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An epidemiological study of metagonimiasis along the upper reaches of the Namhan River

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Abstract: An epidemiological study of *Metagonimus* infection was undertaken along the upper reaches of the Namhan River, with special consideration on the species (type) of the worms collected from humans. Eggs of *Metagonimus* spp. were detected from 15 (9.7%) of 154 people examined in Umsong-gun, and from each infected person (5 cases) 6,015-24,060 worms (mean 13,233) were recovered after treatment with praziquantel (10 mg/kg). Eggs were also detected from 37 (48.1%) of 77 people in Yongwol-gun, from whom (27 cases) 1-4,965 worms (mean 1,215) were collected. The worm from Umsong-gun consisted of both *Metagonimus* Miyata type and *Metagonimus takahashii*, whereas those from Yongwol-gun consisted of only *Metagonimus* Miyata type. When the uterine eggs of the two kinds and *M. yokogawai* (obtained from people in Tamjin River basin) were morphologically compared, it was suggested that the egg size should be a good indicator for discrimination of the species or type. The source of human infection was proved to be fresh water fishes; 49 of 52 *Zacco platypus* examined, 6 of 8 *Hemibarbus longirostris*, 13 of 15 *Pseudogobio esocinus*, 4 of 6 *Odontobutis obscura interrupta*, and 17 of 18 *Carassius carassius* were found infected with *Metagonimus* metacercariae. From the results, it is concluded that the upper reaches of the Namhan River are endemic foci of *Metagonimus* Miyata type and *M. takahashii*.

Key words: *Metagonimus yokogawai*, *Metagonimus* Miyata type, *M. takahashii*, metagonimiasis, fish, Namhan River, taxonomy, epidemiology

INTRODUCTION

Metagonimiasis, one of the three major trematodiases of humans in Korea, can cause severe gastrointestinal troubles and easy fatigability in heavily infected patients. The most responsible species has been *Metagonimus yokogawai* Katsurada, 1912. It is distributed widely along the riverside areas where the sweetfish are available (Seo *et al.*, 1981; Chai and Lee, 1990).

However, to our and other investigators' experience (Kim, 1980; Kim *et al.*, 1987; Ahn and Ryang, 1988), adult *Metagonimus* specimens collected from human patients in areas where no sweetfish are produced frequently revealed significantly different morphology from *M. yokogawai*. They include

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Metagonimus Miyata type of Saito (1984) (Kim *et al.*, 1987) and *Metagonimus takahashii* Suzuki, 1930 (Ahn and Ryang, 1988). But as the validity of these two kinds of *Metagonimus*, especially the Miyata type, has been put to questions, further studies are required to clarify the taxonomy, biology, epidemiology, and other characteristics.

In the present study, we found that the upper reaches of the Namhan River are endemic foci of *Metagonimus* Miyata type and *M. takahashii*, and confirmed that the source of human infection was several kinds of fresh water fishes other than the sweetfish. Uterine eggs of two kinds of *Metagonimus*, and *M. yokogawai* from a known endemic area, were morphologically compared.

MATERIALS AND METHODS

1. Areas surveyed

Six localities at the upper reaches of the Namhan River (the southern branch of the Han River) were subjected for this epidemiological study (Fig. 1), during the period from February 1987 to February 1989; Hoingsong-gun Hoingsong-up (area code 1), Yongwol-gun Suju-myon (2) and Chuchon-myon (3), Tanyang-gun Taehung-myon (4), Chewon-gun Hansu-myon (5), and Umsong-gun Soi-myon (6). In the areas 3 and 6, both fecal examination of the inhabitants and fish examination for *Metagonimus* metacercariae were performed, and in the areas 1, 2, 4 and 5 only fish examination was undertaken.

2. Fecal examination of inhabitants for helminth eggs

The fecal specimens of 154 people in Umsong-gun and 77 in Yongwol-gun, both sex and all ages, were collected and examined for helminth eggs by cellophane thick smear and formalin-ether concentration techniques.

3. Worm collection from the infected inhabitants

Some of the *Metagonimus* egg positive cases were cooperative for the adult worm collection. They were treated with praziquantel (10 mg/kg single dose) and purged with magnesium sulfate (20-40 g in 2-4 divided doses). After an hour or two, three to four times watery stools were thoroughly collected, washed with several changes of tap water, and examined under stereomicroscopy for adult flukes. The specimens of *Metagonimus* were counted per each case. In order to observe the morphology of the worms, some of the worms (10-100 per each case) were flattened gently under cover slip pressure, fixed with 10% formalin, and observed under light microscopy. The fixed specimens were stained with Semichon's acetocarmine.

