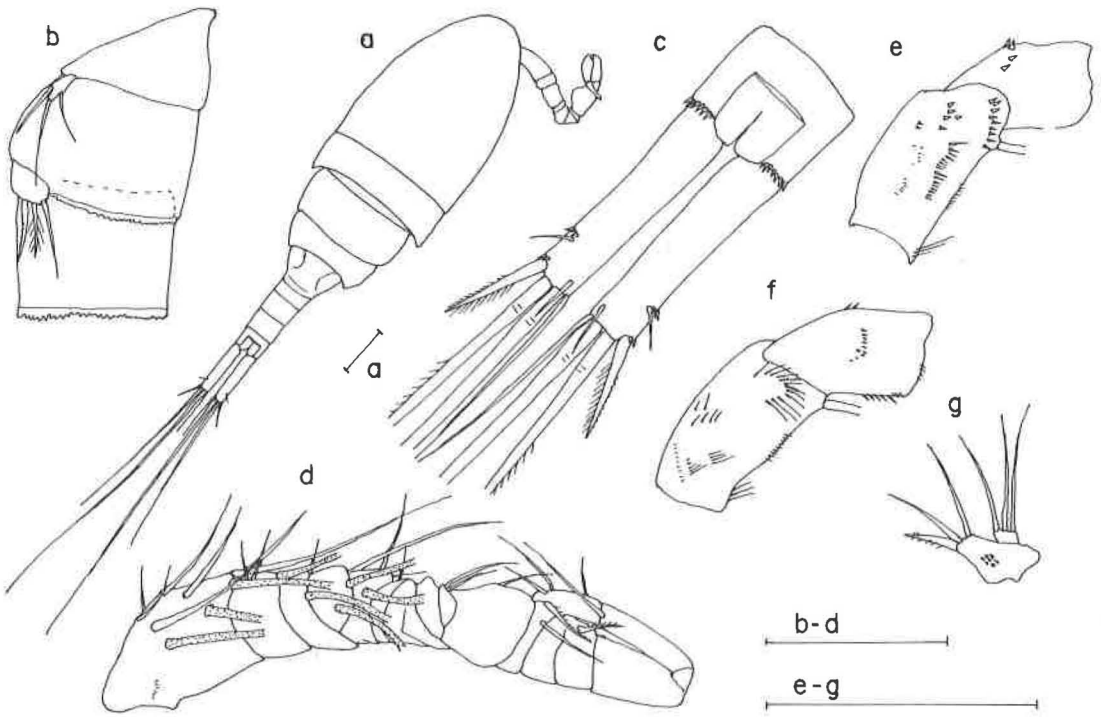


Fig. 3. *Eucyclops pacificus* sp. nov., paratype male: a, habitus, dorsal; b, prosomite 5 and succeeding two urosomites, lateral; c, anal somite and caudal rami, dorsal; d, A1; e, A2 basis and enp1, posterior; f, A2 basis and enp1, anterior; g, Mxl palp. Scales = 100 $\mu$m.

oligotrophic caldera lakes inhabited by *Eucyclops serrulatus* (Fischer, 1851). *Eucyclops pacificus* shows an allopatric distribution with respect to *E. serrulatus*. In the spring streams of the Kokubunji Escarpment, Tokyo, *E. serrulatus* occupies the spring heads and *E. pacificus* inhabits down the streams and puddles. In western Honshu and the Ryukyu Is, populations of *E. pacificus* mainly inhabit hillside waters and cool streams shaded by forests.

### ***Eucyclops ohtakai* sp. nov.** (Figs 4-5)

*Eucyclops* sp.: Ishida, 1997: 356, fig. 4i-l.

*Material examined.* Holotype ♀, dissected on 1 slide, NSMT-Cr 13154. Paratypes, 1 ♂, dissected on 1 slide, 2♀♀, dissected on 2 slides, NSMT-Cr 13155-57; 15♀♀, undissected specimens in 70% ethanol, USNM 298344, all from Lake Ikeda, Kagoshima Pref., Kyushu, 16 July 1998, coll. A. Ohtaka.

