

Infection status of pond smelts, *Hypomesus olidus*, and other freshwater fishes with trematode metacercariae in 6 large lakes

Shin-Hyeong CHO¹⁾, Woon-Mok SOHN²⁾, Sung-Shik SHIN³⁾, Hyeon-Je SONG⁴⁾, Taek-Gyun CHOI¹⁾,
Chang-Mi OH¹⁾, Yoon KONG⁵⁾ and Tong-Soo KIM^{1)*}

¹⁾Department of Malaria and Parasitic Diseases, National Institute of Health, Seoul 122-701,

²⁾Departments of Parasitology and Institute of Health Sciences, Gyeongsang National University College of Medicine, Jinju 660-751,

³⁾Department of Veterinary Parasitology, Chonnam National University College of Veterinary Medicine, Gwangju 500-757,

⁴⁾Department of Microbiology, Jeollanam-do Government Public Institute of Health & Environment, Gwangju, 502-810,

⁵⁾Department of Molecular Parasitology, School of Medicine, SungKyunKwan University, Suwon 440-746, Korea

Abstract: In order to determine the current infection status of pond smelts, *Hypomesus olidus*, and other freshwater fishes with trematode metacercariae, a total of 4,861 pond smelts and 18 other freshwater fishes, collected from the Soyang and Uiam Lakes in Gangwon-do, the Unam Lake in Jeollabuk-do, the Jangseong Lake in Jeollanam-do, the Uirim-ji (lake) in Chungcheongbuk-do, and the Andong Lake in Gyeongsangbuk-do, were individually digested with 1% pepsin-HCl and examined under a dissecting microscope. In all pond smelts caught from the 6 lakes, we were unable to detect any known human infectious trematode metacercariae in Korea. However, in other freshwater fishes, such as, *Squalidus japonicus coreanus* (Unam Lake), and *Zacco platypus* (Jangseong Lake) and *Opsariichthys uncirostris amurensis* (Jangseong Lake), metacercariae of human-infecting trematodes, i.e., *Clonorchis sinensis* and *Metagonimus* sp. were detected, respectively.

Key words: *Hypomesus olidus*, pond smelt, *Clonorchis sinensis*, *Metagonimus* sp., trematode metacercaria

A few surveys for human-infecting trematode metacercariae in freshwater fishes have been reported several times in Korea (Chun, 1962; Rhee et al., 1984; Kong and Choi, 1994; Sohn, 2002). The pond smelt (*Hypomesus olidus*), which is one of the fish most frequently consumed raw, particularly during the winter season functions, as a source of infection for several trematodes of humans, including *Clonorchis sinensis* (Nam and Sohn, 2000; Park et al., 2004) in Korea.

The numbers and localities of lakes investigated in previous studies, however, have been quite limited, and the rates of trematode metacercarial infection in fish have varied considerably. Therefore, a clear necessity exists for the large-scale determination of trematode metacercarial infections in pond smelts. In this study, we evaluated the infection status of pond smelts and other freshwater fishes caught in 6 lakes, including the Soyang Lake, a popular locale for ice-fishing festivals (Fig. 1).

A total of 4,861 pond smelts were collected between January 2003 and February 2005 from the Soyang and Uiam Lakes in Gangwon-do (3,920 and 56 fish, respec-

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*Corresponding author (e-mail: nihkim@nih.go.kr)

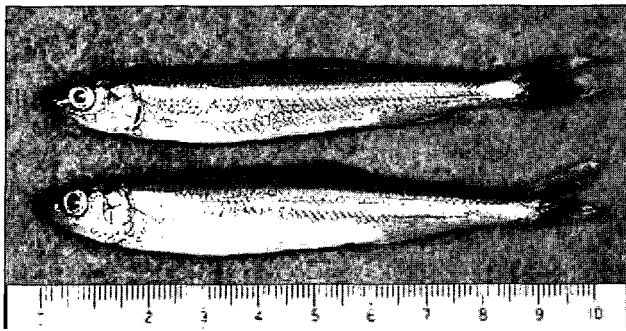


Fig. 1. Pond smelts, *Hypomesus olidus*, collected from Uirimji (Lake), Chungchongbuk-do.

