

Original papers

Studies on the gastrointestinal and lung parasite fauna of wild boars (*Sus scrofa scrofa* L.) from Bulgaria

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ABSTRACT. Eighty fecal samples from free living wild boars and internal organs from eleven hunted animals from Bulgaria were investigated during 2016–2017. The fecal samples were analyzed with the coproscopical methods of Fulleborn, Shterbovich and serial sedimentations, as well as the modified Baermann technique. Helminthological necropsies of the lungs and gastrointestinal tracts of the animals were carried out through the common technique. Ten helminth genera (*Metastrongylus*, *Strongyloides*, *Oesophagostomum*, *Hyostrongylus*, *Globocephalus*, *Nematodirus*, *Ascaris*, *Ascarops*, *Trichuris*, *Macracanthorhynchus*) and one protozoa (*Eimeria*) were established through coproscopical investigations. Helminths of the species *Metastrongylus elongatus*, *M. pudendotectus*, *M. salmi*, *Globocephalus urosubulatus*, *Oesophagostomum dentatum*, *O. quadrispinulatum*, *Trichuris suis*, *Macracanthorhynchus hirudinaceus*, *Ascaris suum*, *Ascarops strongylina* and *Physocephalus sexalatus* were found during the necropsies. *Metastrongylus*, *Globocephalus* and *Oesophagostomum* were the genera with the highest prevalence of infection being respectively 28.75%, 13.75% and 12.5%. These were also the genera with the highest territorial incidence. *Metastrongylids* were found in eight of the eleven examined areas, while *globocephalids* and *oesophagostomids* were found in four of them. The infections of *Metastrongylus* spp., *Oesophagostomum* spp. and *Ascarops* spp. were with the highest intensity. This is the first study in which *O. quadrispinulatum* has been found in wild boar from Bulgaria.

Key words: wild boar, *Sus scrofa scrofa* L., gastrointestinal helminths, lung helminths, Bulgaria

Introduction

The wild boar (*Sus scrofa* L.) is a suiform native to much of Eurasia, North Africa, and the Greater Sunda Islands. The species is one of the widest-ranging mammals in the world, as well as the most widely spread suiform [1]. The subspecies *Sus scrofa scrofa* is a wide-spread big game in Bulgaria with an important role for hunting reserves [2]. Survival of animals, especially of piglets, is connected to a big degree with the parasitic burden. Parasites take away nutrients and vitamins which carries risk of deficiency diseases, provoke inflammations in their locations, weaken the immune system of the organism, which can lead to secondary infectious diseases, even directly to death. The severity of the parasitic impact depends on the individual condition of the animals, the intensity of the invasion and, last but not least, the

type of the parasite.

The wild boars regularly change their habitats. They make long night passages from place to place, thus distribute the parasitic infections on large areas. On the other hand a great part of the parasites, specific for them, can be found in other wild animals, domestic animals and humans. The wild boar is one of the important biotic factors in the epidemiology of a number of parasitoses. Thus it is up-to-date subject for system research.

Most of the studies on the helminth fauna of the wild boar in Bulgaria have been performed in the 60s of the 20th century [3–5]. The new investigations are scanty and referred only to the wild boars from the eastern parts of the country [6,7]. In this connection, the aim of the present study was updating the data about gastrointestinal and pulmonary parasite fauna of wild boars from Bulgaria.

