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Faunistic survey of pseudoscorpions (Arachnida: Pseudoscorpiones) collected from trees and using Malaise traps in Slovakia and the Czech Republic

Faunistický prieskum šťúrikov (Arachnida: Pseudoscorpiones) zbieraných na stromoch a pomocou Malaiseho pascí na Slovensku a v Českej republike

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Central Europe, habitat preference, Malaise trap, pseudoscorpion, tree bark, tree hollow, wood

Abstract. Altogether 390 pseudoscorpions belonging to 16 species and four families were examined during the present study. The samples were collected at more than 40 localities in Slovakia and one locality in the Czech Republic. The material includes specimens found in several microhabitats, such as mould of tree hollows, wood-decay fungi, dead wood, under tree bark, as well as specimens collected using Malaise traps, tree trunk photoeclectors and cardboard strips. A total of 13 species were found in tree hollows; the closest association with this type of microhabitat demonstrated by the species *Allochernes wideri* (C. L. Koch, 1843) and *Dinocheirus panzeri* (C. L. Koch, 1837). A total of 10 species were collected under tree bark; the most abundant was *Chernes cimicoides* (Fabricius, 1793). Both *C. cimicoides* and *Chernes hahnii* (C. L. Koch, 1839) showed a strong association with the microhabitat under tree bark. The Chernetidae family was the most abundant in all of the seven microhabitats examined, except for the samples from cardboard strips. In the cardboard strip samples, only the family Neobisiidae was collected. The species *Pselaphochernes scorpioides* (Hermann, 1804) was the most abundant in the samples from dead wood, wood-decay fungi and in Malaise traps.

INTRODUCTION

A tree can be a habitat in itself, including several microhabitats such as bark, wood and tree hollows. Wood and bark-inhabiting organisms constitute a large proportion of forest species (Růžička & Boháč 1991, Humphrey et al. 2002, Persson et al. 2013). However, studies of wood and bark inhabiting invertebrate faunas are few and mainly concentrate on beetles. Generally, records of pseudoscorpions living in tree hollows and under bark in Central Europe were published as part of faunistic or ecological works (e.g. Beier 1963, Rafalski 1967, Drogla & Lippold 2004, Šťáhlavský 2006a, 2006b, 2011, Šťáhlavský & Krásný 2007, Šťáhlavský & Tuf 2009, Šťáhlavský & Chytil 2013).

In the Czech Republic and Slovakia, few authors have paid detailed attention to pseudoscorpions in tree hollows. Ducháč (1993) collected pseudoscorpions using pitfall traps, which were placed inside tree hollows in Třeboňsko, Southern Bohemia. This author divided the species collected into three groups based on the strength of their association with this microhabitat; *Larca lata* (Hansen, 1884) indicated the closest relationship of the five species discovered. Šťáhlavský (2001) systematically investigated pseudoscorpions from tree hollows in an urban environment in Prague, Central Bohemia. Recorded species were classified into five groups based on the strength of their association with tree hollows. The species

Anthrenochernes stellae Lohmander, 1939, *Mundochthonius styriacus* Beier, 1971, *Dinocheirus panzeri* (C. L. Koch, 1837) and *Allochernes wideri* (C. L. Koch, 1843) comprised the group with the closest association with this microhabitat. Šťáhlavský (2001) also reported on the preference of pseudoscorpions to certain substrate humidities. Christophoryová (2010) published a detailed paper about pseudoscorpions living in tree hollows and under tree bark in Slovakia; altogether eight pseudoscorpion species were found in tree hollows, and three species under tree bark. Christophoryová (2010) also tried to classify the pseudoscorpions based on their association with the habitat and substrate humidity. The species *D. panzeri* and *A. wideri* had the strongest association with tree hollows, where they are found periodically (Christophoryová 2010). Only six pseudoscorpion species have been found under tree bark in Slovakia; the species *Rhacochelifer quadrimaculatus* (Tömösváry, 1882) and *Mesochelifer ressli* Mahnert, 1981 were added to the fauna of Slovakia based on specimen collection under tree bark (Verner 1960, Krumpálová & Krumpál 1993, Krumpál & Christophoryová 2007, Christophoryová 2010).

Besides tree hollows and tree bark, dead wood and decaying tree stumps also provide microhabitats for pseudoscorpions (Humphrey et al. 2002, Drogla & Lippold 2004, Persson et al. 2013). Pseudoscorpions living on trees could be also collected using photoeclectors and Malaise traps. Marx et al. (2008) recorded pseudoscorpion assemblages from tree trunks using photoeclectors in floodplain forest in Germany.

Malaise traps are primarily used for the collecting of flying insects, mainly flies (Diptera) and wasps (Hymenoptera), although they also catch many other insects and arachnids, including pseudoscorpions (Roller & Vidlička 2001). Six pseudoscorpion species were recorded from Malaise traps in Slovakia (Krumpál & Christophoryová 2007, Christophoryová & Krumpál 2010). Phoresy is one of the possible ways that pseudoscorpions could be collected in Malaise traps. In Europe, phoresy is typical mainly for the families Chernetidae and Cheliferidae (Ressl & Beier 1958, Beier 1963, Drogla & Lippold 2004, Christophoryová et al. 2011b).

