

## Three New Copepods from Brackish-Water Lakes of Japan

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THE PRESENT PAPER deals with three new copepods found in brackish-water lakes of Japan. Two of them were obtained from the brackish fish-culture ponds along the western coast of Ise Bay, Mie Prefecture. The third specimen was sent by Professor Kikuya Mashiko of Kanazawa University and was collected from a small brackish-water lake in Hegura Island, one of the isolated islands in the Sea of Japan.

I wish to acknowledge my indebtedness to Professor Yaichiro Okada who kindly afforded me the facilities for studying the specimens which I have described in the present paper; to Dr. Masuzo Ueno, Otsu Hydrobiological Station of Kyoto University for his valuable advice; and to Professor Kikuya Mashiko of Kanazawa University who sent me the material of *Halicyclops japonicus*.

### *Acartia iseana* n. sp.

Fig. 1

FEMALE: Length 0.955 mm., not including furcal setae.

Head distinctly separated from first thoracic segment. Rostral filaments present (Fig. 1c). Fourth thoracic segment completely fused with fifth. Lateral angle of last thoracic segment rounded, furnished with 4 spinules on either side. Genital segment not laterally dilated, about as long as other two abdominal segments combined, second segment about twice as long as anal segment. First two abdominal segments each with 6 spinules along distal margin of dorsal surface.

Furcal rami about 2 times as long as wide; inner margin with a few hairs. First antenna

of 17 segments, when reflexed scarcely reaching end of anterior division of body.

Legs 1-4 with formula 3,2/3,2/3,2/3,2. Leg 5 with basal segment longer than wide; outer seta relatively short, shorter than terminal spine. Exopodite unsegmented, in form of a stout spine with rounded protuberance on ventral side of base; terminal spine nearly straight, about 3 times as long as basal segment, armed distally with stout spinules on either side. (Fig. 1b, i.)

MALE: Length 0.880 mm. Abdomen relatively longer than in female, and consisting of 5 segments, segment 4 well defined, but small. Furcal rami shorter than in female, 1.3 times as long as wide.

Leg 5: Right leg; basal segment longer than wide (about 2:1); lengths of basal segment and exopodites 1 and 2, 27:35:30 ( $\mu$ ); inner margin of exopodite 1 smooth, but with row of fine hairs; inner lobe of exopodite 2 very prominent, longer than wide, bifurcate at top; exopodite 3 very narrow at base, curved, without spine on outer margin, but with a spine on inner edge. Left leg; lengths of segments, 35:30:41 ( $\mu$ ); exopodite 2 elongate, more than 4 times as long as wide, bearing a small spine on top, with a few hairs on inner margin distally. (Fig. 1j.)

LOCALITY: Brackish-water fish ponds on coastal regions of Tsu and Matsusaka Cities, Mie Prefecture, middle Japan.

HOLOTYPE: Female, and allotype male. Taken from a mullet pond in Yonezu, Tsu City, Mie Prefecture. The type is deposited in the Faculty of Fisheries Collection, Prefectural University of Mie.

VARIATION IN BODY LENGTH: Female 0.856-1.054 mm., male 0.868-0.905 mm.

