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Short note

## *Terrestrial Snails (Mollusca: Gastropoda) as Intermediate Hosts of Protostrongylid Nematodes in Balkan Chamois in the Regions of Western Rhodopes Mts and Pirin Mts., Bulgaria: Preliminary Data*

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**Abstract:** The nematodes from family Protostrongylidae Leiper, 1926 parasitize in the lungs of wild and domestic ruminants and rabbits. Five meadows from the region of Western Rhodopes Mts and Pirin Mts used from the Balkan chamois (*Rupicapra rupicapra balcanica*) were studied for terrestrial gastropods as a potential intermediate hosts of protostrongylids, during the summer of 2018. A total of 28 specimens of *Cattania haberhaueri*, *Xerolenta macedonica* and *Helix pomatia* in the Pirin Mts and 161 specimens of *Zebrina detrita*, *Chondrus zebra tantalus*, *Xerolenta* sp., *Cattania rumelica*, *Cepaea vindobonensis* and *Euomphalia strigella* in the Western Rhodopes Mts were collected. The highest levels of infestation with protostrongylids were detected in *Xerolenta macedonica* and *Xerolenta* sp. for the meadows of Pirin Mts and Western Rhodopes Mts, respectively.

**Key words:** *Protostrongylidae*, natural invasion, gastropods, larvae.

### Introduction

The nematodes from Family Protostrongylidae Leiper, 1926 parasitize in the lungs of rabbits and wild or domestic ruminants including Balkan chamois, *Rupicapra rupicapra balcanica* Bolkey, 1925 (PANAYOTOVA-PENCHEVA, 2007). Their life cycles going with the obligatory involvement of terrestrial snails as intermediate hosts, reaching stage L3, invasive for final hosts (BOEV, 1975). The intermediate hosts species composition of protostrongylids has been studied in a European and the Mediterranean countries (CABARET, 1983; SKORPING, 1981).

In Bulgaria, *Zebrina detrita* and *Xerolenta obvia* were recorded as intermediate hosts of protostrongylids for the Sofia region

(SAMNALIEV, 1966); *Z. detrita*, *X. obvia*, *Cepaea vindobonensis* and *Monacha* sp. (reported as *cartusiana*) - for the region of Varna (ZURLIYSKI, 1994), and *Z. detrita*, *X. obvia*, *M. cartusiana* and *Cerņuella virgata variabilis* - for the Stara Zagora region (GEORGIEV & GEORGIEV, 2002). Data for the range of natural invasion with protostrongylids for the terrestrial snails in mountain regions of Bulgaria are still lacking.

The aim of our study was to obtain data about gastropod intermediate hosts species composition in Pirin Mts and Western Rhodopes Mts meadows inhabited by the Balkan chamois.