4. Comparison of the egg size

To compare the egg size of the two kinds of *Metagonimus* with that of *M. yokogawai*, the average length and width of intrauterine eggs, at least 10 eggs per each adult specimen (formalin-fixed), were measured, and plotted (Fig. 8). Total 121 *M. takahashii*, 90 *Metagonimus* Miyata type, and 122 *M. yokogawai* specimens were subjected for this egg measurement. The specimens of *M. yokogawai* were those previously obtained from inhabitants in Tamjin River basin (Chai *et al.*, 1985).

5. Examination of fish hosts for *Metagonimus* metacercariae

Several kinds of fish hosts, *i.e.*, *Zacco platypus*, *Hemibarbus longirostris*, *Pseudogobio esocinus*, *Odontobutis obscura interrupta*, *Carassius carassius*, and *Paracheilognathus rhombea*, were caught from areas 1-6 (Fig. 1), and examined for the presence of *Metagonimus* metacercariae. Peptic digestion technique was applied, and the isolated metacercariae from each fish were counted under stereomicroscopy.

RESULTS

1. *Metagonimus* egg positive rate of inhabitants

The total number of intestinal helminth egg positive cases was 35 (22.7%) among 154 people examined in Umsong-gun (Soi-myon) and 38 (49.4%) among 77 examined in Yongwol-gun (Chuchon-myon) (Table 1). *Metagonimus* spp. eggs were detected from 15 cases (9.7%) in Umsong-gun and 37 cases (48.

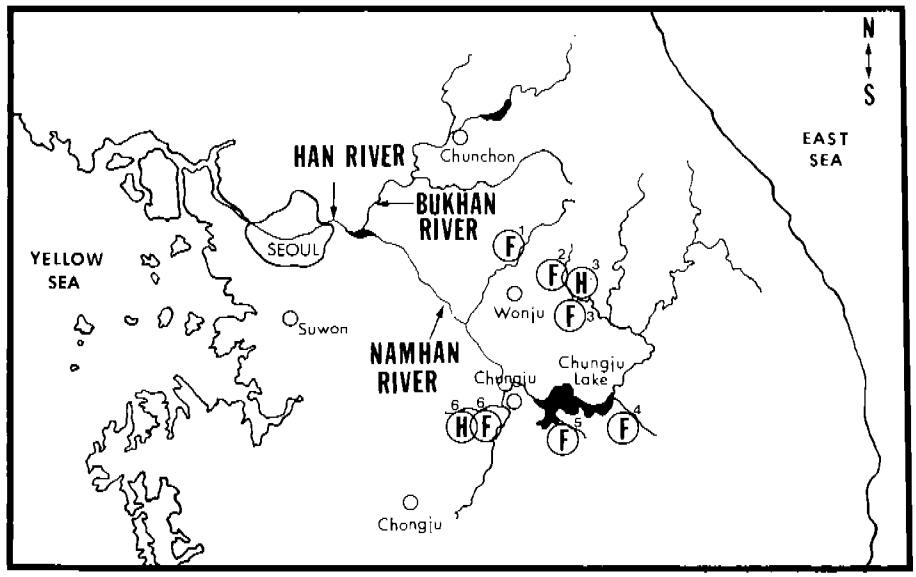


Fig. 1. Map showing the surveyed areas (area codes 1-6). 1. Hoingsong-gun (Hoingsong-up), 2. Yongwol-gun (Suju-myon), 3. Yongwol-gun (Chuchon-myon), 4. Tanyang-gun (Taehung-myon), 5. Chewon-gun (Hansu-myon), 6. Umsong-gun (Soi-myon). In the areas 3 and 6, both fecal examination of the inhabitants (H) and fish examination for *Metagonimus* metacercariae (F) were performed, and in the areas 1, 2, 4 and 5, only fish examination (F) was undertaken.

1%) in Yongwol-gun. Eggs of other kinds of helminths were also found from a few cases, but *Metagonimus* spp. appeared the most prevalent one (Table 1).

2. Worm burden of *Metagonimus* among the infected inhabitants

Five *Metagonimus* egg positive cases in Umsong-gun and 27 cases in Yongwol-gun were cooperative for successful adult worm collection after treatment with praziquantel and purgation. From Umsong-gun (5 cases), a total of 66,165 (individually 6,015-24,060; mean 13,233) adult specimens of *Metagonimus* were collected, and from Yongwol-gun (27 cases), a total of 32,805 (1-4,965; mean 1,215) specimens were collected. The worm burden per infected case was generally higher in Umsong-gun than in Yongwol-gun (Table 2).