The present paper gives new reports of pseudoscorpion species living in trunks of spruce, tree hollows and under tree bark in Central Europe. The studied material also includes specimens collected using tree stump photoeclectors, cardboard strips and Malaise traps.

MATERIAL AND METHODS

The studied material was collected by different collectors at 48 localities in Slovakia and on one locality in the Czech Republic (Table 1). The collection includes specimens found in wood-mould in tree hollows and dead wood, under tree bark, by extraction from wood-decay fungi and collected using Malaise traps, tree trunk photoeclectors and cardboard strips. The wood-mould was taken from tree hollows of 11 tree taxa (Table 2). Pseudoscorpions were collected from under bark of five tree taxa (Table 2). The specimens from tree hollows and dead wood were heat extracted in Tullgren funnels or sifted directly on site and collected individually. Dead wood refers to fallen dead trees in various stages of decomposition. Wood-decay fungi were cut from tree trunks and subsequently heat extracted in Tullgren funnels. Pseudoscorpions under tree bark were collected individually using tweezers. Tree trunk photoeclectors were installed on tree trunks at a height of one to three meters above the ground. Cardboard strips were installed on tree trunks at a height of 1.5 meter above the ground. The sampling methods of tree trunk photoeclectors and Malaise traps are described in detail in Roller & Vidlička (2001), Dubovský & Masarovič (2007), Fedor et al. (2007). All pseudoscorpion specimens were studied as permanent slide mounts using the 'Liquido de Swann' mounting medium. All specimens were identified using the key in Christophoryová et al. (2011c). Nomenclature for all taxa follows Harvey (2013). The material is deposited in the zoological collections of Comenius University, Bratislava.

Table 1. List of localities. Abbreviations: Lc. – locality code, SR – Slovak Republic, CR – Czech Republic.
Tabuľka 1. Zoznam lokalít. Skratky: Lk. – kód lokality, SR – Slovenská republika, CR – Česká republika.

Lc.	Country	Locality	N	E	m a.s.l.
Lk.	Krajina	Lokalita	S	V	m n. m.
1	SR	Báb pri Nitre	48°24′26.78″	17°45′33.92″	138
2	SR	Bratislava, Kamzík	48°10′54.54″	17°05′52.72″	417
3	SR	Bratislava, Krasňany	48°12′04.41″	17°07′29.97″	228
4	SR	Bratislava, Mlynská dolina	48°09′23.92″	17°03′59.36″	197
5	SR	Bratislava, Rusovce	48°03′09.16″	17°09′12.90″	139
6	SR	Bratislava, Ružinov	48°09′23.00″	17°09′46.00″	136
7	SR	Boky	48°34′11.00″	19°02′43.00″	352
8	SR	Cejkov	48°27′26.00″	21°45′44.00″	220
9	SR	Červený Kameň	48°23′36.00″	17°20′02.00″	341
10	SR	Čierna Lehota	48°52′30.13″	18°20′14.34″	437
11	SR	Číčov	47°45′40.56″	17°46′54.18″	110
12	SR	Devínska Kobyla	48°11′05.00″	16°59′50.00″	340
13	SR	Humenec	48º51′43.00″	21º10′23.00″	480
14	SR	Humenec	48º51′43.00″	21º10′14.00″	600
15	SR	Igram	48°17′10.00″	17°27′31.00″	139
16	SR	Ipeľské Predmostie	48°03′48.00″	19°03′26.00″	127
17	SR	Jalná	48°30′54.00″	18°55′36.00″	760
18	SR	Kalinkovský les	48°03′50.00″	17°12′11.00″	136
19	SR	Kašivárová	48°28′03.20″	18°46′06.20″	490
20	SR	Kerling, Hodruša-Hámre	48°27′10.00″	18°50′48.00″	820
21	SR	Košické Hámre	48º50′02.00″	21º03′46.00″	385
22	SR	Kováčová	48°38′13.00″	19°04′06.00″	496
23	SR	Kráľová pri Senci	48°11′50.08″	17°26′38.32″	125
24	SR	Martinský les	48°16′28.00″	17°22′21.00″	118
25	SR	Martinský les	48°16′10.00″	17°22′17.00″	169
26	SR	Martinský les	48°16′04.00″	17°22′15.00″	163
27	SR	Martinský les	48°16′08.00″	17°22′09.00″	168
28	SR	Martinský les	48°16′10.00″	17°22′17.00″	169
29	SR	Nitra	48°19′11.00″	18°04′59.00″	146
30	SR	Nitrianske Rudno	48°47′10.85″	18°27′16.87″	464
31	SR	NR Jurský Šúr	48°13′55.62″	17°12′31.80″	130
32	SR	NR Jurský Šúr	48°13′16.80″	17°13′07.02″	132
33	SR	NR Ľutovský Drieňovec, Timoradza	48°48′29.22″	18°15′42.72″	452
34	SR	On the road from Červený Kameň to Fúgeľka	48°22′05.00″	17°18′54.00″	513
35	SR	Poľany	48°28′00.00″	21°59′00.00″	103
36	SR	Pravenec	48°51′24.94″	18°38′36.83″	325
37	SR	Pribeník	48º23′24.00″	22º00′18.00″	102
38	SR	Streda nad Bodrogom	48º22′13.00″	21º45′04.00″	101
39	SR	Stropkov	49º12′00.00″	21º40′00.00″	280
40	SR	Stupava	48°17′34.00″	17°01′54.00″	172
41	SR	Svätý Jur	48°15′38.21″	17°12′24.21″	241
42	SR	Tilič	48°12′33.00″	19°55′54.00″	425
43	SR	Tomášikovo	48°05′07.58″	17°41′49.61″	121
44	SR	Tomášikovo	48°05′00.27″	17°42′00.08″	114
45	SR	Viniansky hrad	48°49′13.27″	21°56′59.12″	319
46	SR	Východná	49°03′31.00″	19°53′25.00″	750
47	SR	Zlatníky, NR Kulháň	48°42′15.33″	18°05′44.75″	324
48	SR	Zvonová hora	49°00′01.23″	18°00′01.11″	509
49	CR	Lednice, park	48°47′59.00″	16°48′12.00″	171

