

Infestation of the road-killed Eastern European hedgehogs (*Erinaceus roumanicus*) with Ixodidae ticks in some parts of Upper Thracian Plain (Bulgaria)

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Abstract. Infestation of the road-killed hedgehogs (*Erinaceus roumanicus*) with Ixodes ticks in some parts of Upper Thracian Plain (Bulgaria) was investigated. A total of 5 tick species from 3 genera were identified.

Key-words: *Erinaceus roumanicus*, Ixodidae ticks, Upper Thracian Plain.

Introduction

Ixodidae ticks have important epidemiological and epizootological significance, and therefore their distribution has been studied by a large number of researchers, including on various species of hedgehogs (Gaglio *et al.* 2010, Dziemian *et al.* 2014, Horak *et al.* 2011, Thamm *et al.* 2009). However, data on the infestation of *Erinaceus roumanicus* (Barret-Hamilton, 1900), the main species inhabiting Bulgaria, are scanty and date back to more than 80 years ago (according to Markov 1957). The insufficient data on the ixodofauna of the Eastern European hedgehog in Bulgaria made us conduct the present study. Its purpose was to determine the distribution and species composition of ticks parasitizing on the Eastern European hedgehog among road-killed specimens inhabiting the Upper Thracian Plain (or Lowland, a part of Southern Bulgaria).

Material and Methods

The study was conducted in the period 01.03.2017 - 30.04.2020. Road-killed hedgehogs of the species *Erinaceus roumanicus* were collected on three national roads and the nearby settlements in the Upper Thracian Plain: 1. a part of national road II-66 in the section from Plovdiv (42.13N/24.74E) to the junction for the village of Hrishteni, Stara Zagora region (43.44N/25.72E); 2. a part of national road I-8 in the section Plovdiv (42.13N/27.74E) - Svilengrad (41.76N/26.20E) and 3. the national road Karlovo (42.64N/24.80E) - Plovdiv (42.13N/27.74E) (Fig. 1).

The infestation of 27 found road-killed hedgehogs was studied. The hosts were examined immediately after they were found. The collected material was preserved in 70% ethyl alcohol solution. The determinant of Pomerantsev (1950) was used to determine and differentiate the sex of ticks. Ticks were monitored using Ceti 1800.1000M binocular magnifier (magnification x2). The quantification of hedgehog infestation was made by estimating of the following parameters: 1. invasion density among hosts (Extensity of invasion, EI%); 2. the prevalence of mites (Intensity of invasion, II), which represents the number of ticks of one species found in one infested animal.



Fig. 1. Location of the field study area (1- part of national road II-66; 2- part of national road I-8; 3- national road Karlovo - Plovdiv).

Results and Discussion

In the present study, infestation was found in 11 hedgehogs (40.74 % of all hedgehogs examined). Co-infestation by two tick species was found in three hedgehogs. A total of 68 ticks were collected - 19 females and 49 males. Five species from three genera were identified: from the genus *Rhipicephalus* - *Rhipicephalus bursa* (Canestrini et Fanzago, 1877), *Rhipicephalus sanguineus* (Latreille, 1806) and *Rhipicephalus turanicus* (Pomeranzev, 1940), from the genus *Ixodes* - *Ixodes ricinus* (Linnaeus, 1758) and from the genus *Hyalomma* - *Hyalomma marginatum* (Koch, 1844). The indicators of the invasion are shown in Table 1.

Table 1. Invasion indicators (P% - prevalence, II – intensity of infection) of ticks collected from road-killed Eastern European hedgehogs in some parts of the Upper Thracian plain, Bulgaria.

Ticks	<i>Rhipicephalus bursa</i>	<i>Rhipicephalus sanguineus</i>	<i>Rhipicephalus turanicus</i>	<i>Ixodes ricinus</i>	<i>Hyalomma marginatum</i>
Number	27	35	1	2	3
(Male/Female)	(17/10)	(29/6)	(1/0)	(0/2)	(2/1)
P%	18.5	14.8	3.7	7.4	7.4
II	1 – 12	2-18	1	1	1-2

Rhipicephalus bursa (Fig. 2a) was the predominant parasitic species, with the highest percentage of extensity of invasion – 18.5 %. It was found in all of the studied areas but its highest prevalence was observed in the area of road I-8 – the village of Levka (41.67N/26.21E) and near the town of Harmanli (41.91N/25.95E). The intensity of invasion which was identified there was over 10. The number of males was higher than that of females.

Rhipicephalus sanguineus (Fig. 2b) was also prevalent on hedgehogs (EI – 14.8%). It was found in the area of the Plovdiv-Karlovo road (near the village of Graf Ignatievo (42.28N / 24.74E) and Karlovo (42.64N / 24.80E) and the highest prevalence (II – 18) was observed in the village of Hrishteni, Stara Zagora region (42.44N/25.72E). For this species the prevalence of mites was the highest. The number of identified males was more than 5 times higher than that of females.

Rhipicephalus turanicus (Fig. 2b) was found together with *Rhipicephalus sanguineus* as a single specimen on hedgehog found in the village of Hrishteni, Stara Zagora region (42.44N/25.72E).

Ixodes ricinus and *Hyalomma marginatus* (Fig. 2c) were found as single specimens on hedgehogs found in the area of the city of Plovdiv (42.13N/24.71E). Their prevalence was low (1 and 1-2). Only engorged females of the *I. ricinus* species were found (Fig. 2d). The low

prevalence and invasion density of the hedgehogs with *I. ricinus* that were examined can be explained by the seasonality of the biological activity of the said species. During the first peak of activity (March), the majority of hedgehogs are still in a state of hibernation, which severely hampers their infestation.

The results obtained confirm that a relatively small number of species of ixodes ticks (up to 4-5 species for the respective area) parasitize on hedgehogs in the different geographical areas. Compared to Drenski's data for Bulgaria (cited by Markov, 1957), an invasion on hedgehogs by ticks rather of the genera *Rhipicephalus* and *Hyalomma* than of the genus *Hemaphysalis*, was found during the present study. Unlike the data coming from the Western and Central European countries, where the main species parasitizing on hedgehogs were of the genus *Ixodes*, in our study the predominant species of ticks were of the genus *Rhipicephalus*. Invasion on hedgehogs by representatives of the *Rhipicephalus* genus was reported by Youssefi *et al.* (2011) in Iran (*Rh. turanicus*) and Girisgin *et al.* (2015) in Republic of Turkey (*Rh. sanguineus*). There are no reports of hedgehogs' infestation by *Rh. bursa*.

Similar to our results, infestation with *Hyalomma marginatus* on hedgehogs is rare. Such an invasion is reported only in Ukraine (Akimov *et al.* 2011) and Hungary (Földvári *et al.* 2011). The prevalence and invasion density in such cases are low. Gazyağci (2010) found a hedgehog infestation in Central Anatolia, Republic of Turkey, but by a different species - *Hyalomma aegypticum*.

It can be assumed that the established species composition of the ticks is determined mainly by the geographical location of the study area. Both the species *I. ricinus*, predominant in European countries, and the species of the genera *Rhipicephalus* and *Hyalomma*, which are prevalent in the Middle Eastern countries, were identified.



Fig. 2. Ixodidae ticks found parasitizing on road-killed Eastern European hedgehogs: (A) male *Rh. bursa*; (B) engorged female *Rh. sanguineus* (left) and male *Rh. turanicus* (right); (C) male *H. marginatus*; (D) engorged female *I. ricinus*.

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