

Brief Notes on the Life Cycle and Geographical Distribution of *Allocreadium gotoi* (Digenea: Allocreadiidae) in Nagano, Japan

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Abstract: Sporocysts, mother and daughter rediae, and cercariae of *Allocreadium gotoi* (Hasegawa and Ozaki, 1926) Shimazu, 1988 (Digenea: Allocreadiidae) are briefly described from *Pisidium nikkoense* Mori (Bivalvia: Pisidiidae) collected in a small river at Midori, Iiyama, Nagano Prefecture, central Japan. New localities of this species in Nagano Prefecture are added.

Key words: *Allocreadium gotoi*, Digenea, life cycle, rediae, cercariae, *Pisidium nikkoense*, new localities, Nagano.

Hasegawa and Ozaki (1926) described a new genus and species of digenean, *Macrolecithus gotoi*, on the basis of the adults found in the intestine of *Misgurnus anguillicaudatus* (Cantor) (Osteichthyes: Cobitidae) from Japan. Shimazu (1988) transferred this species to the genus *Allocreadium* Looss, 1900, as *A. gotoi* (Hasegawa and Ozaki, 1926); and re-described the species on the basis of the museum and his own specimens obtained from *M. anguillicaudatus*, "moroko" [=? *Gnathopogon caerulescens* (Sauvage)] (Cyprinidae), and *Chaenogobius annularis* Gill (the middle reaches type) (now *Gymnogobius opperiens* Stevenson) (Gobiidae) at several places in Japan.

The life cycle of the species has not been known. I studied the life cycle in a small river in Nagano Prefecture, central Japan. This paper briefly describes sporocysts, mother and daughter rediae, and cercariae of the species obtained during this study and refers to new localities of the species in Nagano Prefecture.

Materials and Methods

A total of 139 clams of *Pisidium nikkoense* Mori [= *P. (P.) cinereum nikkoense* Mori]

(Bivalvia: Pisidiidae) were collected in a small river at Midori, Iiyama, Nagano Prefecture, central Japan, on 3 and 23 November 1992 and 9 December 1994. They were crashed for cercariae and metacercariae of digeneans. Dozens of amphipods, isopods, and aquatic insect larvae of several species (not identified to species) were collected in the river and examined for metacercariae of digeneans.

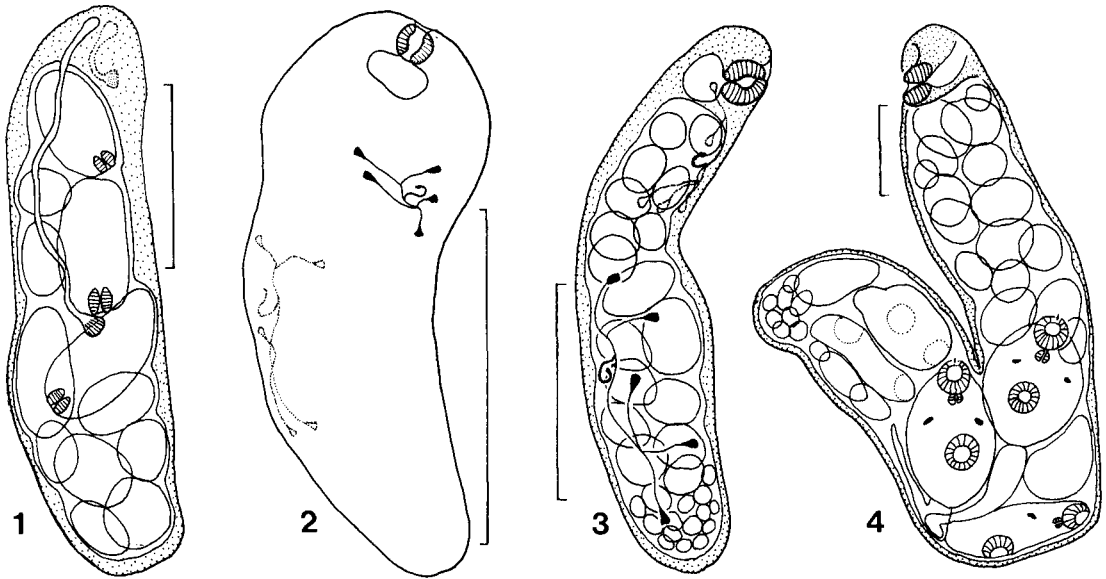
Sporocysts, rediae, and cercariae obtained from the crashed hosts were slightly flattened, fixed in 70% ethanol, stained with alum carmine, and mounted in Canada balsam. Cercariae which had spontaneously emerged out of hosts were fixed in hot 10% formalin. Some sporocysts, rediae, and cercariae were observed alive for the study of the excretory system.

