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New Data on the Hosts and Attachment Sites of the Fish Leech *Taimenobdella amurensis* (Hirudinida, Piscicolidae)

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Abstract. New information on the hosts and attachment sites of *Taimenobdella amurensis* (Epshtein, 1964) is presented based on various surveys conducted in the Chitose River and its tributary, Mamachi River, central Hokkaido, Japan. Chum salmon *Oncorhynchus keta* from the Chitose River and brown trout *Salmo trutta* from the Mamachi River were infested by *T. amurensis*: these two fishes are new hosts. Leeches were found on the skin and fins of the fishes although the species was previously known only from the gills. Underwater observations made in the Chitose River showed that leeches (probably *T. amurensis*) were attached to the body surface of eight fish species (*O. keta*, *O. masou masou*, *S. trutta*, *Salvelinus leucomaenis leucomaenis*, *Gasterosteus aculeatus aculeatus*, *Pungitius pungitius*, *Cottus nozawae*, and *Gymnogobius urotaenia*).

Key words: *Taimenobdella amurensis*, Piscicolidae, fish leech, parasite, new host, *Oncorhynchus keta*, *Salmo trutta*.

Introduction

Taimenobdella amurensis (Epshtein, 1964) is a poorly known piscicolid leech found in Far Eastern Asia. The species was originally described as *Piscicola amurensis* by Epshtein (1964) based on two specimens from the gills of taimen *Hucho taimen* (Pallas) in the Khivanda River, lower reaches of the Amur River, Russia. It was later placed in a new genus *Taimenobdella* (Epshtein, 1969) and is listed as one of the piscicolid leeches found in Russian fresh waters (Lukin, 1976; Epshtein, 1987). Recently, based on newly collected material from the Naibetsu River, Hokkaido, northern Japan (Fig. 1), Furiness *et al*. (2007) redescribed *T. amurensis*, including its external morphology, digestive system, reproductive system, and coelomic system. The host fish, however, from which the leeches were taken, was reported "Salmonidae, genus and species unknown" or "an unidentified salmonid fish." These authors also stated that attachment site was "unknown."

Even before Furiness *et al*.'s paper was published in 2007, the staff of the Chitose Salmon Aquarium (CSA) at Hanazono in Chitose, central Hokkaido, had noticed the presence of leeches on fishes in the Chitose River (Fig. 1). As early as in September 1994, for example, they found leeches on adult chum salmon *Oncorhynchus keta* (Walbaum). These leeches have not been identified to species to date. The Chitose River is one of the main streams of the Ishikari River system and is joined at its upper reaches by the Naibetsu River (Fig. 1), in which the specimens of *T. amurensis* reported by Furiness *et al*. (2007) were sampled. Since 2001, we have conducted various surveys to study the biology of fish leeches in the Chitose River and its tributary, Mamachi River (Fig. 1). The results obtained are presented herein.

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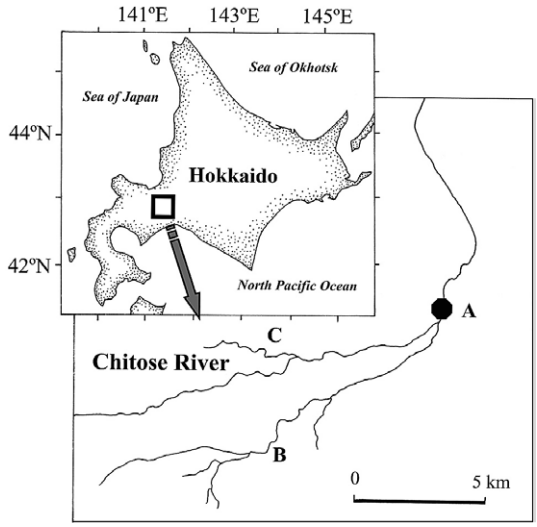

Fig. 1. A map of the Chitose River, central Hokkaido, Japan, showing the sampling localities of fishes examined for *Taimenobdella amurensis*. A. Hanazono, B. Mamachi River, C. Naibetsu River.

Materials and Methods

Based on their own experience, the CSA staff know that, every fall, leeches are parasitic on the skin of adult chum salmon *Oncorhynchus keta* swimming in the Chitose River near CSA at Hanazono (Fig. 1), which is located about 70 km upstream from the mouth of the Ishikari River. The staff are also acquainted with the fact that some leeches often drop off from chum salmon while the fish are temporarily kept (usually for 15–20 min.) in a canvas tank before transported from the Chitose River to the aquarium. The salmon are mature fish that return there from the North Pacific Ocean for spawning and are caught every fall at Hanazono using a fish wheel.

