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Limnotrachelobdella okae (Hirudinida, Piscicolidae) from Cherry Salmon *Oncorhynchus masou masou* in Neritic Deep Waters of the Western North Pacific Ocean

Kazuya Nagasawa[1]*, Yasuhiro Ueno[2], Yoshio Ishito[3] and Takeo Yamauchi[4]
[1] Graduate School of Biosphere Science, Hiroshima University,
1-4-4 Kagamiyama, Higashi-Hiroshima, Hiroshima, 739-8528 Japan
[2] Hachinohe Branch, Tohoku National Fisheries Research Institute
Fisheries Research Agency, Hachinohe, Aomori, 031-0841 Japan
[3] Minato-takadai 4-5-19, Hachinohe, Aomori, 031-0823 Japan
[4] Toyama Institute of Health, Imizu, 939-0363 Japan

Abstract. The piscicolid leech *Limnotrachelobdella okae* (Moore, 1924) was found attached to the skin near the pectoral fin of a cherry salmon *Oncorhynchus masou masou* caught at a depth of 180–200 m in the western North Pacific Ocean off the east coast of northern Honshu, Japan. This is the first record of *L. okae* from the ocean-swimming salmonid in neritic deep waters although it is not known where the fish was infected. *L. okae* has been generally believed to be a parasite of both marine and freshwater fishes, but it is concluded, based on the present results and the literature review on the host and distributional records, that the leech is a coastal marine or brackish-water species: the infection occurs only in salt waters, and anadromous fishes, such as salmonids, carry the leech to fresh waters, where it can survive for a certain period.

Key words: Parasite, leech, *Limnotrachelobdella okae*, cherry salmon, *Oncorhynchus masou masou*.

Introduction

The piscicolid leech *Limnotrachelobdella okae* (Moore, 1924) is distributed in Japan, China, and Russia (Oka, 1910, 1927; Epshtein, 1962, 1964, 1987; Lukin, 1976; Yang, 1987; Bauer *et al.*, 2002; Utevsky & Trontelj, 2004; Utevsky *et al.*, 2007; Furiness *et al.*, 2007). In Japan, this species was first reported as *Trachelobdella sinensis* Blanchard, 1896 by Oka (1910) from several localities. Moore (1924), however, treated it as a new species, *Trachelobdella okae*, which is currently placed in the genus *Limnotrachelobdella* (Sawyer, 1968). The species is known to occur on various marine and freshwater fishes (Oka & Nagao, 1965) and to infect marine fishes cultured in Japan (Mizuno, 1989, 2006; Izumikawa, 1999). In China, it is a parasite of coastal marine fishes (Yang, 1987), while in Far Eastern Russia it is found on teleosts in large rivers as well as in the sea (Lukin, 1976; Epshtein, 1987). The present paper reports on the occurrence of *L. okae* on a cherry salmon *Oncorhynchus masou masou* (Brevoort, 1856) caught in neritic deep waters of the western North Pacific Ocean and discusses whether this leech is a marine and/or freshwater species. Literary information on the geographical records of the leech is also reviewed.

*Corresponding author: ornatus@hiroshima-u.ac.jp

Materials and Methods

A freshly-caught cherry salmon, *Oncorhynchus* *masou masou*, was brought to the junior author (YU) for parasite identification in March 1999 because the fish was found to be infected by a large parasite. The fish was captured by a bottom trawler at 180–200 m depth in the western North Pacific Ocean off the east coast of Rokkasho in Aomori Prefecture, northern Honshu, Japan during the night to early morning of March 27–28, 1999. In the laboratory, the fish was measured and photographed. The parasite was examined alive for its coloration and then fixed in 70% ethanol after it was slowly relaxed in weak alcohol prior to fixation. This fixed specimen was examined using a stereoscopic microscope. A drawing was made with the aid of an Olympus microscope drawing attachment. The leech specimen is deposited in the annelid (An) collection at the National Science Museum, Tokyo, Japan (NSMT-An 377). The English and scientific names of fishes follow Froese & Pauly (2007).

Results

The parasite was identified as *Limnotrachelobdella okae*. It was attached to the skin near the base of the left pectoral fin of a cherry salmon (total length=517 mm). There was a large feeding scar at the site of attachment, where a large hemorrhage was found (Fig. 1A). When the fish was examined in the laboratory on the morning of March 28, the leech was still attached to the host by the caudal sucker, and it slowly crept on the tray even after it was removed from the host (Fig. 1B).

