Discovery of *Endocotyle incana* and *Spelotrema pseudogonotyla* (Digenea: Microphallidae) from Scolopacid Migratory Birds in Korea

Ho-Jin Yoo¹, Ok-Sik Chung² and Min Seo³,*

¹Gyeonggi Science High School, Suwon 440-210, Korea; ²Division of Ecology and Environment, Chungnam Development Institute, Gongju 314-140, Korea; ³Department of Parasitology, College of Medicine, Dankook University, Cheonan 330-714, Korea

**Abstract:** Migratory birds have been suspected as playing a central role in transmission of various trematodes, but few surveys have been undertaken in the Republic of Korea. In the present study, we describe new fauna of microphallid flukes in Korea. Two species of microphallids were found in the intestines of 2 migratory bird species, namely the red necked stints (*Calidris ruficollis*) and the terek sandpiper (*Xenus cinereus*), in a coastal area of Gunsan-si, Jeollabuk-do. The microphallids recovered from the latter were 451 µm in length and 217 µm in width, and the eggs were very small, 13 µm by 8 µm. They had the characteristic extracecal vitellaria intruding into the median posttesticular area, belonging to *Endocotyle incana*. Another microphallids were discovered from both migratory birds, 417 µm in length and 249 µm in width. The cirrus was projecting into the genital atrium in form of male papilla, and bounded by a muscular flap, termed pseudogonotyl. They were identified as *Spelotrema pseudogonotyla* in consideration of the distinctive male papilla and pseudogonotyl. Besides these flukes, *Maritrema obstipum* and *Gynaecotyla squatarolae* also were recovered. This paper is in fact the first report on the presence of *Spelotrema* and *Endocotyle* in Korea.

**Key words:** *Endocotyle incana*, *Spelotrema pseudogonotyla*, red necked stint, terek sandpiper

The prevalence of parasitic diseases in Korea has been dramatically reduced over the past 30 years, though the public health importance of intestinal trematodes is remained due to high prevalences in coastal areas [1]. A total of 21 species, transmitted typically through consumption of raw sea foods, have been reported as the human infecting intestinal flukes in Korea [1,2]. Migratory birds have been suspected of playing a central role in that transmission as their reservoir hosts, but few surveys on the avian trematode fauna have been undertaken. The paleartic oystercatcher, *Haematopus ostralegus osculans*, has been reported to be a natural final host of *Gymnophalloides seoi* [3], and the ruddy turnstone, *Arenaria interpers interpers* is the host of *Gynaecotyla squatarolae* [4]. Recently, adult worms of *Maritrema obstipum* were found in the intestines of certain migratory birds [5]. Considering the number and diversity of migratory birds in Korea; however, additional investigation of their parasites certainly is required. In the present study, we made the first Korean discovery of adult worms of *Endocotyle incana* and *Spelotrema pseudogonotyla* in the intestines of migratory birds. We herein report our findings with morphological descriptions.

Five red necked stints (*Calidris ruficollis*), and 4 terek sandpipers (*Xenus cinereus*) were found in dead on the coastal area of Gunsan-si, Jeollabuk-do in October 2009, and were immediately transferred to the laboratory for further study. Their intestinal tracts were separated, fixed in 3% formalin, and examined under a stereomicroscope. The intestinal trematodes recovered from each bird were counted and preserved in 10% formalin, and subsequently stained with Semichon’s acetocarmine for species identification.

From the red necked stints, a total of 174 flukes were recovered. Among them, 1 fluke was easily identified as the adult worm of *M. obstipum* by the presence of the cirrus sac, the ring-like distribution of the vitellaria, and the posteromedially curved ejaculatory duct. The others belonged to the same species, *E. incana*, and the infection rate was 80% (4/5). The num-
ber of specimens per host was 162, 3, 3, 5, and 0 (mean 34.6), and the morphological characteristics were as follows (Fig. 1).

Body pyriform, 417 (405-440) µm long and 249 (230-263) µm wide. Cuticle is armed with numerous spines, but less conspicuous from the level of ventral sucker. Oral sucker terminal, 39 (30-43) µm long and 49 (45-53) µm wide. Prepharynx conspicuous, esophagus long. Ceca short, terminates at equatorial level. Ventral sucker distinctly smaller, 24 (18-38) µm long and 28 (23-33) µm wide, located at posterior third. Testes postacetabular, right one 35 (30-38) µm by 60 (50-63) wide, left one 41 (25-65) µm by 53 (30-63) µm. Seminal vesicle in intercecal space, anterior to ventral sucker. Prostatic glands well developed. Cirrus pouch absent, and cirrus projecting into genital atrium in form of muscular papilla, termed male papilla. Male papilla bounded by muscular flap, termed pseudogonotyl. Ovary dextral to ventral sucker, lying close against right cecum, 41 (25-53) µm long and 53 (30-63) µm wide. Vitellarium forms 2 clusters, right one obscuring right testis. Uterus

