**Euryhelmis squamula** (Digenea: Heterophyidae) Recovered from Korean Raccoon Dog, *Nyctereutes procyonoides koreensis*, in Korea

Hyeon Cheol Kim†,‡, Eui Ju Hong‡,§, Si Yun Ryu‡,§, Jinho Park†, Jeong Gon Cho‡, Do Hyeon Yu‡, Joon Seok Chae‡, Kyoung Seong Choi§, Bae Keun Park‡,*

1College of Veterinary Medicine and Institute of Veterinary Science, Kangwon National University, Chuncheon 24289, Korea; 2College of Veterinary Medicine, Chungnam National University, Daejeon 34134, Korea; 3College of Veterinary Medicine, Chonbuk National University, Iksan 54596, Korea; 4College of Veterinary Medicine, Gyeongsang National University, Jinju 52828, Korea; 5Laboratory of Veterinary Internal Medicine, BK21 FOUR Future Veterinary Medicine Leading Education and Research Centre, Research Institute for Veterinary Science and College of Veterinary Medicine, Seoul National University, Seoul 08826, Korea; 6College of Ecology and Environmental Science, Kyungpook National University, Sangju 37224, Korea

**Abstract:** In this study, we intended to describe an unrecorded species of heterophyid trematode recovered from the small intestine of a Korean raccoon dog, *Nyctereutes procyonoides koreensis*, in Korea. A total of 13 small flukes were collected from a deceased Korean raccoon dog which was found in Chuncheon-si, Gangwon-do, Korea in May 2017. The trematode body was covered with many small spines, rectangular, broader than long, 807-1,103 μm long and 1,270-1,550 μm wide. Oral sucker in the anterior end slightly smaller than acetabulum. Pharynx muscular and well developed. Esophagus relatively long and sigmoid. Acetabulum small and located at median in anterior 2/5 portion. Ceca bifurcated at the anterior of genital pore and acetabulum and terminated at testis level. Testes larger, deeply lobed and located at the near of posterior end of body. Ovary small, triangular and located at the slight left of median and the anterior of left testis. Vitelline follicles dendritic and extend from the middle level of esophagus to the posterior portion of body. Eggs embryonated, operculated, small and 33-35 × 15-16 μm in size. Based on the morphological characteristics, the small heterophyid flukes recovered from the small intestines of Korean raccoon dog, *N. procyonoides koreensis*, were identified as *Euryhelmis squamula* (Digenea: Heterophyidae). Accordingly, this species of heterophyid flukes is to be a new trematode fauna in Korea by this study.

**Key words:** *Euryhelmis squamula*, *Nyctereutes procyonoides koreensis*, Korean raccoon dog, Korea

Trematode members in the genus *Euryhelmis* (Digenea: Heterophyidae) are small, rectangular or pyriform intestinal parasites of frog- and salamander eating mammals [1,2]. About 8 species, i.e., *E. squamula*, *E. monorchis*, *E. pacificus*, *E. costaricensis*, *E. pyriformis*, *E. zelleri*, *E. cotti*, and *E. asiatica*, have been reported in this genus [3-9] (Table 1). Most of them including *E. squamula* were reported from mustelid mammalian hosts, i.e., Mustela putorius, *M. vison*, *M. frenata costaricensis*, and *Martes flavigula*. Adult worms of *E. pacificus* were also found in the intestines of muskrat, *Ondatra zibethicus*, and marsh shrew, *Sorex bendirii palmeri*, [4]. and *E. pyriformis* adults were detected from striped skunk, *Mephitis mephitis* [6]. *E. zelleri* [7] and *E. cotti* [8] were reported from experimental animals such as mink, white rats, albino mice, hamster, and chicks.