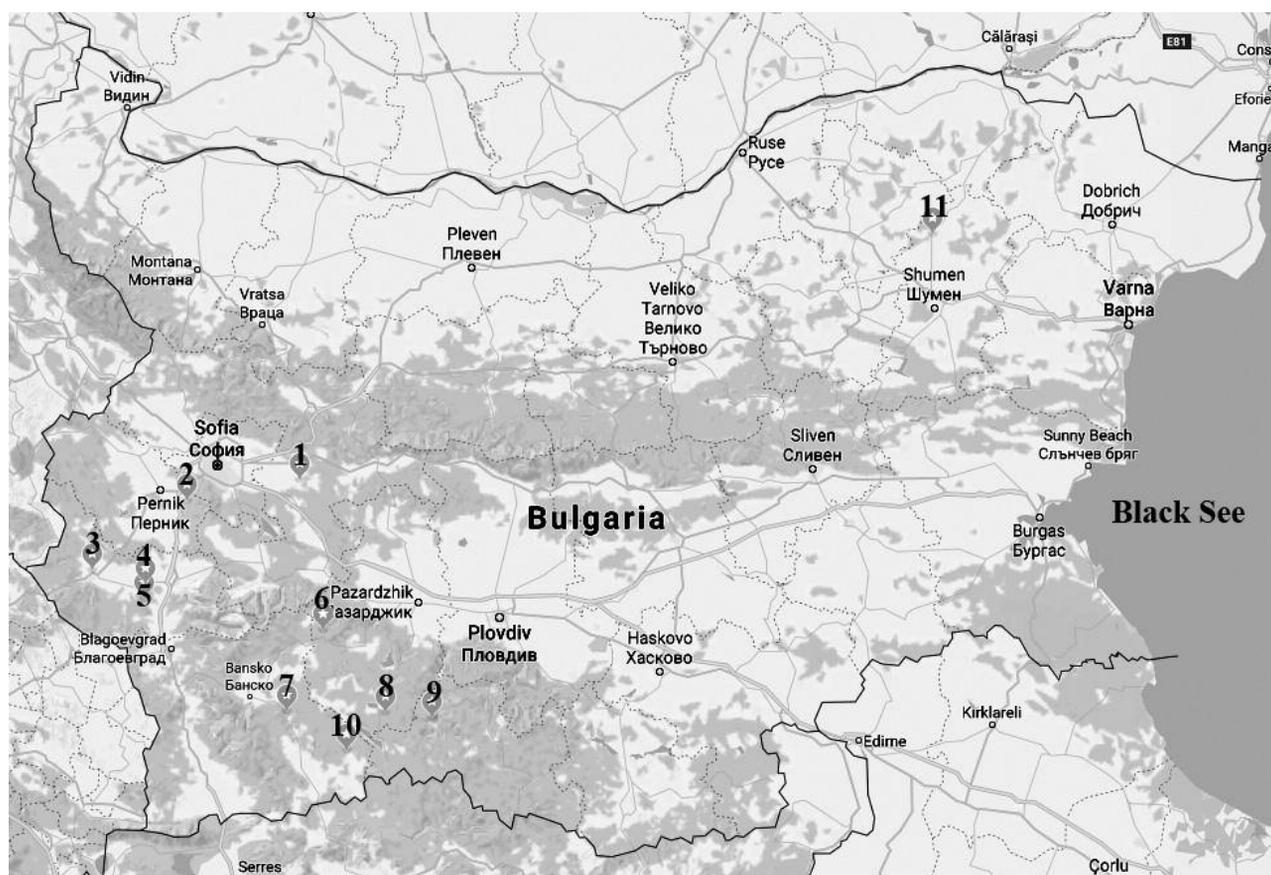


Fig. 1. Areas of Bulgaria from which materials from wild boars have been obtained: 1. State Hunting Enterprise (SHE) "Aramliets"; 2. SHE "Vitoshko-Studena"; 3. SHE "Osogovo"; 4. Land of the village Lokvata (municipality Bobov dol); 5. Land of the village Skrinno (municipality Boboshevo); 6. Yundola Training and Experimental Forest Range "G. St. Avramov"; 7. State Forestry "Mesta"; 8. SHE "Shiroka polyana"; 9. SHE "Izvora"; 10. SHE "Dikchan"; 11. SHE "Palamara".

Materials and Methods

The studies were carried out on 80 fecal samples from free living wild boars and 11 hunted animals during the period 2016–2017 in 11 areas of Bulgaria. These are situated on the territories of Vitosha Mountain, Sredna gora, West Rhodope Mountain, Kraishte and Ludogorie (Fig. 1).

The fecal samples were analyzed with the coproscopical methods of Fulleborn, Shterbovich and serial sedimentations, as well as the modified Baermann technique used after cultivation of larvae [8].

The helminthological necropsies of the lungs and gastrointestinal tracts from 11 wild boars were carried out through the common technique [8]. The detected adult helminthes were collected and cleaned in saline solution and after that were stored in 70% ethanol. The species identification of adult helminths was performed according to their morphometric features after enlightening some of the specimens in lactophenol.

Results

Eleven parasite genera were detected by examining the fecal samples (Table 1). *Metastrongylus* genus was the most common of them with 28.75% prevalence of infection, followed by the genera *Globocephalus* (13.75%), *Oesophagostomum* (12.5%), *Strongyloides* (10%), *Hyostromgylus*, *Nematodirus*, *Ascaris* and *Eimeria* (7.5%), *Trichuris* (6.25%) and *Macracanthorhynchus* (5%). *Ascarops* genus was the least common with 3.75% prevalence of infection. The distribution of the different genera in the different areas is showed in Table 2.