Table 1. Helminth egg positive rate by fecal examination of the inhabitants of Umsong-gun and Yongwol-gun

Parasite	Umsong-gun[a] (Soi-myon)	Yongwol-gun[b] (Chuchon-myon)
No. examined	154	77
No. helminth egg posit. (%)	35 (22.7)	38 (49.4)
Ascaris lumbricoides (U)	2 (1.3)	0 (0.0)
Trichuris trichiura	9 (5.8)	0 (0.0)
Hookworm	1 (0.6)	0 (0.0)
Clonorchis sinensis	4 (2.6)	3 (3.9)
Metagonimus sp.	15 (9.7)	37 (48.1)
Echinostoma hortense	5 (3.2)	1 (1.3)
Taenia sp.	1 (0.6)	0 (0.0)
Hymenolepis nana	4 (2.6)	0 (0.0)

[a]area 6 in Fig. 1. [b]area 3 in Fig. 1

3. Species(type) of *Metagonimus* in the two areas

The formalin-fixed adult specimens of *Metagonimus* from the two areas were easily discriminated into two kinds (*Metagonimus* Miyata type and *M. takahashii*) under stereomicroscopy, based on the locations of the two testes and the distribution and extent of the vitellaria (Figs. 2, 3, 5 & 6). The worms from Umsong-gun consisted of both *Metagonimus* Miyata type and *M. takahashii*, whereas those from Yongwol-gun consisted only of *Metagonimus* Miyata type.

Metagonimus Miyata type of Saito (1984)
(Figs. 2-4)

Body broadly or a little elongated oval, flattened, tapering anteriorly, rounded posteriorly, 0.85-1.47 (av. 1.16) mm long and 0.35-0.81 (av. 0.58) mm wide (based on 10 specimens). Ventral sucker larger than oral sucker, deviated to right side of body. Prepharynx very short. Esophagus moderately long, bifurcating laterally to form intestinal ceca. Ceca terminating before the middle level of right testis. Testes two, lying obliquely, right one reaching to posterior end of body, left one a little separated from the right one. Uterine tubules occupying almost whole posterior field of body, overlapping left testis, crossing the intertesticular junction. Vitelline follicles in middle to lateral fields of posterior body, 7-8 groups on each side, but not extending beyond the middle portion of right testis, never reaching to posterior end of body. Uterine eggs many, elliptical, yellowish brown in color, a little larger than *M. yokogawai* and smaller than *M. takahashii*.

Table 2. Worm collection from the inhabitants after treatment with praziquantel

No. worms collected	No. cases	
	Umsong-gun	Yongwol-gun
less than 999	0	22
1,000-4,999	0	5[a]
5,000-9,999	3	0
10,000 & over	2[b]	0
Total	5	27

[a]heaviest worm burden; 4,965. [b]heaviest worm burden; 24,060

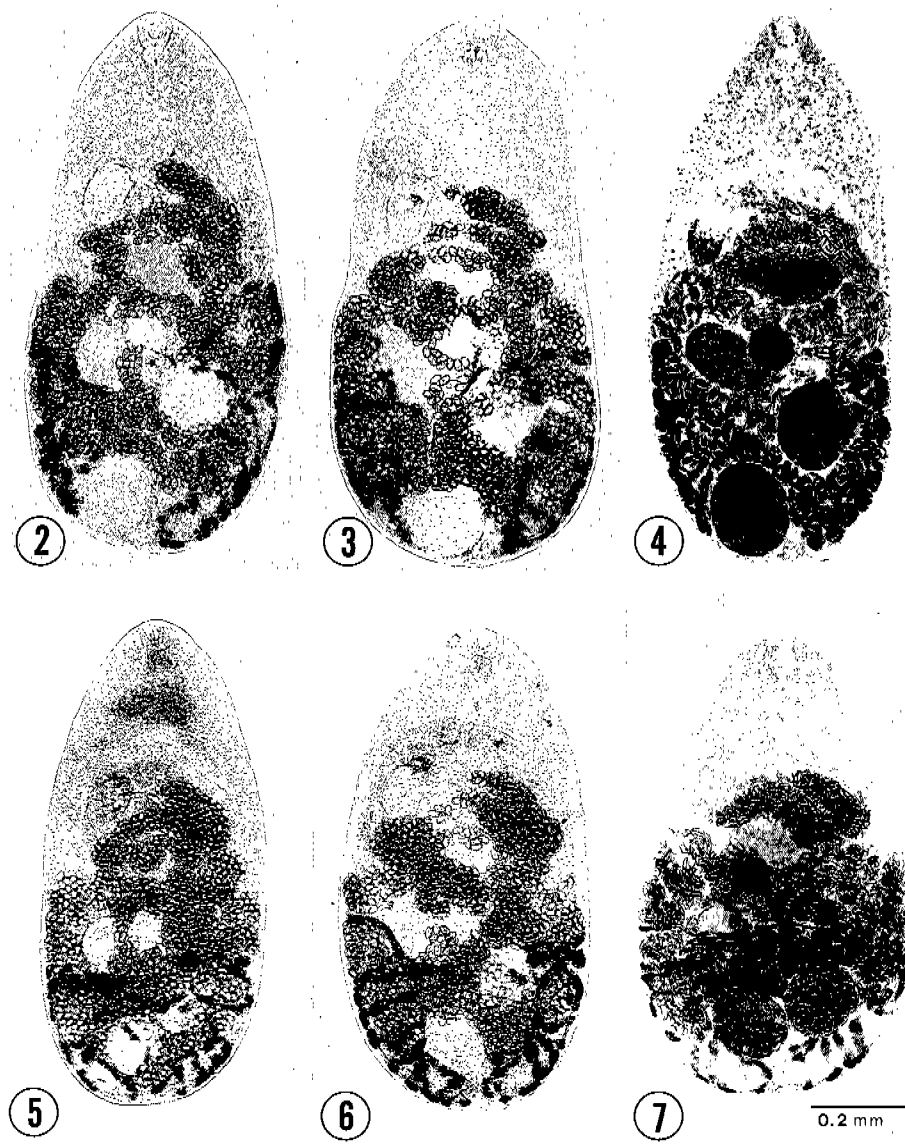
Metagonimus takahashii Suzuki, 1930
(Figs. 5-7)

