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# *Salvelinema salmonicola* (  )

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The cystidicolid nematode *Salvelinema salmonicola* (Ishii, 1916) is a parasite of freshwater salmonids in the North Pacific rim region, including Japan, Far Eastern Russia, Alaska (USA) and northern British Columbia (Canada). This species was found in the swim bladder of river-resident amago salmon (*Oncorhynchus masou ishikawae* Jordan and McGregor)(Salmoniformes: Salmonidae) from the Tsutsuga River and its tributary, Inomata River, of the Ota River System in Hiroshima Prefecture, western Honshu, Japan. This is the first record of *S. salmonicola* from western Japan, extending its distribution from central to western Honshu in the country. *Oncorhynchus masou ishikawae* is a new host for *S. salmonicola*. The life cycle of *S. salmonicola* and the impact of the past and current construction on the fish definitive host, invertebrate (probably amphipod) intermediate host and parasite populations in the sampling locality are discussed.

amago salmon, new host record, new locality record, *Oncorhynchus masou ishikawae*, parasitic nematode, *Salvelinema salmonicola*

More than 90 species of the metazoan and protistan parasites have been reported from salmonid fishes in Japan (Nagasawa et al., 1987). The past records of the salmonid parasites are mainly from northern Japan, where salmonids are important fisheries resources and many parasitological studies have been conducted. But on the other hand, there is little information on the parasites of salmonids in western Japan. Only Moravec and Nagasawa (1985) studied the nematode parasites of freshwater salmonids that were collected widely in western Japan.

Some salmonids, including anadromous populations of chum salmon (*Oncorhychus keta*) and amago salmon (*Oncorhynchus masou ishikawae*) and river-resident or land-locked populations of amago salmon, Japanese charr (*Salivelnus leucomaenis pluvius*) and gogi charr (*S. leucomaenis imbrius*), are distributed in western Honshu, Japan. During a study on the parasite fauna of salmonids in this region, we collected the cystidicolid nematode *Salvelinema salmonicola* (Ishii, 1916) from river-resident amago salmon (*O. masou ishikawae*) in Hiroshima Prefecture. This collection constitutes a new host record and extends the distribution of the nematode from central to western Honshu, Japan.

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A total of 11 river-resident amago salmon (*Oncorhynchus masou ishikawae* Jordan and McGregor)(Salmoniformes: Salmonidae) were collected with rod and line in Tsutsuga River and its tributary, Inomata River, of the Ota River System at Kami-Tsutsuga (34 °32'N, 132 °13'E, Fig. 1) in Aki-Ota, Hiroshima Prefecture, Japan, on March 4, 2006. The fish were brought to the laboratory, where the fish were measured and examined for parasites. Two fish were first dissected in fresh, while the remaining nine fish were fixed in 10% formalin and later examined. Nematodes collected from the fresh fish were fixed in hot 70% ethanol, while those from the fixed fish were preserved in 70% ethanol. They were cleared with glycerine for microscopy examination. Voucher specimens have been deposited in the Department of Zoology of the National Science Museum, Tokyo (NSMT) in Japan (NSMT-As 3032). The scientific names of fishes follow those recommended by Nakabo (2002).

