

Contribution to the knowledge of fleas (Siphonaptera) in the nests of *Micromys minutus* and *Muscardinus avellanarius* in north-eastern Slovakia

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Abstract

Associations of fleas that live in nests and burrows of small mammals are relatively well explored. In this study we try to expand the knowledge about flea communities of two small mammals, namely *Micromys minutus* (Pallas, 1771) and *Muscardinus avellanarius* (Linnaeus, 1758) in Slovakia. Part of the research into the nesting biology and ecology of both rodent species in north-eastern Slovakia was also research into parasites in their nests. In nests of *M. minutus* three flea species (*Megabothris turbidus* (Rothschild, 1909), *Ctenophthalmus assimilis* (Taschenberg, 1880), *C. solutus* Jordan & Rothschild, 1920), while in hazel dormouse nest five species were found – *M. turbidus*, *C. assimilis*, *C. solutus*, *Ceratophyllus (Monopsyllus) sciutorum* (Schrank, 1803) and *Doratomylla dasytisma* (Rothschild, 1897).

Key words: Eurasian Harvest Mouse, Hazel Dormouse, Ondavská vrchovina highlands, parasites

Introduction

Parasitic and non-parasitic groups of invertebrates inhabit nests that provide suitable habitat for their survival and reproduction. Important factors that affect the species and trophic composition of arthropods in nests are the character of the surrounding habitat, the structure of the nest, food remains in nests, and also the nest position, it means if the nests are located above or below the soil surface (e.g., Cyprich & Krumpál 1996, 2007; Cyprich et al. 1992; Tryjanowski et al. 2001; Büchner et al. 2003; Mašán & Stanko 2005; Bajerlein et al. 2006; Błoszyk et al. 2006, 2011; Gwiazdowicz et al. 2006; Šustek & Stanko 2012; Krawczyk et al. 2015; Roháček et al. 2022).

The flea fauna (Siphonaptera) of rodents in Slovakia is relatively well described. Information about fleas on *Micromys minutus* (Pallas, 1771) can be found in several works (Rosický 1957; Dudich 1984, 1986; Cyprich et al. 1987; Stanko 1987a). A total of seven species of fleas have been confirmed from this host in Slovakia. Similarly, data on the flea fauna on *Muscardinus avellanarius* (Linnaeus, 1758) can be found in several publications too (Rosický 1957; Dudich 1983, 1987, 1988, 1991; Dudich & Matoušek 1985; Stanko 1987b; Stanko & Fričová 2001), four flea species have been recorded on this rodent species from our territory. On the other hand, there are few published works on the flea fauna in the nests of both species of rodents from the territory of Slovakia (Cyprich & Kiefer 1981; Cyprich et al. 1992), and at the same time it should be noted that numerous nests were examined in these publications. This is reflected in the relatively high number of flea species found in the nests of both rodent species.

The main aim of our study was to describe the flea's fauna living in the Eurasian harvest mouse and the hazel dormouse nests in north-eastern Slovakia. Data on the

fleas of these hosts, as well as their nests, are missing from the study territory.

Material and methods

The field margins and woodland edges were systematically searched by hand for nests of *M. minutus* and *M. avellanarius*. All evaluated nests were obtained between July and November of 2011. The study sites were in predominantly arable landscapes in the vicinity of Duplín village (49°14'08"N, 21°38'11"E, 260 m a.s.l.) and Stropkov city (49°11'36"N, 21°39'35"E, 216 m a.s.l.) all in north-eastern Slovakia (Ondavská vrchovina highlands). Nests of *M. minutus* were identified and distinguished from similar grassland nests of *M. avellanarius* according to studies by Čanády (2012, 2013, 2015) and Csanády (2022). A total of six nests of *M. minutus* and 12 nests of *M. avellanarius* were evaluated.

Each nest was placed in a plastic bag, the top of which was sealed to prevent arthropod escape. Under laboratory conditions, each nest was placed in modified Berlese-Tullgren funnels for 72 hours. Arthropods were collected in 70% ethyl alcohol in a catch bottle that was attached to the bottom of the funnel. The extracted arthropods were then sorted according to taxonomic affiliation (see Roháček et al. 2022) and fleas (Siphonaptera) were identified according to the key of Rosický (1957).