### Materials and Methods

Five meadows from the Pirin Mts and the Western Rhodopes Mts inhabited by the

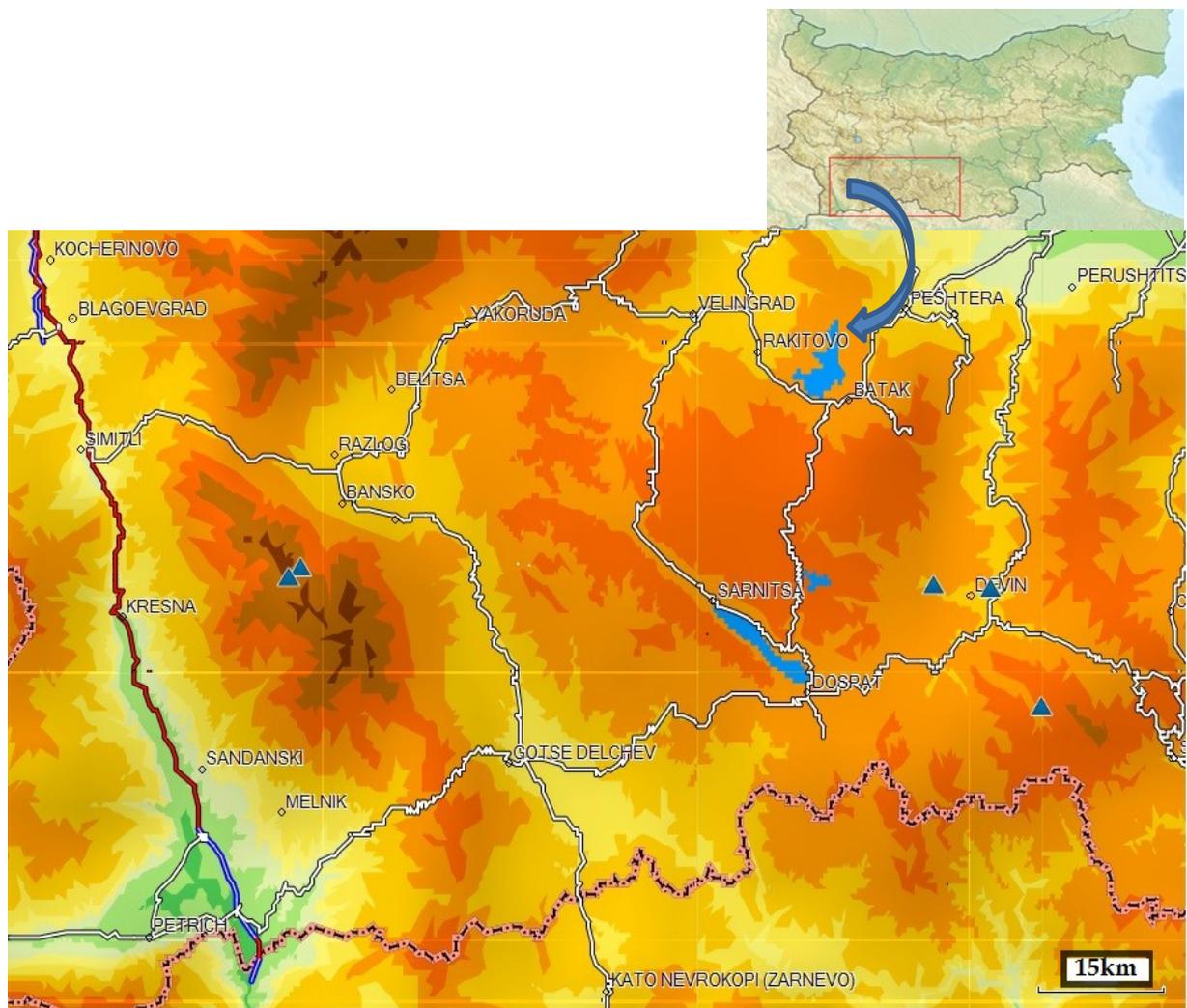
chamois were examined for the presence of terrestrial snails positive for protostrongylid larvae, during the summer of 2018. The meadows' locations were as follows: Vihren SE: N41° 45.709' E23° 24.258', Kazanite-Banderitsa: N41° 46.304' E23° 25.307', Lakata: N41° 45.234' E24° 20.412', Tsankow Kamak: N41° 45.017' E24 25.383', Mugla: N41° 37.843' E24° 29.801', with an altitude between 840 and 2500 m a.s.l. (fig. 1). A total of 189 snails have been collected by hand, from all the meadows visited. Snails were further processed in the laboratory conditions. After shell removing, the body of each snail was pressed between glass plates and observed

under microscope (10x), to register the number of protostrongylid larvae (L3).

The species were identified by DAMYANOV & LIKHAREV (1975) and WELTER-SCHULTES (2012). The updated nomenclature of gastropods accepted by IRIKOV & ERÖSS (2008) was adopted in the present study.

### Results and Discussion

A total of nine terrestrial snails' species, members of 3 families were found in the investigated area (Table 1). Three species were identified in Mugla meadow, two - in meadows of Lakata and Vihren SE and one - in Tsankov kamak and Kazanite Banderitsa.



**Fig. 1.** Locations of meadows investigated for the presence of protostrongylid nematodes' larvae in terrestrial snails in Pirin Mts and Western Rhodopes Mts.

**Table 1.** Species composition of terrestrial gastropods registered in the Pirin Mts and Western Rhodopes Mts at the summer of 2018 (by [IRIKOV & ERÖSS, 2008](#)).

Taxa	Pirin Mts.		Western Rodopi Mts.		
	Vihren SE	Kazanite Banderitsa	Lakata	Tsankov kamak	Mugla
Family Enidae					
<i>Zebrina detrita</i>	-	-	-	-	+
<i>Chondrus zebra tantalus</i>	-	-	-	+	-
Family Helicidae					
<i>Cattania haberhaueri</i>	+	-	-	-	-
<i>Cattania rumelica</i>	-	-	-	-	+
<i>Cepaea vindobonensis</i>	-	-	+	-	-
<i>Helix pomatia</i>	-	+	-	-	-
Family Hygromiidae					
<i>Xerolenta macedonica</i>	+	-	-	-	-
<i>Xerolenta</i> sp.	-	-	-	-	+
<i>Euomphalia strigella</i>	-	-	+	-	-

Seven of the founded species belonged to the European faunistic complex, in zoogeographical terms. *Cattania haberhaueri* was Bulgarian endemic and *Cattania rumelica* was Balkan endemic ([IRIKOV & MOLLOV, 2006](#)). The Balkan endemic *Xerolenta macedonica* ([IRIKOV & ERÖSS, 2008](#)) should be included in the European faunistic complex as well. *Cepaea vindobonensis* was representative of the Euroasian faunistic complex (Table 2).

In the two of registered species: *Xerolenta macedonica* from the meadows of Pirin Mts and *Xerolenta* sp. from Western Rhodopes Mts, infections of protostrongylids were found. The first comprehensive summary of Bulgarian terrestrial snails' fauna provided data on 213 species ([DAMYANOV & LIKHAREV, 1975](#)). [DEDOV, \(1998\)](#) reported 236 species and 42 subspecies terrestrial snails. Recent information for the Bulgarian malacofauna revealed 226 species and 33 subspecies, making altogether 259 taxa ([IRIKOV & ERÖSS, 2008](#)). Only 9 species of them (3.47%) were able to register on the examined meadows, during the summer of 2018. Three (13.04%) of the 23 terrestrial snails' species reported for the northern Pirin areas ([DEDOV & MITOV, 1998](#)),

were registered in the present study. [IRIKOV & MOLLOV, \(2006\)](#) announced 106 species and 19 subspecies as valid for Bulgarian part of Western Rhodopes Mts.- 125 taxa. Six of them (4.7%) were registered in this mountain (Table 1).