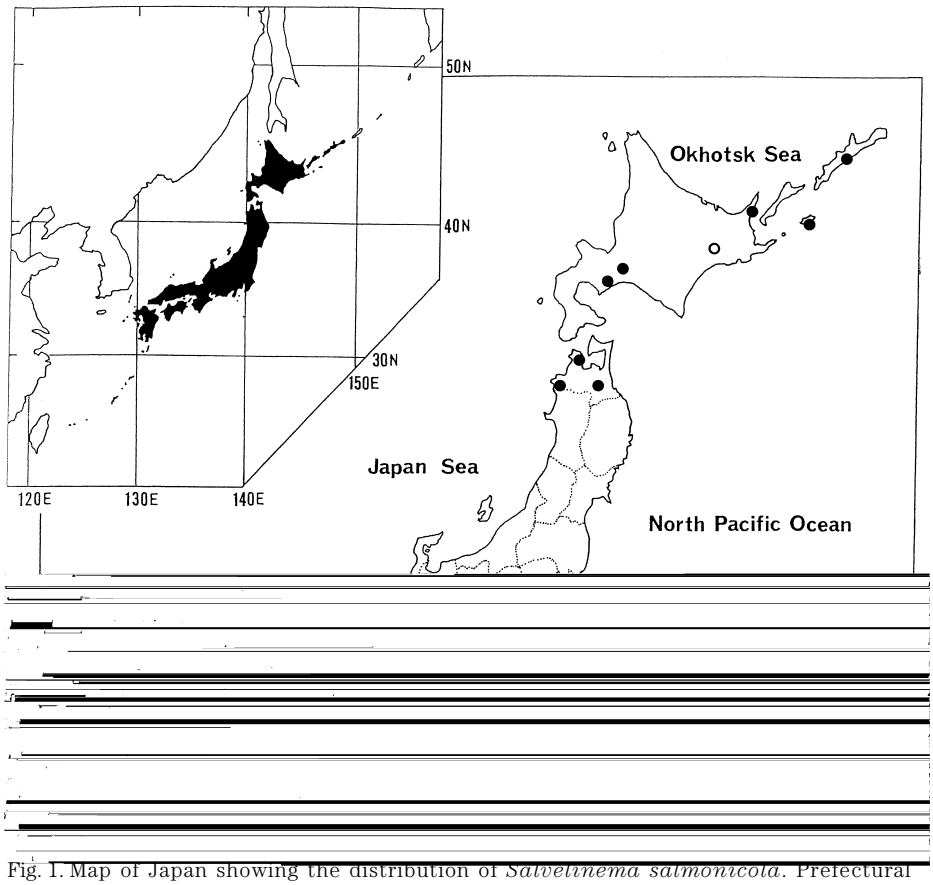


Fig. 1. Map of Japan showing the distribution of *Salvelinema salmonicola*. Prefectural boundaries are shown by dotted lines. ▲: present record from *Oncorhynchus masou ishikawae*, ●: past records from other salmonids, ○: past record from *Hypomesus nipponensis*.

All nematodes found in the swim bladder of amago salmon were identified as *Salvelinema salmonicola*. The morphology of nematodes of the present material fully corresponds to the redescription of this species as given by Moravec and Nagasawa (1999): we refrained from describing the species herein again because the redescripition by these authors was based on specimens from Japan. Eight (72.7%) of the 11 fish examined (98-215 [mean 143] mm in body length) were infected by 1-79 (mean 16.3) nematodes. There was a tendency that the number of nematodes found in a fish increased with increasing fish size: largest fish was most heavily infected. Nematodes of the present material comprised young and adult specimens: some gravid females contained mature larvated eggs with two thread-like filaments at each pole in the uterus.

*Salvelinema salmonicola* is a swim-bladder parasite of salmonids in the North Pacific rim region, including Japan, Far Eastern Russia, Alaska (USA) and northern British Columbia (Canada)(Moravec and Nagasawa, 1999). In Japan, this species was first reported as *Oxyuris* sp. (erroneously as "*Oxguris* sp.") from salmonids in Hokkaido (Koshida, 1905). It was later described as *Ancyracanthus salmonicola* from juvenile masu salmon (*Oncorhynchus masou masou*) at Chitose Hatchery in Hokkaido (Ishii, 1916), which was subsequently transferred to the genus *Cystidicola* (Fujita, 1927) and then to the genus *Salvelinema* (see Margolis, 1967). The species was also described from Japan and adjacent regions under different names: *Cystidicola iwana*, *C. chitosensis*, *Metabronema oncorhynchi*, *M. kosugii*, *M. amemasu*, *M. salvelini* (later as *M. ishii*)(Fujita, 1928, 1939, 1940, 1941) and "*Cystidicola farionis*" (Zhukov, 1960). Of these species, *C. chitosensis* and "*Cystidicola farionis*" were regarded as junior synonyms of *S. salmonicola* (Margolis, 1967). The remaining five species (*C. iwana*, *M. oncorhynchi*, *M. kosugii*, *M. amemasu* and *M. ishii*) were later transferred to the genus *Salvelinema* (Margolis, 1968) and then synonymised with *S. salmonicola* (Moravec and Nagasawa, 1999).