These materials in alcohol are deposited in the collection of the Institute of Parasitology, Slovak Academy of Sciences in Košice, Slovakia.

Results and Discussion

***Micromys minutus* (Pallas, 1771) – Eurasian Harvest Mouse**

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In previous studies (e.g., Bence et al. 2003; Čanádý 2013; Csanádý 2022) were showed that harvest mice spend most of their life above the soil surface, in tall, dense vegetation, where they build their woven ball-shaped nests anchored above the ground. Nests are used for breeding and resting, and most nests are damaged within one month. The mice abandon old nests and build new ones during their reproductive period (Čanádý 2013). The spherical nests, 4.5 – 14 cm in diameter, are usually located at a height of 8 – 115 cm above the ground and attached to vegetation.

Flea communities recorded from Eurasian harvest mouse nests in Slovakia

Together, six *M. minutus* nests were examined, and 29 fleas of three species we confirmed in four positive nests: *Megabothris turbidus* (Rothschild, 1909), *Ctenophthalmus assimilis* (Taschenberg, 1880), *C. solutus* (Jordan & Rothschild, 1920).

While two flea species (*C. assimilis*, *C. solutus*) were recorded with only one specimen each, the third registered species – *M. turbidus* was more numerous and we found it in four nests in both localities (Table 1).

Megabothris turbidus (Rothschild, 1909)

Fleas occur in equal proportions in the fur and in the nests of hosts (Skuratowicz 1967; Baláz & Ševčík 2021; Baláz & Košša 2022). It is a typical representative of the small mammals such as *Apodemus agrarius* (Pallas, 1771), *A. flavicollis* (Melchior, 1834), *A. sylvaticus* (Linnaeus, 1758), *Clethrionomys glareolus* (Schreber, 1780), *Microtus agrestis* (Linnaeus, 1761), *M. arvalis* (Pallas, 1778), *M. subterraneus* (de Selys-Longchamps, 1836), *Sorex araneus* Linnaeus, 1758 and, *S. minutus* Linnaeus, 1766. In forest habitats of lower altitudes, it is their second most abundant flea species (the first is *Ctenophthalmus agyrtus* (Heller, 1896). It prefers mainly floodplain forests and does not avoid secondary tree formations. It also penetrates from forests into adjacent open areas of fields and meadows. It also occurs in mountain environments up to the alpine zone. It is most abundant in the warm part of the year, peaking in summer and autumn. In winter, it mainly stays in nests. According to Baláz & Ševčík (2021), the host spectrum is very broad, attacking mainly members of the genera *Microtus* and *Clethrionomys*, quite often also *Apodemus* (Brinck-Lindroth & Smit 2007). It has also been recorded on other species of small mammals, squirrels, dormice, some carnivores (*Mustela*) and also birds. *C. glareolus* is considered to be the most common host (Rosický 1957; Skuratowicz 1967; Dudich 1995; Baláz & Ševčík 2021).

Table 1. The fleas found in the nest of the Eurasian harvest mouse (*Micromys minutus*) in Slovakia.

Species	Nest no.	N/Sex	Site	Date
<i>Megabothris turbidus</i>	H9	2 M, 2 F	Stropkov	25.VIII.2011
	H9 ^a	1 M, 2 F	Duplín	16.IX.2011
	H4 ^b	1 M, 2 F	Duplín	16.IX.2011
	H6	1 M	Duplín	16.IX.2011
	H16	2 F	Duplín	17.IX.2011
	H20	5 M, 9 F	Duplín	18.XI.2011
<i>Ctenophthalmus assimilis</i>	H9 ^a	1 M	Duplín	16.IX.2011
<i>Ctenophthalmus solutus</i>	H4 ^b	1 M	Duplín	16.IX.2011

^{a, b} – species and individuals recorded in the same nest.

M – male.

F – female.

