

Parasitological Survey on Wild Carnivora in North-Western Tohoku, Japan

Hiroshi SATO, Takashi INABA, Yasushi IHAMA and Haruo KAMIYA*

Department of Parasitology, Hirosaki University School of Medicine, 5 Zaifu-cho, Hirosaki 036-8562, Japan

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ABSTRACT. In the winter of 1997–1998, we collected parasitological data from 60 wild carnivora in the north-western part of Tohoku region, Japan. These included 7 foxes (*Vulpes vulpes japonica*), 20 raccoon dogs (*Nyctereutes procyonoides viverrinus*), 29 martens (*Martes melampus melampus*), 3 weasels (two *Mustela sibirica itatsi* and one *M. nivalis namiyei*), and one Japanese badger (*Meles meles anakuma*). Roundworms (*Toxocara canis* in foxes and *Toxocara tanuki* in raccoon dogs), hookworms (*Ancylostoma kusimaense* and *Arthrostoma miyazakiense*) and *Molineus* sp. in the small intestine were the most prevalent in foxes and raccoon dogs. In martens, *Aonchotheca putorii* in the stomach, *Concinnum ten* in the pancreatic duct, *Molineus* sp. and *Euryhelminis costaricensis* in the small intestine were the most prevalent. Collected parasites include some new helminth species for this region or Japan; the strobilar stage of *Taenia polyacantha* from foxes, *Pygidiopsis summa* from a raccoon dog, *Eucoleus aerophilus*, *A. putorii*, and *Soboliphyme baturini* from martens.—**KEY WORDS:** Japan, *Martes melampus*, *Nyctereutes procyonoides*, Parasite, *Vulpes vulpes*.

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Yagisawa [14] examined parasitic helminths from 878 mammals of 17 species (16 genera) collected in the northern part of Tohoku region (Aomori, Akita and Iwate Prefectures), Japan, during the period of 1966–1977, and detected 49 helminth species belonging to 40 genera. Recently, distribution of some helminth parasites including zoonotic species that were not recorded by Yagisawa [14] has been reported in the same region. These include *Gnathostoma nipponicum* from Japanese weasels (*Mustela sibirica itatsi*) in Aomori Pref. [8] that is a cause of several human cases of creeping eruption and itching there [11]. Furthermore, *Taenia crassiceps* and *Taenia polyacantha* were found from wild rodents, *Microtus montebelli montebelli* and *Apodemus argenteus argenteus*, respectively, in Aomori Pref. [3]. These two taeniid species have been rarely or never recorded in Japan [13].

In the winter of 1997–1998, we collected parasitological data from 60 wild carnivora including 7 foxes, 20 raccoon dogs and 29 martens in the north-western part of Tohoku region. Collected parasites include some new helminth species for this region or Japan.

MATERIALS AND METHODS

All examined carcasses were obtained from a taxidermist living in Hirosaki, Aomori Pref., after his process. These included 7 foxes (*Vulpes vulpes japonica*), 20 raccoon dogs (*Nyctereutes procyonoides viverrinus*), 29 martens (*Martes melampus melampus*), 3 weasels (two *M. sibirica itatsi* and one *Mustela nivalis namiyei*), and one Japanese badger (*Meles meles anakuma*) caught in Aomori and Akita Prefectures during the winter (October, 1997 to March,

1998).

After gross examination on the muscle and viscera, helminth parasites were collected separately from the stomach, small intestine and large intestine under a dissection microscope. Collected parasites were fixed in 10% neutral-buffered formalin or 70% alcohol, and parts of cestodes and trematodes were stained with Semichon's carmine and mounted by a conventional technique. The organs having any gross lesions were fixed in 10% neutral-buffered formalin, and processed for histological examination.

RESULTS

Animals were mainly collected in the western part of Aomori Pref., so-called Tsugaru area (Fig. 1). In Akita Pref., 4 foxes, 3 raccoon dogs, 10 martens and one weasel were collected. Helminth parasites collected from foxes, raccoon dogs and martens are listed in Tables 1–3.