Eleven helminth species were found during the necropsies. Their distribution is shown in Table 3. The infections with metastrongylids were single or mixed. Single infection with *M. pudendotectus* was found in two of the eleven necropsied animals. Mixed infections were established in five wild boars. In three of them infection was by *M. pudendotectus* and *M. salmi*, and in two – by *M. pudendotectus* and *M.*

Table 1. Results from coproscopical analysis of 80 fecal samples from wild boars from Bulgaria

Parasite genera	Number of positive samples	Total prevalence (%)
<i>Metastrongylus</i>	23	28.75
<i>Globocephalus</i>	11	13.75
<i>Oesophagostomum</i>	10	12.5
<i>Trichuris</i>	5	6.25
<i>Strongyloides</i>	8	10
<i>Hyostrongylus</i>	6	7.5
<i>Macracanthorhynchus</i>	4	5
<i>Nematodirus</i>	6	7.5
<i>Ascaris</i>	6	7.5
<i>Ascarops</i>	3	3.75
<i>Eimeria</i>	6	7.5

elongatus. All of the oesophagostomid infections were mixed. The infection intensity for the different species is also shown in Table 3.

Discussion

The present results showed that half of the detected helminths were of order Strongylida. The strongylids were with the highest prevalence of infection and leading among them were those of *Metastrongylus*, *Globocephalus* and *Oesophagostomum* genera. They were also found in the most of the studied areas, and the most common of them were metastrongylids. Our results confirm data by Dimitrova [5] and Mutafova et al. [6] according which metastrongylids and globocephalids have been the most spread parasites in the wild boars in

Bulgaria. The same authors [5,6] have reported *O. dentatum* as a rare parasite in wild boars from the country. The present results confirm this finding too. We have registered *O. dentatum* only in one of the eleven examined areas. Previously, in Bulgaria *O. quadrispinulatum* has been detected as a mixed infection with *O. dentatum* in domestic pigs [9]. We have also observed mixed oesophagostomid infections without dominant species.

Some of the helminth genera, found by us, were with a relatively low prevalence of infection, and were detected in a small number of regions. The eggs of *Strongyloides* spp. were observed in 10% of the samples and *Hyostrongylus* spp., *Ascaris* spp. and *Nematodirus* spp. – in 7.5%. The finding of *Nematodirus* spp. in populations of wild boars from the regions of SHE “Izvor” and “Shiroka polyana” was unusual as these helminthes parasitize in ruminants and some herbivores. Our parallel research on wild ruminants from the territory of these hunting enterprises showed high prevalence of infection with *Nematodirus* spp. (64%). Probably, the close coexistence of wild boars and ruminants in these areas facilitates the exchange of parasites. That way, the wild boar becomes a nonspecific host for *Nematodirus* spp., although these parasites do not affect pigs [10]. This finding confirms the important role of wild boar as an epidemiological factor in the parasitic diseases development.

The prevalence of infection with trichurids according to our results was lower (6.25%) than it has been found previously in Bulgaria – 38.6% [5]. The infection intensity (5 helminths in one animal), however, was similar to that (5.9 mean infection intensity) pointed out by Dimitrova [5].

Table 2. Parasite genera detected in wild boars from some regions of Bulgaria

Parasites	A	VS	D	I	M	O	v.L	v.S	SP	Y	P	Total
<i>Metastrongylus</i>	+	+	+	+		+		+	+		+	8
<i>Strongyloides</i>						+			+	+		3
<i>Oesophagostomum</i>		+	+	+						+		4
<i>Hyostrongylus</i>					+				+	+		3
<i>Globocephalus</i>	+					+			+	+		4
<i>Nematodirus</i>				+					+			2
<i>Ascaris</i>	+									+		2
<i>Ascarops</i>	+						+					2
<i>Trichuris</i>	+			+						+	+	4
<i>Macracanthorhynchus</i>	+	+		+								3
<i>Eimeria</i>									+		+	2

A – State Hunting Enterprise (SHE) “Aramliets”, VS – SHE “Vitoshko-Studena”, D – SHE “Dikchan”, I – SHE “Izvor”, M – State Forestry “Mesta”, O – SHE “Osogovo”, SP – SHE “Shiroka polyana”, P – SHE “Palamara”, Y – Yundola Training and Experimental Forest Range “G. St. Avramov”, v. S – vilage Skrino, v. L – village Lokvata

pulmonary and gastrointestinal helminths that have been recorded in these studies are shown in Table 4. This literary check up shows that the helminthological status of the currently studied wild boars from Bulgaria is identical to that in other European regions with a few exceptions. In our study, we have not found only capillaries, *H. rubidus*, *M. asymmetricus* and *M. confusus*. The foreign data confirm our findings that metastrongylids are dominant helminths among the wild boar. These nematodes have been the most prevalent in the wild boar in a number of European countries. In Turkey prevalence of infection with metastrongylids has been 52–59% [26], in Hungary – 50.5–90.8% [27], in Spain – 85% [24], in France – 92% [18] and in some regions of Belarus it has reached 100% [13].

