

Endoparasites of wild boars (*Sus scrofa*) in Primorsky Krai, Russia

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Summary

This study identified helminthic species among wild boars (*Sus scrofa*) in Primorsky Krai, Russia. In total, 66 fecal samples were taken from wild boars and examined using the floatation-sedimentation method to identify helminths eggs and protozoan cysts. Age and sex were estimated for each host animal investigated. The helminthic fauna of the wild boars examined involved six parasite genera, but 4 are helminths and 2 are protozoans: the nematodes *Metastrongylus* spp., *Trichuris suis*, *Capillaria* sp. and *Ascaris suum*; and the protozoan parasites *Eimeria* sp. and *Cystoisospora suis*. The most prevalent parasite was *Metastrongylus* spp. (13.6 %) followed by *Trichuris suis* (7.6 %). The other parasites found were *Eimeria* sp. (3 %), *Ascaris suum* (3 %), *Capillaria* sp. (1.5 %) and *Cystoisospora suis* (1.5 %).

Not found positive correlation between the host's age and sex and the parasite prevalence. This was the first detailed study on helminths infections among wild boars in Primorsky Krai.

Keywords: helminths; protozoans, feces; prevalence; wild boars

Introduction

Wild boars (*Sus scrofa*) have worldwide distribution and are commonly encountered in Primorsky Krai (Primorye region), Russia. This area is located in the extreme southeastern part of Russia and have border with North Korea and the Heilongjiang province of China. Wild boars are living in the forests of southern, south-western, northern and northeastern parts of the Primorye region in dense populations (Ramayo *et al.*, 2011). They form part of the diet of rare carnivores living in this region, such as the Amur tiger (*Panthera tigris altaica*) and Far Eastern leopard (*Panthera pardus orientalis*).

Wild boars have also an important role in the epizootiology and circulation of some major infections (African Swine Fever; Classical

Swine Fever) and some zoonotic parasites. They can also transmit zoonotic helminths and protozoa to humans living in rural communities where wild boars roam freely around the villages. There is a lack of data regarding helminths in the gastrointestinal and hepatic systems of wild boar populations in Primorsky Krai. We focused our work on this area of research through by microscopic fecal examination.

Materials and Methods

Between December 2017 and January 2018, fecal samples were taken from 66 wild boars in Primorsky Krai. Totally investigated of 34 males and 32 females. These samples were collected from 10 areas, in hunting areas including Anuchinskii, Mihailovskii, Us-

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Fig. 1. Map of research area (Primorye region).

suriiskii, Spasskii, Partizanskii, Pogranichnii, Yakovlevskii, Krasnoarmeiskii, Pozharskii and Chuguevskii districts. Each sample was placed in plastic jar that labeled with records of the animal's age and sex. The age of each boar has been determined through examination of the teeth, as described by Sáez-Royuela *et al.* (1989) (Table 1, Fig. 1).

Fecal examination

All the fecal samples were examined through light microscope for the presence of helminths eggs, proglottids and protozoan cysts. All of them placed to the Far Eastern Bank of Biological Materials (Shchelkanov *et al.*, 2017). Before examination, the samples were

stored at 6 °C during for 2 – 3 days. Each sample examined by means of the flotation technique using commercially available zinc sulfate solution (specific gravity, SG 1.18 – 1.2). The quantity of 3 – 5 gr of the sample was placed in a 10 mL glass jar with a saturated zinc sulfate solution and then mixed thoroughly using glass rod and stored for 10 – 15 min. Helminths eggs and protozoa cyst, that came to the surface, were collected using a copper loop and placed on a slide with some drops of glycerol. The classical sedimentation method used for detection of Trematoda eggs (Becker *et al.*, 2016).

Statistical analysis

Table 1. Wild boars investigated.

Host parameter	Totally examined	Infected	Prevalence, %
Sex			
Female	32	10	31.3
Male	34	10	29.4
Total	66	20	30.3
Age			
Piglets	23	5	21.7
1-2 years of ages	13	7	53.8
2-3 years of ages	7	2	28.6
3-4 years of ages	21	6	28.6
Elder than 4 years of ages	2	0	-
Year			
2017	38	9	23.7
2018	28	11	39.3

