

## PARASITIC ALIEN TERRESTRIAL ARTHROPODS ON SMALL MAMMALS IN NORTHEAST AND SOUTH BULGARIA

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### Abstract

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Small mammals (Micromammalia) are the most widespread wild vertebrates in a number of natural biotopes in Northeast and South Bulgaria.

The arachnids of the superorder Parasitiformes (syn. Gamazoidea) are among the most frequently encountered ectoparasites on them, representatives of the metastigmal (order Ixodida) and mesostigmal (order Mesostigmata) mites.

A number of small mammals (Micromammalia) of 10 animal species were captured and examined for the presence of ectoparasites: *Crocidura leucodon* (bicoloured white-toothed shrew), *Apodemus sylvaticus* (wood mouse), *Apodemus agrarius* (striped field mouse), *Apodemus flavicollis* (yellow-necked field mouse), *Microtus arvalis* (common vole), *Microtus subterraneus* (common pine vole), *Mus musculus musculus* (house mouse), *Rattus rattus* (black rat), *Arvicola terrestris* (European water vole) and *Dryomys nitedula* (forest dormouse).

The mammals were captured in specially selected border and intensive traffic regions in Northeast and South Bulgaria near 12 residential areas.

Ten species of parasite arthropods were found and identified. Of them, 6 species were mites (Acari) in different stages of development. The following species belonged to order Mesostigmata: *Ornithonyssus bacoti* (Hirst) and *Laelaps echidninus* (Berlese) and to order Ixodida, family Ixodidae: *Ixodes ricinus* (Linnaeus), *Hyalomma plumbeum* (Panzer), *Dermacentor marginatus* (Sulzer) and *Boophilus calcaratus* (Olenev). The remaining 4 species were insects (Insecta), of which 3 species were fleas (Siphonaptera): *Ctenocephalides canis* (Curtis), *Pulex irritans* (Lineus) and *Leptopsilla segnis* (Schonher) and one species was louse (Anoplura): *Polyplax spinulosa* (Burmeister).

Two of the identified species of parasite arthropods had not been reported in our country so far, probably imported from other countries (alien species). These were the mite *Laelaps echidninus* (Berlese, 1887) and the louse *Polyplax spinulosa* (Burmeister, 1839).

*Key words:* alien species, parasitic arthropods (Arthropoda), small mammals (Micromammalia)

### Introduction

Terrestrial arthropods (Arthropoda) compose the most numerous group of animal organisms on earth. Part of them is external (ecto) parasites on farm animals, pets, wildlife and bird (Kamburov et al., 1994; Soulsby, 1982; Taylor et al., 2007). Parasitic arthropods

are the agents, carriers or hosts of a number of other agents of dangerous human or animal diseases (Stran-sky and Usunov, 1992; Hopla et al., 1994; Estrada-Pena and Jongejan, 1999).

Small mammals (Micromammalia) are the most numerous wild vertebrates in a number of natural biotopes in Northeast and South Bulgaria.

The arachnids of the superorder Parasitiformes (syn. Gamazoidea, Reuter, 1909), are among the most frequently encountered ectoparasites on them, basically representatives of the metastigmal (order Ixodida, Leach, 1815) and mesostigmal (order Mesostigmata, G. Canestrini, 1891) mites. The most thorough studies and publications on the species of these mites found on small mammals in Bulgaria belong to Koyumdzhieva (1979, 1982). The author has conducted many studies on the gamazoid mites on small wild mammals in 1967 – 1979 in different areas of Bulgaria: in Vitosha mountain (1967), West Balkan Mountain (1968), Srebarna reservation (1971), Pirin and Rila mountains (1972), Burgas district (1973), Sofia district (1974), Ropotamo National Park and Parangalitsa reservation (1978). Koyumdzhieva conducted the same studies in the district of Varna with Sarbova (1973) and with Yaneva (1980) in the district of Yambol. Previously, studies on gamazoid mites in small mammals in Bulgaria had been carried out by Sarbova (1964) in the districts of Burgas, Petrich and Gotse Delchev and, with L. Hristov, in the region of the Thracian plane (1966).

Fleas (order Siphonaptera, syn. Aphaniptera, Latreille, 1825) were the most frequently found insects (class Insecta) on small mammals. L. Hristov has conducted the basic studies of flea species found on small mammals in Bulgaria in the period 1964-1978 (Serbezov, 2006). The author has described 28 flea species in small mammals from natural biotopes in Thracia (1964, 1966), West, Middle and East Balkan Mountains (1967, 1974), The Rose Valley (1974) and Yambol district (1978). According to Hristov, the region of West Balkan Mountain is the most populated by fleas – 27 of 28 species. Mateva et al. (1985) have also carried out studies on ectoparasites in small mammals along the Valley of Rilska River, having found 8 flea species.

