

Original papers

A survey of intestinal helminths in wild carnivores from the Tatra National Park, southern Poland

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ABSTRACT. From January 2011 to July 2012, 144 faecal samples of wild carnivores from the Tatra National Park were examined to evaluate the prevalence of intestinal helminths – 72 of wolves (*Canis lupus*), 45 of red foxes (*Vulpes vulpes*), 15 of pine martens (*Martes martes*) and 12 of brown bears (*Ursus arctos*). In wolves, monospecific infection with *Trichuris vulpis* (13.9%), *Toxocara canis* (6.9%), *Ancylostoma/Uncinaria* (5.6%) and taeniids (1.4%) was revealed. In red foxes, the most prevalent infection was *T. vulpis* (64.4%), followed by *T. canis* (11.1%), *Ancylostoma/Uncinaria* (8.9%) and taeniids (2.2%). Monospecific infection with *T. vulpis* was more frequent (44.4%), than infection with two species, i.e. *T. vulpis* with *Ancylostoma/Uncinaria*, *T. vulpis* with *T. canis* or *T. vulpis* with taeniids (17.8%). In pine martens, *Trichuris* spp. was the most prevalent (40.0%), while *T. cati* and *Ancylostoma/Uncinaria* were found in 13.3% and 6.7% samples, respectively. In faeces from brown bears, no parasite eggs were found. The present survey of wild carnivores revealed a significant prevalence of parasites such as *Toxocara* spp. and *Trichuris* spp. (8.3% and 31.0% in all examined samples, respectively), which are hazardous to human and animal health.

Key words: intestinal helminths, eggs, infection, faeces, wild carnivores, southern Poland

Introduction

The Tatra National Park (TPN) is located in the Tatra Mountains in southern Poland on the border of Slovakia. The National Park was created in 1954 on an area of 215 km². It is the most visited national park in Poland, with more than 3 million tourists every year. Within this area live many species of predatory mammals, namely wolves (*Canis lupus*), red foxes (*Vulpes vulpes*), pine martens (*Martes martes*), beech martens (*Martes foina*), brown bears (*Ursus arctos*), Eurasian lynxes (*Lynx lynx*), marmots (*Marmota marmota latirostris*), wildcats (*Felis silvestris*), European polecats (*Mustela putorius*), stoats (*Mustela erminea*), least weasels (*Mustela nivalis*), European otters (*Lutra lutra*) and European badgers (*Meles meles*).

The populations of wolves and brown bears in the TPN is more than ten of each species, while red foxes and martens number about a hundred. To date, no examinations of the internal parasites of the

predatory animals in the Tatra National Park have been performed.

The aim of the present study was to provide data on the intestinal helminth fauna of wolves (*Canis lupus*), red foxes (*Vulpes vulpes*), pine martens (*Martes martes*) and brown bears (*Ursus arctos*) from the Tatra National Park, Poland.

Materials and Methods

From January 2011 to July 2012, 144 faecal samples of wolves (72), red foxes (45), pine martens (15) and brown bears (12) from the Tatra National Park were taken for examination. The scats were identified by the staff of the National Park by their appearance, size and shape. The collected samples were frozen at -18°C to eliminate *Ancylostoma/Uncinaria* larvae hatching from eggs.

To recover the parasite eggs, flotation with saturated NaCl solution (specific gravity 1.2) was used according to Fülleborn's method with Willis'

modification. In the procedure, 1 gram of faeces was mixed with 10 ml of saline solution, passed through a sieve, and then transferred to a 10 ml centrifuge tube. The tubes were centrifuged at 1200 rpm for 10 min. The solution was added to each tube to form a meniscus and a coverslip was overlaid. After 15 min, the coverslip was transferred to a glass slide and the parasite eggs were counted under a light microscope at 100× magnification.

The eggs were identified according to their morphological features as described by Mehlhorn et al. [1]. Both the percentage of positive samples and the number of worm eggs per gram of feces sample (epg) were calculated.

Results

The results are shown in Table 1. Among 144 faecal samples examined in 60 samples (41.7%) helminth eggs were found. No eggs were revealed in samples from bears. Among 72 faecal samples from wolves, monospecific infection was found in 20 (27.8%): *Toxocara canis* (6.9%), *Trichuris vulpis* (13.9%), *AncylostomalUncinaria* (5.6%) or taeniids (1.4%). Both *T. canis* and *T. vulpis* infection was revealed in one sample (1.4% of all wolf samples).

Out of the 45 faecal samples of red foxes, 31 contained parasite eggs (68.9%). The most prevalent was *T. vulpis* (64.4%), along with *T. canis* (11.1%), *AncylostomalUncinaria* (8.9%) and taeniids (2.2%). Monospecific infection with *T. vulpis* was more frequent (44.4%), than infection by two species (*T. vulpis* with *AncylostomalUncinaria*, *T. vulpis* with *T. canis*, and *T. vulpis* with taeniids) or three species (*T. canis*, *T. vulpis* and *AncylostomalUncinaria*) (17.8% and 2.2% of all red fox samples, respectively). Among 15 faecal samples from pine martens, *Trichuris* spp. was the most prevalent (40.0%), while *T. cati* and

AncylostomalUncinaria were found to be 13.3% and 6.7%, respectively.