Available literatures on the trematode fauna from carnivora are not so many in Korea. Sohn and Chai [10] reported more than 11 species of heterophyid flukes, i.e., *Metagonimus* spp., *Heterophyes nocens*, *Pygidopsis summa*, *Heterophyopsis continua*, *Stictodora fuscata*, *Stictodora lari*, *Acanthotrema felis*, *Stellantchasmus falcatus*, *Centrocestus armatus*, *Procercovum varium*, *Cryptocotyle* sp., in the small intestines of 438 feral cats from a wholesale house of animals in Busan Metropolitan City, Korea. They also reported 11 other species of trematodes, such as *Clonorchis sinensis*, *Paragonimus westermani*, *Eurytrema panamericum*, *Pharyngostomum catodontum*, *Echinostoma revolutum*, *Echinostoma hortense* (= *Isthmiophora hortensis*), *Echinocochasmus japonicus*, *Stephanoprora* sp., *Plagiorchis muris*, *Neodiplostomum* sp., and *Diplodostomum* (mesocercaria of *Diplodostomum* sp.). Shin et al. [11] detected 4 species of heterophyid flukes, i.e., *H. nocens*, *P. summa*, *S. fuscata*, *A. felis*, and *Gymnophalloides sei* in the small int-
Table 1. Comparison of morphometric features of species in the genus *Euryhelmis*

|                   | *E. monorchis* [3] | *E. pacificus* [4] | *E. costarcensis* [5] | *E. pyriformis* [6] | *E. zelleri* [7] | *E. cotti* [8] | *E. asiaticus* [9] | *E. squamula* [7] | Present study |
|-------------------|--------------------|--------------------|-----------------------|--------------------|-----------------|----------------|-------------------|-------------------|---------------|
| **Body length**   | 390-460            | 660-1,040          | 1,074-1,281           | 2,250              | 347-495         | 270-550        | 920-1,117         | 723-1,050         | 807-1,103     |
| **width**         | 520-690            | 340-680            | 716-854               | 570                | 915-1,504       | 150-290        | 630-900           | 1,080-1,380       | 1,270-1,550   |
| **Shape of body** | Much broader than long | Pyriform or elongate | Quadrangular          | Pyriform or elongate | Much broader than long | Pyriform or elongate | Mostly pyriform     | Broader than long | Broader than long |
| **Spine on body** | Spinose overall    | Spinose overall    | Spinose               | Spinose anterior absent posterior | Spinose overall | Spinose | Spinose | Spinose |
| **Oral sucker**   | 32-48×67.2         | 35-87×49-90        | 73-90×53-82           | 100                | 45-68×59-87     | 32.5-42.5×37.5-55.0 | 51-68×63-74     | 73-111×90-128     | 93-143×100-141 |
| **Pharynx**       | 32-40×32-43        | 35-59              | 64×48                 | 50-70              | 34-45×34-48     | 25-30          | 31-43×29-40       | 45-60×55-69       | 79-95×85-106   |
| **Esophagus**     | 115-161×11-13      | 115-161×11-13      | 600                   | 62.5-140           | 110-180 (Slander & straight) | (Sigmoid) | (Sigmoid) | (Sigmoid) |
| **Gonotyl**       | 14×50              | 52×73              | 230                   | 14-20×24-38        | 34×57           | 38-52×76-97    |                  |                  |
| **Acetabulum**    | 40-64×62-76        | 35-65              | 96-101×96-10          | 90                 | 38-52×35-52     | 25-29          | 68-80×86-103      | 97-139×97-125    | 103-124×127-150 |
| **Anterior (left) testis** | Absent           | 100-160×180-320    | 193×277               | 55-120×41-90       | 76-152.5×55-80 | 190-260×250-400 |                  |                  |
| **Posterior (right) testis** | 140-180×150-260   | 184×230            | Absent                | 55-114×48-100      | 76-152.5×55-80 | 170-230×260-420 |                  |                  |
| **Seminal vesicle** | Absent            | 207×80             | 230                   | 230-410            | 295-443×221-361 | 380-424×311-371 |                  |                  |
| **Seminal receptacule** | 60-160×70-320    | 184×298            | 150                   | 59-111×25-52       | 60-100×200-300  | 258-428×76-192  | 502-582×197-229  |                  |
| **Ovary**         | 70-140×100-250     | 29×230             | 45-93×25-52           | 37.5-67.5×40-50    | 40-120×160-290  | 177-265×97-177  | 125-141×97-124   |                  |
| **Shape of ovary** | Dextral, elliptical or lobate | Club-shaped | Strongly elongated | Triangular | Oval | Oval to triangular | Club-shaped | Club-shaped | Heart-shaped or triangular |
| **Ova**           | 25-30×12-14        | 20-34×10-17        | 29×16                 | 28-34×18-23        | 30-37×16-22.5  | 2,813          | 28-33×12-15       | 33-35×15-16      |
Kim et al.: E. squamula from Korean Raccoon Dog