Roundworms (*Toxocara canis* in foxes and *Toxocara tanuki* in raccoon dogs), hookworms (*Ancylostoma kusimaense* and *Arthrostoma miyazakiense*) and *Molineus* sp. were the most prevalent in foxes and raccoon dogs. *T. pisiformis* was collected as destrobilated adults, and had large (240–279 μm in length) and small hooks (127–162 μm in length), 20–23 each in number. *T. polyacantha* was found in two foxes from Goshogawara, Aomori Pref., and Ohdate, Akita Pref., as mature or gravid adults having 68–101 proglottides. They have large (218–231 μm in length) and small hooks (133–143 μm in length), 30 each in number. The morphological features of mature proglottides coincided well with the original description [1], and the uterus was longitudinally truncated with 7–9 pairs of transverse branches in gravid proglottides. *Pygidiopsis summa* was collected from one raccoon dog (Fig. 2).

Martens had some helminth species dwelling in extraintestinal locations; *Soboliphyme baturini* and

* CORRESPONDENCE TO: KAMIYA, H., Department of Parasitology, Hirosaki University School of Medicine, 5 Zaifu-cho, Hirosaki 036-8562, Japan.

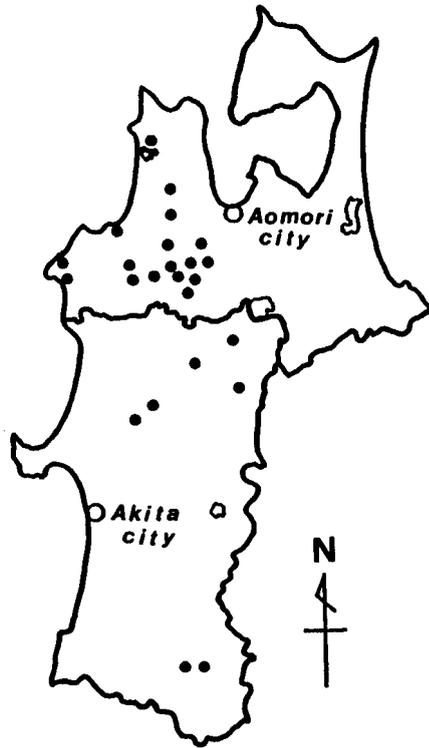


Fig. 1. Localities of collection of wild carnivora in Aomori and Akita Prefectures. One dot means one administrative unit where wild carnivora were collected regardless of the number of animals.

Aonchotheca putorii in the stomach, *Concinnum ten* in the pancreatic duct, and *Eucoleus aerophilus* in the lungs (Fig. 3). *A. putorii*, *Molineus* sp., *C. ten* and *Euryhelmins*

Table 1. Helminth parasites from 7 foxes (*Vulpes vulpes japonica*) in Aomori and Akita Prefectures

Parasite species	Incidence	Intensity (range)
<i>Toxocara canis</i>	71%	1–10
<i>Ancylostoma kusimaense</i>	43%	1–2
<i>Arthrostoma miyazakiense</i>	43%	1–25
<i>Molineus</i> sp.	29%	2–4
<i>Alaria alata</i>	29%	8–21
<i>Metagonimus yokogawai</i>	14%	20
<i>Taenia pisiformis</i>	29%	13–120
<i>Taenia polyacantha</i>	29%	3–28
<i>Spirometra erinaceieuropaei</i>	29%	1–2

Table 2. Helminth parasites from 20 raccoon dogs (*Nyctereutes procyonoides viverrinus*) in Aomori and Akita Prefectures

