A survey of helminths of polar bears in the Russian Arctic

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Abstract

The polar bear *Ursus maritimus* is a circumpolar species classified as vulnerable and included in the IUCN Red List. It is considered to be practically free of helminth parasites with the only species reported being *Trichinella spiralis* s. l. Samples of feces were collected on Chukotka coast, Wrangel Island and on ice floes in the Kara, Laptev and Chukchi seas in 2013-2015 in different seasons of the year. Coprological diagnostics was carried out using the standard flotation and sedimentation methods. In the samples collected in the snow-free period, a single sample (3.7%) was found to contain eggs of the nematode *Toxascaris* sp. In three out of 9 samples collected in the winter, eggs of a cestode *Diphyllobothrium* sp., of unidentified trematodes (presumably Heterophyidae) and of the strongylid nematode *Uncinaria stenocephala* were found as well as the first stage nematode larvae tentatively identified as *Crenosoma* sp. Viable *Trichinella nativa* larvae were recovered from the muscles of a female animal from north of Yakutia.

Key words: *Ursus maritimus*, parasites, coproscopy, helminth eggs, *Trichinella*, *Diphyllobothrium*

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Introduction

The polar bear *Ursus maritimus* is a circumpolar Arctic species, an obligate carnivore. The main area of its distribution is the Arctic ice in the zone of the continental shelf along the Arctic Ocean, where the most productive habitats of marine mammals, *i.e.* the ringed seal (*Phoca hispida*), the bearded seal (*Erignathus barbatus*) and the walrus (*Odobenus rosmarus*) are concentrated. According to recent estimates, the total population of the polar bear accounts about 25 thousands of animals with 5,600-6,000 adults permanently inhabiting the territory of the Russian Federation (Wiig et al. 2015). Arctic ice melting owing to global warming as well as habitat pollution and loss together with poaching have led to a steady reduction in the global polar bear population in recent years (Derocher et Lynch 2012). The polar bear is listed in the International Union for Conservation of Nature's (IUCN) Red List of

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Threatened Species and Red Data Book of Russia and the polar bear hunt is outlawed in Russia ([1]).

The polar bears are considered to be practically free from helminths in nature unlike other species of the family Ursidae. *Trichinella spiralis* s.l. is the only species of helminths quite often recorded in a wild polar bear (Rogers et Rogers 1976, Uspensky 1989, Forbes 2000, Derocher et Lynch 2012). Recent studies have shown that *Trichinella* isolates from the polar bear actually belong to the species of *Trichinella nativa* (Pozio et al. 1992, Forbes 2000, Gajadhar et Forbes 2010, Skırnisson et al. 2010). Apart of *Trichinella*, a single case of a seropositive animal to *Dirofilaria* sp. has been revealed while carrying out serological studies of blood samples of bears from the islands of the Barents Sea (Naidenko et al. 2013).

Material and Methods

Totally, 36 samples of feces of polar bears were collected in different regions of the Russian Arctic and in different seasons of the year in 2013-2015. Twenty-seven samples were collected during the snow-free period (August-September) along the coast of the Chukotka Peninsula and Wrangel Island and 9 samples in the winter time from the ice surface at the Kara, Laptev and Chukchi seas. The samples were taken using the standard method avoiding contamination with a foreign material, and were stored frozen up before the examination. Coprological diagnostics was carried out using standard methods of flotation in a solution of sodium nitrate and ether-formalin sedimentation followed by microscopy (Zajac et Conboy 2012). Samples of the muscle tissue from the head of the female polar bear found dead at the Cape Krestovyi at the mouth of the River Kolyma (northern Yakutia) were studied using the trichinoscopic method (Nöckler et al. 2000). Samples were examined using a light microscope Zeiss Axio Imager Z1. Microphotographs and measurements were taken with the help of a digital camera attached to the microscope, and the associated software Zeiss Axio Vision.

Results and Discussion

Of the 27 samples of faeces collected during a snowless period on the coast, only in one sample (3.7 %) were found eggs of *Toxascaris* sp. Of the 9 samples collected during the winter on ice floes, in 3 (33%) were revealed eggs or larvae of *Diphyllobothrium* sp., *Uncinaria* sp., *Trematoda* gen. sp., *Crenosoma* sp.