RESULTS

Altogether 390 pseudoscorpion specimens of 16 species from four families were identified (Tables 2, 3). Two species (*Chthonius* sp., *Roncus* sp.) were identified only to genus level. The recorded species were divided into seven groups based on the microhabitat type and the sampling method (Table 3).

1. Tree hollows

Altogether 216 specimens belonging to 13 species and four families were identified from tree hollows (Tables 2, 3). The most abundant family was Chernetidae. The most abundant species *A. wideri* was found in the wood-mould of all examined tree taxa. The nymphal stages of seven species were present in tree hollows: *M. carpaticus*, *N. carcinoides*, *C. cimicoides*, *C. hahnii*, *D. panzeri*, *A. wideri* and *P. scorpioides* (Table 2).

2. Under tree bark

Altogether 65 specimens of 10 species and three families were collected under tree bark. The family Chernetidae was the most abundant, as in the previous group (Table 3). The most abundant species under the tree bark were *C. cimicoides*, *C. hahnii* and *M. ressli* (Table 3). The nymphal stages of the species *M. ressli*, *C. cimicoides*, *C. hahnii* and *P. scorpioides* were found under the tree bark. The species *M. ressli* was found only under bark of *Pinus* trees (Table 2).

3. Dead wood

Altogether three pseudoscorpion families were recorded in the samples from dead wood (Table 3). The most abundant family was again Chernetidae, represented by 12 specimens of two species (Table 3). The nymphal stages of all four species were present in the dead wood (Table 2).

4. Wood-decay fungi

The families Chernetidae and Cheliferidae were extracted from wood-decay fungi. Altogether 28 specimens were recorded, comprising three species of Chernetidae, but only one specimen belonging to Cheliferidae (Table 3). The nymphal stages of *D. latreillii*, *C. hahnii* and *P. scorpioides* were present in the samples (Table 2).

5. Malaise traps

Although Malaise traps are not commonly used for pseudoscorpion collecting, 39 specimens of six species and three families were collected using this method (Table 3). The Chernetidae was most abundant, principally represented by the species *P. scorpioides* (Table 3). Except for a single *N. carcinoides* tritonymph, no nymphal stages were recorded in the Malaise traps (Table 2).

6. Tree trunk photoeclectors

Altogether 11 specimens of *C. hahnii* (Chernetidae) were collected using tree trunk photoeclectors on *Quercus petraea* in Slovakia (Tables 2, 3). All developmental stages of *C. hahnii* were found using this sampling method (Table 2).

7. Cardboard strips

Two species of Neobisiidae, *N. erythrodactylum* and *N. sylvaticum*, were collected using cardboard strips; *N. sylvaticum* was the more numerous (Table 3). The tritonymphs of both species were present in the samples collected using this method (Table 2).

Table 2. List of pseudoscorpion species. Abbreviations: Lc. – locality code (see Table 1), m – male, f – female, tn – tritonymph, dn – deutonymph, pn – protonymph; AČ – Alexander Čanády, AM – Andrej Mock, JCH – Jana Christophoryová, JP – Jozef Plachý, JS – Jaroslav Svatoň, KK – Katarína Krajčovičová, ĽČ – Ľudmila Černecká, ĽV – Ľubomír Vidlička, MC – Martina Compľová, MD – Michal Dubovský, MF – Marián Filípek, MK – Miroslav Krumpál, OM – Oto Majzlan, PB – Petra Bícená, PF – Peter Fenďa, PM – Peter Mašán, RM – Rudolf Masarovič, TL – Terézia Lučeničová, ZK – Zuzana Krumpálová.
Tabuľka 2. Zoznam druhov šťúrikov. Skratky: Lk. – kód lokality (viď. Tabuľka 1), m – samec, f – samica, tn – tritonymfa, dn – deutonymfa, pn – protonymfa; AČ – Alexander Čanády, AM – Andrej Mock, JCH – Jana Christophoryová, JP – Jozef Plachý, JS – Jaroslav Svatoň, KK – Katarína Krajčovičová, ĽČ – Ľudmila Černecká, ĽV – Ľubomír Vidlička, MC – Martina Compľová, MD – Michal Dubovský, MF – Marián Filípek, MK – Miroslav Krumpál, OM – Oto Majzlan, PB – Petra Bícená, PF – Peter Fenďa, PM – Peter Mašán, RM – Rudolf Masarovič, TL – Terézia Lučeničová, ZK – Zuzana Krumpálová.