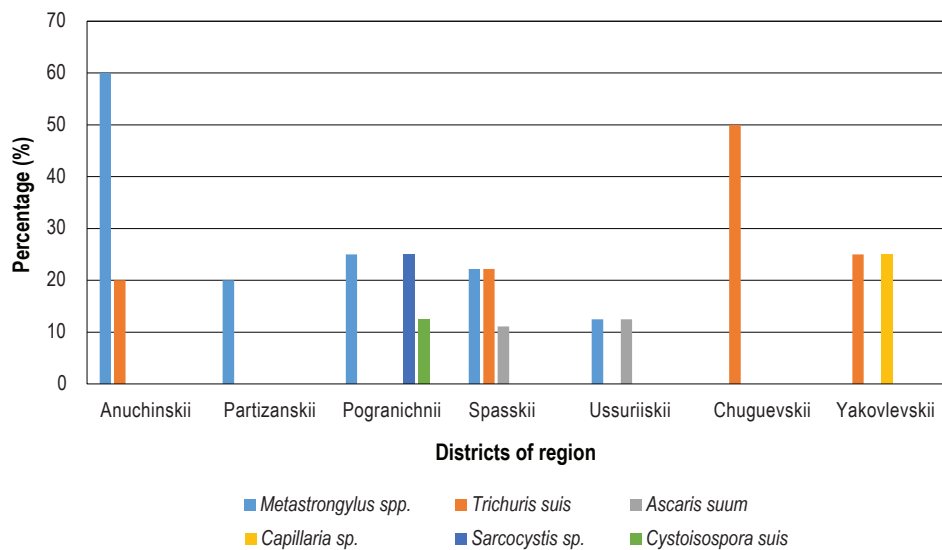


Fig. 2. The prevalence of wild boar intestinal parasites in Primorye region.

The data analyzed using Stata/MP 14.1. Correlations between infection and wild boars' age and sex were determined using Fisher's exact test. Bivariate logistic regression was used to assess associations between infection and the animals' characteristics. Odds ratios (OR) and 95 % confidence intervals (CI) were calculated and $p < 0.05$ was considered to be statistically significant.

Ethical Approval and/or Informed Consent

This research relating to animals complied with all the relevant national regulations and institutional policies for the care and use of animals (Federal Act entitled "The animal world" (1995); Far Eastern Federal University ethical statement).

This study received approval from a research committee at the Far Eastern Federal University, under protocol number 612-004, dated December 10, 2017.

Results

Intestinal parasites were found in 20 (30.3 %) of the 66 wild boars studied. In total six parasite genera/species were found. The most parasites belong to Nematoda (66.6 %) and some of them belong to Protozoa (33.3 %). The most prevalent parasites were *Metastrongylus* spp. (13.6 %) followed by *Trichuris suis* (7.6 %). The other parasites found were *Eimeria* sp. (3 %), *Ascaris suum* (3 %), *Capillaria* sp. (1.5 %) and *Cystoisospora suis* (1.5 %). Infection was present in 31.3 % of the females and 29.4 % of the males. In total six parasite species were found in the females. The most prevalent parasites in females were *Metastrongylus* spp. (9.4 %), followed by *Sarcocystis* sp. and *Ascaris suum* (6.3 %). The other species found had low prevalence (Table 2). In the males, the most prevalent parasites were *Metastrongylus* spp.

(17.6 %) and *Trichuris suis* (11.7 %) (Table 2).

The highest parasite prevalence was among wild boars aged 1 – 2 years (53.8 %), followed by those aged 2 – 3 years (28.6 %) and 3 – 4 years (28.6 %), then piglets (21.7 %). Parasite infections were not found in boars older than 4 years.

Seven out of ten of the areas investigated were positive for infected wild boars. The highest parasite prevalences appeared in Anuchinskii (80 %), Pogranichnii (62.5 %) Spasskii (55.5 %) and Chuguevskii (50 %) districts. *Metastrongylus* spp. was found in five areas: Anuchinskii, Partizanskii, Pogranichnii, Spasskii and Ussuriiskii. Another frequently found parasite was *Trichuris suis*, which was recorded in four areas: Anuchinskii, Spasskii, Chuguevskii and Yakovlevskii, among which the highest prevalence was in Spasskii district (33.3 %) (Fig. 2).

Higher parasite prevalences were recorded in 2018 (Table 2).

A positive correlation was found between parasite prevalence and sex ($p < 0.05$). The prevalence was higher in males.

No correlations were found between prevalence and other parameters (age and area investigated).

Discussion

The aim of the present study was to investigate wild boar parasites in the Primorye region. There are few researches about wild boar parasites in Russia. Our study was the first to highlight the prevalence of parasites in wild boars in Primorsky Krai.