tively), the Unam Lake in Jeollabuk-do (300), the Jangseong Lake in Jeollanam-do (200), the Uirimji Lake in Chungcheongbuk-do (185) and the Andong Lake in Gyeongsangbuk-do (200) (Fig. 2) (Table 1). In addition, 18 other freshwater fishes were collected. The fishes were transported to the laboratory at a temperature of 4°C. After species identification and length and weight measurement, the fishes were individually evaluated for the presence of metacercariae. The fishes were ground with a mortar and pestle, and digested with 1% pepsin-HCl at 37°C for 2 hr, after which the liquefied specimens were passed through 1 x 1 mm mesh sieves, washed in 0.85% saline, and examined under a stereomicroscope.

Among the 4,861 pond smelts collected from 6 lakes, we were unable to find any metacercariae of

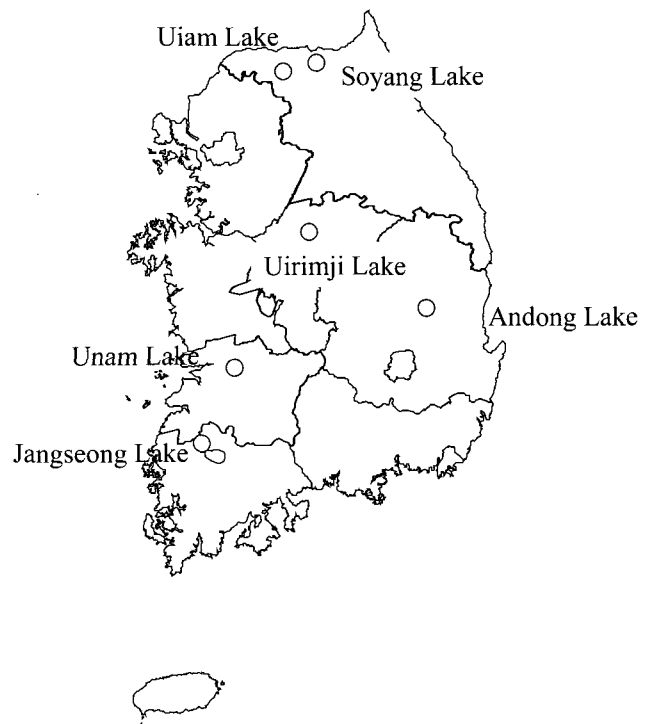


Fig. 2. Collection areas of pond smelts, *H. olidus*, and other freshwater fishes.

human-infectious trematodes (Table 2). A few metacercariae of *Diplostomum* sp. were detected in pond smelts caught from the Jangseong Lake. Contrarily, in other freshwater fishes, such as, *Squalidus japonicus coreanus* (Unam Lake), and *Zacco platypus* and *Opsariichthys uncirostris amurensis* (Jangseong Lake),

Table 1. Name and locations of lakes from which pond smelts, *Hypomesus olidus*, were collected

Name and location of lake	Date examined (d/m/y) ^{a)}	No. of fish examined	Length of fish (cm)	Weight of fish (g)
Soyang Lake, Gangwon-do	21/01/2003	420	5.2~3.9	1.3~1.0
	26/02/2003	717	5.4~4.2	1.3~1.1
	09/12/2003	223	6.6~3.8	1.4~0.9
	08/01/2004	520	6.4~4.3	1.4~1.0
	19/01/2004	1,040	6.2~4.5	1.3~1.0
	10/01/2005	1,000	3.5~5.9	1.2~0.9
Uiam Lake, Gangwon-do	22/02/2005	56	4.5~8.8	1.9~1.2
Unam, Jeollabuk-do	20/02/2004	300	5.2~8.0	1.8~1.3
Jangseong Lake, Jeollanam-do	20/03/2004	200	7.5~10.2	1.9~1.5
Andong Lake, Gyeongsangbuk-do	28/02/2004	200	5.3~6.9	1.5~1.1
Uirimji Lake, Chungchongbuk-do	20/02/2004	185	5.5~9.3	1.9~6.0
Total		4,861	6.9~4.7	1.5~1.1

^{a)} day/month/year.

metacercariae of human-infecting trematodes, i.e., *C. sinensis* and *Metagonimus* sp. were detected, respectively (Table 2).

