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**The first report of *Linguatula serrata* in grey wolf (*Canis lupus*)
from Central Balkans**

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ABSTRACT. *Linguatula serrata* is a cosmopolitan, bloodsucking parasite found in both domestic and wild animals. Humans are not considered as its main hosts but can act as both intermediate (visceral linguatuliiasis) and final hosts (nasopharyngeal linguatuliiasis). Reports on wild canids as definitive hosts of this parasite are scarce. During 2009-2011 the autopsy was performed on 42 legally hunted grey wolves (*Canis lupus*) from Serbia and Former Yugoslav Republic of Macedonia (FYROM). Only one specimen was infected with a single adult female of *L. serrata*. The parasite was found in the nasal cavity of the grey wolf. The infected male wolf was shot in the eastern part of the territory of Former Yugoslav Republic of Macedonia (FYROM). This finding is the first record of linguatuliiasis in wolves from FYROM. Previous records of this parasite from the central Balkans region originated from dogs, cattle and hares. Only few records of this parasite are known for the grey wolf in general.

Key words: *Linguatula serrata*, *Canis lupus*, grey wolf, Central Balkans

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INTRODUCTION

Linguatula serrata is a cosmopolitan zoonotic parasite from the phylum Pentastomida which are also known as tongue worms. Adult worms inhabit nasal cavities, frontal sinuses and tympanic cavities of their final hosts - domestic and wild canids (wolves, foxes, jackals) (Riley, 1986; Drabick, 1987). Adult tongue worms attach themselves into the nasopharyngeal mucosa, feeding on blood and fluids of the host. Eggs are discharged through nasopharyngeal secretions from infected hosts and ingested through contaminated plants or water by their natural intermediate hosts –rodents and herbivores including goats, sheep and other ruminants (Alcala-Canto et al., 2007). Animals that can act as their hosts include also European roe deer (*Capreolus capreolus*), European fallow deer (*Dama dama*), grey wolf (*Canis lupus*), red fox (*Vulpes vulpes*), wildcat (*Felis silvestris*), common hare (*Lepus europaeus*), European rabbit (*Oryctolagus cuniculus*), crested porcupine (*Hystrix cristata*), house mouse (*Mus musculus*), brown rat (*Rattus norvegicus*), black rat (*Rattus rattus*) (Christoffersen and De Assis, 2013). Birds are rarely involved as intermediate hosts for this parasite (Bogdaschew, 1930).

Humans can be both intermediate and final host and are infected by visceral and nasopharyngeal linguatuli-
liasis. In endemic areas, they can become infected by domestic dogs or when eating raw or undercooked meat (liver) of infected sheep, goat or camel (Christoffersen and De Assis, 2013). The infection rate of goats in endemic areas, such as Iran, reach up to 50.75% (Rezaei et al., 2011) and in dogs up to 76.47% (Oryan et al., 2008). Ova expelled by sneezing of the host (through nasal discharge or feces) may contaminate food and water sources. After ingestion, primary larva hatches from egg and exit the digestive tract to create cyst in viscera, causing visceral linguatuli-
liasis. When humans eat raw or undercooked sheep or goat meat containing encapsulated infective nymphs, they can get infected with nasopharyngeal linguatuli-
liasis (Christoffersen and De Assis, 2013). Most of the literature about human infections originates from Iran, Turkey, India and Romania (EFSA, 2013), although sporadic cases have also been reported in Germany (Tappe et al., 2006) and Austria (Koehsler et al., 2011).

Little is known about wildlife acting as reservoirs

of this disease in nature. This report is a contribution to the knowledge of wild canids – namely wolves' role in the life cycle of *L. serrata*.

MATERIAL AND METHODS

During a three year period (2009-2011), 38 wolves from Serbia and four wolves from Former Yugoslav Republic of Macedonia (FYROM) were inspected for presence of *L. serrata*. The wolves were legally hunted at seven localities in Serbia and one in FYROM (Figure 1). In order to detect the tongue worm, during the processing of trophy skulls, special attention was focused on inspection of nasal cavities, frontal sinuses and tympanic cavities of the host body. The parasite was identified using standardized identification keys (Christoffersen and De Assis, 2013).



Figure 1. Map with localities in Serbia and Former Yugoslav Republic of Macedonia where wolves were hunted during 2009-2011.