Parasite species	Incidence	Intensity (range)
<i>Toxocara tanuki</i>	80%	1–29
<i>Ancylostoma kusimaense</i>	75%	1–40
<i>Arthrostoma miyazakiense</i>	90%	1–207
<i>Molineus</i> sp.	50%	1–30
<i>Trichuris vulpis</i>	5%	1
<i>Echinostoma cinetorchis</i>	15%	1–28
<i>Echinoparyphium recurvatus</i>	15%	1–19
<i>Metagonimus takahashii</i>	10%	3–62
<i>Metagonimus yokogawai</i>	5%	26
<i>Pygidiopsis summa</i>	5%	33
<i>Pseudotroglorema</i> sp. (?)*	10%	1
<i>Taenia pisiformis</i>	10%	13–26
<i>Spirometra erinaceieuropaei</i>	5%	2
<i>Centrorhynchus elongatus</i>	5%	3

* This trematode had a morphology closely resembling to *Pseudotroglorema* sp. reported by Yagisawa [14], but still immature.

Table 3. Helminth parasites from 29 martens (*Martes melampus melampus*) in Aomori and Akita Prefectures

Parasite species	Incidence	Intensity (range)
<i>Eucoleus aerophilus</i>	17%	Not examined
<i>Aonchotheca putorii</i>	72%	1–104
<i>Molineus</i> sp.*	48%	1–37
<i>Soboliphyme baturini</i>	3%	1
<i>Concinnum ten</i>	48%	3–1522
<i>Echinostoma hortense</i>	7%	1–4
<i>Euryhelmins costaricensis</i>	38%	1–1476
Unidentified small trematode from the lungs	3%	Not examined
<i>Pseudotroglorema</i> sp. (?)*	7%	1–2
Cestode with armed rostellum from the small intestine	3%	1
Cestode with rudimentary rostellum from the small intestine	3%	9
<i>Centrorhynchus elongatus</i>	24%	1

* Detailed morphological features of these parasites were recorded by Yagisawa [14].

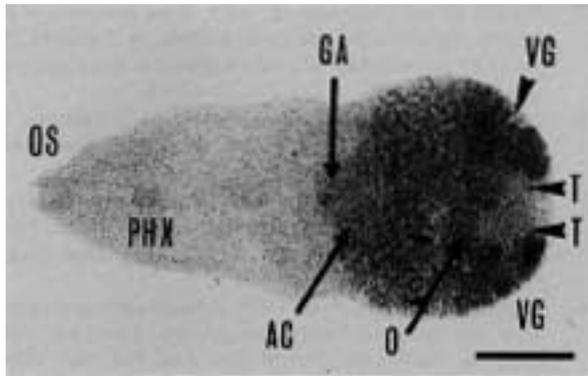


Fig. 2. *Pygidiopsis summa* from a raccoon dog. Abbreviation: AC, acetabulum; GA, genital atrium; O, ovary; OS, oral sucker; PHX, pharynx; T, testis; VG, vitelline gland. Semichon's carmine stain, scale bar = 0.100 mm.

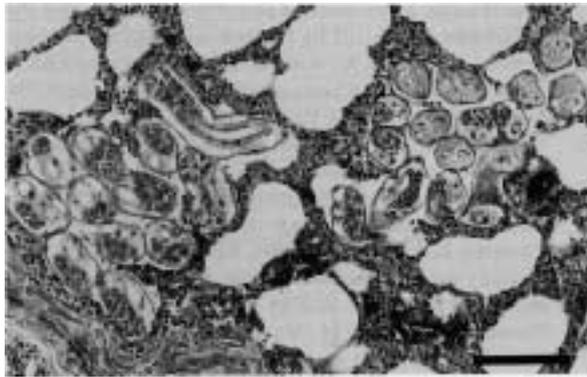


Fig. 3. Young adults of *Eucoleus aerophilus* without eggs in the lungs of a marten. HE stain, scale bar = 0.100 mm.

costaricensis were the most prevalent in this animal species. A single species, *Echinostoma hortense*, was found in two *M. sibirica itatsi*. No parasites were found from a *M. nivalis namiyei* and a Japanese badger.