Ctenophthalmus assimilis (Taschenberg, 1880)

It is a predominantly nest-dwelling species (Beaucournu & Launay 1990), but often occurs on hosts, originally restricted to the forest-steppe of Eurasia (Rosický 1957). Several authors (Baláz & Ševčík 2021; Baláz & Košša 2022) state that it prefers open habitats, especially fields, meadows, clearings, where it is the dominant species of small mammal flea. Although its main host is the field rodent species – *Microtus arvalis*, it sometimes invades into forest habitats together with its host. Conversely, it is absent in high mountains where its main host is also

absent. Flea is present on hosts during all seasons. On the other hand, apart from its main host, *C. assimilis* has been recorded on various species of other small mammals – other voles, mice, and shrews such as (*Apodemus agrarius*, *A. flavicollis*, *A. sylvaticus*, *Clethrionomys glareolus*, *Microtus agrestis*, *M. subterraneus*, *Sorex araneus*, and *S. minutus*) and also on species of *Spermophilus citellus* (Linnaeus, 1766) or *Cricetus cricetus* (Linnaeus, 1758), and on the mole (*Talpa europaea* Linnaeus, 1758) it tends to be the most abundant flea species (Rosický 1957; Skuratowicz 1967; Dudich 1995; Brinck-Lindroth & Smit 2007).

***Ctenophthalmus solutus* Jordan & Rothschild, 1920**

According to review papers by Baláz & Ševčík (2021) and Baláz & Košša (2022), the species is found primarily in the fur of the host. The ecological optimum of the species is in forest habitats of the upland stage; on the northern edge of the Pannonian Plain it ascends to the fir-beech vegetation stage (Dudich 1986). It is especially abundant in thermophilous oak woods, over-wooded groves and in their close vicinity. It is less common in open areas and spruce forests, completely avoiding floodplain forests. Rosický (1957) and Skuratowicz (1967) state that it can be recorded during all seasons, but reaches its maximum especially in spring. The main hosts are members of the genus *Apodemus*, especially *A. flavicollis*, *A. sylvaticus* and *A. agrarius*. A common secondary host is *Mus musculus*, and it also parasitizes microtid rodents and insectivores more sporadically (*Clethrionomys glareolus*, *Microtus agrestis*, *M. arvalis*, *M. subterraneus*, *Sorex araneus*, *S. minutus*; Rosický 1957).

Cyprich & Kiefer (1981), who so far examined the most voluminous material of nests of *M. minutus* (100 nests in total) from the territory near Bratislava, during the population expansion of the Eurasian harvest mouse in 1966,

recorded fleas in 75% of nests. The average number of fleas in their research was approximately 10 fleas per examined nest. They registered 5 flea species in the nests, while the species *M. turbidus* significantly dominated (97.5%). In addition to the three species that we also confirmed in our research, the authors mention 2 more species – *Ctenophthalmus agyrtes* (Heller, 1896) (10 specimens) and *Nosopsyllus fasciatus* (Bosc, 1800) (1 specimen).

***Muscardinus avellanarius* (Linnaeus, 1758) – Hazel Dormouse**

In previous studies (cf. Čanády 2012, 2015; Csanády 2022) were showed that the hazel dormouse occupies woodland habitats, shrub stands, clearings and other ecotone habitats mostly in deciduous or mixed deciduous-coniferous forests with a well-developed understorey. Arboreal nests are important for predator avoidance, protection from weather conditions and security for offspring.

Spherical nests, mostly 5 – 15 cm in diameter (depending on the nest type), were usually located 20 – 140 cm above the ground attached to vegetation (Čanády 2015; Csanády 2022).

Table 2. The fleas (Siphonaptera) found in nest of the hazel dormouse, *Muscardinus avellanarius* in Slovakia.