Body broadly oval, leaf-like, 1.09-1.46 (av. 1.28) mm long and 0.56-0.81 (av. 0.68) mm wide (based on 10 specimens). Ventral sucker larger than oral sucker, deviated to right side of anterior one third body. Prepharynx short. Esophagus moderately long, bifurcating laterally to form intestinal ceca. Testes two, lying obliquely in posterior half of body, separated from one another. Right testis not reaching to posteriormost portion of body. Uterine tubules occupying nearly all available space of posterior body, crossing the intertesticular junction, overlapping left testis. Vitelline follicles very well developed, extending to middle and lateral fields of posterior body, 8-9 groups on each side, passing through the posterior end of body. Uterine eggs many, large

Table 3. Prevalence of *Metagonimus* sp. metacercariae in fresh water fishes collected from the upper reaches of the Namhan River

Fishes	No. exam.	No. posit. (%)	No. metacercariae /fish (average)	Collection Area (area code[b])
Zacco platypus	7	7 (100)	8-340 (90)	1
	6	6 (100)	42-252 (151)	2
	4	4 (100)	78-4,593 (1,723)	3
	3	3 (100)	14-405 (198)	4
	22	21 (98)	2-1,197 (212)	5
	10	8 (80)	n.c[a]	6
Hemibarbus longirostris	2	0 (0)	–	1
	1	1 (100)	4 (4)	3
	5	5 (100)	8-43 (21)	4
Pseudogobio esocinus	2	2 (100)	3-5 (4)	4
	13	11 (85)	n.c	6
Odontobutis obscura interrupta	6	4 (67)	n.c	6
Carassius carassius	18	17 (94)	n.c	6

[a]not counted. [b]area code (Fig. 1)



Figs. 2-7. *Metagonimus* Miyata type (2-4) and *M. takahashii* (5-7) recovered from the inhabitants of Umsong-gun (under same magnification). **2.** A fresh specimen showing the arrangement of genital organs and uterine eggs. Note the two separated testes and uterine tubule crossing the intertesticular junction, and limited distribution of the vitelline follicles near the posterior end of the body. **3.** Another specimen recovered from a different person. **4.** An acetocarmine stained specimen of the same type. **5.** A fresh specimen showing its typical location of two testes, and abundant distribution of vitelline follicles. Also note the uterine tubule covering the left (and right) testis. **6.** Another specimen recovered from a different person. **7.** An acetocarmine stained specimen.

and elliptical, dark yellowish brown in color.

4. Comparative size of *Metagonimus* eggs

When the length and width of the eggs of *Metagonimus* Miyata type, *M. takahashii*, and *M. yokogawai* were plotted (Fig. 8), the eggs of *M. takahashii* were the largest of the three, *Metagonimus* Miyata type was the second, and *M. yokogawai* was the smallest. The majority of *M. takahashii* eggs were 30.5-35.5 (av. 33.0) μm long and 17.5-20.0 (av. 19.0) μm wide,

Metagonimus Miyata type was 28.5-31.5 (av. 30.0) μm long and 16.0-18.0 (av. 17.0) μm wide, and *M. yokogawai* was 26.5-29.0 (av. 28. 0) μm long and 15.5-17.5 (av. 16.5) μm wide.