In the present study, leeches were collected on October 19, 21 and 28, 2006 from the bottom of the canvas tank in which adult chum salmon were held. Some of these leeches were fixed at CSA in 10% formalin after relaxation in 5% ethanol and then preserved in 5% formalin, while others were transported alive to the laboratory of Hiroshima University (HU), where they were relaxed in 5% ethanol and fixed in 5% formalin. On November 11, 2006, 60 adult chum salmon kept in the canvas tank were examined to determine the infestation level of leeches. In addition, some leeches were collected from the tank on October 18, 2008 and were brought alive to the laboratory of HU to observe the coloration and pigmentation. The leeches were examined, photographed, and measured for total length (including the suckers).

In order to elucidate the host range of fish leeches in the Chitose River system, freshwater fishes were collected in the Mamachi River (Fig. 1) using an electric shocker on November 6, 2006. These fishes were examined for leeches immediately after capture and then released into the river. The leech found was brought alive to CSA, where it was fixed in 10% formalin. It was later sent to the laboratory of HU, where it was preserved in 5% formalin and measured for total length.

In the underwater observation room of CSA, we sometimes observed the behavior of various fishes swimming in the Chitose River through acrylic viewing-windows (7 windows: 1 m high × 2 m wide each) from 2001 to 2008. When we found leech-infested fishes, we recorded the fish name and the attachment sites of the leeches. Sampling of those infested fishes was impossible but photographs or videos were taken.

Voucher specimens of *Taimenobdella amurensis* are deposited in the annelid (An) collection at the National Museum of Nature and Science, Tokyo, Japan (NSMT-An 392 from *Oncorhynchus keta* and NSMT-An 393 from *Salmo trutta* Linnaeus). The English and scientific names of fishes follow Froese & Pauly (2008).

Results

The leech specimens collected are all identified as *Taimenobdella amurensis* (Fig. 2). The body is slightly flattened dorsoventrally. The trachelosome is nearly elongate and is not distinctly separated from the urosome that slightly widened posteriorly. Color is pale brown in formalin, but in live or recently fixed specimens, three dark-colored transverse bands exist

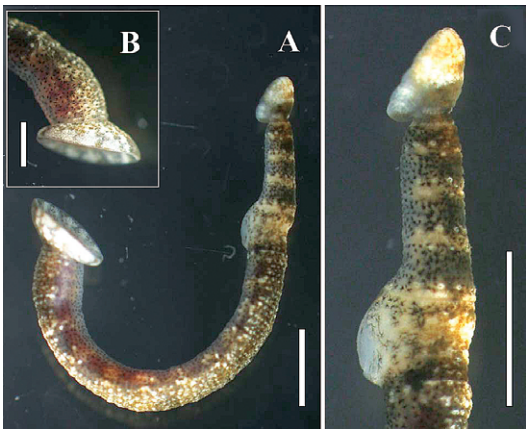

Fig. 2. *Taimenobdella amurensis* (a live specimen) from chum salmon from the Chitose River on October 18, 2008. A. Whole body, lateral view, B. Posterior portion of body, lateral view, C. Anterior portion of body, dorsolateral view. Scale bars: 2 mm in A and C, 1 mm in B.

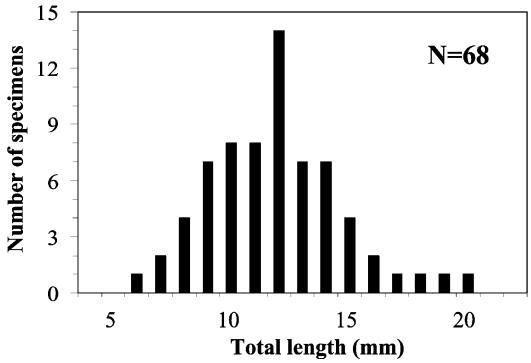

Fig. 3. Size frequency distribution of the specimens of *Taimenobdella amurensis* from adult chum salmon in the Chitose River in October 2006.

on the surface of the trachelosome and mottled dark brown pigmentation on the surface of the urosome. Pigmented and unpigmented regions alternate near the margin of the caudal sucker. Two pairs of eyes are present on the oral sucker. Ocelli are found on the caudal sucker and urosomal segments. Both suckers are well developed and eccentrically attached: the oral sucker is deeply cupped and smaller than the caudal sucker. The clitellum is usually swollen in the region of the male gonopore (in fixed specimens). Twelve pairs of pulsatile vesicles are present. Total length of the specimens (*N*=68) sampled in October 2006 ranges from 6.8 to 20.0 (mean 12.1) mm, showing a unimodal distribution (Fig. 3).