The leech is big: total length, including suckers, is 117 mm and maximum body width is 22 mm near midpoint of the urosome. Color is greenish black (in fresh) or pale brown (in 70% ethanol). The body is distinctly divided into the subcylindrical trachelosome and the much larger, dorsoventrally flattened urosome (Fig. 2). The trachelosome eccentrically attaches to the oral sucker. The posterior urosome tapers toward the caudal sucker. The body surface is wrinkled and lacks tubercles and papillae. Eleven pairs of pulsatile vesicles on the lateral margins of the urosome are big and well recognized. The twelfth pair of pulsatile vesicles is much smaller, and the presence of a thirteenth pair is uncertain. Eyes are not visible. The oral sucker, with a diameter of 5 mm, is small and deeply cupped, facing laterally. The mouth is centrally open in the oral sucker. The caudal sucker is larger (8 mm in diameter) than the oral sucker, deeply cupped, very muscular, and faces laterally. The bursa is everted from the male gonopore on the ventral side of the clitellum.

Fig. 1. *Limnotrachelobdella okae* and its host, cherry salmon *Oncorhynchus masou masou*. A. A host (top) with a scar (arrow) caused by *L. okae* (bottom). B. A live, slightly contracted *L. okae* removed from the host, ventral view. Scale bars: 10 cm in A; 20 mm in B.

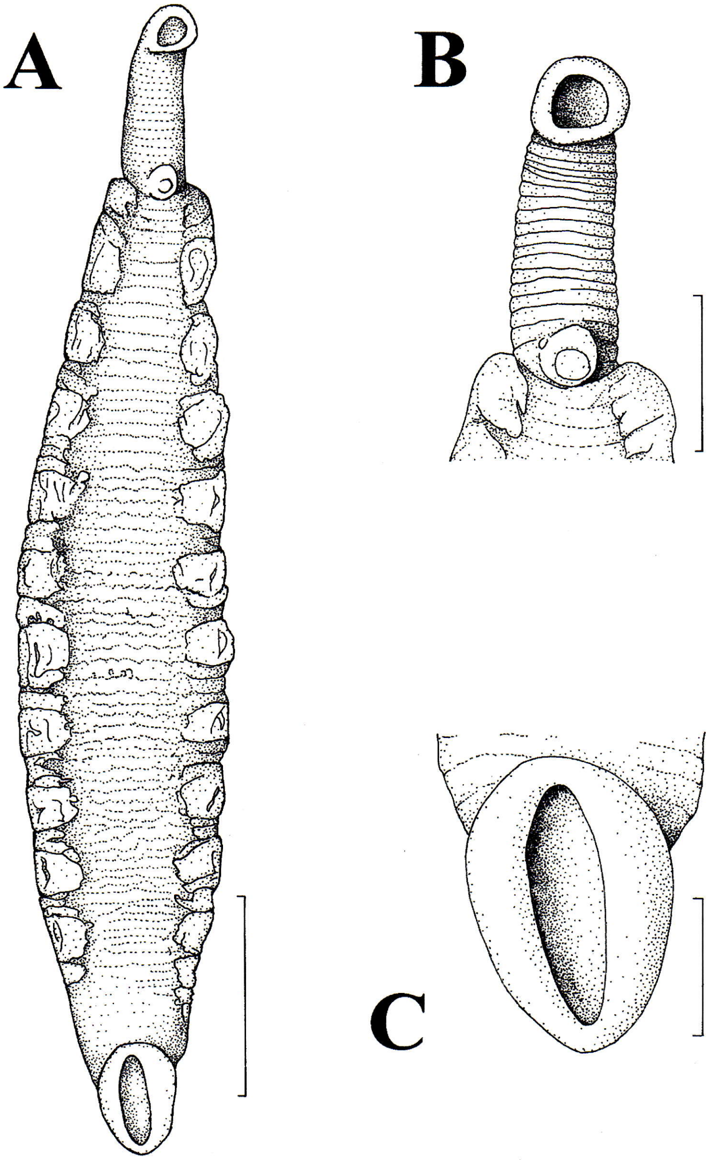

Fig. 2. *Limnotrachelobdella okae*. A. Whole body, ventral view. B. Oral sucker and trachelosome, ventral view. C. Caudal sucker, ventral view. Scale bars: 20 mm in A; 10 mm in B; 5 mm in C.

Discussion

The external morphology of the leech specimen from a cherry salmon *O. masou masou* is identical with that of *Limnotrachelobdella okae*. There were no substantial differences in morphology between specimens described by Oka (1927), Oka & Nagao (1965) and the present authors. The species is one of the biggest piscicolid leeches: the present specimen was as big as 117 mm in total length, and a similar size (up to 110 mm) was previously reported by Oka (1910).