A considerable number of *Trichuris* and *Toxocara* eggs per gram (epg) was found in samples from red foxes, pine martens and wolves, with respective mean epg values of 132.2 (1–592), 84.7 (1–284), 22.2 (1–120) for *Trichuris*, and 27.2 (3–65), 156.0 (40–272), 69.2 (4–262) for *Toxocara*. For *AncylostomalUncinaria*, the mean epg was 25.5 (2–40) in foxes and 3.0 (1–5) in wolves. In case of taeniids, 22 eggs were found in each wolf sample while one egg was found in each fox sample.

Discussion

Parasite eggs were found to be present in 41.4% of the examined faecal samples from five species of wild carnivores, with 27.8% samples being positive in wolves, 68.9% in foxes and 53.4% in martens. In this study, only a small number of samples were obtained from brown bears (12) due to the difficulty of obtaining material in the large mountainous area inhabited by their small population. Accordingly, in the case of the 72 samples collected from wolves, the small population of these predators in the Tatra National Park (about ten animals) implies that some samples were obtained from the same individual.

Infection with *Toxocara* spp. and *Trichuris* spp. was found in wolves, red foxes and pine martens, with the highest prevalence of *Trichuris vulpis* being seen in red foxes (64.4%). Ascarids and hookworms are the most common parasites in wild carnivores all over the world.

In Poland and other European countries, *Toxocara canis* has been recorded in wolves. *T. canis* was found in the mountainous areas of southern Poland, with a prevalence of 5.6%, in the wooded areas of north-eastern Poland (13.5%), in Latvia (5.8%) and in southern Kazakhstan (39%)

Table 1. Prevalence of intestinal helminths based of faecal sample examination in wolves (*Canis lupus*), red foxes (*Vulpes vulpes*) and pine martens (*Martes martes*) from the Tatra National Park, Poland

Host Family	Species	Number of samples	% positive					
			<i>Toxocara canis</i>	<i>Toxocara cati</i>	<i>Trichuris vulpis</i>	<i>Trichuris</i> spp.	<i>Ancylostoma/Uncinaria</i>	Taeniidae
Canidae	<i>Canis lupus</i>	72	6.9		13.9		6.9	1.4
Canidae	<i>Vulpes vulpes</i>	45	11.1		64.4		8.9	2.2
Mustelidae	<i>Martes martes</i>	15		13.3		40.0	6.7	–

[2–5]. The present study identified *Trichuris vulpis* eggs in 13.9% samples from wolves, a lower level than was noted in north-eastern Poland, 38.5% (3), and in southern Kazakhstan, 22.0% [5].

Ancylostoma/Uncinaria eggs were found at a low prevalence in samples taken from wolves in the Tatra National Park (5.6%), however Kloch et al. [3] found the parasites in 31% of faecal samples from 57 wolves. One wolf sample was found to contain taeniid eggs (1.4%), which can not be determined to the species level based on their morphology. Segovia et al. [6] found four species from the Taeniidae family in wolves from various localities in Spain: *T. hydatigena*, *T. multiceps*, *T. serialis* and *T. pisiformis*.

Red foxes are the most frequently studied wild carnivore species. An analysis of available data shows that the intestinal helminth fauna of red foxes from the Tatra National Park bears a strong resemblance to those found in other regions in Poland. The most common nematodes in foxes identified in previous studies include *T. canis* (13.6%–28.3%), *T. vulpis* (28%) and *Uncinaria stenocephala* (11.1%–35.8%) [7,8,9]. Previously, *Alaria alata* flukes (2.2%–56.7%) and the tapeworms *Mesocestoides* spp. (63.8%–76.8%) and *Echinococcus multilocularis* (1%–62.9%) have also been found in foxes [8–13].

In this study, two nematode species were found in pine martens: *T. cati* and *Trichuris* spp. Górski et al. [7] note the presence of *T. cati* and *Uncinaria criniformis* in the same host species from Białowieża Primeval Forest (eastern Poland). Segovia et al. [6] found seventeen helminth species, with three dominant trichurid species, in pine martens from the Iberian Peninsula and Balearic Archipelago: namely *Pearsonema plica*, *Eucoelus aerophilus* and *Aonchotheca putorii*, which constituted 72.2% of total helminth individuals detected.

In bear faeces collected in the Tatra National Park, no parasites were present. Other authors showed the most frequent bear parasite to be *Baylisascaris transfuga*, followed in order of prevalence, by the fish tapeworm *Diphyllobothrium* spp., taeniid tapeworms, *Uncinaria* spp. hookworms, *Echinostoma revolutum* flukes and the filarial worm *Dirofilaria ursi* [14].

The present survey in wild carnivores revealed considerable prevalence of parasites such as *Toxocara* spp. and *Trichuris* spp., which are hazardous to human and animal health: present in 8.3% and 31.0% in all examined samples,

respectively. Trichurids were highly prevalent in foxes (64.4%) and martens (40.0%), and their faecal samples contained a considerable number of eggs: mean 132.2 epg in foxes, 84.7 in martens. Ascarids were found in wolf, fox and marten faeces, with a prevalence of 6.9%–13.3%: the highest epg of *T. cati* being in martens, with a mean value of 156.0. Hence, a high potential exists for the spread of trichurid and ascarid eggs by wild carnivores. Red foxes act as main parasite reservoirs for pet dogs, and through the invasion of urban areas, play an important role in the transmission of helminthic zoonoses.

The present survey reveals a serious risk of such zoonoses in the Tatra National Park for tourists, especially children. Regional county authorities should implement educational programs for the prevention of zoonotic parasite infections aimed at visitors to the Tatra National Park. Posters and noticeboards should provide such information for residents and guests.

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