Lc.	**Environment**	**Microhabitat/Method**	**m**	**f**	**tn**	**dn**	**pn**	**Date**	**Lgt.**
Lk.	**Prostredie**	**Mikrohabitat/Metóda**	**m**	**f**	**tn**	**dn**	**pn**	**Dátum**	**Lgt.**
***Chthonius* sp.**									
41	*Quercetum*	tree hollow, *Castanea sativa*	1	1	-	-	-	28.iii.2012	OM
***Mundochthonius carpaticus* Rafalski, 1948**									
14	*Querceto–Fagetum*	tree hollow, *Fagus*	-	1	1	-	-	08.vi.2006	AM
42	*Querceto–Alnetum*	tree hollow, *Quercus*	-	1	1	-	-	21.ix.2012	KK
46	monoculture *Picea abies*	dead wood, *Picea*	2	2	-	2	-	10.x.2012	MK
***Neobisium carcinoides* (Hermann, 1804)**									
3	*Querceto–Fagetum*	Malaise trap	-	1	-	-	-	02.ix.2012	OM
10	*Quercetum*	Malaise trap	1	-	-	-	-	13.vi.2011	OM
11	forest around the gamekeeper`s house	tree hollow, *Acer negundo*	1	-	1	-	-	14.v.2011	OM
11	forest around the gamekeeper`s house	tree hollow, *Acer negundo*	-	1	2	-	-	10.vi.2011	OM
41	*Quercetum*	Malaise trap	-	2	1	-	-	28.v.2010	OM
46	monoculture *Picea abies*	dead wood, *Picea*	1	1	1	-	-	10.x.2012	MK
***Neobisium erythrodactylum* (L. Koch, 1873)**									
22	*Fageto–Abietum*	cardboard strip, *Abies*	-	-	3	-	-	07.vi.2012	ĽČ
***Neobisium sylvaticum* (C. L. Koch, 1835)**									
7	*Querceto–Fagetum*	cardboard strip, *Fagus*	1	1	-	-	-	06.xi.2012	ĽČ
17	*Fagetum*	cardboard strip, *Fagus*	-	2	-	-	-	27.ix.2012	ĽČ
22	*Fageto–Abietum*	cardboard strip, *Abies*	-	2	1	-	-	24.x.2012	ĽČ

Lc.	Environment	Microhabitat/Method	m	f	tn	dn	pn	Date	Lgt.
Lk.	**Prostredie**	**Mikrohabitat/Metóda**	**m**	**f**	**tn**	**dn**	**pn**	**Dátum**	**Lgt.**
***Roncus* sp.**									
24	*Quercetum*	tree hollow, *Quercus*	-	1	-	-	-	28.iii.2012	JCH
40	park	under tree bark, *Platanus*	-	1	-	-	-	May 2010	TL
42	*Querceto–Alnetum*	tree hollow, *Quercus*	1	2	-	-	-	21.ix.2012	KK
***Chelifer cancroides* (Linnaeus, 1758)**									
25	*Quercetum*	tree hollow, *Quercus*	-	1	-	-	-	2012	OM
49	park	under tree bark, *Quercus*	-	1	-	-	-	02.vii.2005	JS
***Dactylochelifer latreillii* (Leach, 1817)**									
10	*Quercetum*	Malaise trap	-	1	-	-	-	13.vi.2011	OM
11	forest around the gamekeeper`s house	tree hollow, *Acer negundo*	-	2	-	-	-	14.v.2011	OM
12	*Querceto–Carpinetum*	tree hollow, *Quercus*	1	-	-	-	-	07.vii.2007	JCH
16	dry swamp	tree hollow, *Salix*	1	-	-	-	-	21.vi.2008	JCH, ZK
18	hardwood floodplain forest	wood-decay fungi	-	-	-	1	-	01.iv.2011	RM
43	park	under tree bark, *Pinus*	-	1	-	-	-	23.iii.2012	JCH, KK
***Mesochelifer ressli* Mahnert, 1981**									
29	park	tree hollow, *Salix*	-	1	-	-	-	28.ix.2012	JCH, KK
29	park	under tree bark, *Pinus*	4	-	-	-	-	28.ix.2012	JCH, KK
43	park	under tree bark, *Pinus*	3	4	1	1	1	23.iii.2012	JCH, KK
***Chernes cimicoides* (Fabricius, 1793)**									
2	*Querceto–Fagetum*	tree hollow, *Fagus sylvatica*	1	-	-	-	-	18.ii.2012	OM
3	*Querceto–Fagetum*	tree hollow, *Fagus sylvatica*	1	1	-	-	-	16.iii.2012	OM
3	*Querceto–Fagetum*	Malaise trap	1	2	-	-	-	31.v.2012	OM
19	*Quercetum*	under tree bark, *Quercus*	1	8	4	-	-	21.vi.2012	JCH
20	*Fageto–Carpinetum*	under tree bark, *Acer*	-	1	-	-	-	20.vi.2012	JCH
30	*Quercetum*	tree hollow, *Quercus*	-	2	-	-	-	20.v.2008	OM
31	alder forest	tree hollow, *Alnus glutinosa*	1	2	1	-	-	29.xi.2009	JCH
33	xerothermic meadow	Malaise trap	1	-	-	-	-	18.iv.2007	OM
34	*Querceto–Fagetum*	under tree bark, *Quercus*	1	3	7	-	-	15.v.2013	JCH, KK