Drawings were made with the aid of a drawing tube, some with supplements with free-hand details from living material. Measurements are given in micrometers. Representatives of the specimens studied have been deposited in the National Science Museum, Tokyo (NSMT) (NSMT-P1 5215).

Results

Of the 139 clams of *P. nikkoense* crashed, 9 were infected with sporocysts, mother and daughter rediae, and cercariae of a digenean species, each with a few. The exact site of

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Figs. 1-4. Sporocyst and rediae of *Allocreadium gotoi* found in *Pisidium nikkoense*. 1: Sporocyst, living. 2: Small mother rediae, living. 3: Young daughter rediae, living. 4: Mature daughter rediae, whole-mounted, anterior tip of body folded up. Scale bars=200 μ m.

infection of the hosts with the parasites was not determined. None of the clams, amphipods, isopods, and aquatic insect larvae examined harbored any metacercariae of *A. gotoi*.

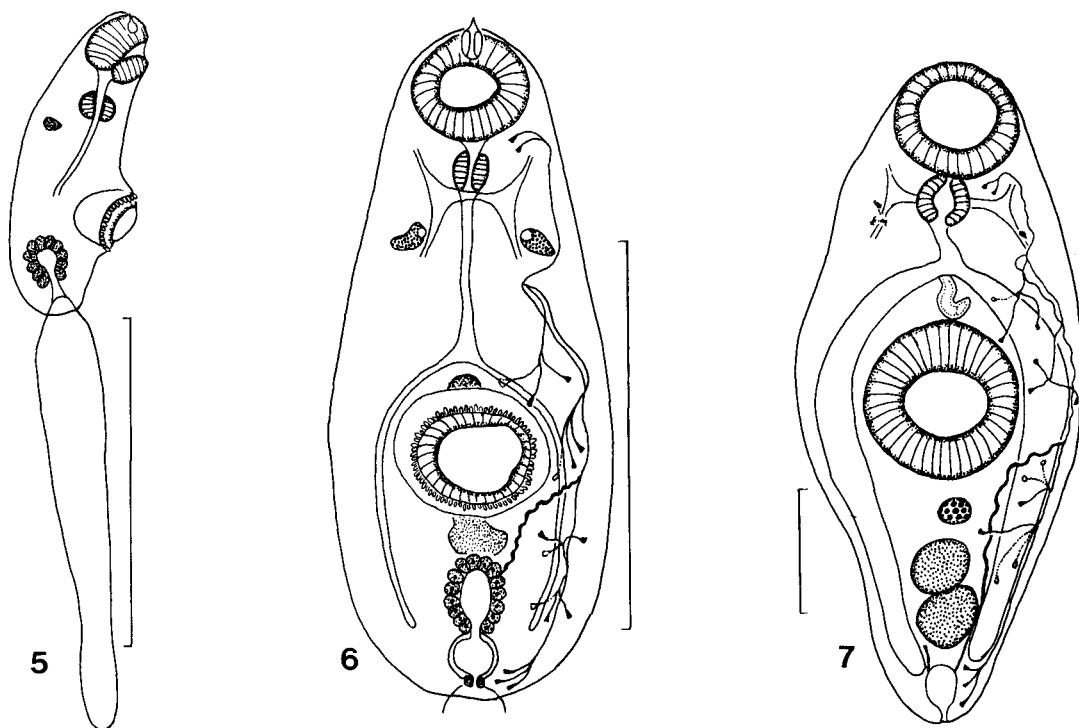
The morphology and measurements of the sporocysts, mother and daughter rediae, and cercariae were as follows.

Sporocysts (Fig. 1). Three whole-mounts measured. Body sausage-shaped, 409-535 long by 117-159 wide, containing many developing mother rediae in body cavity. Flame cells 2, bearing a large fun-shaped flame (37 wide by 29 long), located at different levels of body; excretory canals opening side by side at near one end of body.