REMARKS: I found this species in six brack-

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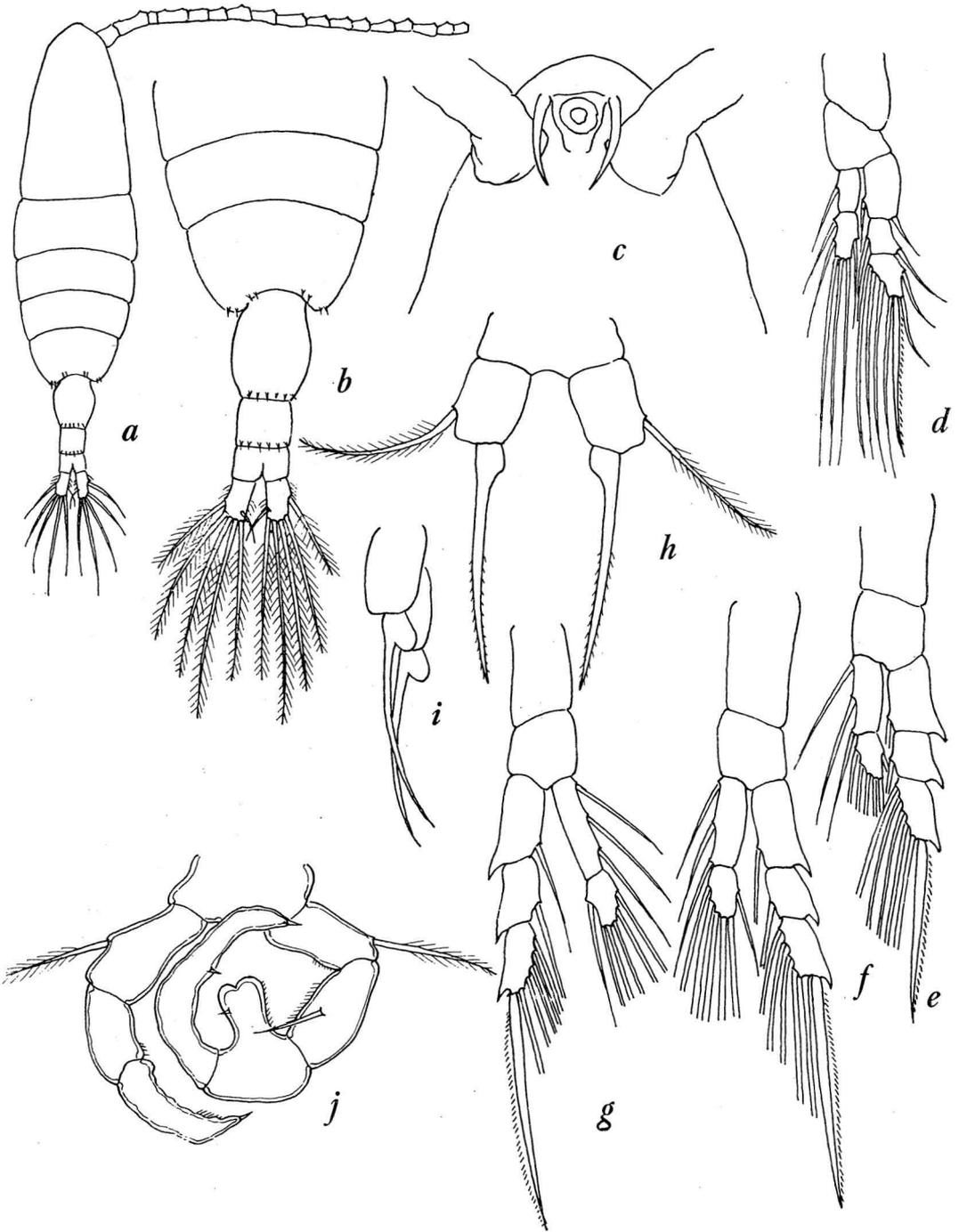


FIG. 1. *Acartia iseana* n. sp.: a, Dorsal aspect of female; b, abdomen and furca (dorsal); c, rostrum; d-g, legs 1-4; b, i, leg 5 of female, dorsal and lateral; j, leg 5 of male.

ish-water ponds on the coast regions of Yonezu, Tsu City, of Karasu-machi and of Matsusaka City, Mie Prefecture. Usually, this species is in company with other brackish-water forms, *Sinocalanus tenellus* (Kikuchi), *Pseudodiaptomus inopinus* Burckhardt, and *Brachionus plicatilis* O. F. Müller. The chlorinity of the ponds in which the species is distributed, ranges from 5.560 to 12.928 parts per thousand.

*Acartia iseana* is allied to a marine form, *Acartia biflosa* Giesbrecht, but it is distinguishable from *biflosa* by the absence of the fine hairs on the dorsal surface of the abdomen and by the structures of leg 5 of both sexes.

*Acartia tsuensis* n. sp.

Fig. 2

FEMALE: Length 0.943 mm., not including furcal setae.

Head separated from first thoracic segment. Rostral filaments present, more slender than in *A. iseana*. Last two thoracic segments fused. Lateral angle of last thoracic segment rounded, with 6 spinules on either side. Genital segment scarcely longer than other two abdominal segments combined. First two abdominal segments each with 6 spinules along distal margins of dorsal surface. Furcal rami rather shorter than that of the former species, 1.5 times as long as wide.

First antenna of 17 segments, when reflexed extending beyond end of anterior division of body and reaching to middle portion of genital segment.

Legs 1-4 with formula 3,2/3,2/3,2/3,2. Leg 5 with basal segment longer than wide, outer seta rather slender and long. Exopodite unsegmented, proximal portion wider than distal spine, about 2 times as long as wide, bearing well-developed, pointed process on outer edge; terminal spine curved inwards midway, without spinules on either side. (Fig. 2*b*.)