Lc.	Environment	Microhabitat/Method	m	f	tn	dn	pn	Date	Lgt.
Lk.	**Prostredie**	**Mikrohabitat/Metóda**	**m**	**f**	**tn**	**dn**	**pn**	**Dátum**	**Lgt.**
41	xerothermic *Quercetum*	tree hollow, *Castanea sativa*	-	-	1	-	-	28.iii.2012	OM
42	*Querceto–Alnetum*	tree hollow, *Quercus*	-	-	3	-	-	21.ix.2012	KK
47	*Quercetum*	tree hollow, *Quercus*	-	-	1	-	-	14.iii.2012	OM, ĽV
***Chernes hahnii* (C. L. Koch, 1839)**									
1	*Querceto–Carpinetum*	Malaise trap	1	-	-	-	-	23.vi.2008	OM, ĽV
3	*Querceto–Fagetum*	tree hollow, *Fagus sylvatica*	-	-	1	-	-	16.iii.2012	OM
6	urban area	under tree bark, *Platanus*	1	1	1	-	-	06.ii.2010	MD
9	park around the castle	under tree bark, *Tilia cordata*	2	-	1	2	-	15.v.2013	JCH, KK
9	park around the castle	under tree bark, *Platanus*	-	-	-	2	1	15.v.2013	JCH, KK
15	village	tree hollow, *Salix fragilis*	-	-	-	1	-	21.x.2012	KK
16	dry swamp	tree hollow, *Salix*	2	-	1	1	-	21.vi.2008	JCH, ZK
24	*Quercetum*	tree photoeclector	-	-	1	-	-	01.vi.2007	MD, RM
24	*Quercetum*	tree photoeclector	-	1	-	-	-	02.v.2007	MD, M
24	*Quercetum*	tree photoeclector	1	1	1	-	-	11.v.2007	MD, RM
24	*Quercetum*	tree photoeclector	-	1	-	1	-	24.viii.2007	MD, RM
24	*Quercetum*	tree photoeclector	-	-	-	-	1	13.ix.2007	MD, RM
24	*Quercetum*	tree photoeclector	-	1	-	-	-	05.x.2007	MD, RM
24	*Quercetum*	tree photoeclector	-	1	-	-	-	26.iv.2008	MD, RM
24	*Quercetum*	tree photoeclector	-	-	1	-	-	30.vi.2008	MD, RM
24	*Quercetum*	under tree bark, *Quercus*	-	1	1	-	-	28.iii.2012	JCH
25	*Quercetum*	tree hollow, *Quercus*	-	1	-	-	-	2012	OM
27	*Quercetum*	wood-decay fungi	-	-	-	-	6	25.iii.2011	RM
28	*Quercetum*	wood-decay fungi	-	-	-	-	1	27.ix.2010	RM
28	*Quercetum*	wood-decay fungi	-	2	-	-	2	01.x.2010	RM
28	*Quercetum*	wood-decay fungi	-	-	-	-	1	07.xi.2010	RM
32	*Quercetum*	under tree bark, *Quercus*	-	1	-	-	-	05.v.2013	PM
***Dendrochernes cyrneus* (L. Koch, 1873)**									
11	forest around the gamekeeper`s house	tree hollow, *Acer negundo*	-	1	-	-	-	14.v.2011	OM
40	park	under tree bark, *Platanus*	-	1	-	-	-	May 2010	TL

