

On Japanese freshwater Cyclopidae with
descriptions of two new species and
one new subspecies.

BY

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With Pl. II.

In my study of Japanese freshwater copepoda, I have thus far met with 8 species of the Cyclopidae, of which I propose to give notes in this paper. The greater part of my material was collected in several parts of Hokkaidō, principally in the ponds and ditches in and about Sapporo, in Lake Shikotsu, and in Lake Ōnuma; the remaining part was obtained in Lake Biwa (Prov. Ōmi), in Lake Kawaguchi (Prov. Suruga), in several small ponds in Prov. Musashi, and in some other localities. The specimens were thrown into formalin of about 4% strength at the time of capture and after 2-20 days were transferred into 70% alcohol.

I wish here to express my sincere thanks to Professor T. Fujita for the many help extended to me during the work.

Genus *Cyclops* Müller.

1. *Cyclops serrulatus* Fischer.

Pl. II., figs. 1-4,

Cyclops serrulatus Fischer 1851; Brady 1876; Schmeil 1891.

This almost cosmopolitan species seems to be one of the most common representative of the genus, being to be found in all seasons of the year. It can not be confounded with any other species on account of the characteristic shape of its egg-sacs. The

specimens collected near Kyōto have the three terminal joints of first antennæ provided each with an inconspicuous "Rudermembran" on the inner border. The crenulation on the rami of furca is subject to much variation, as it appears according to localities.

The habitats in Japan known to me at present are: Kyōto and Saitama in Hondō, and Sapporo in Hokkaidō.

2. *Cyclops strenuus* Fischer.

Pl. II, figs. 5—7,

Cyclops strenuus Fischer 1851.

Cyclops clausii Lubbock 1863.

This is another common species of the genus in Japan. It occurs in abundance in the muddy bottom of marshes and also in large lakes. In Lake Shikotsu (Hokkaidō) it appears in early spring and forms the main part of its plankton fauna in that season. It may be worth mentioning that specimens collected in shallow water are brown in colour, while those from open lakes of clear water present a deep red hue, as is known to be the case with *Diaptomas denticornis*.

In Hokkaidō, reproduction occurs in winter under ice, the nauplii coming forth under the same circumstance. The nauplii are seen most profusely in the months of June and July. In a laboratory aquarium with water temperature varying from 19° to 23° C., I have observed individuals laden with egg-sacs for the first time on January 31st (in 1910); and it was on the 5th of the following month that the larvae hatched out from the eggs.

The species has been recorded in Russia, England, Germany, Holland, and Hungary.

3. *Cyclops magnoctavus* Cragin.

Pl. II, figs. 8—12,

Cyclops magnoctavus Cragin 1883.

This species occurs in early spring in the neighbourhood of Sapporo. It is the smallest species so far known in Japan, the female

measuring only about 0.85 mm. in length. The body is nearly colourless excepting the red eyes and the greenish intestine. The breeding season falls in June as shown by the females carrying egg-sacs of a dark-bluish colour. The seta with which the first joint of first antennæ is provided, is very long and conspicuous as shown in fig. 8. The seta of the fourth joint is not so prominent as represented in a figure given by Brady in his work.⁽¹⁾ Furthermore, I have not been able to detect the hairs which Brady observed at the base of fifth foot. The two egg-sacs, each containing 15—16 eggs, are so disposed that they come in contact on the dorsal surface of abdomen.

My specimens were obtained in Lake Biwa, in Lake Kawaguchi, and in Hokkaidō.

4. *Cyclops leuckartii* G. O. Sars.

Pl. II, figs. 13—15.

Cyclops leuckartii, G. O. Sars 1883.

Cyclops Scourfeldi, G. S. Brady 1891.

The body is very slender, the breadth decreasing from head posteriorly to the end of thorax. The female is 1.35 mm. long. The formula of first antennæ is similar to that of *Cyclops strenuus*, being composed of 17 joints, of which the terminal two are much longer than any other and are provided each with a "Rudermembran" along the inner margin. The "Rudermembran" of terminal joint is not only serrated on margin but is also deeply notched in the middle (Fig. 15). The second joint of first maxilliped presents minute crenulation on the posterior margin. The receptaculum seminis is T-shaped.

For the first specimens of this interesting species I am indebted to

(1) G. S. Brady.—A revision of the British species of freshwater Cyclopidae and Calanidae. P. 20. London, 1891.

my friend Mr. T. Sato, by whom they were collected in Lake Kawaguchi (Province Suruga) in August 1910. Later, I have discovered this species also near Sapporo. Specimens from this latter locality differ from those from Lake Kawaguchi in being a little larger in size, besides being slightly different in the structure of the "Rudermembran." The variations are however to be looked upon as local.