MALE: Length 0.843 mm. Leg 5: Right leg; basal segment longer than wide (about 2:1); lengths of basal segment and exopodite 1 and

2, 39:42:39 ( $\mu$ ); inner margin of exopodite 1 smooth; inner lobe of exopodite 2 very prominent, about as long as wide, its top not bifurcate; exopodite 3 very narrow at base, curved, without spines on outer margin, but with a spine on inner edge as in *A. iseana*. Left leg; lengths of basal segment and exopodite 1 and 2, 46:31:26 ( $\mu$ ); basal segment rather slender, about 2 times as long as wide; exopodite 1 very simple and smooth; exopodite 2 consisting of 2 portions, proximal protuberance bearing a slender spine on inner margin and narrower distal portion with small spine on top and subapical small process. (Fig. 2*i*.)

LOCALITY: Twelve brackish-water fish ponds in which the mullet, *Mugil cephalus* L. is cultured, on coasts of Kumozu, Tsukaigan, and Heta regions in Tsu City, Mie Prefecture, middle Japan.

HOLOTYPE: Female, and allotype male. Taken from a brackish-water fish pond in Heta of Tsu City, Mie Prefecture. The type is preserved in the Faculty of Fisheries Collection, Prefectural University of Mie.

VARIATION IN BODY LENGTH: Female 0.893-0.992 mm., male 0.818-0.868 mm.

REMARKS: This species is found in company with other brackish-water plankton animals, *Sinocalanus tenellus* (Kikuchi), *Pseudodiaptomus inopinus* Burckhardt, *Neomysis japonica* (Nakazawa), and *Brachionus plicatilis* O. F. Müller in most cases, but not accompanied by *Acartia iseana*. The chlorinity of these ponds ranges from 6.696 to 7.768 parts per thousand.

*A. tsuensis* is allied to *A. iseana* but it is distinguishable from the latter as follows:

Furcal rami 2 times as long as wide; exopodite of leg 5 in female bearing a rounded lobe at base of terminal spine; inner prominence of exopodite 2 of right leg 5 in male bifurcate. . . . . *Acartia iseana*  
Furcal rami 1.5 times as long as wide; exopodite of leg 5 in female with a pointed process; inner prominence of right leg 5 in male rounded. . . . . *Acartia tsuensis*