Lc.	Environment	Microhabitat/Method	m	f	tn	dn	pn	Date	Lgt.
Lk.	**Prostredie**	**Mikrohabitat/Metóda**	**m**	**f**	**tn**	**dn**	**pn**	**Dátum**	**Lgt.**
***Dinocheirus panzeri* (C. L. Koch, 1837)**									
5	*Querceto–Ailanthum*	tree hollow, *Quercus*	-	1	-	-	-	26.xii.2011	OM
8	*Querceto–Carpinetum*	under tree bark, *Quercus*	1	-	-	-	-	24.v.2011	JCH
13	*Fagetum*	tree hollow *Acer pseudoplatanus*	2	3	-	-	-	08.vi.2006	PB, MC, AM
14	*Querceto–Fagetum*	tree hollow, *Fagus*	-	2	2	10	2	08.vi.2006	AM
39	rural area	deadwood	-	-	-		2	01.v.2010	AČ
42	*Querceto–Alnetum*	tree hollow, *Quercus*	-	2	-	3	2	01.ix.2012	KK
45	*Querceto–Carpinetum*	tree hollow, *Quercus*	-	4	-	-	-	26.v.2011	JCH
***Allochernes wideri* (C. L. Koch, 1843)**									
2	*Querceto–Fagetum*	tree hollow, *Fagus sylvatica*	-	2	-	-	-	11.iv.2012	OM
3	*Querceto–Fagetum*	tree hollow, *Fagus sylvatica*	-	1	-	-	-	16.iii.2012	OM
3	*Querceto–Fagetum*	tree hollow, *Quercus*	-	3	-	-	-	21.iii.2012	OM
3	*Querceto–Fagetum*	Malaise trap	-	1	-	-	-	12.vii.2012	OM
5	*Querceto–Ailanthum*	tree hollow, *Quercus*	3	10	-	-	-	26.xii.2011	OM
11	forest around the gamekeeper`s house	tree hollow, *Acer negundo*	-	2	-	1	-	27.xi.2010	OM
14	*Querceto–Fagetum*	tree hollow, *Fagus*	-	1	1	1	1	08.vi.2006	AM
15	village	tree hollow, *Robinia pseudoacacia*	-	1	1	1	-	21.x.2012	KK
15	village	tree hollow, *Fraxinus*	-	-	-	1	-	21.x.2012	KK
15	village	tree hollow, *Tilia*	-	1	-	-	-	01.x.2012	KK
21	forest above the stream	tree hollow, *Acer campestre*	1	-	-	-	-	10.v.2007	AM
23	park	tree hollow, *Aesculus hippocastaneum*	2	4	1	-	-	05.v.1992	OM
24	*Quercetum*	tree hollow, *Quercus*	-	1	-	-	-	28.iii.2012	JCH
25	*Quercetum*	tree hollow, *Quercus*	-	2	1	-	-	2012	OM
31	*Alnetum*	tree hollow, *Alnus glutinosa*	3	-	6	1	2	29.xi.2009	JCH
32	*Quercetum*	Malaise trap	1	2	-	-	-	07.iv.2011	OM
32	*Quercetum*	under tree bark, *Quercus*	1	-	-	-	-	05.v.2013	PM
35	church area	tree hollow, *Tilia*	-	-	1	-	-	16.vi.2012	JCH
36	alluvium	tree hollow, *Salix*	2	-	-	-	-	10.iv.2011	OM
36	alluvium	tree hollow, *Salix*	3	3	-	-	-	31.xii.2012	OM
37	park around chateaux	tree hollow, *Quercus*	1	-	1	1	1	28.vii.2011	AM
41	*Quercetum*	Malaise trap	1	-	-	-	-	28.v.2010	OM

Lc.	Environment	Microhabitat/Method	m	f	tn	dn	pn	Date	Lgt.
Lk.	**Prostredie**	**Mikrohabitat/Metóda**	**m**	**f**	**tn**	**dn**	**pn**	**Dátum**	**Lgt.**
41	*Quercetum*	tree hollow, *Castanea sativa*	-	-	2	-	-	28.iii.2012	OM
44	alluvium	tree hollow, *Salix*	-	-	2	1	-	23.iii.2012	CH, KK
47	*Quercetum*	tree hollow, *Quercus*	-	2	1	-	-	14.iii.2012	OM, ĽV
***Lamprochernes nodosus* (Schrank, 1803)**									
27	*Quercetum*	wood-decay fungi	1	-	-	-	-	25.iii.2011	RM
***Pselaphochernes scorpioides* (Hermann, 1804)**									
2	*Querceto–Fagetum*	tree hollow, *Fagus sylvatica*	-	1	-	-	-	11.iv.2012	OM
3	*Querceto–Fagetum*	tree hollow, *Fagus sylvatica*	2	1	-	-	-	16.iii.2012	OM
3	*Querceto–Fagetum*	Malaise trap	-	1	-	-	-	08.v.2012	OM
4	*Quercetum*	Malaise trap	4	1	-	-	-	07.iv.2013	OM
11	forest around the gamekeeper`s house	tree hollow, *Acer negundo*	2	-	-	-	-	27.xi.2010	OM
11	forest around the gamekeeper`s house	tree hollow, *Acer negundo*	1	4	-	-	-	13.xii.2011	OM
15	village	tree hollow, *Salix fragilis*	1	-	-	2	-	01.x.2012	KK
15	village	tree hollow, *Fraxinus*	-	2	-	-	-	21.x.2012	K
15	village	tree hollow, *Tilia*	-	1	1	-		21.x.2012	KK
18	hardwood floodplain forest	wood-decay fungi	1	1	-	1	1	01.iv.2011	RM
24	*Quercetum*	under tree bark, *Quercus*	1	2	1	2	-	28.iii.2012	PF
24	*Quercetum*	tree hollow, *Quercus*	-	4	-	-	-	28.iii.2012	JCH
26	*Quercetum*	wood-decay fungi	1	3	4	1	-	19.ix.2010	RM
28	*Quercetum*	wood-decay fungi	-	1	-	-	-	23.ix.2010	RM
29	park	tree hollow, *Salix*	1	-	-	-	-	28.ix.2012	JCH, KK
32	*Quercetum*	Malaise trap	-	2	-	-	-	07.iv.2011	OM
33	xerothermic meadow	Malaise trap	7	8	-	-	-	18.iv.2007	OM, ĽV
38	park around chateaux	tree hollow, *Quercus*	4	8	9	11	-	03.x.2009	AM
39	rural area	deadwood	-	1	-	-	-	01.v.2010	AČ
41	*Quercetum*	tree hollow, *Castanea sativa*	-	3	-	-	-	28.iii.2012	OM
42	*Querceto–Alnetum*	tree hollow, *Quercus*	-	3	1	1	-	21.ix.2012	KK
48	*Fagetum*	deadwood	4	3	1	1	-	06.iv.2009	MF, JP

Table 3. List of pseudoscorpion species and specimen numbers collected from various microhabitat types and using various sampling methods.
Tabuľka 3. Zoznam druhov a počtov jedincov šťúrikov zbieraných v rôznych typoch mikrohabitatov a pomocou rôznych metód zberu.