The present results evidenced no presence of human-infecting trematode metacercariae in muscles of 4,861 pond smelts, collected from 6 lakes throughout Korea. This result is contrasting to previous studies which demonstrated that pond smelts caught in the Soyang Lake were infected with metacercariae of *C. sinensis* (Nam and Sohn, 2000; Park et al., 2004). Although seasonal variations in fishing sometimes affect the infection rate of fish with regard to *C. sinensis* metacercariae (Kang et al., 1985; Kim et al., 1979; Sohn, 2002), it does not appear to have influenced the results of this study, as the fish were collected between December and March, coinciding with the collection period adopted in previous reports.

The Soyang Lake, the basin of which covers parts of Inje-gun, Yanggu-gun and Hongcheon-gun of Gangwon-do, as well as Chuncheon-shi, is the largest lake in Korea by volume, with a storage capacity of $2,900 \times 10^6 \text{m}^3$ of water. Reaching 118 m at its deepest point, and containing relatively clean and cold water, this lake is well-known as one of the major breeding places for pond smelts. Located in the northeastern region of South Korea, the rate of *C. sinensis* infection

of people living in the surrounds of the basin of the lake is quite low, and the infection rate of fish caught in the lake, with regard specifically to *C. sinensis* metacercariae is also quite low (Korea Centers for Disease Control and Prevention and Korea Association of Health Promotion, 2004; Nam and Sohn, 2000).

Fish species of the genus *Hypomesus* prefer cold water, and are relatively tolerant to pollution, salinity, and temperature fluctuations (Sato, 1951). Two species of smelts, the pond smelt, *H. olidus*, and the Japanese smelt, *Hypomesus japonicus*, inhabit the seas around Korea (Chyung, 1977; Youn et al., 1999). The pond smelt is aqua-cultured for human consumption on a large scale in several lakes in Korea. Unlike the Japanese smelt, which lives in the northeastern area of the East Sea, pond smelts live in cold, clean freshwater.

Although the results of this study indicate that the infection rate of the fish species living in the 6 lakes may be lower than previously reported, as well as the fact that pond smelts become adults within a year, which makes it rather difficult for them to serve as a second intermediate host for *C. sinensis*, the presence of *C. sinensis* metacercariae in the muscle of pond smelts caught in Korea and Japan, as reported previously (Ide, 1935; Komiya, 1965; Nam and Sohn, 2000;

Table 2. Infection status of lake fishes with trematode metacercariae

Name of lake	Species of fish	No. of fish infected/ examined	Fluke species	No. of MC ^{a)} detected (Total No.)
Soyang Lake	<i>H. olidus</i>	0/3,920	ND ^{b)}	0
Uiam Lake	<i>H. olidus</i>	0/56	ND	0
Unam Lake	<i>Squalidus japonicus coreanus</i>	1/1	<i>Clonorchis sinensis</i>	19 (19)
Jangseong Lake	<i>H. olidus</i>	0/300	ND	0
	<i>H. olidus</i>	4/200	<i>Diplostomum</i> sp.	2-4 (12)
	<i>Hemiculter eigenmanni</i>	4/10	<i>Diplostomum</i> sp.	1-2 (5)
	<i>Opsariichthys uncirostris</i>	2/2	<i>Metorchis orientalis</i>	10-12 (22)
	<i>amurensis</i>	1/2	<i>Metagonimus</i> sp.	6 (6)
	<i>Zacco platypus</i>	5/5	<i>Metorchis orientalis</i>	2-7 (18)
		2/5	<i>Metagonimus</i> sp.	3-4 (7)
Andong Lake	<i>H. olidus</i>	0/200	ND	0
Uirimji Lake	<i>H. olidus</i>	0/185	ND	0

^{a)}Metacercariae.

^{b)}Not detected.

Park et al., 2004) should be enough to raise public awareness not to consume raw pond smelt meat at ice-fishing or pond-smelt festivals during the winter season. The presence of *C. sinensis* metacercariae in a short barbel gudgeon (*S. japonicus coreanus*), as well as of *Metagonimus* sp. and *Metorchis orientalis* metacercariae in fingerlings (*O. uncirostris amurensis*) and minnows (*Z. platypus*), further emphasize the importance of not consuming small-sized freshwater fish species, as these fish are morphologically indistinguishable.

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