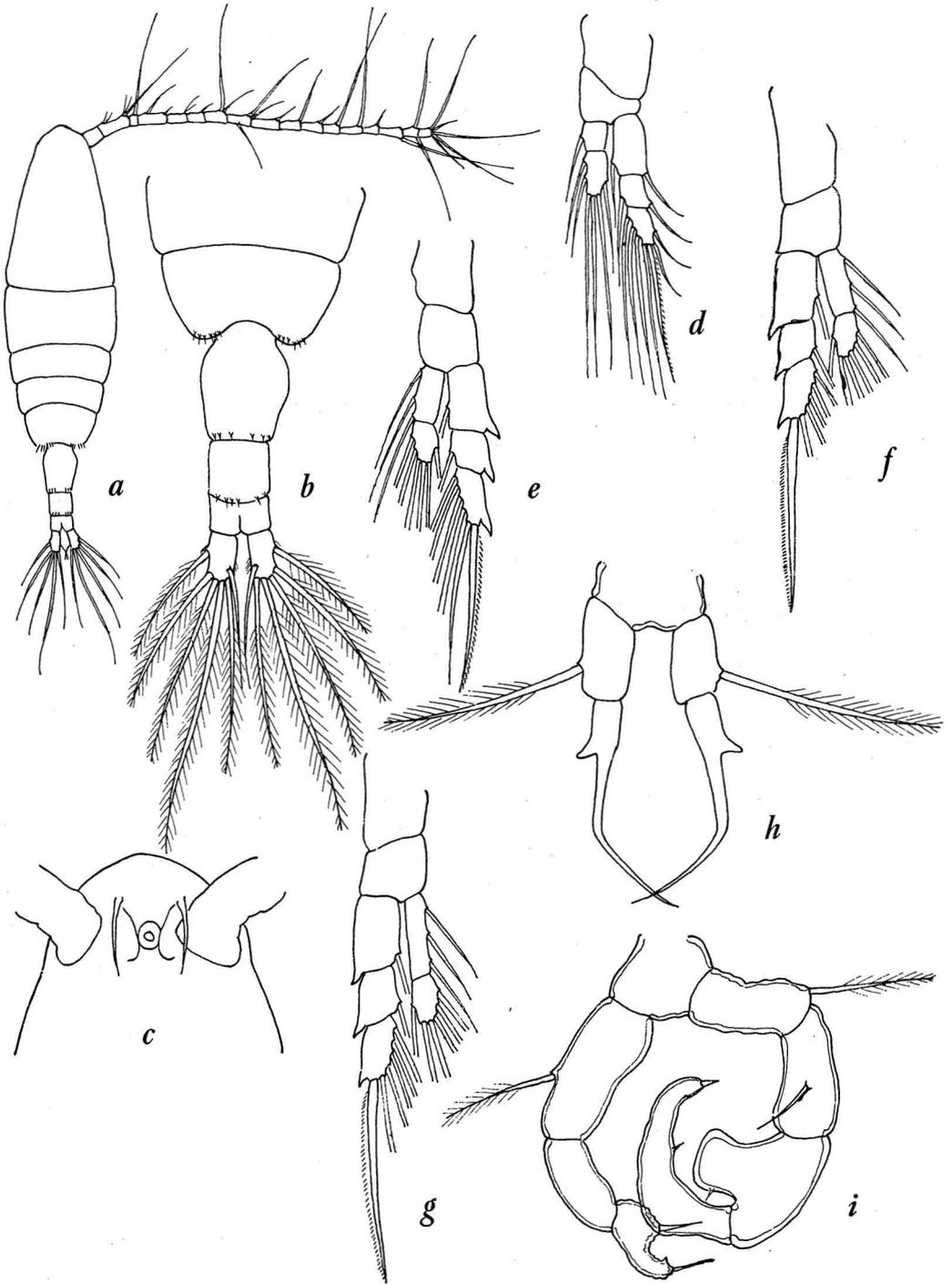


FIG. 2. *Acartia tsuensis* n. sp.: a, Dorsal aspect of female; b, abdomen and furca (dorsal); c, rostrum; d-g, legs 1-4; h, leg 5 of female; i, leg 5 of male.