The lack of up-to-date studies on the species of parasitic arthropods in small mammals in Bulgaria as well as the numerous reports about the occurrence of new (alien) species of terrestrial arthropods in the European and Bulgarian fauna were a good reason to conduct studies on the species composition of the ectoparasites in those animals, living in biotopes in Northeast and South Bulgaria.

The studies were carried out within the frames of a 3-year International Multi-university Scientific Project

“ATARTIB” (Contract №D002-191/17.12.2008) of the Bulgarian Science Fund of the Ministry of Education, Youth and Science.

### Aims and Objectives

The aim of the present study was to collect up-to-date information about the species composition of parasitic arthropods in small mammals in the border areas as well as areas with intensive traffic in Northeast and South Bulgaria in order to establish new (alien) arthropod species, having invaded our country.

In order to achieve our aim, we set the following objectives:

1. To catch small mammals from natural habitats in the studied areas.
2. To collect and preserve the ectoparasites, found on their bodies.
3. To identify the species of parasitic arthropods.
4. To identify the alien species of parasitic arthropods.

### Material and Methods

52 small mammals (Micromammalia) were caught and examined for ectoparasites. They belonged to 10 animal species: one species of order Insectivora (insect eaters) - *Crocidura leucodon* (bicoloured white-toothed shrew) and nine species, representatives of order Rodentia (rodents) – *Apodemus sylvaticus* (wood mouse), *Apodemus agrarius* (striped field mouse), *Apodemus flavicollis* (yellow-necked field mouse), *Microtus arvalis* (common vole), *Microtus subterraneus* (common pine vole), *Mus musculus musculus* (house mouse), *Rattus rattus* (black rat), *Arvicola terrestris* (European water vole) and *Dryomys nitedula* (forest dormouse).

The mammals were caught in specially selected for the purpose border and intensive traffic regions of Northeast and South Bulgaria, in close proximity to 12 residential areas, namely: in the vicinity of Kardam village (Dobrich district), Durankulak village (Dobrich district), Bezmer village (Dobrich district), Kobalaka area in the vicinity of the town of Dobrich, Tyulenovo village (Dobrich district), the town of Kavarna, Kalimok BASci scientific base in Nova Cherna village (Tutrakan municipality), Bezhanovo village (Dobrich district), Botevo village (Varna district), Zlatna Niva

village (Shumen district), Kapitan Andreevo village (Haskovo district) and the town of Svilengrad in the summer and autumn of 2009.

Standard live-traps, purchased from the store, were used for the capture of the small mammals. After being delivered to the lab, the animals were fixated on a white sheet of paper. Following the external examination under strong light, we collected the bigger ectoparasites with fine tweezers and placed them in small plastic containers with 70% ethanol for fixation and permanent preservation. The small ectoparasites on the skin and hair of the small mammals were collected with a fine brush, soaked in 70 % ethanol, and then placed in a container with the same conservation solution. The fast moving ectoparasites, such as fleas, were located after spraying animal hair with a synthetic pyrethroid solution. Finally, the white paper pad was examined for parasitic arthropods that were moved to the container with the preservative.

The species composition of the parasitic arthropods was identified by means of morphological marks and based on modern references (Kamenov and Radev, 2002; Koynarski et al., 2009; Taylor et al., 2007; Besch-Williford, 2007; Heddergot, 2008; Mullen and Durden, 2009).

## Results and Discussion

The results obtained are presented in Table 1.

The data in Table 1 show that 10 species of small mammals, originating from biotopes in the proximity of 12 residential areas of Northeast and South Bulgaria, were examined for ectoparasites. We found and identified 10 species of parasitic arthropods. Of these, six species were mites (Acari) in different stages of development. The species *Ornithonyssus bacoti* (Hirst) and *Laelaps echidninus* (Berlese) belonged to order Mesostigmata and *Ixodes ricinus* (Linnaeus), *Hyalomma plumbeum* (Panzer), *Dermacentor marginatus* (Sulzer) and *Boophilus calcaratus* (Olenov) belonged to sub-order Ixodida, family Ixodidae. The remaining 4 species were insects (Insecta), among them 3 flea species (order Siphonaptera): *Ctenocephalides canis* (Curtis), *Pulex irritans* (Lineus) and *Leptopsilla segnis* (Schonher) and one species of louse (Anoplura): *Polyplax spinulosa* (Burmeister).

Mites were the most common (Acari) – they were found in 96.7% of the small mammals with ectoparasites. The representatives of the other two groups of ectoparasites – fleas and lice – occurred relatively less frequently and were found in 33.3% and 30% of the mammals, respectively (Figure 1).