The specimen of *L. okae* in the present study was found on a cherry salmon captured at 180–200 m

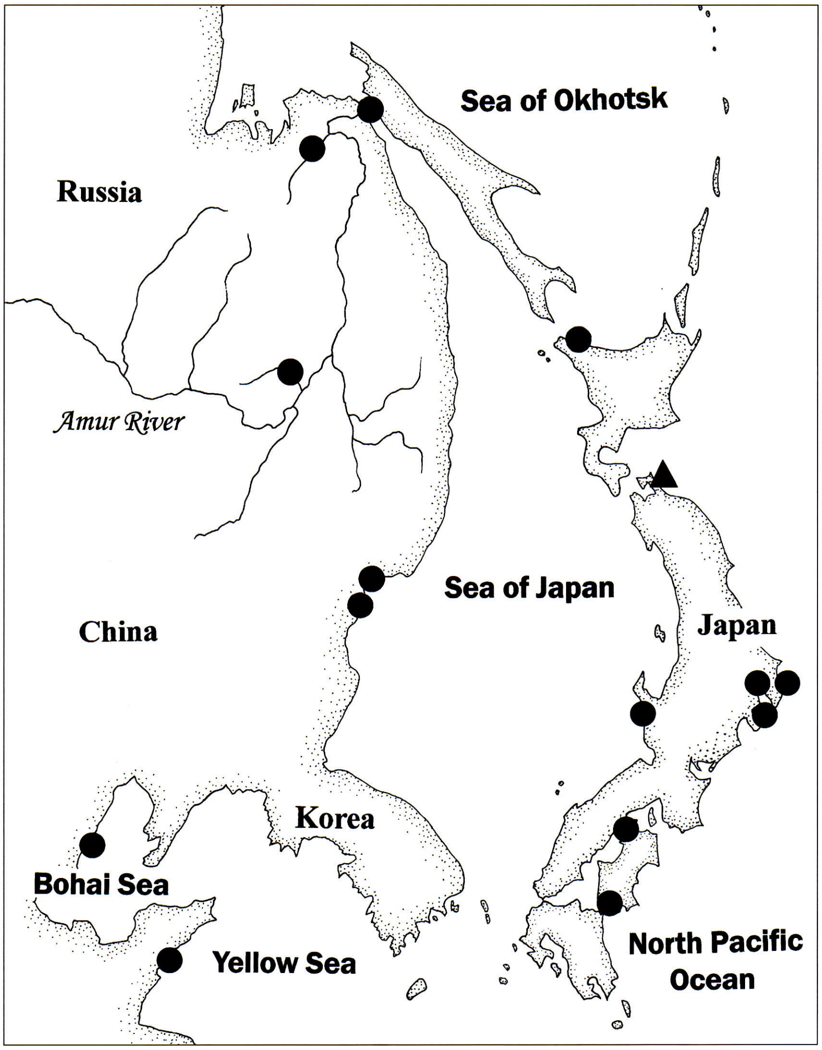

Fig. 3. Distributional records of *Limnotrachelobdella okae* in Far East Asia. Closed circles and triangle represent localities reported by the previous authors (Oka, 1910; Epshtein, 1964, 1987, Yang, 1987; Mizuno, 1989, 2006; Izumikawa, 1999; Utevsky & Trontelj, 2004; Utevsky *et al*., 2007; Furiness *et al*., 2007) and in this paper, respectively. The Khivanda River (lower reaches of the Amur River) reported by Epshtein (1964, 1987) is not shown here because its location was not determined.

depth on the continental shelf in the western North Pacific Ocean. This finding constitutes the first record of the leech from an ocean-swimming salmonid although it is unknown where the fish had been infected. The cherry salmon is a new host in Japan, but in Far Eastern Russia there was a record of the leech from the same fish (Epshtein, 1987).