	Microhabitat/Sampling method							
Taxon	Tree hollow	Under tree bark	Dead wood	Wood decay fungi	Malaise trap	Photoeclector	Cardboard strip	∑
	Mikrohabitat/Metóda zberu							
Taxón	Dutina	Pod kôrou	Mŕtve drevo	Drevné huby	Malaiseho pasca	Fotoeklektor	Kartónový lepiaci pás	
Chthoniidae								
Mundochthonius carpaticus	4		6					10
Chthonius sp.	2							2
Neobisiidae								
Neobisium carcinoides	5		3		5			13
Neobisium erythrodactylum							3	3
Neobisium sylvaticum							7	7
Roncus sp.	4	1						5
Cheliferidae								
Chelifer cancroides	1	1						2
Dactylochelifer latreillii	4	1		1	1			7
Mesochelifer ressli	1	14						15
Chernetidae								
Chernes cimicoides	14	25			4			43
Chernes hahnii	7	14		12	1	11		45
Dendrochernes cyrneus	1	1						2
Dinocheirus panzeri	34	1	2					37
Allochernes wideri	76	1			5			82
Lamprochernes nodosus				1				1
Pselaphochernes scorpioides	63	6	10	14	23			116
∑	216	65	21	28	39	11	10	390

DISCUSSION

During this study, the largest number of pseudoscorpions was collected in tree hollows and under tree bark. Previously, Christophoryová (2010) divided the species from tree hollows into three categories: species occurring regularly in tree hollows (*D. panzeri*, *A. wideri*); species occurring in tree hollows and partly in other habitats (*M. carpaticus*, *C. hahnii*, *P. scorpioides*) and species occurring accidentally in tree hollows (*Chthonius tetrachelatus* (Preyssler, 1790), *N. carcinoides*, *D. latreillii*). The results of our research supported this classification. Additionally, the species *C. cimicoides* was recorded during the present study in tree hollows of four tree taxa at seven localities. The species *Roncus* sp., *C. cancroides*, *M. ressli* and *D. cyrneus* were collected from tree hollows for the first time in Slovakia. The pseudoscorpion *D. cyrneus* had been recorded mainly from the nests of *Passer montanus* (Linnaeus, 1758) and from Malaise traps at the locality NR Jurský Šúr in Slovakia (Christophoryová & Krumpál 2010, Christophoryová et al. 2011a). In the present paper, the species was extracted from wood-mould in an *Acer negundo* hollow at the locality Čičov and under *Platanus* bark at the locality Stupava. The species *A. stellae,* living in tree hollows in the Czech Republic (Šťáhlavský 2001, 2011) was not found in Slovakia during the present study.

Until now, records of only six species, *Neobisium carpaticum* Beier, 1935, *N. sylvaticum*, *M. ressli*, *R. quadrimaculatus*, *C. hahnii* and *Lamprochernes chyzeri* (Tömösváry, 1882) have been published from the microhabitat of under tree bark in Slovakia (Verner 1960, Krumpálová & Krumpál 1993, Krumpál & Christophoryová 2007, Christophoryová 2010). Nine pseudoscorpion species were collected under tree bark during our study in Slovakia, two of them recorded previously, and seven recorded for the first time. The species *C. cancroides* was collected under *Quercus* bark at the locality Lednice, Czech Republic and has not been recorded in this microhabitat in Slovakia until now. The most abundant species *M. ressli*, *C. cimicoides*, *C. hahnii* can be considered as the species with the closest association with this type of microhabitat. Furthermore we can assume that the species *Roncus* sp., *C. cancroides*, *D. cyrneus*, *D. panzeri* and *A. wideri* occurred only accidentally under tree bark; these taxa showed low abundance under tree bark and are typical inhabitants of tree hollows and bird nests (Šťáhlavský 2001, Christophoryová 2010, Christophoryová et al. 2011a, Šťáhlavský 2011). Until now, only one male and one female of *M. ressli* had been found in Slovakia, under bark of *Pinus sylvestris* in Veľké Leváre (Krumpálová & Krumpál 1993). During the present study, *M. ressli* was collected under *Pinus* bark at two new localities – Nitra and Tomášikovo, as well as in a new microhabitat type – in wood-mould in a *Salix* hollow in Nitra. The species *R. quadrimaculatus*, recorded from Slovakia (Verner 1960), has not been recorded again. The species *Chernes nigrimanus* Ellingsen, 1897 recorded under tree bark in Czech Republic (Schmarda 1995, Šťáhlavský 2011) has not yet been found in Slovakia.