The mite *O. bacoti* occurred most frequently in the small mammals from the studied areas, namely on the bodies of 21 small mammals of 7 different species in almost all examined areas (Table 1). The mite *L. echidninus* was second to it – found in 20 small mammals of 7 different species, followed by the ixodid tick *I. ricinus* – in 18 of the small mammals of 6 different species. The other ixodid ticks were found even more rarely on the bodies of the hosts: *B. calcaratus* (in 5 of 5 species), *H. plumbeum* (1 of 1 species) and *D. marginatus* (1 of 1 species).

Of the parasitic insects, the species *P. spinulosa* was the most frequently found (in 9 of 5 species of), followed by the flea *Ct. canis* (6 of 4 species), *L. segnis* (4 small mammals of 3 species) and the rarest found insect was the human flea *P. irritans* (1 of 1 species of small mammal).

Two of the identified species of parasitic arthropods have not been detected in Bulgaria so far, being probably brought from other countries (alien species). These were the mites *Laelaps echidninus* (Berlese, 1887) and louse *Polyplax spinulosa* (Burmeister, 1839).

*Laelaps echidninus* (syn. *Laelaps echidnina*), is a mite that belongs to order Mesostigmata, family Lael-

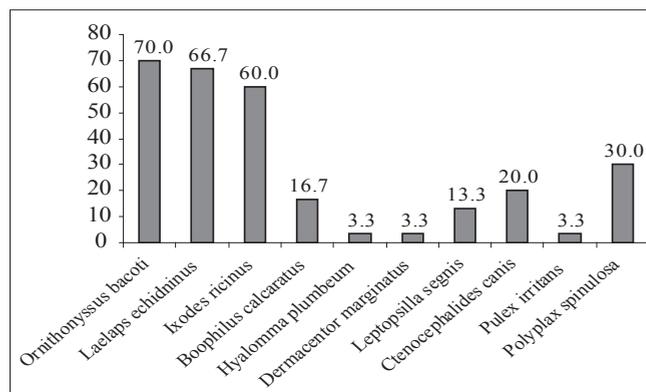


Fig. 1. Frequency of occurrence of parasitic arthropods in the investigated micromammals with ectoparasites, %