Species	Nest no.	N/Sex	Site	Date	
<i>Megabothris turbidus</i>	H6 ^a	1 M, 4 F	Duplín	21.VII.2011	
	H4 ^b	6 M, 7 F	Duplín	24.VIII.2011	
	H12	1 F	Duplín	26.VIII.2011	
	H16 ^c	1 M, 3 F	Duplín	26.VIII.2011	
	H17	3 F	Duplín	26.VIII.2011	
	H7	1 F	Duplín	16.IX.2011	
	H14	2 F	Duplín	17.IX.2011	
	H13	6 M, 8 F	Duplín	18.XI.2011	
	H6	8 M, 8 F	Duplín	18.XI.2011	
	H15	3 M, 5 F	Duplín	18.XI.2011	
	H25 ^d	15 M 14 F	Duplín	19.XI.2011	
	<i>Ctenophthalmus assimilis</i>	H16 ^c	2 F	Duplín	26.VIII.2011
	<i>Ctenophthalmus solutus</i>	H4 ^b	1 M	Duplín	16.IX.2011
<i>Ceratophyllus sciurorum</i>	H6 ^a	1 M	Duplín	21.VII.2011	
	H16 ^c	1 F	Duplín	26.VIII.2011	
	H25 ^d	1 M, 1 F	Duplín	19.XI.2011	
<i>Doratopsylla dasyncnema</i>	H3	1 F	Duplín	21.VII.2011	

^{a, b, c, d} species and individuals recorded in the same nest.

M – male.

F – female.

Flea communities recorded from Hazel Dormouse nests

Twelve nests of *M. avellanarius* were examined from the Duplín locality, from which we recorded 96 fleas belonging to five species: *M. turbidus*, *C. assimilis*, *C. solutus*, *Ceratophyllus sciurorum* and *Doratopsylla dasyncnema* (Table 2).

M. turbidus flea in the hazel dormouse nests dominated.

We recorded 96 fleas, it means 40 males and 56 females in 11 nests. Two *C. assimilis* females were recorded in one nest, together with two other species – *M. turbidus* and *C. sciurorum*. Similarly, one *C. solutus* male was confirmed with several individuals of *M. turbidus* (Table 2).

Data on the ecology of the three-flea species – *M. turbidus*,

C. assimilis and *C. solutus* were presented above (see *M. minutus*).

***Ceratophyllus (Monopsyllus) sciurorum* (Schrank, 1803)**

It is a nest-dwelling flea species (Skuratowicz 1967) associated with arboreal mammals and cavity-nesting bird species (Rosický 1957; Skuratowicz 1967; Dudich 1986; Baláž & Ševčík 2021; Baláž & Košša 2022). According to the mentioned authors, its main host is *Sciurus vulgaris* Linnaeus, 1758. Together with its host, it occurs in forest habitats from lowlands to the montane zone. Typically, this species can also be captured in the wild (e.g., on a flag), where it actively seeks out its host. It occurs throughout the year, but is more abundant in the warmer months. In autumn and winter, its abundance decreases. In addition to the squirrel, it is a common parasite of dormice (e.g., *Muscardinus avellanarius*, *Glis glis*) and sporadically attacks small mammals (*Apodemus agrarius*, *A. flavicollis*, *Clethrionomys glareolus*, *Microtus subterraneus*). It has also been recorded on the species *Erinaceus europaeus* Linnaeus, 1758, on some carnivores, such as *Martes martes* Linnaeus, 1758, *Vulpes vulpes* Linnaeus, 1758, also *Canis lupus* forma *familiaris* Linnaeus, 1758 (see Baláž & Ševčík 2021) and on human (Rosický 1957; Skuratowicz 1967; Bartkowska 1973; Brinck-Lindroth & Smit 2007).

Four fleas (two males, and two females) were recorded in three nests, together with two species of *M. turbidus* and *C. assimilis* obtained from Duplín village (Table 2).

***Doratopsylla dasyncnema* (Rothschild, 1897)**

It belongs to the species parasitizing in the fur of the host (Brinck-Lindroth & Smit 2007; Baláž & Ševčík 2021; Baláž & Košša 2022). It is a common parasite of shrews (Soricidae) such as *Sorex*, *Neomys* and *Crocidura* (Dudich & Ambros 1985). It is a widespread and dominant species that is associated with forest formations (Dudich 1991), avoiding areas of large river floodplains that are periodically flooded (Dudich 1995). The species is especially abundant in the upland, foothill and mountain grades. The most common host is *Sorex araneus* and, together with it, can reach up to the alpine stage. In lowland areas, its occurrence is more sporadic. It reaches its highest abundance in the warm months. In addition to the insectivores mentioned above, it has also been recorded on a wide range of other small mammal species (*Apodemus agrarius*, *A. flavicollis*, *A. sylvaticus*, *Micromys minutus*, *Mus musculus*, *Clethrionomys glareolus*, *Microtus agrestis*, *M. arvalis*, *M. subterraneus*, *M. tatraicus*, *Crocidura leucodon*, *C. suaveolens*, *Neomys anomalus*, *N. fodiens*, *Sorex alpinus*, *S. araneus*, *S. minutus*, *Talpa europaea*) (Rosický 1957; Skuratowicz 1967; Baláž & Ševčík 2021; Baláž & Košša 2022). However, Brinck-Lindroth & Smit (2007) consider its occurrence on voles and murid rodents to be coincidental. One female was recorded in a nest (Table 2).