Other specimens dissected on slides: 3♀♀, marsh, Abira town, Hokkaido, 12 May 1987; 3♀♀, Bibi Stream, Tomakomai city, Hokkaido, 12 January 1994; 7♀♀, cress-field, Hirosaki city, Aomori Pref., 21 June 1998; 3♀♀, Sanpoh Pond, Shakujii Park, Tokyo, 7 April 1996; 6♀♀, Lake Biwa, Shiga Pref., 4 December 1995; 2♀♀, pond, Tamaki town, Mie Pref., 15 March 1986; 12♀♀, pond, Higashi-Hiroshima city, and 2 ♀♀, Kohri Pond, Mt Noro, Yasu-ura town, Hiroshima Pref., 16 December 1996; 5♀♀, hillside pond, Yoshimi town, Yamaguchi Pref., 18 December 1996; 2♀♀, Lake Ikeda, Kagoshima Pref., 16 July 1998, coll. A. Ohtaka; 2♀♀, pond, Yaku town, Yakushima I., Kagoshima Pref., 25 May 1991, coll. E. Enomoto; 2♀♀, small stream, Kin town, Okinawa I., Okinawa Pref., 2 April 1987;

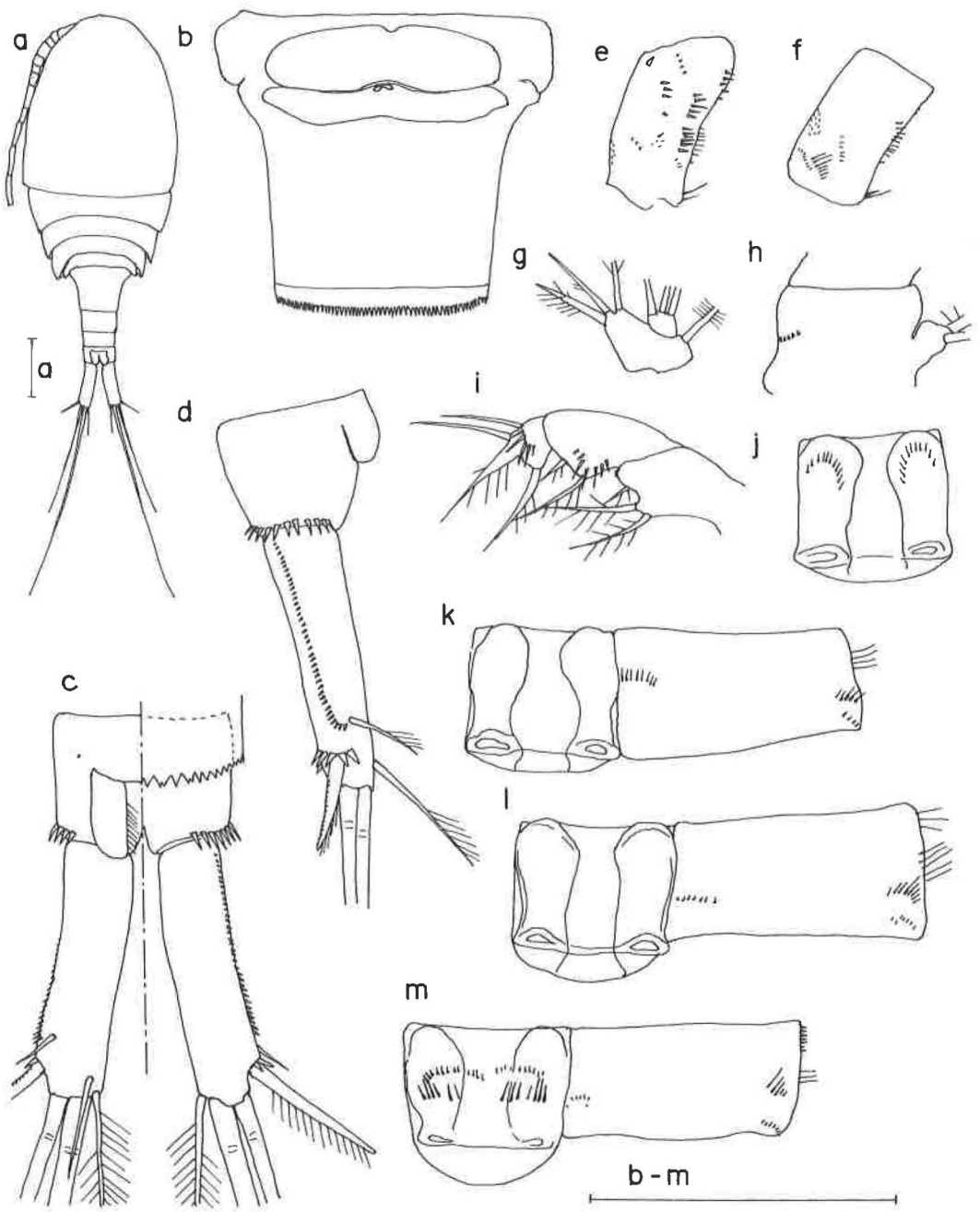


Fig. 4. *Eucyclops ohtakai* sp. nov., holotype female: a, habitus, dorsal; b, genital double-somite, ventral; c, anal somite and caudal ramus, with part of 4th urosomite, dorsal/ventral; d, anal somite and caudal ramus, lateral; e, A2 basis, posterior; f, A2 basis, anterior; g, Mxl palp; h, Mx praecoxa; i, Mxp; j, P1 coupler, anterior; k-m, coxae and couplers of P1-P3, posterior. Scales = 100 $\mu$m.

12♀♀, streams, Ishigaki I., Okinawa Pref., 23 April 1993 and 12 May 1996; 5 ♀♀, roadside marsh, Iriomote I., Okinawa Pref., 13 May 1996.

*Description.*