The six genera of parasites found, included four genera/species of nematodes and two protozoan genera/species. Some have zoonotic potential such as *Capillaria* sp. and *Ascaris suum*. Significant zoonotic endoparasites of wild boar, such as cysticercosis, trichinosis and cestodosis, which were not studied in this work.

Previously found the lungworm *Metastrongylus* spp. is the most

Table 2. Results of parasitological examination.

Species	<i>Metastrongylus</i> spp.	<i>Sarcocystis</i> sp.	<i>Cystoisospora suis</i>	<i>Trichuris suis</i>	<i>Ascaris suum</i>	<i>Capillaria</i> sp.
Sex						
Female	3(15.0%)	2(10.0%)	1(5.0%)	1(5.0%)	2(10.0%)	1(5.0%)
Male	6(30.0%)			4 (20.0%)		
Age						
Piglets	4 (20.0%)			1(5.0%)		
1-2 years of ages	2(10.0%)	2(10.0%)	1(5.0%)	1(5.0%)	1(5.0%)	
2-3 years of ages	1(5.0%)			1(5.0%)		
3-4 years of ages	2(10.0%)			2(10.0%)	1 (5.0%)	1 (5.0%)
Elder than 4 years of ages	0	0	0	0	0	0
Year of research						
2017	7(35.0%)			2(10.0%)		
2018	2(10.0%)	2(10.0%)	1(5.0%)	3(15.0%)	2(10.0%)	1(5.0%)

prevalent parasite of wild boars in Europe (Castagna *et al.*, 2018; García-González *et al.*, 2013; Senlik *et al.*, 2013; Panayotova-Pencheva *et al.*, 2018). These results can be explained by the wide geographical distribution of earthworm species, which act as intermediate hosts for *Metastrongylus* spp. and form part of wild boars' diet (Antipov *et al.*, 2018).

The species *Ascaris suum* and *Trichuris suis* were previously recorded in wild boars in Poland (Popiolek *et al.*, 2010), Spain (Gasso *et al.*, 2015), Brazil (da Silva *et al.*, 2013) and Finland (Hälli *et al.*, 2010). *Capillaria* spp. was previously recorded in wild boars in Slovakia (Kanka *et al.*, 2017) and Tunisia (Lahmar *et al.*, 2009). Although fecal examination is a simple method, it is also less effective than parasitological autopsy. Some studies based on examination of fecal samples from wild boars have been conducted (Moretta *et al.*, 2010).

In Bulgaria, eleven parasite genera were found based on fecal examination. *Metastrongylus* sp. was the most prevalent species (28.8 %) (Panayotova-Pencheva *et al.*, 2018). The most prevalent species in wild boars in Italy, based on coproscopic examination, was *Ascaris suum* (Castagna *et al.*, 2019). In the research that conducted in Umbria, central Italy, the most prevalent parasite was also *Metastrongylus* spp. (Castro *et al.*, 2018).

Eimeria spp. are frequently found as parasites in *Sus scrofa* worldwide (Calero-Bernal *et al.*, 2016; Berger-Schoch *et al.*, 2011; Castro *et al.*, 2018). In our study, *Eimeria* sp. had low prevalence due to the low sensitivity of the fecal flotation method. Because of the low concentration of *Eimeria* oocysts in fecal material, these species were not identified in the present study.

Host factors such as age and sex can influence the presence of parasite infection (Krasnov *et al.*, 2005; Marwaha *et al.*, 2019;

Moretta *et al.*, 2011). For example, young animals are frequently affected by parasites due to immature immune system and perinatal infection of some parasite species. Animals' diet and activity also influences on parasite infection rates. For example, piglets are often infected by *Metastrongylus* spp. due to eating more earthworms than adults do (Senlik *et al.*, 2011). In the current study, male sex was associated with infection. This can relate to cold season of the year when boars aren't eating earthworms.

In conclusion, the present study showed that wild boars are infected with a broad spectrum of parasites. This is one of the first studies to investigate the parasites of wild boars in Primorsky Krai. Therefore, further comparative studies to determine the population dynamics, prevalence, intensity and abundance of helminths would help in assessing the relationship between these parasite communities and their host populations.

Conflict of Interest Statement

The authors declare that they did not have any conflict of interest in conducting this study. Moreover, the authors do not have any potential conflict of interest pertaining to this submission to Helminthologia.

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