We sampled the leeches three times in October 2006 but could not obtain any data on prevalence and intensity of leech infestation because the leeches dropped off from the chum salmon kept in the canvas tank. However, on November 11, 2006, 60 adult chum salmon (53.5–75.0 cm in fork length [FL]) were examined, and 2 (3.3%) were infested each by a single leech. These leeches were attached to the dorsolateral caudal peduncle near the adipose fin and the dorsolateral skin posterior to the dorsal fin, respectively.

Four fish species were collected in the Mamachi River: brown trout *Salmo trutta* (*N*=7, *ca* 10–20 cm FL), cherry salmon (juveniles) *Oncorhynchus masou masou* (Brevoort) (*N*=5, *ca* 10–15 cm FL), whitespotted charr (juveniles) *Salvelinus leucomaenis leucomaenis* (Pallas) (*N*=2, *ca* 8–10 cm FL), and hanakajika *Cottus nozawae* Snyder (*N*=2, *ca* 10 cm FL). Of these fishes, a brown trout was infested by a single leech (total length=14.5 mm). Attachment site was the skin just anterior to the dorsal fin.

Through the viewing-windows of the underwater observation room at the Chitose Salmon Aquarium, we found leech-infested fishes 16 times from 2001 to 2008 (Table 1). Infestation was observed on eight species [chum salmon, cherry salmon, brown trout, whitespotted charr, three-spined stickleback *Gasterosteus aculeatus aculeatus* Linnaeus, ninespine stickleback *Pungitius pungitius* (Linnaeus), hanakajika, ukigori *Gymnogobius urotaenia* (Hilgendorf)], which belong to four families (Salmonidae, Gasterosteidae, Cottidae, Gobiidae) in four orders (Salmoniformes, Gasterosteiformes, Scorpaeniformes, Perciformes). Three cases of the observed leech infestation are shown in Fig. 4. The leeches found were blackish in color and were attached to the skin, fins, and outer surface of the operculum of the fishes. Through the photographs, the leeches were estimated to be about 10–15 mm long. They occurred from September to May but were not found during the summer months (June to August).

Table 1. Leech infestation of freshwater fishes in the Chitose River found through the viewing-windows of the underwater observation room at the Chitose Salmon Aquarium in 2001–2008.

No.	Date	Fish (No. of fish infested)	Total length of fish	Total no. of leeches found	Attachment sites (No. of leeches per site)
1	May 2001	*Oncorhynchus keta* (juvenile, *N*=1)	*ca* 5 cm	1	ventral skin (1)
2	Sep. 28, 2003	*Gymnogobius urotaenia* (*N*=1)	*ca* 10 cm	3	ventral fin (2), ventral skin near lower jaw (1)
3	Dec. 19, 2003	*Gasterosteus a. aculeatus* (*N*=1)	*ca* 5 cm	2	caudal fin (1), lateral skin near ventral fin (1)
4	Oct. 14, 2004	*Gymnogobius urotaenia* (*N*=1)	*ca* 10 cm	4	pectoral fin (2), caudal fin (2)
5	Oct. 15, 2004	*Cottus nozawae* (*N*=1)	*ca* 10 cm	1	caudal fin (1)
6	Nov. 22, 2006	*Gasterosteus a. aculeatus* (*N*=1)	NR*	NR	NR
7	Dec. 8, 2006	*Oncorhynchus m. masou* (juvenile, *N*=1)	*ca* 20 cm	1	ventral skin near anus (1, Fig. 4a)
8	Dec. 14, 2008	*Oncorhynchus keta* (adults, *N*=5)	*ca* 60–80 cm	5 (1 for each)	mid-body skin below lateral line (2), ventral skin at ventral fin base (1), ventral skin between pectoral and ventral fins (1), anal fin (1)
9	Dec. 14, 2006	*Salmo trutta* (*N*=1)	*ca* 30 cm	4	outer operculum (1), pectoral fin (1), ventral fin (1), caudal fin (1)
10	Dec. 21, 2006	*Gasterosteus a. aculeatus* (*N*=1)	NR	NR	NR
11	Jan. 12, 2007	*Salmo trutta* (*N*=1)	*ca* 30 cm	3	pectoral fin (1), ventral fin (1), caudal fin (1)
12	Jan. 28, 2007	*Oncorhynchus keta* (adult, *N*=1)	*ca* 70 cm	5	dorsal fin (3, Fig. 4b), caudal fin (2)
13	Feb. 6, 2007	*Salvelinus l. leucomaenis* (adult, *N*=1)	NR	2	dorsal head skin (1), skin near mouth (1)
14	Mar. 1, 2007	*Pungitius pungitius* (*N*=1)	*ca* 4 cm	1	caudal fin (1)
15	Jan. 12, 2007	*Oncorhynchus m. masou* (juvenile, *N*=1)	*ca* 10 cm	2	dorsal fin (2)
16	Apr. 1, 2008	*Oncorhynchus keta* (juvenile, *N*=1)	*ca* 4 cm	1	dorsal skin (1, Fig. 4c)

*Not recorded.