*Female.* Length of holotype 0.78 mm; range of lengths of 17 paratypes 0.69-0.82 mm, mean 0.75 mm. Habitus (fig. 4a) typical for genus. L/W of genital double-somite 0.85. Seminal receptacle as in Fig. 4b. Posterior edge of genital double-somite with finely serrated hyaline frill: next two urosomites with coarsely and irregularly serrated frills. Anal operculum (Fig. 4c) convex. Caudal rami (Fig. 4c, d) divergent; L/W 3.6 in holotype, 3.7 and 3.8 in 2 paratypes; lateral margins with saw among full length. Lengths of caudal terminal setae of holotype in $\mu$m: medialmost to lateralmost 88, 415, 225, and 55, respectively.

A1 with 12 segments, reaching middle of 1st free thoracic somite; last 3 segments with hyaline membrane. Posterior surface of basis of A2 (Fig. 4e) without spinules in distalmost portion; anterior surface (Fig. 4f) without spinules in distal portion. Labrum with 8 teeth and 2 + 2 minute processes between lateral protuberances. Mandible as in congeners. Lateral surface of proximal article of Mxl palp without spinules (Fig. 4g). Mx as in congeners; praecoxa with spinules on lateral surface (Fig. 4h). Mxp as illustrated in Fig. 4i.

Spine-seta formula of P1-4 as in congeners. Basis of P1 with medial seta reaching middle of enp3. Ornamentation of posterior surfaces of couplers and coxae of P1-3 as in Fig. 4k-m; couplers of P1, P2 bare; medial spinules of coxae not prominent. P4 and coupler as in Fig. 5a; proximal width of coupler narrower than distal width; number of spinules on distal edge of coxa 17 in holotype; Sp/Sg 0.89. Medial spine of P5 rather narrow and with sparse spinules (Fig. 5b).