5. Metacercarial infection in fishes

Among the six kinds of fish hosts (*Zacco platypus, Hemibarbus longirostris, Pseudogobio esocinus, Odontobutis obscura interrupta, Carassius carassius,* and *Paracheilognathus rhombea*) caught from 6 localities, all but one (*P. rhombea*) were found infected with *Metagonimus* metacercariae (Table 3). The infection rate of each fish species was 94% (40 of 52 examined) for *Z. platypus*, 75% (6 of 8) for *H. longirostris*, 87% (13 of 15) for *P. esocinus*, 67% (4 of 6) for *O. obscura interrupta*, and 94% (17 of 18) for *C. carassius* (Table 3).

The metacercarial density per fish was highest in *Z. platypus* (1,723/fish) caught from Yongwol-gun (Table 3; area 3). It was practically not possible to discriminate 2 kinds of metacercariae when they were encysted in the fish or after isolation.

DISCUSSION

In Korea, the majority of epidemiological studies on the genus *Metagonimus* have been concerned with *M. yokogawai* (Seo *et al.*, 1981; Song *et al.*, 1985; Chai and Lee, 1990), and only a few were with other species or types. Human infections with *Metagonimus* sp. different from *M. yokogawai* were first noticed by Kim (1980) from the inhabitants of the Kum River, and they later reported it as *Metagonimus* Miyata type (Kim *et al.*, 1987). *M. takahashii* was reported from the inhabitants of the Hongchon River (Ahn and Ryang, 1988).

As for the fish intermediate hosts, *M. takahashii* was found from *Carassius carassius* caught from the Nakdong River (Chun, 1960), and *Metagonimus* Miyata type was found from *Opsariichthys bidens, Z. platypus* or other fresh water fishes caught from the Kum River (Kim *et al.*, 1987). Three kinds of *Metagonimus* (*M. yokogawai, Metagonimus* Miyata type, and *M. takahashii*) were found encysted in the dace, *Tribolodon taczanowskii*, caught from the Somjin River (Chai *et al.*, 1991).

The present study confirmed that *Metagonimus* Miyata type and *M. takahashii* are prevalent in the upper reaches of the Namhan River, and the source of human infection was verified to be several kinds of fresh water fishes, especially *Z. platypus* and *C. carassius*. This study also confirmed that the large-size *Metagonimus* eggs, often found from the feces of riverside people where no sweetfish are available, are not those of *M. yokogawai* but presumably of *Metagonimus* Miyata type or *M. takahashii*. Therefore, it is speculated that endemic areas of metagonimiasis are not confined to the eastern coastal and southern riverside areas (Chai and Lee, 1990), but scattered over the inland areas (small streams) where no sweetfish are produced.

It was interesting that the prevalence and worm burden of inhabitants, and species (type) of *Metagonimus* recovered from the inhabitants were different between the two areas surveyed. Both *Metagonimus* Miyata type and *M. takahashii* were prevalent in Umsong-gun, whereas only *Metagonimus* Miyata type was found in Yongwol-gun. It seems to be due to some difference in the ecology of the parasite and intermediate hosts, as well as socio-economic conditions of the people in the two areas. For example, it was not possible in this study to obtain *C. carassius* from Yongwol-gun, one of the most important and well known fish host of *M. takahashii* (Saito, 1984). Hence, it is speculated that the inhabitants of Yongwol-gun could not eat *C. carassius*, and became free of *M. takahashii* infection. Meanwhile, *C. carassius* was available and said to be eaten by the people in Umsong-gun and almost all of the *C. carassius* examined were found infected with *Metagonimus* metacercariae, presumably *M. takahashii*.

Taxonomically the genus *Metagonimus* consists of five species, namely *M. yokogawai* (Katsurada, 1912), *M. takahashii* Suzuki, 1930, *M. minutus* Katsuda, 1932, *M. katsuradai* Izumi, 1935, and *M. otsurui* Saito and Shimizu, 1968. Major differential points among the species were, 1) habitat in the host, 2) kinds of intermediate hosts, 3) vitelline follicle distribution, 4) extension pattern of uterine tubules, 5) location and size of ovary and seminal vesicle, 6) relative size of oral and

ventral suckers, and 7) egg size. *M. yokogawai*, *M. takahashii* and *M. minutus* are easily differed from *M. katsuradai* and *M. otsurui* in that they have larger ventral sucker compared with their oral sucker. *M. minutus* is different from *M. yokogawai* and *M. takahashii* by its smaller body size, smaller egg size (23 × 13 μm), larger seminal vesicle, and different fish host (*Mugil cephalus*) (Katsuda, 1932).