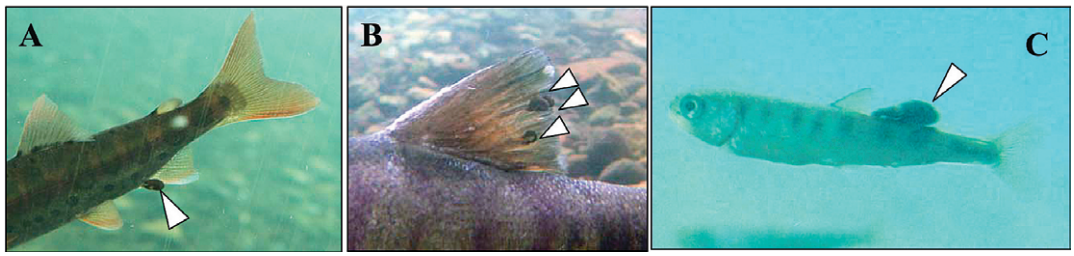

Fig. 4. Photographs of the leech-infested fishes observed in the Chitose River. A. Juvenile cherry salmon (*ca* 20 cm TL) infested by a leech (arrowhead), B. Adult chum salmon (*ca* 70 cm TL) infested by five leeches, three of which (arrowheads) were found on the dorsal fin, C. Juvenile chum salmon (*ca* 4 cm TL) infested by a leech (arrowhead).

Discussion

The previously known hosts of *Taimenobdella amurensis* are only taimen *Hucho taimen* (Epshtein, 1964) and an unidentified salmonid (Furiness *et al*., 2007). Two species of salmonids, chum salmon *Oncorhynchus keta* and brown trout *Salmo trutta*, from which we collected *T. amurensis* in this study, are new hosts for this leech.

Our knowledge of the piscicolid leeches in Hokkaido is quite limited. *Taimenobdella amurensis* is the only one species of leech from freshwater fishes in this island (Furiness *et al*., 2007; Nagasawa *et al*., 2008*b*; this paper). Another piscicolid leech *Limnotrachelobdella okae* (Moore, 1924) was reported from Japanese huchen *Hucho perryi* (Brevoort) caught at the mouth of a river in Hokkaido (Furiness *et al*., 2007) but this leech is currently regarded to be a coastal marine or brackish-water species (Nagasawa *et al*., 2008*a*). Approximately 70 species of freshwater fishes are known to occur in Hokkaido (Maekawa & Goto, 1982) and it is necessary to study the fauna of piscicolid leeches from these fishes.

Although the attachment site of *T. amurensis* was earlier reported to be the gills (Epshtein, 1964, 1987), our specimens of the species were found attached to the skin and fins of chum salmon and brown trout. Nonetheless, at this moment, it is impossible to say that the skin and fins are more preferred sites than the gills because we did not examine the gill region of the fishes for leech infestation.

Various leech-infested freshwater fishes were found in the Chitose River (Table 1, Fig. 4). Since the leeches were not sampled from the infested fishes, we cannot easily regard them as *T. amurensis*. However, it is likely that the leeches observed are identical with this species because their size and coloration were very similar to those in *T. amurensis*. If this is the case, *T. amurensis* shows a low degree of host specificity.

Cystobranchus salmositicus (Meyer, 1946) (=*Piscicola salmositica*), a leech infesting Pacific salmon (*Oncorhynchus* spp.) along the Pacific coast of North America, has been well studied for the biology, ecology, and control method (*e. g*. Earp & Schwab, 1954; Becker & Katz, 1965; Bower *et al*., 1985; Bower & Thompson, 1987; Burreson *et al*., 2005). One of the interesting biological aspects of this leech is a close relation of its life cycle to the host's spawning run to rivers from the sea (Becker & Katz, 1965): when salmon hosts begin to return to rivers in September, leeches hatch and then feed on spawning salmon, and before being dead in December, they deposit cocoons, which do not hatch until the following September. In our study at the Chitose River, no infestation of fishes by leeches (possibly *T. amurensis*) was observed during the summer months (June to August) (Table 1) and the total length distribution of the specimens of *T. amurensis* collected in October 2006 was unimodal (Fig. 3). These facts imply that the species has a similar cycle to *C. salmositicus*. In other words, it may spend the summer months as cocoons and hatch at the almost same time in early fall.

The biology of *T. amurensis* is poorly understood. We need to study its ecology and life history, including the geographical distribution, host range, cocoon deposition, hatching, feeding, growth, reproduction, and impact on the host fish.

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