A representative and so far, the largest number of *M. avellanarius* nests in Slovakia were investigated by Cyprich et al. (1992). They examined 163 nests in the many localities of Slovakia, of which 141 were located in birdhouses. The authors registered a total of 2099 fleas belonging to 16 species in the nests, *C. sciurorum* absolutely dominated (51%), i.e., a species associated with arboreal mammals (dormouse, squirrels). Another seven species represented fleas associated with parasitism on birds and made up a total of 38.6% of fleas in nests. The remaining eight species of fleas were created by flea communities, which are mostly associated with small mammals, and made up 10.4% of the flea material in *M. avellanarius* nests. Within this mammal's flea species, the authors mention the species *M. turbidus*, *C. solutus* and *C. assimilis*. The flea *D. dasyncnema* was missing in their collections.

The number of investigated nests of both rodent species is not large, therefore the range of detected flea taxa in the given region is not complete. At the same time, we can state that although both species of rodents are taxonomically quite distant, they still have very ecologically similar trophic and topical requirements due to some characteristics of nidobiology and ecology. This was reflected in similar coenoses of fleas in both species, which points to strong contacts and common parasitofauna with other species of small mammals (genera *Ctenophthalmus*, *Megabothris*, *Doratopsylla*). *Ceratophyllus sciurorum* is an important flea species for the hazel dormouse (both in nests and on hosts), which is typical for the parasitofauna of dormouse and squirrels and some species of birds nesting on trees (Rosický 1957; Stanko 1987b; Dudich 1988, Cyprich et al. 1992).

Conclusion

During 2011, there were examined nests of *Micromys minutus* and *Muscardinus avellanarius* in the surroundings of Duplín village and Stropkov city (north-eastern Slovakia). In twelve hazel mouse nests, five flea species were recorded. In six Eurasian harvest mouse nests, three flea species were recorded. In nests of both rodent species, *Megabothris turbidus* dominates in flea communities. The occurrence of *Doratopsylla dasyncnema* flea in hazel mouse nest, according to the author's knowledge, is new data from this territory of Slovakia.

Acknowledgements

We thank the editor and all anonymous reviewers for their valuable and constructive comments on the first version of the manuscript. Our thanks also go to Viera Kleinová, Andrej Mock, Peter Luptáčík and Jozef Oboňa for their help in laboratory processing of nests and separation of individual taxa. This work was supported by the Slovak Scientific Grant Agency under contract No. KEGA 051PU-4/2021 and APVV-21-0166.