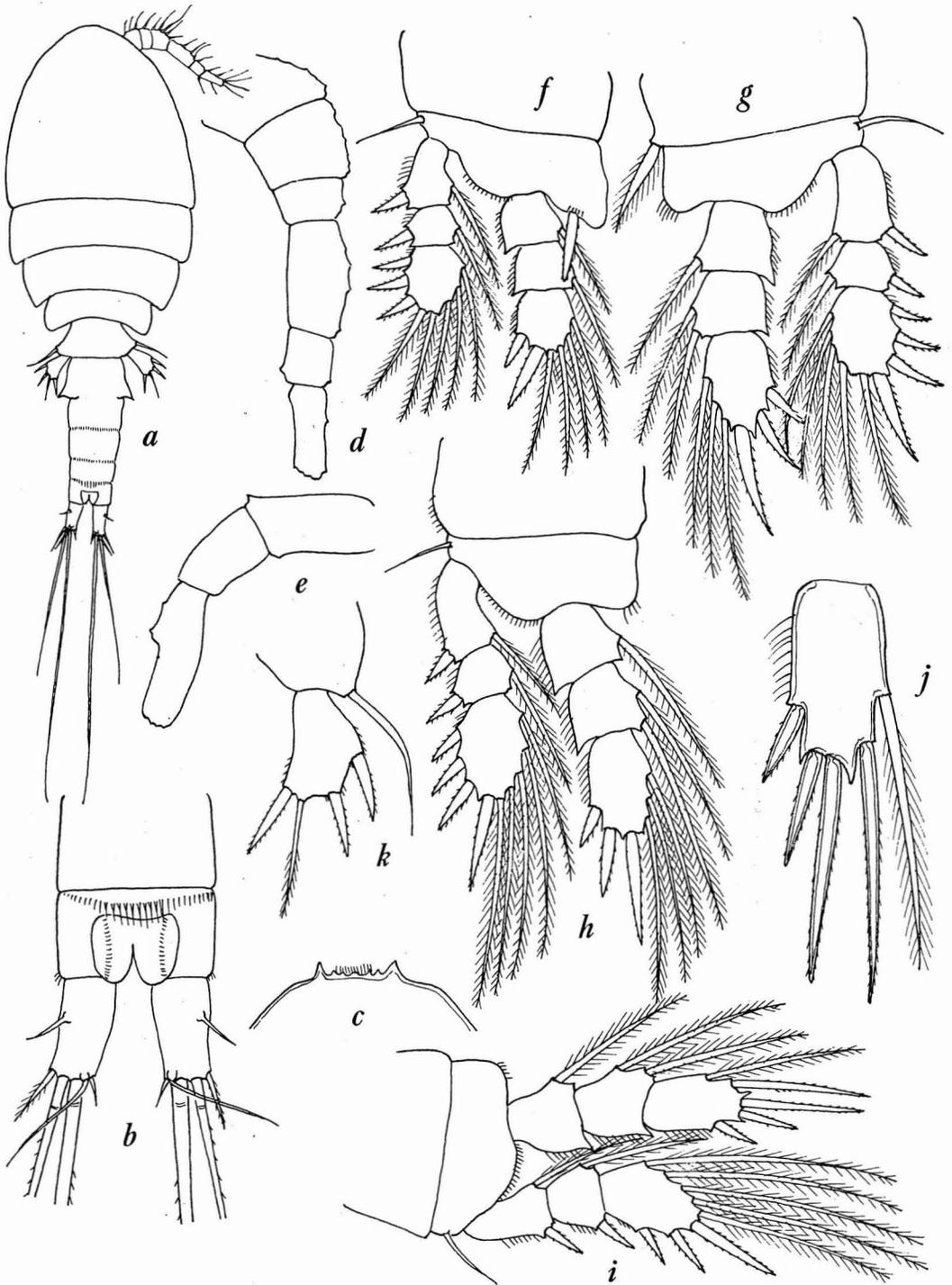


FIG. 3. *Halicyclops japonicus* n. sp.: a, Dorsal aspect of female; b, abdomen and furca (dorsal); c, upper lip; d, e, first and second antennae; f-i, legs 1-4; j, endopodite 3 of leg 4, k, leg 5.

*Halicyclops japonicus* n. sp.

Fig. 3

FEMALE: Length 0.66 mm., not including furcal setae. Body somewhat flattened, with distinct nauplius eye.

Upper lip rather narrow, with about 7 small, blunt teeth (Fig. 3c). First three abdominal segments bearing a row of spinules along posterior end of dorsal surface, middle spinules of the third segment especially well developed. Genital segment sharply produced towards side at middle on either side (Fig. 3a).

Furcal rami relatively long (38  $\mu$ ), nearly twice as long as wide (1.9:1); lateral seta inserted at about middle of furcal rami, somewhat dorsal in position. Lengths of furcal setae as follows (from inner to outer and dorsal): 13:359:184:23:38 ( $\mu$ ). Inner furcal seta very short and small, 0.6 as long as outer (13:23  $\mu$ ); outer seta shorter than furcal ramus; dorsal seta relatively long, much longer than the outer, arising from small protuberance; inner median seta about twice as long as the outer median seta. (Figs. 3a, b.)

First antenna very short, consisting of 6 segments, reaching to middle of cephalothorax, relative length of each segment as shown in Fig. 3d. Second antenna of 3 segments (Fig. 3e).

Legs 1-4 with formula 3,3/3,3/3,3/3,3; spine-formula in exopodite, 3,4,4,3; seta-formula in exopodite, 5,5,5,5; spine-formula in endopodite, 2,3,3,4; seta-formula in endopodite, 4,3,3,1. (Figs. 3f-j.) Endopodite 2 of leg 1 with an inner seta, of legs 2-4 with 2 inner setae. Leg 4 with endopodite 3 rather slender, about twice as long as wide (1.9:1), terminal spines unequal in length, inner spine 1.8 times as long as outer (45:25  $\mu$ ); outer marginal seta replaced by stout spine, 15  $\mu$  in length; distal inner seta also a long, slender spine, 45  $\mu$  in length; but proximal inner seta of usual form. (Fig. 3i, j.) Connecting plate of leg 4 very simple and smooth, without special appendage.

Leg 5 with segment 1 fused with last thoracic segment, with one slender seta; seg-

ment 2 very narrow at base, rather wide at apex, bearing 3 short spines and one slender seta, each side of distal portion with several denticles. (Fig. 3k.)

MALE: Unknown.

LOCALITY: Ryujin-ike (brackish-water lake) on Hegura Island, Japan Sea.

HOLOTYPE: Female, is deposited in the collection of the Faculty of Fisheries, Prefectural University of Mie.

REMARKS: I found this new species in the plankton material collected by Professor Kikuya Mashiko of the Biological Institute, Kanazawa University, 3-VIII-1948, from a brackish-water lake, Ryujin-ike on Hegurajima, Ishikawa Prefecture. The species was accompanied by another brackish-water copepod, *Paracyclopsina nana* Smirnov. According to Mashiko (1950), the chlorinity of the water of the lake was 5.730 parts per thousand.

*Halicyclops japonicus* is allied to *Halicyclops thermophilus* Kiefer, which was described by Kiefer (1929, 1936) from a salt spring in Koeripan, Java, and which has also been reported by Lindberg (1952), from a limestone cave in Aven Vatonsifitsy, Madagascar. *H. japonicus* is distinguished from *thermophilus* by the more slender furcal rami, by the usually armed proximal inner seta of endopodite 3 of leg 4 and by the more distal location of the lateral seta on the furcal rami.

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