**Table 1**  
**Species composition of parasitic arthropods in small mammals in Northeast and South Bulgaria in 2009**

	Location	Species of small mammals with ectoparasites	Species of ectoparasitic arthropods
North-east Bulgaria	1. Kardam village (Dobrich district)	<i>Apodemus sylvaticus</i>	<i>Ornithonyssus bacoti</i> , <i>Laelaps echidninus</i>
		<i>Apodemus agrarius</i>	<i>O. bacoti</i> , <i>L. echidninus</i> , <i>Ixodes ricinus</i> , <i>Hyalomma plumbeum</i>
		<i>Dryomys nitedula</i>	<i>O. bacoti</i> , <i>L. echidninus</i>
	2. Durankulak village (Dobrich district)	<i>Apodemus sylvaticus</i>	<i>O. bacoti</i> , <i>L. echidninus</i> , <i>I. ricinus</i> , <b><i>Polyplax spinulosa</i></b>
		<b><i>Microtus arvalis</i></b>	<i>L. echidninus</i>
		<b><i>Crociodura leucodon</i></b>	<i>O. bacoti</i> , <i>I. ricinus</i>
	3. Bezmer village (Dobrich district)	<i>Microtus arvalis</i>	<i>O. bacoti</i> , <i>P. spinulosa</i>
	4. Kobalaka area in the vicinity of the town of Dobrich	<i>Apodemus sylvaticus</i>	<i>L. echidninus</i>
		<i>Apodemus agrarius</i>	<i>O. bacoti</i> , <i>L. echidninus</i> , <b><i>Ctenocephalides canis</i></b> , <b><i>Leptopsilla segnis</i></b> , <i>P. spinulosa</i>
		<b><i>Apodemus flavicollis</i></b>	<i>O. bacoti</i>
	5. Town of Kavarna	<i>Apodemus sylvaticus</i>	<i>O. bacoti</i> , <i>L. echidninus</i> , <i>I. ricinus</i> , <b><i>Dermacentor marginatus</i></b> , <i>Ct. canis</i> , <i>P. spinulosa</i>
		<i>Microtus arvalis</i>	<i>O. bacoti</i> , <i>I. ricinus</i> , <i>L. segnis</i>
	6. Tyulenovo village (Dobrich district)	<i>Microtus arvalis</i>	<i>I. ricinus</i>
		<i>Crociodura leucodon</i>	<i>L. echidninus</i> , <i>I. ricinus</i>
	7. Kalimok BASci scientific base in Nova Cherna village (Tutrakan municipality)	<i>Microtus arvalis</i>	<i>O. bacoti</i> , <i>L. echidninus</i> , <i>I. ricinus</i> , <i>Ct. canis</i>
		<i>Crociodura leucodon</i>	<i>O. bacoti</i> , <i>I. ricinus</i>
<b><i>Mus musculus musculus</i></b>		<i>O. bacoti</i> , <i>L. echidninus</i> , <i>I. ricinus</i>	
<b><i>Rattus rattus</i></b>		<i>P. spinulosa</i>	
	<b><i>Arvicola terrestris</i></b>	<i>L. echidninus</i> , <b><i>Boophilus calcaratus</i></b> , <i>Ct. canis</i>	
8. Bezhanovo village (Dobrich district)	<i>Apodemus agrarius</i>	<i>I. ricinus</i>	
9. Botevo village (Varna district)	<b><i>Microtus subterraneus</i></b>	<i>I. ricinus</i> , <b><i>Pulex irritans</i></b>	
10. Zlatna Niva village (Shumen district)	<i>Apodemus sylvaticus</i>	<i>L. echidninus</i> , <i>Ct. canis</i>	
	<i>Apodemus agrarius</i>	<i>O. bacoti</i> , <i>L. echidninus</i> , <i>I. ricinus</i> , <i>L. segnis</i> , <i>P. spinulosa</i>	
	<i>Microtus arvalis</i>	<i>O. bacoti</i> , <i>L. echidninus</i> , <i>Ct. canis</i> , <i>P. spinulosa</i>	
	<i>Dryomys nitedula</i>	<i>O. bacoti</i> , <i>L. echidninus</i>	
South Bulgaria	11. Kapitan Andreevo village (Haskovo district)	<i>Apodemus sylvaticus</i>	<i>O. bacoti</i> , <i>L. echidninus</i> , <i>I. ricinus</i> , <i>B. calcaratus</i> , <i>L. segnis</i>
		<i>Apodemus agrarius</i>	<i>O. bacoti</i> , <i>L. echidninus</i> , <i>I. ricinus</i> , <i>B. calcaratus</i> , <i>P. spinulosa</i>
		<i>Microtus arvalis</i>	<i>O. bacoti</i> , <i>L. echidninus</i> , <i>I. ricinus</i> , <i>B. calcaratus</i>
		<i>Mus musculus musculus</i>	<i>O. bacoti</i> , <i>L. echidninus</i> , <i>I. ricinus</i> , <i>B. calcaratus</i> , <i>P. spinulosa</i>
12. Town of Svilengrad	<i>Mus musculus musculus</i>	<i>O. bacoti</i> , <i>L. echidninus</i> , <i>I. ricinus</i>	

apidae (Berlese, 1892), genus *Laelaps* (Koch, 1836) and has been described as a parasite in mice, rats (Taylor et al., 2007) and bats by other European authors (Pereira and Alonso, 1993). This mite is a carrier of a number of pathogens such as *Francisella tularensis* and *Hepatozoon muris* (Taylor et al., 2007).

*Polyplax spinulosa* (syn. *Haematopinus spinulosus* Denny, 1842) is a louse that belongs to order Phthiraptera (Haeckel, 1896), suborder Anoplura, family Polyplacidae, genus *Polyplax* and is a mouse and rat parasite (Taylor et al., 2007), added to a list of 31 more species of Phthiraptera that are new to Europe (alien) and are important to animal biodiversity and as carriers of dangerous infectious human diseases (Kenis and Roques, 2010).

A big part of the identified species of mites and insects use as hosts both farm animals and humans. Some of them are carriers and final hosts of a number of protozoa diseases. The data show that *Ixodes ricinus* ranked third in terms of frequency of occurrence and the small mammals from our investigation exchanged the colonization of this mite with farm animals and humans in nature. It is a known fact that *Ixodes ricinus* is the only mite in Europe, carrier of the parasite *Borrelia burgdorferi* that causes Lyme disease in animals and humans (Johnson et al., 1984 emend. Baranton et al., 1992). Therefore, the role of small mammals in the epizootology and dissemination of a number of parasitic and contagious diseases is important.

## Conclusions

The following conclusions can be made as a result of this study:

Up-to-date information about the species composition of parasitic arthropods in 10 species of small mammals in Northeast and South Bulgaria were obtained. The species composition of the ectoparasites in small mammals in the area of South Dobrudzha was studied for the first time. Two arthropod species were found that had not been detected in Bulgaria before (alien arthropods).

New invasive species of parasitic arthropods were proved to have colonized our country from neighboring European countries.

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