They also found P. summa and unidentified echinostomes in the small intestines of a raccoon dog. Chai et al. [12] morphologically described 13 trematode species i.e., S. falcatus, S. fuscata, S. lari, C. armatus, P. varium, Cryptocotyle concava, E. hortense, E. revolutum, E. japonicus, Stephanoprora sp., Neodiplostomum seoulense, P. muris, and Eurytrema pancreaticum, as the cat fluke fauna in Korea. Shin et al. [13] detected more than 10 species of heterophyid fluke, i.e., Metagonimus spp., P. summa, H. nocens, S. falcatus, H. continua, A. felis, C. armatus, P. varium, C. concava, and S. lari, together with 5 species of echinostomes and Plagiorchis spp. in the small intestines of 400 stray cats from riverside areas of 5 major rivers in Korea. Recently, Choe et al. [14] reported 2 Isthmiophora species recovered from 4 species of wild carnivores, i.e., Nyctereutes procyonoides, Mustela sibirica, Meles lucurus, and M. flavigula with morphological descriptions. So many species of trematodes including heterophyid flukes have been reported from carnivora in Korea. However, there is no reports on the Euryhelmis species in Korea. Herein, we describe a new trematode fauna, E. squamula, of which heterophyid flukes recovered from a Korean raccoon dog, N. procyonoides koreensis, in Korea.

In May 2017, a deceased Korean raccoon dog was found in Chuncheon, Korea, and transferred to the Gangwon Wildlife Medical Rescue Center at Kangwon National University. The raccoon dog was autopsied, and 13 flukes were harvested from the contents of the small intestine, which is washed with saline, under the stereo microscope. Unfortunately, we tried to stain the flukes with Semichon’s aceto-carmine, but the body of flukes were so thin, that it contracted during the dyeing process, thus, we could not obtain a properly stained specimens. However, fortunately the internal organs of the flukes could be confirmed from the non-stained flukes. The morphology was documented by photographing the flukes before fixation, and measured and drawn with tracing paper. All measurement (n = 10) unit are in micrometer.

The morphological characters of heterophyid flukes in this study were as follow (Fig. 1). Body covered with many minute spines, rectangular, broader than length, 807-1,103 (1,053) × 1,270-1,550 (1,460) μm. Oral sucker 91-143 × 100-141 μm, lying at the anterior end of the body. Pharynx nearly spherical, 79-95 (91) × 85-106 (98.5) μm, and esophagus well-developed, sigmoid and long. Esophagus bifurcates at the anterior to acetabulum, and ceca follow the contour of the body to the posterior. Acetabulum 103-124 (118) × 127-150 (140) μm, lying in the middle of the body. Genital atrium opens immediately anterior to acetabulum and is overhung by genital papillae. Testes symmetric or slightly diagonal, globular and lie on either side of the median at the posterior of the body. Testes 511-582 (557) × 268-300 (294) μm and 468-547 (515) × 254-300 (287) μm and deeply lobed. Ovary 125-141 (139) × 97-124 (117) μm, heart-shaped or triangular in shape and lies slightly to the left side, anterior to left testis. Seminal receptacle 502-582 (552) × 197-229 (217) μm, heart or club-shaped and lies between the right testis and seminal vesicle. Seminal vesicle 380-424 (413) × 311-371 (352) μm, club-shaped, bends medially beneath the right edge of acetabulum, and opens via a short ejaculatory duct into genital pore.
atrium located medially in front of acetabulum and covered by gonotyle. Uterus consists of 3 or 4 loops at the right side of the body and opens into genital atrium. Vitelline follicles dendritic and extend from the intestinal bifurcation to the posterior part of the body, following the ceca, but do not exceed the extra-cecal margin. Eggs 33-35 (34.5) \( \times \) 15-16 (15.6) \( \mu \)m, polar thickening and operculated.

The several species of carnivora act as definitive host of the genus *Euryhelmis* [1-9]. Although many heterophyid flukes from carnivora had been reported and described in Korea [10-21], there is no literature of *E. squamula* and their host in Korea. In this study, *E. squamula* was recorded for the first time as the natural infection in a raccoon dog from Korea.

In 1819, Rudolphi [22] incompletely described *Distomum squamula*, which later became the genus *Eurysoma* (Dujardin, 1845), and finally, *Euryhelmis* (Heterophyidae) in 1925 by Poche [23]. The Heterophyidae subfamily, Euryhelminthinae, is composed of wide-bodied trematodes. Baer [24] fully described *E. squamula* (type species) in 1931, and the taxonomic location of *E. squamula* was confirmed by Callot’s, publishing the adult measurements in 1946 [25].