5. *Cyclops signatus* Koch.

Pl. II, figs. 16—19.

Cyclops signatus, Koch 1841; Brady 1878.

Cyclops tenuicornis, Brady 1876.

The female, 1.7 mm. long, carries egg-sacs in spring, indicating the breeding season. The blue colouration of the cephalothorax is due to pigments scattered all over that part; the eyes are red as in other species. The three terminal joints of first antennæ are provided with "Rudermembran" on the inner margin. The receptaculum seminis is orange-coloured and is of a mushroom-like shape. The furcal rami are very short and densely haired on the inner margin.

The recorded habitats of this species are: northern and southern Europe, Scandinavia, Germany, Holland, France, England, and North America. It occurs frequently in the vicinity of Sapporo, but never in any great abundance.

6. *Cyclops flexipes*, n. sp.

Pl. II, figs. 20—23.

Body broad, widest in front, rather abruptly narrowed backwards. Female 1.40 mm. and male 1.25 mm. in length. First antennæ not slender, and almost reaching the posterior border of first body segment, when turned backwards; 12-jointed; 8th, 9th and 12th joints nearly equal in length and longest; 2nd, 3rd and 6th shorter, but nearly equal in length among themselves; the remaining 6 joints subequal and of a medium length. The anterior 4 pairs of

swimming feet with their 3-jointed branches, the terminal joint of which is provided with appendages in the form of spines and setae, the number of these appendages being as follows:

	1st pair of swim. feet.	2nd pair of swim. feet.	3rd pair of swim. feet.	4th pair of swim. feet.
Exopod	6	7	7	7
Endopod	6	6	6	5

Fifth foot peculiar: small, 2-jointed, the larger distal joint articulating with the inner aspect of the proximal joint instead of with the distal end of same; the appendages represented by 3 setae; the longest seta on the outer edge of distal joint pinnate; the shortest seta on the inner edge of same lanceolate; and the 3rd seta of medium length situated on the outer produced edge of the distal end of proximal joint. First abdominal segment by far longer than the three following taken together. Furcal rami about 6 times as long as broad, only slightly divergent, without hair on their inner margin. Each furcal ramus with 4 apical setae: the outermost the shortest; the innermost a little longer than the outermost; the outer of the middle two much longer than the innermost; and the inner of same the longest of all, being longer than the entire length of abdomen. Fifth setae very short; lateral seta still shorter and situated a little below the level of the distal fourth of furca.

The form, to which the present species seems to be nearest, is *C. strenuus*; but the two species differ very considerably in the following respects. In the first place, the first antenna in the new species is decidedly shorter than in *C. strenuus* in relation to the fact that it is made up of 12-joints instead of 17. Secondly, the furca in the present species is but slightly divergent and quite smooth on their inner margin, whereas in *C. strenuus* they are strongly divergent and thickly beset with hair. Thirdly, the fifth foot of the new species is peculiar in that the distal of its two component joints is long and slender, obviously differing in this respect from *C. strenuus*, in which

the same joint is thick and short with the distal end obliquely cut off. Further, the articulating point of the distal joint with the proximal is shifted very much farther inwards than in *C. strenuus*, causing in consequence the remarkable bending of the foot, which character I have availed of in naming the species. Finally, all the three setae, with which the fifth foot is provided, are very much longer than in *C. strenuus*; the inner seta of the distal joint being straightly directed, while the corresponding seta in *C. strenuus* is inwardly directed making an obtuse angle with the axis of the joint.

I have collected this new species in the vicinity of Sapporo in May, 1911. Reproduction occurs in spring. Each egg-sac contains about 25 eggs.

7. *Cyclops soli* n. sp.

Pl. II, figs. 24—26.

Body obtusely rounded in front, brown in colour, the female measuring 0.9 mm. in length. First antennae unusually thick and short, about $\frac{1}{2}$ as long as first body segment, composed of 8 short segments, the first and fourth segments being the longest and all the rest shorter. Mouth appendages small. The anterior 4 pairs of swimming feet with their branches 3-jointed. Fifth foot very small, 1-jointed, and with two appendages at the extremity. The posterolateral border of last thoracic segment fringed with a row of spines (fig. 25). The posterior margin of third and fourth abdominal segments slightly serrated. Furcal rami long and cylindrical, parallel with and widely separated from each other, each bearing a transverse row of several spines at the beginning of the distal fourth of its length. Of the 4 apical setae the outer and inner are the shortest and nearly equal in length; the inner of the remaining two is the longest and about as long as the entire length of abdomen, while the outer is about $\frac{1}{2}$ as long as the inner.