Eight terrestrial snails' species were reported as intermediate hosts for Bulgaria: *Z. detrita*, *H. obvia*, *C. vindobonensis*, *Monacha cartusiana* and *Cerņuella virgata variabilis* ([SAMNALIEV, 1968](#); [ZURLIYSKI, 1994](#); [GEORGIEV AND GEORGIEV, 2002](#); [GEORGIEV et al., 2003](#)), *Chondrula microtraga*, *Helix pomatia* and *Deroceras reticulatum* ([GEORGIEV et al., 2003](#)). Two of them were found in the course of the present study, without being registered invasion of protostrongylids: *Z. detrita* and *C. vindobonensis*. Only two species of terrestrial snails were identified as intermediate hosts of protostrongylids. The highest values of protostrongylids larvae prevalence were recorded in *X. macedonica* -85%. The other species determined to order (*Xerolenta* sp.) was infected with 47% prevalence (Table 3).

One of the snails' species found, *X. macedonica* was first reported as an intermediate host of protostrongylids.

**Table 2.** Some biogeographic characteristics of the registered snail species in the meadows in the Pirin Mts and Western Rhodopes Mts (IRIKOV & MOLLOV, 2006; DAMYANOV & LIHAREV, 1975).

Species	Zoogeographic categories	Ekological data
<i>Zebrina detrita</i>	Holosubmediterranean subelement, Submediterranean element, European faunistic complex.	Inhabits limestones and prefers open herbarous habitats, but often it. can be found in bushes and rarely in oak and pine forests. Drought-resistant, capable of surviving big and continuous dry periods. Xerophilic, thermophilic, drought-resistant, eurythermic and euryhygrobiotic species.
<i>Chondrus zebra tantalus</i>	Euxinian subelement, Submediterranean element, European faunistic complex	Inhabits exclusively limestones, but prefers open herbaceous habitats with bush vegetation. Drought-resistant, capable of surviving big and continuous dry periods. Xerophilic, thermophilic, drought-resistant, distributed in heterozonal mountain sites eurythermic and euryhygrobiotic species.
<i>Cattania haberhaueri</i>	Bulgarian endemic, Eastsubmediterranean subelement, Submediterranean element, European faunistic complex.	Inhabits very diverse habitats in the middle and high parts of the. mountain and prefers rocks within broadleaved forests, but rarely it can be found in pinetree forests with high humidity. Meso- to microthermic, mesohygrophilic, cool-loving, cold-resistant.
<i>Cattania rumelica</i>	Balkan endemic, Eastsubmediterranean subelement, Submediterranean element, European faunistic complex.	Inhabits limestones, but it can also be found in broadleaved forests and rarely in pinetree forests as well as in open rocky terrains. Mesophilic, thermophilic, relatively drought-resistant.
<i>Cepaea vindobonensis</i>	Pontosubmediterranean subelement, Steppe element, Steppe Euroasian faunistic complex	Inhabits open herbaceous habitats, sparse broadleaved forests, within shrubs and in open rocky areas in the lower and middle parts of the mountain. Xeromesophilic, thermophilic, drought-resistant.
<i>Helix pomatia</i>	Mid European element, European faunistic complex	Inhabits broad-leaved forests as well as pinetree forests and open terrains with herbaceous vegetation, especially along rivers, mostly in the middle and the high parts of the mountain. It prefers high humidity and lower temperatures. Mesophilic, mesothermic, cool-loving.
<i>Xerolenta macedonica</i>	Balkan endemic	Under stones, in shallow rocky cracks and on herbaceous plants, strongly lit by the sun.
<i>Xerolenta</i> sp.	Eastsubmediterranean subelement, Submediterranean element, European faunistic complex	Inhabits open limestone terrains with tall herbaceous vegetation at low humidity. Xerophilic, thermophilic, drought-resistant.
<i>Eoumphalia strigella</i>	Mid European element, European faunistic complex	A forest species, which prefers broad-leaved forests especially in the mountain river valleys. It inhabits humid and shady places. Mesophilic, cool-loving, cold-resistant

**Table 3.** Invasion of terrestrial snails with protostrongylids larvae in the meadows from Pirin Mts and Western Rhodopes Mts during summer of 2018.

Snail species	N	N <sub>inf</sub>	P %	I	I <sub>av</sub>	A
<i>X. macedonica</i>	14	12	85%	1 - 11	5.42	4.64
<i>Xerolenta sp.</i>	23	11	47%	1 - 32	6.37	3.04

Legend: N - sample size; N<sub>inf</sub>- number of infected snails; P% - prevalence; I - intensity of the invasion; I<sub>av</sub> - Average intensity; A - abundance.

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