Yamaguti [26] reported that the most identifiable features of the subfamily Euryhelminae are a wider body, short esophagus, almost symmetrical testes, and vitelline follicles located in the extra-cecal margin, lateral to the pharynx and testes. Further exploration of the species from genus *Euryhelmis* showed that the morphology, taxonomy, and occurrence of these trematodes were variable [27], but the superfamily Euryhelminae: Heterophyidae could be identified based on the following characteristics: a longitudinally or transversally elongated flat body, a variable esophagus length, the acetabulum is located a small distance in front of the middle of the body, the genital pore is immediately in front of the acetabulum and covered by a gonotyl (varying in size and structure). 1 or 2 testes are located at the posterior of the body, the ovary and seminal receptacles are transversally elongated and lie in front of the right testes, the vitelline follicles are in the lateral margins and reach behind the testes at the body’s posterior end to the intestine bifurcation level, or to the level of the pharynx and oral sucker at the body’s anterior end, the uterus is short with several convolutions between the gonotyl and transversal vitelline channels, and there is a Y-shaped excretory vesicle. The characteristic keys of *Euryhelmis* are the body rectangular or pyriform, testis lobed, vitelline follicles in both fore- and hind-body, natural definitive host raccoon and mink [1]. In this study, the wider body is rectangular, testis deeply lobed, vitelline follicles in both fore- and hind-body. The genital pore opening in front of the acetabulum is an important characteristic note of Heterophyidae [1], and this is same as this study.

The *E. squamula* morphological characteristics are as follows: the body is small, leaf-like, and broader than long, the excretory vesicle is Y- or T-shaped, there is 1 transitory testis or 2 spherical or lobate testes that are large and persist throughout adult life, the uterus relatively short and consists of 3 loops, principally situated at the left side of the body between the acetabulum and excretory vesicle, the vitelline follicles are numerous, primarily lateral, and extend from the posterior region of the body to the intestinal bifurcation, the genital atrium is immediately in front of the acetabulum, the intestinal crura extends to the posterior extremity of the body, the eggs are operculated, with or without slight polar thickening, and the adults are found in the intestine of mustelids [3]. The morphological appearance of heterophyid flukes shown in this study was well consistent with the morphological characteristics of *E. squamula*: the body is small, leaf-like, and broader than long. The uterus relatively short and consists of 3 loops, and the vitelline follicles numerous, primarily lateral, and extend from the posterior region of the body to the intestinal bifurcation. The intestinal crura extends to the posterior extremity of the body. The uterus consists of 3 or 4 loops at the right side of the body.

The comparison of morphometric features of the genus *Euryhelmis* species is compared in Table 1. The body shape of *E. monochis*, *E. zelleri*, *E. squamula*, and this fluke are broader than long, which differs from *E. asiaticus*, *E. costaricensis*, *E. cotti*, *E. pacificus*, *E. pyriformis* that are pyriform or elongate. *E. monochis*, *E. squamula*, and this fluke have the characteristic rectangular shape. *E. monochis*, *E. zelleri* and *E. cotti* are smaller than *E. squamula*, and this fluke that identified from this study. Length and width of the *E. squamula* are 0.6-1 mm and 1.4-1.9 mm, respectively. In this study, the specimen’s body length and width are 807-1,103 \( \mu \)m and 1,270-1,550 \( \mu \)m, respectively. *E. asiaticus*, *E. costaricensis*, *E. monochis*, *E. squamula* and this fluke differ from *E. pacificus*, *E. pyriformis*, and *E. zelleri*, that the acetabulum is larger than the oral sucker. *E. squamula* resembles *E. costaricensis* in morphology (the acetabulum is larger than the oral sucker), but the *E. costaricensis* acetabulum is located anterior to the body length midpoint, and the *E. squamula* acetabulum is located at the body length midpoint. Similarly, *E. asiaticus* has a slender and straight esophagus and an
acetabulum is larger than the oral sucker, but to find the relationships among E. costaricensis, E. squamula, and E. asiaticus require further investigations [27]. E. monorchis and E. pyriformis differ from the other species by having 2 non-transitory testses. E. squamula and E. monorchis are also morphologically similar [4], but differ in the testses. E. monorchis has 1 transitory testes, and E. squamula has 2 persistent testses. Also, E. asiaticus has a slender and straight esophagus, but most of species, including E. squamula and this fluke, have sigmoid esophagus. The seminal vesicle and seminal receptacle of this fluke are larger than other species. The fluke of this study is slightly larger than E. squamula of Grabda-Kazubska [7] in most of the measurements, but similar to E. squamula.