The present species is very closely allied to *C. fimbriatus*, but

differs from it in many points, among which the following two seem to be the most noteworthy. In the first place, this species is characterized by the presence of only 2 spines on the fifth foot (fig. 25), while *C. fimbriatus* should possess 3 of them as is obvious from the figure given by Brady in his work⁽¹⁾ (fig. 25, pl. 23). In the next place, the present species is in constant possession of a transverse row of spines on furcal ramus, which seems to be absent in Brady's species, since this author neither mentions nor figures anything answering to it.

The species is apparently an inhabitant of the muddy bottom of lakes and marshes. My specimens were captured in the vicinity of Sapporo, and it is of interest in fishcultural respect that the animals are often found in the stomach of the carp. The breeding season is not yet exactly known. I have found each egg-sac to contain about 12 eggs.

8. *Cyclops phaleratus japonicus* n. subsp.

Pl. II, figs. 27—29.

Body appears to be rather short on account of the wide abdomen. It gradually narrows backwards, just as in *Canthocamptus*. The first antenna is short, not exceeding the first body segment in length. Body brown in colour, eyes red, the second thoracic segment practically colourless. All the 4 pairs of swimming feet are rather short; the 1-jointed fifth foot is likewise very short. On the hind edge of abdominal segment there is on each side a strong spine about equal to that segment in length. Mouth appendages small and closely put together. Each ramus of furca is short and bears three apical setae, of which the innermost is the longest, the outermost the shortest, and the middle about half as long as the former. Both the innermost and middle setae are not haired, but

(1) Brady, G. S., A monograph of the free and semi-parasitic Copepoda of the British Island, vol. I, p. 116 (London).

are furnished on their outer margin with a row of peculiar tubercular bodies. Each ramus of furca is provided with a row of rod-like processes, which row embraces the furca obliquely from the outside at the end of the proximal third of its length (fig. 29). The rods are longest in the middle of the row and become shorter by degrees toward its both ends. Of this peculiar structure nothing is given in Brady's description (*l. c.*) of the type species, but it constitutes a very characteristic feature of the form which is here made into a new subspecies.

This cyclops is found in the vicinity of Sapporo, but seems to be very rare.

Explanation of Pl. II.

Figs. 1—4, *Cyclops serrulatus* Fischer.

Fig.	1.	Left branch of furca.	398 ×.
„	2.	Fifth foot.	764 ×.
„	3.	First antenna.	232 ×.
„	4.	Receptaculum seminis.	337 ×.

Figs. 5—7, *Cyclops strenuus* Fischer.

„	5.	Dorsal view of female.	55 ×.
„	6.	Fifth foot.	244 ×.
„	7.	Receptaculum seminis.	150 ×.

Figs. 8—12, *Cyclops magnoclavus* Cragin.

„	8.	First antenna.	334 ×.
„	9.	Fifth foot.	626 ×.
„	10.	Maxilla.	401 ×.
„	11.	Labrum.	401 ×.
„	12.	Second maxilliped.	496 ×.

Figs. 13—15, *Cyclops leuckarti* G. O. Sars.

„	13.	Dorsal view of female.	55 ×.
„	14.	Fifth foot.	334 ×.
„	15.	Three distal joints of first antenna.	337 ×.

Figs. 16—19, *Cyclops signatus* Koch.

„	16.	Furca.	
„	17.	Three distal joints of first antenna.	337 ×.
„	18.	Fifth foot.	250 ×.
„	19.	Receptaculum seminis.	110 ×.

Figs. 20—23, *Cyclops flexipes* n. sp.

„	20.	Dorsal view of female.	85 ×.
„	21.	Fifth foot.	334 ×.
„	22.	Right branch of furca.	334 ×.
„	23.	First antenna.	244 ×.

Figs. 24—26, *Cyclops soli* n. sp.

Fig. 24.	Dorsal view of female.	110×.
„ 25.	Fifth foot.	398×.
„ 26.	First antenna.	337×.
Figs. 27—29, <i>Cyclops phaleratus japonicus</i> n. subsp.		
„ 27.	Dorsal view of female.	85×.
„ 28.	Fifth foot.	496×.
„ 29.	Distal part of furca.	244×.