In Japan, *S. salmonicola* has been reported from Hokkaido (including Etorofu and Shikotan islands, southern Kurile Islands) and northern and central Honshu (Aomori, Ishikawa and Shiga prefectures)(e.g., Koshida, 1905; Ishii, 1916; Fujita, 1928, 1931, 1940; Okada, 1935; Yamaguti, 1935; Sakurai and Sakai, 1943; Zhukov, 1960; Fukui, 1960; Nagasawa et al., 1987; Moravec and Nagasawa, 1999). Therefore, the present collection represents the first record of *S. salmonicola* from western Japan, extending its distribution from central (Shiga Prefecture) to western Honshu (Hiroshima Prefecture) in the country (Fig. 1).

The known hosts of S. *salmonicola* are salmonids inhabiting fresh waters, including masu salmon (*Oncorhynchus masou masou*, type host), chum salmon (*O. keta*), coho salmon (*O. kisutch*), sockeye salmon (*O. nerka nerka*), rainbow trout (*O. mykiss*), white-spotted charr (*Salvelinus leucomaenis leucomaenis*), Japanese charr (*S. leucomaenis pluvius*) and Dolly Varden (*S. malma*, *S. malma krascheninnikovi*)(Margolis, 1968; Margolis and Arthur, 1979; Bauer, 1987; Nagasawa et al., 1987; Moravec and Nagasawa, 1999). The nematode was also found in an osmerid fish, wakasagi (*Hypomesus nipponensis*)(Sakurai and Sakai, 1943). The finding of *S. salmonicola* from amago salmon (*O. masou ishikawae*) constitutes a new host record. This salmonid is indigenous to central and western Japan.

Five species of the parasites have been reported from salmonids in Hiroshima Prefecture: two species of Myxozoa (*Myxobolus arcticus* and *M. neurobius*), one species of Trematoda (*Nanophyetus japonensis*) and two species of Nematoda (*Sterliadochona ephemeridarum* and *Rhabdochona oncorhynchi*)(Nagasawa et al., 1987). *Salvelinema salmonicola* is herein added as the sixth species to the parasite fauna of salmonids in Hiroshima Prefecture. The two nematode species are also known to occur in the sampling locality surveyed (Moravec and Nagasawa, 1985).

Amphipods are known to serve as obligate intermediate hosts for members of the genus *Salvelinema* (e.g., Margolis and Moravec, 1982). In Japan, an unidentified gammarid (as "*Gammarus* sp.")(Gammaridae) and *Sternomoera japonica* (as *"Paramoera japonica"*, see Kuribayashi et al., 1996 for taxonomy)(Pontogeneiidae) were reported to harbor larval nematodes of *S. salmonicola* in Hokkaido and Aomori, respectively (Koshida, 1905, 1910; Moravec and Nagasawa, 1986). Although the life cycle of *S. salmonicola* was not studied in the present study, a single amphipod (*Gammarus nipponensis*?) was found in the stomach of one of 11 amago salmon examined. It is thus highly probable that amphipods act as intermediate hosts for *S. salmonicola* in the sampling locality. We need further work to understand the life cycle of the nematode.

When the fish were sampled, a kind of construction was going on in the Tsutsuga River. Also, traces of the previous construction have remained at many sites: the river bank was covered with concrete, and the river bed was artificially flattened. River-resident amago salmon (definitive host) and amphipods (possible intermediate host) both require a very clean, non-polluted, nature-preserved environment as their habitats. Environmental destruction might have negatively affected the populations of both hosts and also that of *S. salmonicola* in the sampling locality studied.

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# マスウキブクロセンチュウ（新称）*Salvelinema salmonicola* の新宿主と新分布地

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**要　旨**　広島県西部を流れる太田川水系の筒賀川とその支流である猪股川においてアマゴ（*Oncorhynchus masou ishikawae* Jordan and McGregor）の鰾から線虫類の *Salvelinema salmonicola* (Ishii, 1916)を採集した。アマゴは本線虫の新宿主である。今回の採集によって，北海道から滋賀県の範囲にあった我が国での本種の分布域は広島県にまで拡大した。本記録により，広島県のサケ科魚類から記録された寄生虫は6種，太田川水系のサケ科魚類から得られた寄生虫は3種となる。採集地におけるヨコエビ類を中間宿主とする本種の生活環について考察するとともに，河川工事が終宿主や中間宿主，本種に与える影響について論議した。本種と *Salvelinema* 属の両者にマスウキブクロセンチュウ（鱒鰾線虫）の新標準和名を提唱する。

**キーワード：**アマゴ，新宿主，新分布地，寄生性線虫，*Salvelinema salmonicola*