In this study, the flukes are small, leaf-like, broader than long, and rectangular in shape. Although, we could not obtain a properly stained specimen, the microscopic finding of non-stained heterophyid fluke revealed the features of internal organ. The acetabulum was smaller than the oral sucker, and the sigmoid esophagus bifurcates anterior to the acetabulum. The tests deeply lobed, and the vitelline follicles numerous, primarily lateral, and extend from the posterior region of the body to the intestinal bifurcation. The genital atrium is immediately located in front of the acetabulum, and the intestinal crura extend to the posterior extremity of the body. The results herein reveal that the fluke of this study is E. squamula.

E. squamula is a trematode parasite with a complex lifecycle, which require at least 3 hosts to complete it. The first intermediate host of E. squamula is a tiny, operculate snail, Bythinella hemphilii Pilsbry (Family Hydrobiidae), which develops lopho-cercous cercariae in the rediae after infection [28]. The second intermediate hosts are frogs and toads, such as Ascaphus truei, Rana aurora, Rana cascadae, Rana esculenta L., Rana pipiens, Rana temporaria, and Triturus cristatus Laurenti, as evidenced by E. squamula encysted metacercariae on the skin [28-30]. The final hosts of Euryhelmis are raccoons, weasels, badgers, and minks [24,29-40]. Moreover, globally, M. vison, M. putorius, Procyon lotor, Mustela frenata, Martes melampus, Martes nivalis, Martes americana, Martes sibirica, Meles analuama, O. zibethicus, and S. bendirii palmeri are distributed. In Europe, E. squamula was reported from M. nivalis, M. putorius, M. frenata and Vulpes vulpes. In North America, E. squamula was reported from M. vison, M. americana, P. lotor, O. zibethicus, and S. bendirii palmeri [29-39], and in Asia from M. melampus and M. analuama [40]. In this study, the adult worms of E. squamula were found in the intestine of N. procyonoides koreensis and now, N. procyonoides kore-

ensis is new definitive host of E. squamula.

A limited point, i.e., no stained specimens were obtained, but our photographs of unstained heterophyid flukes taken before the fixation are closely identical with the characteristic morphologies of E. squamula.

In conclusion, based on the morphological comparison of 8 Euryhelmis species, the small heterophyid flukes recovered from the intestine of Korean raccoon dog, N. procyonoides koreensis, were identified as E. squamula in this study, and E. squamula is to be a new trematode fauna in Korea. Accordingly, we report for the first time that the Korean raccoon dog, N. procyonoides koreensis, serves as the definitive host of E. squamula, and E. squamula is distributed in Korea. However, there is no information on the first and second intermediate hosts of E. squamula in Korea. Further studies on what kind of animals act as the first and second intermediate hosts of E. squamula should be continued in Korea.

ACKNOWLEDGMENT

This research was supported by Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (Grant No. 2017 RIDIAIB06031728).

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest.