Our results showed that the infections with *M. pudentotectus*, *M. salmi*, *O. dentatum*, *O. quadrispinulatum* and *A. strongylina* were with the highest intensity. Moderate was the intensity of infections with *Ph. sexalatus* and *G. urosubulatus*, and that with *A. suum*, *T. suis* and *M. hirudinaceus* was low (Table 3). The present results correspond to those by Dimitrova [5], according who metastrongylids, globosephalids and esophagostomyds have been among the helminths with high value of mean infection intensity. They also correspond to results by foreign authors. For example, the intensity of metastrongylid and esophagostomyd infections has been high and that of *T. suis* and *A. suum* has been low in wild boars from Germany [20]. Metastrongylids have been also pointed out as dominating helminths, with the highest rates of infection intensity, among the wild boars in Estonia [17] and Turkey [26].

In conclusion, during the study nine nematode genera (*Metastrongylus*, *Strongyloides*, *Oesophagostomum*, *Hyostrongylus*, *Globocephalus*, *Ascaris*, *Ascarops*, *Trichuris*, *Nematodirus*), one acanthocephalid genus (*Macracanthorhynchus*) and one protozoa genus (*Eimeria*) were established. Eleven helminth species were identified: *Metastrongylus elongatus*, *M. pudentotectus*, *M. salmi*, *Globocephalus urosubulatus*, *Oesophagostomum dentatum*, *O. quadrispinulatum*, *Trichuris suis*, *Ascaris suum*, *Ascarops strongylina*, *Physocephalus sexalatus* and *Macracanthorhynchus hirudinaceus*. The most common helminths were the lungworms of *Metastrongylus* genus, followed by the intestinal nematodes of *Globocephalus* and *Oesophagostomum* genera. Helminths of the *Metastrongylus*,

Oesophagostomum and *Ascarops* genera were with the highest infection intensity.

References

- [1] Oliver W.L.R., Brisbin I.L., Takahashi S. 1993. The Eurasian Wild Pig (*Sus scrofa*). In: *Pigs, Peccaries, and Hippos – 1993 Status Survey and Conservation Action Plan*. (Ed. W.L.R. Oliver): 112-121.
- [2] Naidenov Y. 2008. Hunting tourism in Bulgaria. New Bulgarian University (in Bulgarian).
- [3] Dimitrova E. 1963. Trematodes of pigs in Bulgaria. *Izvestiya na Tsentralnata Khelmitologichna Laboratoriya* 8: 55-67 (in Bulgarian).
- [4] Dimitrova E. 1966. Occurrence of *Ascarops strongylina* and *Physaloptera sexalatus* in Bulgaria and their intermediate and reservoir hosts in Strandja Mountain. *Izvestiya na Tsentralnata Khelmitologichna Laboratoriya* 11: 43-56 (in Bulgarian).
- [5] Dimitrova E. 1969. Helminthofauna of the wild boar (*Sus scrofa* L.) in Bulgaria. *Izvestiya na Tsentralnata Khelmitologichna Laboratoriya* 13: 169-183 (in Bulgarian).
- [6] Mutafova T., Nanev V., Khrusanov D., Todev I., Nedkova L. 2004. Helminthofauna of wild boars inhabiting areas in the mountain regions of East Bulgaria. *Veterinarna sbirka* 5-6: 19-21 (in Bulgarian).
- [7] Nanev V., Mutafova T., Todev I., Hrusanov D., Radev V. 2007. Morphological characteristics of nematodes of the *Globocephalus* genus prevalent among wild boars from various regions of Bulgaria. *Bulgarian Journal of Veterinary Medicine* 10: 103-111.
- [8] Koinarsky V., Ivanov A., Prelezov P., Kirkova Z. 2009. Guide for exercise in Veterinary Parasitology. Stara Zagora (in Bulgarian).
- [9] Georgiev M., Kamburov P. 1977. Occurrence of *Oesophagostomum quadrispinulatum* Marcone, 1901 (syn. *O. longicaudum* Goodey, 1925) in domestic pigs in Bulgaria. *Khelmitologiya* 4: 11-16 (in Bulgarian).
- [10] Junquera P. 2017. *Nematodirus* spp., parasitic roundworms of cattle, sheep and goats. Biology, prevention and control. *Nematodirus battus*, *Nematodirus filicollis*, *Nematodirus helvetianus*, *Nematodirus spathiger*. http://parasitipedia.net/index.php?option=com_content&view=article&id=2635&Itemid=2913
- [11] Kutzer E. 1978. Treatment of *Metastrongylus* infection in wild boar enclosures. *Tierärztliche Praxis* 6: 325-334.
- [12] Kutzer E., Prosl H. 1979. Anthelmintic effect of Fenbendazole (Panacur R) in red deer (*Cervus elaphus hippelaphus*) and wild boar (*Sus scrofa*) in hunting reserves. *Wiener Tierärztliche Monatsschrift* 66: 285-290.
- [13] Pen'kevich A.A., Litvinov V.F., Zen'kov A.V. 1980. The efficacy of some anthelmintics in metastrongyliasis. *Zapovedniki Belorussii, Minsk, USSR* 4: 122-