However, there have been many debates and confusions on the taxonomy of the genus *Metagonimus*; in most cases on the synonymy of *M. takahashii* with *M. yokogawai* (Asada, 1934; Ito, 1964; Saito, 1984). *M. takahashii* was named as a new species with that it has larger eggs than *M. yokogawai* and takes cyprinoid fish other than the sweetfish (*P. altivelis*) as the intermediate host (Takahashi, 1929; Suzuki, 1930). But the validity of *M. takahashii* has long been put to questions (Ito, 1964). In view of *M. takahashii* as a distinct species, however, Saito (1972) compared the morphology of cercariae, metacercariae and adults of *M. yokogawai* and *M. takahashii*, and concluded that the two are distinctively different. Saito (1973) further performed an experimental study on the susceptibility of fish hosts to the cercariae of the two species, and observed that the sweetfish was highly susceptible to *M. yokogawai*, whereas *C. carassius auratus* (goldfish) was preferably infected by *M. takahashii*. In the present study, *M. takahashii* is also evaluated as a distinct species, based on several characteristic features in the morphology of adult worms (Fig. 9) as well as the peculiarly large size of their eggs (Fig. 8). It was evidently shown that the egg size of *M. yokogawai* and *M. takahashii* never overlapped each other (Fig. 8).

Metagonimus Miyata type was first named by Saito (1984) to designate those worms which have similar morphology to but are not identified as either *M. yokogawai* or *M. takahashii*. Worms of this type have been found from various kinds of fish hosts or humans in Japan and Korea. One of the example was *Metagonimus* adults recovered from humans, which were neither *M. yokogawai* nor *M. takahashii*, in the riverside areas of the Kum River (Kim, 1980; Kim *et al.*, 1987). Another example was one of the two kinds of *Metagonimus* metacercariae found from the sweetfish (Miyata, 1944; Saito and Yamashita, 1982), which were different from *M. yokogawai* or *M. takahashii*. The metacercariae of *Metagonimus* Miyata type are known to encyst in several kinds of fresh water fishes including the sweetfish, the trout, the dace (*Tribolodon* sp.), *Z. platypus*, *etc.* (Saito, 1984; Kim *et al.*, 1987; Chai *et al.*, 1991).

The adult worms of *Metagonimus* Miyata type (Fig. 9B) differ from *M. yokogawai* (Fig. 9A) by posteriormost location of the right testis, separated left testis from the right one, distribution of uterine tubules over the left testis and intertesticular junction, no vitellaria distribution near the posterior end of the body, and larger size of the eggs. *M. takahashii* (Fig. 9C) differs from *M. yokogawai* or *Metagonimus* Miyata type by no posteriormost location of right testis, separated left testis from the right

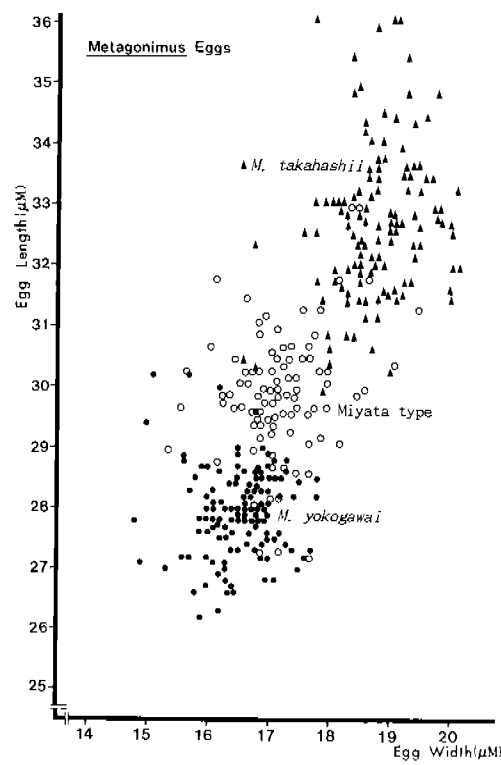


Fig. 8. The distribution patterns of the length and width of three kinds of *Metagonimus* eggs; *M. yokogawai*, *Metagonimus* Miyata type, and *M. takahashii*. Each dot represents the mean value of 10 intrauterine eggs of an adult worm.