RESULTS

During the research period, only one pentastomid parasite was found in a nasal cavity of an adult male wolf. The wolf was shot in vicinity of Sveti Nikole town in Eastern FYROM in March 2010 (Figure 1). No other parasites were found during additional examination of the nasopharynx and esophagus. Also there were no visible abnormalities in nasal cavities. The parasite was identified as a female *L. serrata*. The length of the parasite was 78 mm with clear external segmentation (Figure 2). To the best of our knowledge, this case is the first one to be reported for FYROM in grey wolf.

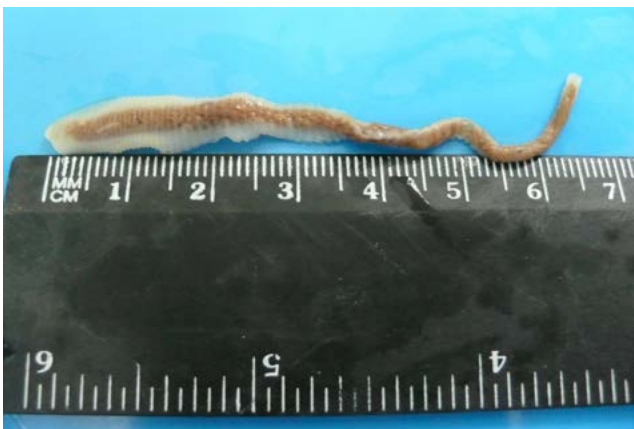


Figure 2. *Linguatula serrata* specimen found in nasal cavity of the grey wolf

DISCUSSION

High prevalence of *Linguatula serrata* found in the grey wolves as hosts in FYROM is a result of a small sample size. The infected wolf was shot in the center of a plain called Ovče Pole (Plain of sheep), famous for sheep farming, lamb meat, and dairy products. Unfortunately the data about sheep infestation, as intermediate hosts, in this area are missing. Literature data from some endemic areas suggests that the prevalence in sheep could be as high as 42.69% (Rezaei et al., 2011). At the territory of the central Balkans, where FYROM is located, a case of *L. serrata* was recorded recently in one dog of german shepard breed in Serbia (Ferenc et al., 2014). Previous records from Serbia, Montenegro and FYROM originate from the fifties of the last century, where the parasite was diagnosed in dogs, cattle and hares (Nevenić, 1940, 1953;

Buljević and Rendić, 1958). Nevenić (1940, 1953) reports that in the population of stray dogs found at the territory of FYROM's capital city Skopje in the period 1938-1939 prevalence of infected dogs varied from 28.6% to 79.5%. Omeragić et al. (2011) reviews records of *L. serrata* in roe deer in Bosnia and Herzegovina recorded by Delić et al. (1965) and Čanković et al. (1962). To the best of our knowledge, from other countries in this part of Europe only few records of this parasite exist, in particular in Romania in sheep and wolf (Gherman et al., 2002; Miclaus et al., 2008), in Bulgaria in dogs (Ivanov, 1937) and in Greece in dogs and humans (Papadakis and Hourmouziadis, 1958; Haralabidis et al., 1988).

There are only few records of this parasite ever recorded in grey wolf (Gherman et al., 2002; Stiles and Baker, 1934 in Mech and Boitani, 2003; Sambon, 1922 in Christoffersen and De Assis, 2013). Although canids are considered to be its main hosts *L. serrata* has not been recorded in wild canids (wolves, foxes, jackals and raccoon dogs) at the whole territory of the central Balkans so far. This finding contributes to better knowledge about the distribution of *L. serrata* and identification of its potential hosts. The parasite has been known to infect humans, but also domestic animals through direct or indirect contact with infected animals and their secretions. Therefore it is important to identify its presence in the population of wild animals, especially the ones which are known to roam in the vicinity of human settlements, as is the case with this report. Further investigations of the presence of this parasite in cattle, especially sheep is needed to be conducted for this scarcely investigated region of Europe. The presence and distribution of *L. serrata* in domestic and wild canids could be an important aspect of public health, especially having in mind the existing problem of stray dogs in both rural and urban areas of most of the countries in the region, and the existing projects of peroral vaccination of wild animals against rabies that might lead to an increase in populations of the wild canids - in particular foxes, jackals and wolves.

CONCLUSION

A pentastomid parasite *Linguatula serrata* was found in a nasal cavity of an adult male wolf that was shot in Eastern FYROM in March 2010. This case is

the first one to be reported in grey wolf for FYROM, as well as from the central Balkans. This finding will contribute to better knowledge about the distribution of *L. serrata* and identification of its potential hosts.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest. ■

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