- 126.
- [14] Foata J., Culioli J.-L., Marchand B. 2005. Helminth fauna of wild boar in Corsica. *Acta Parasitologica* 50: 168-170.
- [15] Foata J., Mouillot D., Culioli J.-L., Marchand B. 2006. Influence of season and host age on wild boar parasites in Corsica using indicator species analysis. *Journal of Helminthology* 50: 168-170.
- [16] Rajkovic-Janje R., Manojlovic' L., Gojmerac T. 2004. In-feed 0.6% ivermectin formulation for treatment of wild boar in the Moslavina hunting ground in Croatia. *European Journal of Wildlife Research* 50: 41-43.
<https://doi.org/10.1007/s10344-003-0033-9>
- [17] Jarvis T., Kapel Ch., Moks E., Talvik H., Mägi E. 2007. Helminths of wild boar in the isolated population close to the northern border of its habitat area. *Veterinary Parasitology* 150: 366-369.
<https://doi.org/10.1016/j.vetpar.2007.09.015>
- [18] Humbert J.-F., Henry C. 1989. Studies on the prevalence and the transmission of lung and stomach nematodes of the wild boar (*Sus scrofa*) in France. *Journal of Wildlife Diseases* 25: 335-341.
<https://doi.org/10.7589/0090-3558-25.3.335>
- [19] Barutzki D., Schoierer R., Gothe R. 1990. Helminth infections in wild boars in enclosures in southern Germany: species spectrum and infection frequency. *Tierärztliche Praxis* 18: 529-534.
- [20] Barutzki D., Schoierer R., Gothe R. 1991. Helminth infections in wild boars kept in enclosures in southern Germany: severity of infections and faecal intensity. *Tierärztliche Praxis* 19: 644-648.
- [21] Mennerich-Bunge B., Pohlmeier K., Stoye M. 1993. The helminth fauna of wild boars of the west Berlin forests. *Berliner und Münchener Tierärztliche Wochenschrift* 106: 203-207.
- [22] Magi M., Bertani M., Dell'Omodarme M., Prati M.C. 2002. Epidemiological study of the intestinal helminths of wild boar (*Sus scrofa*) and mouflon (*Ovis gmelini musimon*) in Central Italy. *Parassitologia* 44: 203-205.
- [23] Popiolek M., Knecht D., Szczesna-Staskiewicz J., Czerwinska-Rozalow A. 2010. Helminths of the wild boar (*Sus scrofa* L.) in natural and breeding conditions. *Bulletin of the Veterinary Institute in Pulawy* 54: 161-166.
- [24] De-la-Muela N., Hernández-de-Luján S., Ferre I. 2001. Helminths of wild boar in Spain. *Journal of Wildlife Diseases* 37: 840-843.
<https://doi.org/10.7589/0090-3558-37.4.840>
- [25] Fernandez-de-Mera I.G., Gortazar Ch., Vicente J., Höfle U., Fierro Y. 2003. Wild boar helminths: risks in animal translocations. *Veterinary Parasitology* 115: 335-341.
- [26] Senlik B., Cirak V.Y., Girisgin O., Akyol C.V. 2011. Helminth infections of wild boars (*Sus scrofa*) in the Bursa province of Turkey. *Journal of Helminthology* 85: 404-440.
<https://doi.org/10.1017/S0022149X1000074X>
- [27] Varga G., Sugár L., Körös A. 2005. Lungworm occurrence in wild boar stocks subject to different management actions. *Wildlife Biology in Practice* 1: 152-155.

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