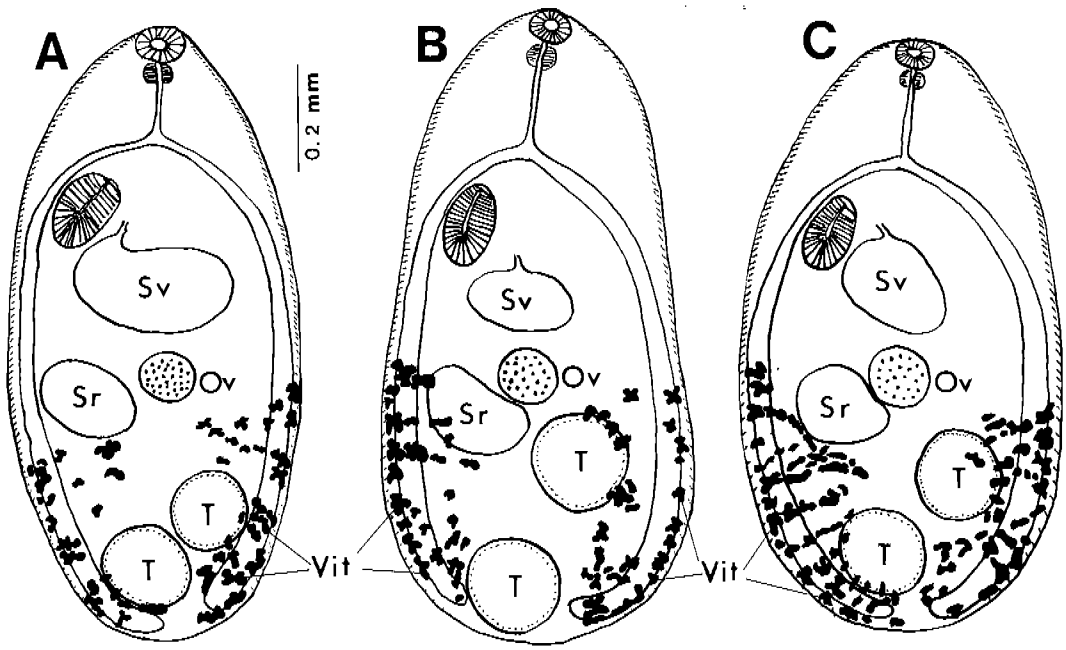


Fig. 9. Schematic representation of three kinds of *Metagonimus*, showing the arrangement of genital organs; ovary (Ov), testis (T), seminal vesicle (Sv), seminal receptacle (Sr), and vitelline follicles (Vit). A: *M. yokogawai*, B: *Metagonimus* Miyata type, C: *M. takahashii*.

one, distribution of uterine tubules over the left testis and intertesticular junction, vitellaria passing through the posteriormost portion of the body, and larger size of the eggs.

However, it seems not appropriate at present to raise *Metagonimus* Miyata type as a new species. It might be an hybrid or intermediate form of *M. yokogawai* and *M. takahashii*, viewing from the size of the eggs (Fig. 8) and morphology of the adult worms (Fig. 9). Not a few eggs of the Miyata type were overlapped with those of *M. yokogawai* or *M. takahashii* in their length and width (Fig. 8). It might also be an intraspecific variation of either *M. yokogawai* or *M. takahashii*. Further studies are required to solve clearly this taxonomic problem. Whole life cycle studies, for example, from eggs to adults with observation of their offsprings, would be very helpful for verification of the validity of *Metagonimus* Miyata type.

REFERENCES

Ahn YK, Ryang YS (1988) Epidemiological studies on *Metagonimus* infection along the Hongcheon River, Kangwon Province. *Korean J Parasit* **26**(2): 207-213 (in Korean).

Asada J (1934) On the *Metagonimus yokogawai* and its related species. *Clin Med* **22**(2): 43-56 (in Japanese).

Chai JY, Lee SH (1990) Intestinal trematodes of humans in Korea: *Metagonimus*, heterophyids and echinostomes. *Korean J Parasit* **28** (suppl.): 103-122.

Chai JY, Nho TY, Lee SH *et al* (1985) An observation on the reinfection pattern of *Metagonimus yokogawai* among inhabitants in Tamjin River basin. *Korean J Parasit* **26**(4): 319-324.

Chai JY, Sohn WM, Kim MH, Hong ST, Lee SH (1991) Three morphological types of the genus *Metagonimus* encysted in the dace, *Tribolodon taczanowskii*, caught from the Sumjin River. *Korean J Parasit* **29**(3): 217-225.

Chun SK (1960) A study on the metacercariae of *Metagonimus takahashii* and *Exorchis oviformis* from *Carassius carassius*. *Bull Pusan Fish Coll* **3**(1): 31-40(in Korean).

Ito J (1964) *Metagonimus* and other human heterophyid trematodes. *Progress of Med Parasit in Japan* **1**: 315-393.