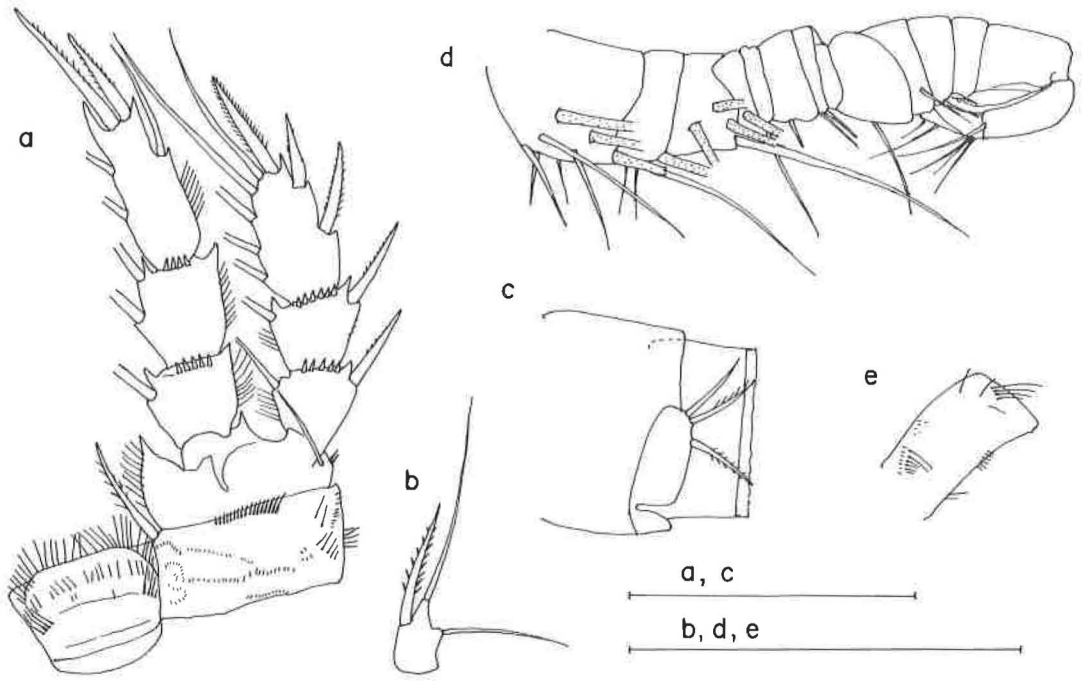


Fig. 5. *Eucyclops ohtakai* sp. nov., holotype female: a. P4 and coupler, posterior; b, P5. Eucyclops ohtakai sp. nov., paratype male: c, 2nd and 3rd urosomites, lateral; d, A1; e, A2 basis, anterior. Scales = 100 $\mu$m.

*Male*. Length of paratype male 0.54 mm. L/W of caudal ramus 3.3. A2 with 16 segments and armed as in Fig. 5d. Anterior surface of A2 basis (Fig. 5e) with hair-like spinules distally. P6 (Fig. 5c) with medial spine and two setae, their lengths subequal, shorter than length of succeeding somite.

*Etymology*. Named for Dr Akifumi Ohtaka of Hirosaki University, who collected the type lot of the new species and graciously provided support for my sampling.

*Variation*. Ranges of lengths varied as follows among localities: Hokkaido, 1.11-1.28 mm; Honshu, 0.99-1.26 mm; Yakushima, Okinawa, Ishigaki, and Iriomote Is, 0.76-1.01 mm. L/W of caudal rami: Hokkaido, 4.9-6.2; Honshu and Kyushu, 3.6-5.8; Yakushima-Iriomote Is, 3.7-5.0. Sp/Sg: Hokkaido, 0.83-0.96; Honshu and Kyushu, 0.75-1.04; Yakushima-Iriomote Is, 0.95-1.00.

*Affinities*. The new species is similar to *E. serrulatus* and *E. biwensis* Ishida, 1998. However, the distal anterior surface of the A2 basis is equipped with hair-like spinules in *E. serrulatus* (*cf.* Ishida, 1997), but bare in *E. biwensis* and *E. ohtakai*, and the saw is short in *E. biwensis* (Ishida, 1998), but long in *E. ohtakai*. The new species is discriminated from *E. speratus* and *E. pacificus* by the absence of spinules on the Mxl palp.

*Geographical distribution and habitats*. Known occurrence of *Eucyclops ohtakai* in Hokkaido is restricted to the waters of the Ishikari Lowland. Since it seems to be a warm-water species, further sampling efforts in floodplain warm waters in Hokkaido are needed. In Honshu and the Ryukyu Is, the species is widely distributed in floodplain running and standing waters. The dominant *Eucyclops* species of irrigation ponds in western Honshu are *E. ohtakai* and *E. roseus*, but the *Eucyclops* species in small ponds in Kyushu were *Eucyclops* cf. *serrulatus* (Ueda, TI & JI, 1996), and *E. roseus* (Ishida, 1997). Further surveys in Kyushu are also needed.

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