![Fig. 1](image1.png)

**Fig. 1.** (A) An adult of *Spelotrema pseudogonotyla* recovered from a red-necked stint, *Calidris ruficollis*. Bar = 100 µm. SV, seminal vesicle; VS, ventral sucker; PG, prostatic gland; PS, pseudogonotyl; OV, ovary; T, testis. (B) Magnification of the midbody of another worm. SV, seminal vesicle; VS, ventral sucker; PG, prostatic gland; PS, pseudogonotyl; OV, ovary.

![Fig. 2](image2.png)

**Fig. 2.** (A) An adult of *Endocotyle incana* recovered from a terek sandpiper, *Xenus cinereus*. Bar = 50 µm. OS, oral sucker; IC, intestinal ceca; SV, seminal vesicle; VS, ventral sucker; GA, genital atrium; OV, ovary; T, testis; VT, vitellarium. (B) A line drawing of (A), the adult worm of *E. incana*. Bar = 50 µm. IC, intestinal ceca; SV, seminal vesicle; VS, ventral sucker; OV, ovary; T, testis; VT, vitellarium.
voluminous, extending anterior to testes, even up to tip of cecum. Size of intrauterine eggs 20 by 13 (11-13) µm. Considering these morphological characteristics, especially the presence of pseudogonotyla, the present specimen was identified as S. pseudogonotyla.

In the intestines of the terek sandpipers, a total of 80 flukes were recovered. They were tentatively divided into 4 groups: 5 G. squatarolae, 2 S. pseudogonotyla, 71 unidentified microphallids, and 2 unknown flukes. Unidentified microphallids were found in only 1 out of 4 terek sandpipers, and had the following morphological characteristics (Fig. 2). Body linguiform, 451 (410-490) µm in length and 217 (161-272) µm in width. Oral sucker terminal, 37 in length by 53 in width. Prepharynx distinct, 24 (22-25) µm long. Pharynx comparatively long, 27 µm long by 25 µm. Esophagus short to medium in length. Ceca wide, divergent in front of ventral sucker. Ventral sucker well developed, at about middle of body, 25 µm in length by 29 µm (27-30) in width. Genital atrium adjacent to ventral sucker, sinistal and posterior to it. Seminal vesicle anterior to ventral sucker. Testes symmetrical, posterior to ventral sucker, right one 39 (37-42) µm x 38 (37-40) µm, left one 37.1 x 37.1 µm. Ovary slightly to right of median line, immediately behind ventral sucker. Uterus mainly postcecal, not reaching posterior extremity. Eggs very small, 13 (12-15) µm by 8 (7-8) µm. Vitellaria composed of numerous, small follicles forming 2 sinusoidal ribbons, initially prececal and marginal in forebody, and then passing into space between ventral sucker and testis. Considering these morphological characteristics, it was concluded that the microphallids belonged to E. incana.

Prior to the present study, only 2 species of microphallids had been discovered in migratory birds in Korea; G. squatarolae from the ruddy turnstone, and M. obstipum from the sandpiper, Kentish plover, Mongolian plover, and red-necked stint [4,5]. In the present study, M. obstipum was also recovered from red-necked stints and G. squatarolae from terek sandpipers, respectively, proving that terek sandpipers also are the definitive hosts for G. squatarolae. In addition, S. pseudogonotyla and E. incana were found, for the first time, in the intestines of migratory birds in Korea [6,7]. These represent the 3rd and 4th such microphallids recovered in migratory birds in Korea. Certainly, the close scrutiny on the parasitic infections in migratory birds will be needed, as the study of bird parasites in littoral areas can provide key insights into the trematode distribution.

The present S. pseudogonotyla specimens fell within the 405-440 µm length range, which is smaller than S. nicoli [8]. The body width increased without interruption from the anterior towards the broadly rounded posterior end, differentiating them from Spelotrema simile [8]. Whereas in Spelotrema pygmaeum the uterus does not extend anterior to the testes, the present specimens showed intrauterine eggs located anteriorly to the testes [8]. They were identified definitively as S. pseudogonotyla on the basis of the location of the acetabulum and the presence of pseudogonotyla [9]. S. pseudogonotyla originally was discovered in the intestines of domestic ducks in Hong Kong [9], but the present results indicated that the migratory birds were also the natural definitive host of this parasite, transmitting them to other localities. The presence of metacercariae of Spelotrema nicoli in the tissues of the green crab, Carcinus maenas, indicates that migratory birds are infected with S. pseudogonotyla through consumption of crustaceans in the western coastal areas of Korea [8]. And notably, the first description of Spelotrema brevicea was reported in a human autopsy case, 11 additional cases having been found in the Philippines [6,7]. Considering the raw-seafood-eating habit of Koreans, human infection with Spelotrema sp., as seen in the case of G. squatarolae [2], is possible.