Gross examination detected white miliary nodules disseminated in the lungs, heart and striated muscles of one male raccoon dog and 8 martens (6 males and 2 females). These animals had adiaspiromycosis in the lungs or hepatozoonosis in muscular tissues, and the lesions were not caused by helminth infections.

DISCUSSION

Yagisawa [14] reported helminth parasites from wild carnivora including 26 foxes, 49 raccoon dogs and 151 martens captured in the northern part of Tohoku region. Although most of parasites reported in this study were listed in his report, some new helminth species for this region or Japan were found as follows; the strobilar stage of *T. polyacantha* from foxes, *P. summa* from a raccoon dog, *E. aerophilus*, *A. putorii* and *S. baturini* from martens. In

addition, a high incidence of adiaspiromycosis in the lungs or hepatozoonosis in muscular tissues of martens was detected. The incidence of the latter is, however, lower than that reported by Yanai *et al.* [15] who detected it in 96% (67 out of 70) martens caught in Gifu Pref., the central part of Japan.

Metacestodes of *T. crassiceps* and *T. polyacantha* that were believed to be uncommon in Japan, were recently found from *M. m. montebelli* and *A. a. argenteus*, respectively, in Aomori Pref. [3]. In this study, the strobilar stage of *T. polyacantha* was found in two foxes from distant localities. This species distributes in the northern part of Eurasia including western Europe and U.K., and Alaska [1, 5]. Rausch and Fay [9, 10] distinguished two subspecies, *T. p. polyacantha* in Eurasia south of the tundra zone and *T. p. arctica* throughout the holarctic tundra. The morphological characters of our specimens are consistent with *T. p. polyacantha*.

P. summa was found for the first time from a raccoon dog. This species is prevalent in the western part of Japan, and has been found from wild birds such as black kite (*Milvus migrans*), black-crowned night heron (*Nycticorax nycticorax*), and grey heron (*Ardea cinerea*), dogs, cats and humans. Ishida *et al.* [4] found a high prevalence of *P. summa* metacercariae in striped mullets (*Mugil cephalus*) (78.7%; 26 out of 33) and natural infections in dogs (1.9%; 4 out of 205) and grey herons (60.0%; 3 out of 5) from Akita Pref.

E. aerophilus and *A. putorii* are cosmopolitan parasites, and found in the mucosa of the respiratory system of carnivores of Canidae, Felidae and Mustelidae, or in the stomach and small intestine of Mustelidae, respectively [2]. *S. baturini* is a parasite mainly of Holarctic terrestrial mustelids (*Martes* spp. and *Mustela* spp.), and found in the stomach and small intestine. *E. aerophilus* has been recorded from Tsushima leopard cats (*Felis bengalensis euphilura*) and Iriomote cats (*Felis iriomotensis*) in the southern part of Japan [16, 17]. *A. putorii* has been recorded from *M. sibirica itatsi* and *Martes zibellina brachyura* from northern Hokkaido, Japan [6]. Our study records these species for the first time from the mainland of Japan (Honshu), indicating that these species are common also in Japan, although records in the past are quite restricted in this country.

This study reveals distribution of some helminth species that have not been recorded previously in northern Tohoku or Japan, although there might remain more helminth species to be recorded from the mainland of Japan [6, 7]. We found for the first time the strobilar stage of *T. polyacantha* from the definitive host, whereas we could not find the strobilar stage of *T. crassiceps* that was recently found from the intermediate host in the same research area [3]. Global distribution of these two taeniid species overlaps that of *Echinococcus multilocularis*, and 16 cases of the human infection in the mainland of Japan are considered to be obtained there, not in Hokkaido island, the endemic area of the organism in Japan [12]. Among these cases, 8 cases

occurred in Aomori Pref. Parasitological researches on wild carnivora have an importance not only to clarify the parasitic fauna of the animal, but also to detect the natural life-cycle of zoonotic helminth species including *E. multilocularis*. From this viewpoint, we plan to continue parasitological surveys on wild carnivora in this region.

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