The eggs of *Toxascaris* sp. in our material were most similar to *Toxascaris leonina* but smaller in size: 66-76 × 54-58 μm versus 75-85 × 60-75 μm in *T. leonina* as described elsewhere (Zajac et Conboy 2012) (Fig. 1). *T. leonina* is a common intestinal parasite of many species of canids and felids. There is a possibility that *Toxascaris* eggs appeared in the polar bear's feces as the result of consuming an infested polar fox.

The eggs of *Diphyllobothrium* sp. measuring 64-72 × 41-44 μm were found in two samples (Fig. 2). Cestodes of this genus are quite common parasites of the brown bear, and so far have been recorded only in polar bears held in captivity (Rogers et Rogers 1976). In the wild they could get infected with this parasite by eating dead fish picked up on the coast during the snowless season.

Small eggs of a trematode (21-23 × 15-17 μm) were detected in a single sample (Fig. 3). Though the specific/generic identification of the eggs was not possible, we assume that they may belong to Heterophyidae family based on its morphology and small size. Representatives of this family are known to parasitize carnivorous mammals and widely distributed in the northeast of Eurasia.

Eggs of a strongylid, closely resembling *Uncinaria stenocephala* and measuring 86-90 × 45-51 μm, were also found in a single sample (Fig. 4). Currently, four species of *Uncinaria* are known as parasites of bears (Ursidae): in Eurasia, there are *U. stenocephala* and *U. skrjabini* from the brown bear (Kozlov 1977) and in North America *U. rauschi* and *U. yukonensis* from the grizzly bear (*Ursus arctos horribilis*) and the American black bear (*Ursus americanus*) (Catalano et al. 2015). *U. stenocephala* is the most widely distributed of all *Uncinaria* and parasitize a wide range of carnivores. It is the first record of *Uncinaria* from polar bears but may present the case of pseudo-infection from prey (*e.g.* polar fox).

The first stage larvae tentatively identified as the lung nematodes belonging to *Crenosoma* sp. were detected in one sample (Fig. 5). The larvae lacked a tail spine and their morphometrics were identical to those described in Conboy (2009). Species of *Crenosoma* are mainly parasites of carnivorous mammals and were reported from the brown bear in Kamchatka (Tranbenkova 2006) and the American black bear in North America (Rogers et Rogers 1976, Addisone 1978).

The fact that in the snow-free period the only sample was positive for one helminth species while three ones collected in the winter revealed the infection by 4 helminth species can be indicative of the change in the seasonal structure of host diet. In the snow-free period, polar bears usually abandon hunting marine mammals and mainly feed on lemmings consuming them often together with its nest material. We presume that the change of the diet with the starvation and the consumption of coarse plant elements in the snow-free period can help to release of intestinal helminths.

Viable *Trichinella* larvae were found in the samples of muscle tissue of the female host (Fig. 6). The larvae were in fully formed rounded capsules with thick and well defined walls. At the poles of the capsules aggregated fat globules were observed. Walls of the capsules were moderately calcified. It is indicative of a long-standing infection of the particular animal.

The high prevalence of trichinosis in polar bears was observed by many researchers. According to Forbes (2000), the infection was registered in different parts of the Arctic with prevalence reaching 59% in the Barents and Norwegian seas. Serological studies of the blood of polar bears on the territory of Canada, Norway, Greenland, USA and Russia revealed a high level of seropositivity to *Trichinella* antigens among adult animals. The highest values were recorded in the Franz Joseph Land archipelago (90.9%), in the Svalbard archipelago (78%) and in Chukotka and Alaska (51%) (Åsbakk et al. 2010, Naidenko et al. 2013).

Concluding remarks

Contrary to the previous studies on the parasite fauna of a polar bear with the only nematode species (*Trichinella spiralis s. l.*) so far recorded, the present study has revealed in the feces of the host the presence of yet another 5 species of helminths belonging to different higher taxa. The fact points out at the necessity of the further research on parasites of a polar bear and will help to assess the role of helminths in the well-being of this endangered mammal species.

Fig. 1. *Toxascaris* sp. egg

Fig. 2. *Diphyllobothrium* sp. egg

Fig. 3. *Trematoda* gen. sp. egg

Fig. 4. *Uncinaria* sp. egg

Fig. 5. *Crenosoma* sp. larva

Fig. 6. *Trichinella* capsule in muscle tissue

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