References

- Bajerlein D, Błoszyk J, Gwiazdowicz DJ, Ptaszyk J, Halliday B. 2006. Community structure and dispersal of mites (Acari, Mesostigmata) in nests of the white stork (*Ciconia ciconia*). *Biologia* 61: 525–530.
- Baláz I, Ševčík M. 2021. Vplyv výškového gradientu na spoločnosť bĺch drobných cicavcov. Nitra: Univerzita Konštantína Filozofa v Nitre, Fakulta Prírodných Vied.
- Baláz I, Košša J. 2022. *Bľchy drobných cicavcov*. Nitra: Univerzita Konštantína Filozofa v Nitre, Fakulta Prírodných Vied.
- Bartkowska K. 1973. Siphonaptera Tatr Polskich. *Fragmenta Faunistica* 19: 227–281.
- Beaucournu JC, Launay H. 1990. *Les puces (Siphonaptera) de France et du Bassin méditerranéen occidental*. Paris: Fédération Française des Sociétés de Sciences Naturelles.
- Bence SL, Stander K, Griffiths M. 2003. Habitat characteristics of harvest mouse nests on arable farmland. *Agriculture, Ecosystems and Environment* 99: 179–186.
- Błoszyk J, Dražina T, Gwiazdowicz D, Halliday B, Gołdyn B, Napierała A, Rybska E. 2011. Mesostigmatic mites (Acari: Mesostigmata) in nests of the Eurasian griffon vulture (*Gyps fulvus*) in Croatia. *Biologia* 66(2): 335–339.
- Błoszyk J, Bajerlein D, Gwiazdowicz DJ, Halliday RB, Dylewska M. 2006. Uropodine mite communities (Acari: Mesostigmata) in birds' nests in Poland. *Belgian Journal of Zoology* 136: 145–153.
- Brinck-Lindroth G, Smit FGAM. 2007. *The fleas (Siphonaptera) of Fennoscandia and Denmark*. Vol. 41. Leiden: Brill.
- Büchner S, Stubbe M, Striese D. 2003. Breeding and biological data for the common dormouse (*Muscardinus avellanarius*) in Eastern Saxony (Germany). *Acta Zoologica Academiae Scientiarum Hungaricae* 49 (Suppl. 1): 19–26.
- Cyprich D, Kiefer M. 1981. Fauna of Siphonaptera in nests of *Micromys minutus* Pallas, 1771 during its population expansion in the natural reservation Šúr in Jur near Bratislava. *Acta Facultatis Rerum Naturalium Universitatis Comenianae, Zoologia* 25: 31–37.
- Cyprich D, Krumpál M. 1996. Fleas (Siphonaptera) in nests of the house sparrow (*Passer domesticus*) and the tree sparrow (*P. montanus*). *Biologia-Bratislava* 51: 153–162.
- Cyprich D, Krumpál M. 2007. Phenology of fleas (Siphonaptera) *Ceratophyllus gallinae*, *C. pullatus* and *C. tribulis* in nests of birds and mammals. *Entomofauna carpathica* 19: 65–69.
- Cyprich D, Krumpál M, Dúha J. 1987. Bľchy (Siphonaptera) cicavcov (Mammalia) štátnej prírodnej rezervácie Šúr. *Ochrana prírody* 8: 241–253.
- Cyprich D, Krumpál M, Lukáš J. 1992. Contribution to the knowledge of the flea fauna (Siphonaptera) of dormouse nests (Myoxidae) in Slovakia. *Parasitologia Hungarica* 25: 97–105.
- Csanády A. 2022. Occurrence of the harvest mouse (*Micromys minutus*) and the hazel dormouse (*Muscardinus avellanarius*) in Slovakia based on summer nests (2013–2021). *Acta Musei Silesiae Scientiae Naturales* 71: 223–236.
- Čanády A. 2012. Contribution to the knowledge of *Micromys minutus* and *Muscardinus avellanarius* distribution in eastern Slovakia based on the survey of summer nests in 2010–2012 (Rodentia). *Lynx, series nova* 43: 5–15.
- Čanády A. 2013. Nest dimensions and nest sites of the harvest mouse (*Micromys minutus* Pallas, 1771) from Slovakia: a case study from field margins. *Zoology and Ecology* 23: 253–259.
- Čanády A. 2015. Factors predicting summer nest construction of *Muscardinus avellanarius* in deciduous woodland edges in Slovakia. *Biologia* 70: 132–140.