It is a question whether *L. okae* is a marine and/or freshwater species. In Japan, Oka (1910) reported the occurrence of the species (as *Trachelobdella sinensis*) in various coastal marine waters, but later, Oka (1927) stated that *T. okae* is not strictly a marine species. Oka & Nagao (1965) also mentioned that *L. okae* is able to live in fresh, brackish, and marine waters, infecting both freshwater fishes in rivers and marine fishes in coastal waters. Thus, it has been widely believed in Japan that *L. okae* occurs in marine and freshwater environments. Although Lukin (1976) stated that the species inhabits the sea, Epshtein (1987: 354, footnote 87) commented that in Far Eastern Russia it is found in fresh waters (*e. g.* Amur River) as well as in brackish waters. As far as we know, however, there have been no published records of *L. okae* from primary freshwater fishes with the life cycles being entirely completed in fresh waters. We think that anadromous fishes, such as salmonids, play an important role in carrying the leech from marine to fresh waters. The following six anadromous species (four in the Salmonidae; one in the Acipenseridae; one in the Cyprinidae) have been recorded as hosts for the leech: Japanese huchen *Hucho perryi* (Brevoort, 1856) and cherry salmon *O. masou masou* in Japan (Furiness *et al.*, 2007; this paper), kaluga *Huso dauricus* (Georgi, 1775), chum salmon *O. keta* (Walbaum, 1792), pink salmon *O. gorbuscha* (Walbaum, 1792), masu salmon, and Pacific redfin *Tribolodon brandtii* (Dybowski, 1872)* in Russia (Epshtein, 1962, 1964, 1987; Utevsky & Trontelj, 2004; Utevsky *et al.*, 2007). In addition to these anadromous species, *L. okae* also infects coastal marine fishes (*e. g.* Yang, 1989) but it has never been reported from offshore teleosts. The leech can survive experimentally in fresh water although it is uncertain for how long (Mizuno, 1989, 2006). Based on these observations, it can be said that the leech is not a pure freshwater species, nor a parasite of oceanic fishes, but a coastal marine or brackish-water species. Individuals of the species found in inland waters are thought to be those carried by anadromous fishes from coastal marine or brackish waters to fresh waters, where the leeches can survive for a certain period. Based on a molecular analysis of fish leeches, Utevsky & Trontelj (2004) found that *L. okae* and an undescribed, brackish-water species are separated from freshwater piscicolids.

The above conclusion is supported by a case of infection of Japanese huchen *H. perryi* with *L. okae*. Furiness *et al.* (2007) found the leech on this salmonid collected near the mouth of the Sarufutsu River, Hokkaido. Some fish of the salmonid population in this river are known to ascend it after staying in coastal waters of the Sea of Okhotsk (Edo *et al.*, 2005) and it is thus most probable that the fish host reported by Furiness *et al.* (2007) became infected with *L. okae* in the coastal sea. A marine nematode parasite, *Anisakis simplex* (Rudolphi, 1809) (Ascaridoidea: Anisakidae), which is a good biological indicator or evidence for the host's residence at sea, was also found from Japanese huchen collected in the Sarufutsu River (Nagasawa, unpublished).

It is apparent that *L. okae* has a wide distribution along the coast of the western North Pacific and its marginal seas (Sea of Okhotsk, Sea of Japan, Bohai Sea, Yellow Sea), ranging from warm, temperate to cold, subarctic waters (Fig. 3). In Japan, the species has been found in various localities in Honshu, Shikoku, and Hokkaido (Oka, 1910; Mizuno, 1989, 2006; Izumikawa, 1999; Furiness *et al.*, 2007; this study). In China, *L. okae* has been recorded from the coasts of the Bohai Sea and the Yellow Sea (Yang, 1987). The leech occurs along the coast of Primorsky Krai, Far Eastern Russia (Epshtein, 1987; Utevsky & Trontelj, 2004; Utevsky *et al.*, 2007). No record has been published in Korea to date. The localities in Honshu and Shikoku (Japan) are affected by a warm current, the Kuroshio, and its branch, the Tsushima Current, while the other localities in Hokkaido (Japan), Russia, and China are close to cold currents or water masses, such as the East Sakhalin Current (Sea of Okhotsk), the Liman Current (Sea of Japan), and the Yellow Sea Central Cold

*Epshtein (1962) collected *L. okae* from "rudd *Leuciscus dubowskyi*". This fish, however, is not found in any fish data bases (*e. g.* Froese & Pauly, 2007) and it can be regarded as an invalid species. As the infected fish was caught in Peter the Great Bay (as Petra Valika Bay), it is apparent that the fish is a euryhaline species, which is very rare among cyprinids. Since Pacific redfin *Tribolodon brandtii* is anadromous and occurs in the sea of Far East Russia, it is most likely that the host fish reported by Epshtein (1962) is *T. brandtii*.

Water (Yellow Sea). Based on its wide distribution in different seas, the leech may be highly tolerant of a wide range of water temperatures.

Studies on the pathology of fishes due to *L. okae* are insufficient. In the present study, a large feeding scar was found at the site of infection by the leech, where a large hemorrhage was observed (Fig. 1A). A similar pathological feature was reported by Mizuno (1989, 2006) in a case of infection with *L. okae* on Japanese amberjack *Seriola quinqueradiata* Temminck & Schlegel, 1845 cultured in Japan. This author has suggested that *L. okae* induces a secondary bacterial infection, but there is no study to confirm it. We need more information to evaluate the pathological impact of the leech on the fish.

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