REFERENCES

1. Schell SC. Handbook of Trematodes of North America North of Mexico. Idaho, USA. University Press of Idaho. 1985, pp 237-242.
2. Bray RA, Gibson DI, Jones A. Keys to the Trematode. Volume 3. London, UK. CAB International and Natural History Museum. 2008, pp 824.
3. Ameel DJ. The morphology and life cycle of Euryhelmis monorchis n. sp. (Trematoda) from the mink. J Parasitol 1938; 24: 219-224. https://doi.org/10.2307/3272291
4. Senger CM, Macy RW. Helminths of northwest mammals. Part III. The description of Euryhelmis pacificus n. sp., and notes on its life cycle. J Parasitol 1952; 38: 481-486. https://doi.org/10.2307/3273929
5. Brenes RR, Arroyo G, Jiménez-Quirós O. Helminths of the República de Costa Rica RR. Helminths of the República de Costa Rica XVIII. Una nueva especie de Euryhelmis (Trematoda: Heterophyidae), parásito de Mustela frenata costaricensis. Re Biol Trop 1960; 8: 247-251 (in Spanish). https://revistas.ucr.ac.cr/index.php/rbt/ar-
6. Webster GA, Wolfgang RW. Alaria canadensis sp. nov. and Euryhelminis pyriformis sp. nov. from the skunk, Mephitis mephitis in Quebec. Can J Zool 1956; 34: 595-601. https://doi.org/10.1139/z56-062
7. Grzabka-Kazubska B. Euryhelminis zelleri sp. n. and Euryhelminis squa-
mula (Rudolphi, 1819) (Trematoda, Heterophyidae), metacercariae from Rana temporaria L., from the Babia Gora National Park, Poland. Acta Parasitol Pol 1980; 26: 115-128.
8. Simon MJ. Euryhelminis cotti N. Sp. (Trematoda: Heterophyidae) with observations on its life cycle. Master's thesis. Portland State University. 1972. Available from: http://pdxscholar.library.pdx.edu/open_access_cetds.
9. Chin TH. A new trematode, Euryhelminis asiaticus, of the yellow-throated marten from Kweiyang. Acta Zootaxonomica Sinica 1965; 2: 30-32 (in Chinese).
10. Sohn WM, Chai JY. Infection status with helminthes in feral cats. Korean J Parasitol 2005; 43: 93-100. https://doi.org/10.3347/kijp.2005.43.3.93
11. Shin EH, Park JH, Guk SM, Kim JI, Chai JY. Intestinal helminth infections in feral cats and a raccoon dog on Aphaedo Island, Shinan-gun, with a special note on Gymnophallusoides infection in cats. Korean J Parasitol 2009; 47: 189-191. https://doi.org/10.3347/kijp.2009.47.2.189
12. Chai JY, Bahk YH, Sohn WM. Trematodes recovered in the small intestine of stray cats in the Republic of Korea. Korean J Parasitol 2013; 51: 99-106. https://doi.org/10.3347/kijp.2013.51.1.99
13. Shin SS, Oh DS, Ahn KS, Cho SH, Lee WJ, Na BK, Sohn WM. Zoonotic intestinal trematodes in stray cats (Felis catus) from riverside areas of the Republic of Korea. Korean J Parasitol 2015; 53: 209-213. https://doi.org/10.3347/kijp.2015.53.2.209
14. Choe S, Na KJ, Kim Y, Jeong DH, Yang JJ, Eom KS. Infections of two Ischnophora species (Digenea: Echinostomatidae) in wild mammals from Republic of Korea with their morphological descriptions. Korean J Parasitol 2019; 57: 647-656. https://doi.org/10.3347/kijp.2019.57.6.647
15. Kang HJ. Studies on the parasitic helminths of the cat in western province of Kyung Sang Nam-do. Res Bull Chinju Agric Coll 1967; 6: 91-96 (in Korean).
16. Lee HS. A survey on helminth parasites of cats in Gyeongbuk Area II. Trematodes. Korean J Vet Res 1979; 19: 57-61 (in Korean). https://www.koreascience.or.kr/article/JAKO197924457072402.page
17. Eom KS, Son SY, Lee JS, Rim HJ. Heterophyid trematodes (Heterophyopsis continua, Pygidiopsis summa and Heterophyes heterophyes novem) from domestic cats in Korea. Korean J Parasitol 1985; 23: 197-202. https://doi.org/10.3347/kijp.1985.23.2.197
18. Huh S, Sohn WM, Chai JY. Intestinal parasites of cats purchased in Seoul. Korean J Parasitol 1993; 31: 371-373. https://doi.org/10.3347/kijp.1993.31.4.371
19. Yang HJ, Park TW, Cheon SJ, Yoon YB, Kim NJ, Park BK, Kim CS. Internal parasites of cats in Iri and its vicinity. Korean J Vet Serv 1995; 18: 33-40 (in Korean).