Mother rediae (Fig. 2). Small mother rediae, soon after having emerged out of sporocysts, possessing a pharynx, a small saccular intestine, and excretory organs located at different levels on right and left sides of body; flame-cell formula [(2) + (3)] = 10. Young mother rediae similar in morphology to young daughter rediae (Fig. 3), but containing many developing daughter rediae with excretory organs as described above.

Daughter rediae (Figs. 3 and 4). Six whole-mounts measured. Body elongate, 624-1170 long by 136-273 wide, containing many developing cercariae in body cavity. Pharynx 22-40 long by 24-46 wide. Intestine saccular, small, slightly larger than pharynx. Excretory organs located at different levels on right and left sides of body; flame-cell formula [(2) + (3)] = 10.

Cercariae (Figs. 5 and 6). Four hot formalin-fixed cercariae measured. Of ophthalmoxiphidiocercous type. Body elongate-oval, unarmed, 194-220 long by 86-102 wide; numerous small protuberances arranged in a circle on periphery of body around ventral sucker. Tail slender, 240-250 long by 50-52 wide, without finfold. Transverse nerve commissure just posterior to pharynx. Eyespots 2, large, 8-12 by 6-8, located at level slightly posterior to transverse nerve commissure. Penetration glands not worked out. Oral sucker globular, subterminal, 40-46 long by 40-52 wide. Stylet elliptical, 8 long by 6-8 wide, with a sharp-pointed straight spine measuring 2-3 long on its anterior tip. Prepharynx short, 8-10 long. Pharynx elliptical, 16-20 long by 20-22 wide. Esophagus long,



Figs. 5-7. *Allocreadium gotoi*. 5: Cercaria obtained from *Pisidium nikkoense*, hot formalin-fixed, lateral view. 6: Body of cercaria, living, excretory system on right side of body omitted, ventral view. 7: Small immature worm found in *Misgurnus anguillicaudatus*, living, excretory system on right side of body omitted, ventral view. Scale bars = 200 μ m.

bifurcating anterior to ventral sucker; intestinal ceca extending to near posterior end of body. Ventral sucker globular, slightly posterior to mid-level of body, 40-46 in diameter. Genital primordia elongate, median, dorsal to ventral sucker. Excretory bladder saccular, epithelial, just posterior to genital primordia, leading posteriorly into a thick-walled short canal; caudal excretory canal not seen; primary excretory pore not worked out. Flame cells present in ventral and dorsal planes of body; flame-cell formula $2 [(2+3+3) + (3+3+3)] = 34$.

Discussion

Immature and mature worms of *A. gotoi* were obtained from the intestine of some fish of *M. anguillicaudatus* collected in the river on 12 July 1987, 3 November 1989, 5 August 1990, and

13 August 1999 (NSMT-PI 5216-5219, my unpublished data, 1987-1999). No allocreadiid species besides *A. gotoi* were found in either fishes or amphibians, all caught in the river (my unpublished data, 1987-1999). Allocreadiid digeneans produce ophthalmoxiphidiocercous cercariae in daughter rediae in pisidiid bivalves (Yamaguti, 1971). The present cercaria was of the ophthalmoxiphidiocercous type. It had the flame-cell formula of $2 [(2+3+3) + (3+3+3)] = 34$. Small ones of the immature worms found in *M. anguillicaudatus* had the same flame-cell formula as described above (Fig. 7, my unpublished data, 1987). Consequently, the present cercaria is identified as *A. gotoi* although there is not any experimental evidence for this. A natural second intermediate host of *A. gotoi* is not yet known anywhere. The present cercaria is the first to be reported from

pisidiid bivalves in Japan.

Allocreadium gotoi was found in *M. anguillicaudatus* during my surveys of digeneans in freshwater fishes at many places in Nagano Prefecture from 1976 to 2000, as follows.

- 1) Lake Kizaki in Oomachi (Shimazu, 1988).
- 2) A small stream at Okada, Matsumoto, on 3 August 1987 (NSMT-P1 5222, unpublished).
- 3) The small river at Midori, Iiyama (this paper).
- 4) Lake Suwa at Suwa on 5 October 1991 (NSMT-P1 5221, unpublished).
- 5) The Furukawa River in Toyoda on 17 June 2000 (NSMT-P1 5220, unpublished).

Acknowledgments

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References

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