Katsuda I (1932) Studies on the metacercariae of

Formosan brackish water fishes (2) On *Metagonimus minutus* n. sp. parasitic in *Mugil cephalus*. *Taiwan Igakkai Zasshi* **31**(2): 26-39 (in Japanese).

Kim CH (1980) Study on the *Metagonimus* sp. in Geum River basin, Chungchung-nam Do. *Korean J Parasit* **18**(2): 215-228 (in Korean).

Kim CH, Kim NM, Lee CH, Park JS (1987) Studies on the *Metagonimus* fluke in the Daecheong reservoir and the upper stream of Geum River. *Korean J Parasit* **25**(1): 69-82 (in Korean).

Miyata I (1944) Some discussions on the classification of the genus *Metagonimus*. *Dobutsugaku Zasshi* **56**(1-3): 16-19 (in Japanese).

Saito S (1972) On the differences between *Metagonimus yokogawai* and *Metagonimus takahashii* I. The morphological comparisons. *Jap J Parasitol* **21**(6): 449-458 (in Japanese).

Saito S (1973) On the differences between *Metagonimus yokogawai* and *Metagonimus takahashii* II. The experimental infections to the second intermediate hosts. *Jap J Parasitol* **22**(1): 39-44 (in Japanese).

Saito S (1984) Taxonomic consideration on the flukes of the genus *Metagonimus*. *Proc Parasite Taxon Morphol Meet* No.2: 1-4 (in Japanese).

Saito S, Yamashita T (1982) Discovery of two morphological types of *Metagonimus yokogawai* in Japan. *Jpn J Parasitol* **31** (Suppl.): 64 (abstract in Japanese).

Seo BS, Cho SY, Lee SH *et al* (1981) An epidemiologic study on clonorchiasis and metagonimiasis in riverside areas in Korea. *Korean J Parasit* **19**(2): 137-150.

Song CY, Lee SH, Jeon SR (1985) Studies on the intestinal fluke, *Metagonimus yokogawai* Katsurada, 1912 in Korea IV. Geographical distribution of sweetfish and infection status with *Metagonimus* metacercariae in south-eastern area of Korea. *Korean J Parasit* **23**(1): 123-138(in Korean).

Suzuki S (1930) *Metagonimus yokogawai;* list of publications concerned with special animals in Okayama Prefecture (in Okayama Prefectural Report): 146-148 (in Japanese).

Takahashi S (1929) On the life of *M. yokogawai*, a new species of *Metagonimus*, and *Exorchis major*. *Okayama Igakkai Zasshi* **41**(12): 2,687-2,775 (in Japanese).

=국문초록=

남한강 상류의 *Metagonimus* 유행에 대한 연구

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남한강 상류 몇 개 지역 주민 및 어류에 있어서 *Metagonimus*속 흡충 유행 상황을 파악하고, 이 지역에서 유행하고 있는 *Metagonimus*의 종에 대하여 검토하였다. 충북 음성군 주민의 경우 대변검사자 154명 중 15명(9.7%)에서 *Metagonimus* 충란이 검출되었고 praziquantel 10 mg/kg로 치료하고 하제를 투여한 5명에서 6,015-24,060마리(평균 13,233마리)의 충체가 회수되었다. 강원도 영월군 주민의 경우에는 77명 검사에서 37명(48.1%)이 충란 양성이었고 치료받은 27명에서 1-4,965마리(평균 1,215마리)의 충체가 회수되었다. 회수된 충체의 형태를 관찰한 바 음성군에는 *Metagonimus* Miyata형(미야타형흡충)과 *Metagonimus takahashii*(다까하시흡충)가 혼재하고 있었고 영월군에는 *Metagonimus* Miyata형만이 확인되었다. *Metagonimus* Miyata형의 자궁내 충란은 *M. takahashii* 및 *M. yokogawai*(전남 탐진강 유역 주민에서 회수된 것)와 비교할 때 중간 정도 크기이었고, 따라서 충란의 크기가 충체 감별에 도움이 될 수 있을 것으로 판단되었다. 검사한 피라미(*Zacco platypus*) 52마리 중 49마리, 참마자(*Hemibarbus longirostris*) 8마리 중 6마리, 모래무지(*Pseudogobio esocinus*) 15마리 중 13마리, 얼룩동사리(*Odontobutis obscura interrupta*) 6마리 중 4마리 및 붕어(*Carassius carassius*) 18마리 중 17마리에서 *Metagonimus* 피낭유충이 검출되어 담수어가 감염원임이 판명되었다. 이 연구로 남한강 상류 지역에 미야타형흡충(*Metagonimus* Miyata형)과 다까하시흡충(*M. takahashii*)이 유행하고 있음을 확인하였다.

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