20. Sohn WM, Na BK. Soboliphyme buturini (Nematoda: Soboliphymatidae) recovered from stomach of Asian badger, Meles leucurus, in Geochang-gun, Geongsangnam-do, Korea. Korean J Parasitol 2019; 57: 521-524. https://doi.org/10.3347/kijp.2019.57.5.521
21. Kim JH, Lee K, Sohn WM, Kim HY, Lee YR, Choi EJ, So B, Jung JY. Necrotizing enteritis caused by Pharyngostomum contortum in a stray cat. Korean J Parasitol 2019; 57: 17-20. https://doi.org/10.3347/kijp.2019.57.1.17
22. Rudolphi CA. Entozoon synopsis: Cui Accedunt Mantissa Du-
pex Et Indices Locupletissimi. Berolini: Sumtibus A. Rücker. 1819. Available from: https://www.biodiversitylibrary.org/page/9698015
23. Poche F. Das system der Platodaria. Arch Naturgesch 1926; 91: 1-458 (in German).
24. Baer JC. Quelques helminthes rares ou peu connus du Putois. Rev Suisse Zool 1931; 38: 313-334 (in French).
25. Callot J. Matériaux pour servir à la faune des distomes de France. Ann Parasitol 1946; 21: 199-201 (in French).
26. Yamaguti S. Synopsis of Digeneric Trematodes of Vertebrates. Vols I and II. Tokyo, Japan. Keigaku Publishing Co. 1971, pp 1074.
27. Janeve J. On the morphology, taxonomy and distribution of Euryhelminis squamula (Rudolphi, 1819) (Trematoda: Heterophyidae) in some Mustelidae in Bulgaria. K helmintologia 1967; 23: 50-58. https://pascal-francis.inist.fr/vibad/index.php?action=getRec andDetail&idt=7551096
28. Anderson GA, Pratt I. cercaria and first intermediate host of Euryhelminis squamula. J Parasitol 1965; 51: 13-15. https://doi.org/10.2307/3275636
29. McIntosh A. The occurrence of Euryhelminis squamula (Rudolphi, 1819) in the United States. J Parasitol 1936; 22: 536.
30. Zeller E. Ueber das enkystierte Vorkommen von Distomum squa-
mula Rud. in braunen Grasfrosh. Z Wissensch Zool 1867; 17: 215-220.
31. Cole RA, Shoop WL. Helminths of the raccoon (Procyon lotor) in Western Kentucky. J Parasitol 1987; 73: 762-768. https://doi.org/10.2307/3282410
32. Torres I, Felici M, Miquel J, Casanova JC, García-Perea R, Gisbert J. Helmintofauna de Mustela putorius Linnaeus, 1758 (Carnivora: Mustelidae) en la península Ibérica. Boll Soco Hist Nat Balears 2001; 1-458 (in German).
33. Sato H, Iinaba T, Ihama Y, Kamiya H. Parasitological survey on wild carnivora in north-western Tohoku, Japan. J Vet Med Sci 1999; 61: 1023-1026. https://doi.org/10.1292/jvms.61.1023
34. Sato H, Ihama Y, Inaba T, Yagishita M, Kamiya H. Helminth fauna of carnivores distributed in north-western Tohoku, Japan, with special reference to Mesostoidei pentasteciatus and Brachylaima tokuyai. J Vet Med Sci 1999; 61: 1339-1342. https://doi.org/10.1292/jvms.61.1339
35. Torres I, Miquel J, Motie J. Helminth parasites of the Eurasian badger (Meles meles L.) in Spain: a biogeographic approach. Parasitol Res 2001; 87: 259-263. https://doi.org/10.1007/s004360000316
36. Millán J, Sevilla I, Gertikagoitia X, García-Pérez AL, Rarral M. Helminth parasites of the Eurasian badger (Meles meles L.) in the
Basque country (Spain). Eur J Wildl Res 2004; 50: 37-40. https://doi.org/10.1007/s10344-003-0032-x
37. Torres J, Miquel J, Fournier P, Fournier-Chambrillon C, Liberge M, Fons R, Feliu C. Helminth communities of the autochthonous mustelids Mustela lutreola and M. putorius and the introduced Mustela vison in south-western France. J Helminthol 2008; 82: 349-355. https://doi.org/10.1017/S0022149X08046920
38. Parker MV. Euryhelmis squamula (Rudolphi), 1819 reported from a raccoon. J Parasitol 1950; 36: 89.
39. Senger CM, Neiland KA. Helminth parasites of some fur-bearers of Oregon. J Parasitol 1955; 41: 637-638. http://www.jstor.org/stable/3274151
40. Yagisawa M. Studies on zoonotic helminths from mammals in Northern Honshu, Japan. Hirosaki Med J 1978; 30: 239-284 (in Japanese).