Dead wood plays a key role in the functioning and productivity of forest ecosystems and provides a large number of microhabitats for invertebrates. In our study, the most abundant family in decaying tree stumps was Chernetidae, represented by the species *D. panzeri* and *P. scorpioides*. Both species have been previously recorded in dead wood in Germany (Drogla & Lippold 2004). Representatives of the epigeic fauna, of the families Chthoniidae and Neobisiidae, were also found in the dead wood samples. Persson et al. (2013) indicate that pseudoscorpions had relatively low abundances in dead wood compared to the rest of the macrofauna, and their abundance did not vary significantly between substrates or stand ages.

Tree trunks provide specific microhabitats, especially for bark-dwelling invertebrates. Bark-dwelling thrips and other arthropods, including pseudoscorpions listed in the present results, were collected in thermophilous oak woods using photoeclectors (Dubovský & Masarovič 2007). The pseudoscorpions were represented only by the species *C. hahnii*. Marx et al. (2008) studied the pseudoscorpion fauna collected using photoeclectors in a hardwood floodplain forest; the species *N. carcinoides* and *C. hahnii* were recorded there. *N. erythrodactylum* and *N. sylvaticum* are typical epigeic species living in forest leaf litter and in the upper part of the soil, but both were collected using cardboard strips 1.5 metres above the ground on tree trunks during our study. These findings indicate migration of pseudoscorpions up tree trunks. The species *N. sylvaticum* has previously been reported as able to climb on shrubs and herbs (Rafalski 1967). This behaviour may be related to the search for food or shelter.

In Slovakia, the pseudoscorpions *D. latreillii*, *C. cimicoides*, *C. hahnii*, *D. cyrneus*, *Allochernes peregrinus* Lohmander, 1939 and *P. scorpioides* have been collected using Malaise traps (Krumpál & Christophoryová 2007, Christophoryová & Krumpál 2010). The species *N. carcinoides* and *A. wideri* were found for the first time in Malaise traps in Slovakia during this study.

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SÚHRN

Predložená práca sa zaoberá výskumom šťúrikov viazaných na drevo a získaných pomocou metód doteraz málo využívaných pri zbere tejto skupiny pavúkovcov (Malaiseho pasce, kartónové lepiace pásy alebo kmeňové fotoeklektory). Celkovo bolo nazbieraných 390 šťúrikov na 48 lokalitách Slovenska a na jednej lokalite v Českej republike. Spolu bolo identifikovaných 16 druhov šťúrikov patriacich do štyroch čeľadí, z nich dva boli určené len na úroveň rodu (*Chthonius* sp., *Roncus* sp.). Najväčšiu skupinu predstavovali šťúriky získané zo stromových dutín v celkovom počte 216 jedincov patriacich ku 13 druhom a do štyroch čeľadí. Najviac

jedincov, a rovnako aj druhov, patrilo do čeľade Chernetidae. Druhy *Dinocheirus panzeri* (C. L. Koch, 1837), *Allochernes wideri* (C. L. Koch, 1843) a *Pselaphochernes scorpioides* (Hermann, 1804) patrili k najpočetnejším vo vzorkách práchna z dutín stromov. Druhy *Roncus* sp., *Chelifer cancroides* (Leach, 1817), *Mesochelifer ressli* Mahnert, 1981a *Dendrochernes cyrneus* (L. Koch, 1873) boli nájdené prvýkrát z práchna dutín na Slovensku. Pod kôrou stromov bolo získaných 65 jedincov patriacich ku 10 druhom. Podľa získaných výsledkov bola najpočetnejšia čeľaď Chernetidae a prostredie pod kôrou stromov najviac vyhovuje druhom *M. ressli*, *Chernes cimicoides* (Fabricius, 1793) a *Chernes hahnii* (C. L. Koch, 1839). Šťúrik *M. ressli* bol nájdený iba pod kôrou borovice. Druh *C. cancroides* bol zbieraný pod kôrou duba v parku Lednice v Českej republike a v tomto type mikrohabitatu nebol doteraz nájdený na Slovensku. Čeľaď Chernetidae bola najpočetnejšia vo vzorkách zo spráchnivených kmeňov stromov, z drevných húb, v Malaiseho pasciach aj vo vzorkách z kmeňových fotoeklektorov. Vo vzorkách zo spráchnivených kmeňov stromov boli nájdené druhy typické pre lesnú hrabanku, ako aj druhy bežne nachádzané v stromových dutinách. Pomocou metódy stromových fotoeklektorov bol odchytený jediný druh *C. hahnii* z čeľade Chernetidae, a to v počte 11 jedincov. Najviac zastúpenými druhmi získanými zo vzoriek z drevných húb boli *C. hahnii* a *P. scorpioides*. Najviac jedincov v Malaiseho pasciach patrilo druhu *P. scorpioides*. Pri použití metódy kartónových lepiacich pásov umiestnených po obvode kmeňa bola zaznamenaná iba jediná čeľaď Neobisiidae zastúpená druhmi *Neobisium erythrodactylum* (L. Koch, 1873) a *Neobisium sylvaticum* (C. L. Koch, 1835). Oba druhy pravdepodobne dokážu migrovať do vyšších výšok, ako bolo doteraz zaznamenané v literatúre.