As for the genus Endocotyle, only 3 species, E. incana, E. africianus and E. bushi, have been reported thus far. In E. incana, the type species, its extracecal vitellaria is characteristically intruding into the median posttesticular area, as in the present specimen [10]. Adult worms of E. bushi have been found in willets (Catoptrophorus semipalmatus) in Florida and Texas, given the disposition of their posterior uterine loops, the extension of the vitellarium, and their geographical distribution, among other indicators, they are thought to represent a new species [5,11]. Indeed, E. bushi was found to be longer (550 µm) than E. incana (400 µm) and to possess large intrauterine eggs (22-24 µm) [5], differentiating it from the present specimens. Moreover, E. africianus, identified as a new species in Kenya, is 404 µm long by 326 µm wide, with intrauterine eggs of 15.3 µm length, clearly differentiating it from the present flukes [12]. Therefore, the present specimens were deemed to be adult worms of E. incana.

In October 2010, an investigation of the terek sandpiper was conducted, though on only 1 individual [5]. However, only 4 adults of G. squatarolae were recovered, and there were no cases of E. incana [5]. In the current study, adult worms of E. incana were recovered from only 1 terek sandpiper out of 4 (25%), reflecting the low infection rate of this fluke. By contrast, in the study of October 2010, 19 unknown worms from red-necked...
stints were newly identified as adults of *S. pseudogonotyla* [5].
This is an illustration of why investigations should be conducted on a frequent basis.

**ACKNOWLEDGMENT**

The present research was conducted by the research fund of Dankook University in 2010.

**REFERENCES**

1. Chai JY, Lee SH. Food-borne intestinal trematode infections in the Republic of Korea. Parasitol Int 2002; 51: 129–154.
2. Chung OS, Lee HJ, Kim YM, Sohn WM, Kwak SJ, Seo M. First report of human infection with *Gynaecotyla squatarolae* and first Korean record of *Haplorchis pumilio* in a patient. Parasitol Int 2011; 60: 227–229.
3. Ryang YS, Yoo JC, Lee SH, Chai JY. The palearctic oystercatcher, *Haematopus ostralegus*, a natural definitive host for *Gymnophallodes seoi*. J Parasitol 2000; 86: 418-419.
4. Seo M, Guk SM, Chai JY. The Ruddy Turnstone, *Arenaria interpres interpres*, a new definitive host for *Gynaecotyla squatarolae* (Digenea: Microphallidae). Korean J Parasitol 2008; 46: 41-43.
5. Chung OS, Sohn WM, Chai JY, Seo M, Lee HJ. Discovery of *Maritrema obstipum* (Digenea: Microphallidae) from migratory birds in Korea. Korean J Parasitol 2011; 49: 457-460.
6. Africa CM, de Leon W, Garcia EY. Visceral complications in intestinal heterophyidiasis of man. Acta Medica Philippina (Monographic Series) 1940; 1: 1–132.
7. Africa CM, Garcia EY. Heterophyid trematodes of man and dog in the Philippines with descriptions of three new species. Phil J Sci 1935; 57: 253-267.
8. Cable RM, Hunninen AV. Studies on the life history of *Spelotrema nicoli* (Trematoda: Microphallidae) with the description of a new microphallid cercaria. Biol Bull 1940; 78: 136-157.
9. Chen HT. *Spelotrema pseudogonoyla* n. sp. (Trematoda: Microphallidae) from Hong Kong. J Parasitol 1944; 30: 159-161.
10. Dronen NO, Badley JE, Tehrany MR, Wardle WJ. *Endocotyle bushi* (Trematoda: Microphallidae) from willets, *Catoptrophorus semipalmatus* from Galveston, Texas. J Parasitol 1998; 84: 1278-1279.
11. Kinsella M, Deblock S. Microphallidae Travassos, 1920 (Trematoda). *Testiculoporus cedarkeyensis* n. g., n. sp. et *Endocotyle bushi* n. sp., parasites d’un *Catoptrophorus* (Aves) des Etats-Unis. Sys Parasitol 1997; 37: 67-72.
12. Canaris AG. Some microphallids collected in Kenya. Parasitology 1971; 62: 53-61.