- Dudich A. 1983. Siphonaptera (Insecta) drobných zemných cicavcov pohoria Vihorlat (Východné Karpaty). *Zborník Východoslovenského múzea v Košiciach, Prírodné vedy* 23: 153–181.
- Dudich A. 1984. Fleas (Insecta: Siphonaptera) of small mammals in the Slánske vrchy and Zemplén Mountains (West Carpathians). *Parasitologica hungarica* 2: 29–34.
- Dudich A. 1986. Príspevok k poznaniu fauny bĺch (Siphonaptera) drobných zemných cicavcov (Insectivora, Rodentia) pohoria Pohronský Inovec (Západné Karpaty). *Rosalia, Nitra* 2: 247–264.
- Dudich A. 1987. Príspevok k poznaniu fauny bĺch (Siphonaptera, Insecta) drobných zemných cicavcov Kremnických vrchov (Západné Karpaty). *Kmetianum* 8: 333–350.
- Dudich A. 1988. Náčrt fauny ektoparazitov drobných cicavcov (Insectivora, Rodentia) horného Ponitria. *Horná Nitra* 13: 175–199.
- Dudich A. 1991. Ektoparazity drobných cicavcov (Insectivora, Rodentia) Kysuckých Beskýd (Západné Karpaty). *Vlastivedný zborník Považia* 16: 203–219.
- Dudich A. 1995. *Synekologická štúdia ektoparazitov drobných cicavcov smrekových lesov v oblasti Stredných Beskýd*. Zvolen: Technická univerzita Zvolen.
- Dudich A, Ambros M. 1985. Dodatky k sifonapterofaune (Siphonaptera: Insecta) drobných zemných cicavcov pohoria Tribeč (Západné Karpaty). *Rosalia (Nitra)*, 1984 1: 163–173.
- Dudich A, Matoušek B. 1985. Bľchy (Siphonaptera, Insecta) zo zbierok Slovenského národného múzea v Bratislave. *Zborník Slovenského národného múzea, Prírodné vedy* 31: 81–104.
- Gwiazdowicz D, Błoszyk J, Bajerlein D, Halliday R, Mizera T. 2006. Mites (Acari: Mesostigmata) inhabiting nests of the white-tailed sea eagle *Haliaeetus albicilla* (L.) in Poland. *Entomologica Fennica* 17(4): 366–372.
- Krawczyk AJ, Augustiničová G, Gwiazdowicz DJ, Konwerski S, Kucharczyk H, Olejniczak I, Rutkowski T, Skubała P, Solarz K, Zdrojewska Z, Tryjanowski P. 2015. Nests of the harvest mouse (*Micromys minutus*) as habitat for invertebrates. *Biologia* 70(12): 1637–1647.
- Mašán P, Stanko M. 2005. Mesostigmatic mites (Acari) and fleas (Siphonaptera) associated with nests of mound-building mouse, *Mus spicilegus* Petényi, 1882 (Mammalia, Rodentia). *Acta Parasitologica* 50(3): 228–234.
- Roháček J, Oboňa J, Csanády A. 2022. New records of Diptera from nests of and in Slovakia. *Acta Musei Silesiae, Scientiae Naturales* 71(3): 285–290.
- Rosický B. 1957. *Fauna ČSR – svazek 10. Bľchy – Aphaniptera*. Praha: Nakladatelství ČSAV.
- Skuratowicz W. 1967. *Pchľy-Siphonaptera (Aphaniptera)*. Stryków: Państwowe Wydawnictwo Naukowe.
- Stanko M. 1987a. Bľchy (Siphonaptera) drobných cicavcov severnej časti Krupinskej planiny. *Stredné Slovensko* 6: 108–117.
- Stanko M. 1987b. Bľchy (Siphonaptera) drobných zemných cicavcov pohoria Javorie. *Zborník Slovenského národného múzea, Prírodné Vedy* 33: 95–108.
- Stanko M, Fričová J. 2001. Teriologický a parazitologický výskum v CHKO Slovenský kras v rokoch 1994 – 1995. II. Ektoparazity drobných cicavcov (Insecta: Anoplura, Siphonaptera). *Natura Carpatica* 52: 109–122.
- Šustek Z, Stanko M. 2012. Beetles (Insecta: Coleoptera) in the nests of mound-building mouse *Mus spicilegus* in four orographic units in Slovakia. *Oltenia Journal for Studies in Natural Sciences* 28: 66–78.
- Tryjanowski P, Baraniak E, Bajaczyk R, Gwiazdowicz DJ, Konwerski S, Olszanowski Z, Szymkowiak P. 2001. Arthropods in nests of the red-backed shrike (*Lanius collurio*) in Poland. *Belgian Journal of Zoology* 131: 69–74.