New records of pseudoscorpions (Arachnida: Pseudoscorpiones) associated with animals and human habitats in Slovakia and the Czech Republic

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Abstract. New data on pseudoscorpions associated with animals (birds, mammals, ants and true flies) and human habitats (synanthropic species) are presented. The collecting was carried out at 35 localities in Slovakia and the Czech Republic in different periods between 1989 and 2016. Altogether 149 nests of nine bird species, one mole nest, 14 nests of three rodent species, one lagomorph nest and four combined bird-rodent nests were examined. Five families were found, of which the Chernetidae was ranked first, with eight taxa and 770 specimens. Nine taxa were extracted from bird nests, from them *Neobisium carcinoides* (Hermann, 1804) and *Dendrochernes cyrneus* (L. Koch, 1873) were recorded only in this habitat type. Five species were found in mammal nests, *Neobisium sylvaticum* (C.L. Koch, 1835) and *Lasiochernes pilosus* (Ellingsen, 1910) were present only in this habitat type. Two species were collected in combined bird-mammal nests and two taxa were phoretic. *Cheiridium museorum* (Leach, 1817) was recorded only in synanthropic habitats and two quite rare species *Microbisium suecicum* Lohmander, 1945 and *Chernes vicinus* (Beier, 1932) were extracted only from anthills of *Formica rufibarbis* Fabricius, 1793. Five species were found for the first time in anthills in Slovakia. The current paper brings the first concrete faunistic data about the species *Chernes vicinus* from Slovakia and the second known locality of *Microbisium suecicum* in Slovakia. The phoresy of *Allochernes peregrinus* Lohmander, 1939 on true fly was recorded for the first time in Slovakia.

Keywords: anthill, bird nest, mammals, phoresy, synanthropic species, true flies

Zusammenfassung. Neue Funde von Pseudoskorpionen (Arachnida: Pseudoscorpiones), vergesellschaftet mit Tieren und in synanthropen Habitaten, in der Slowakei und in der Tschechischen Republik. Neue Funde von Pseudoskorpionen, die mit Tieren (Vögeln, Säugern, Ameisen, Fliegen) und mit anthropogenen Habitaten (synanthrope Arten) vergesellschaftet sind, werden vorgestellt. Es wurde an 35 Orten in der Slowakei und in der Tschechischen Republik in verschiedenen Zeiträumen zwischen 1989 und 2016 gesammelt. Insgesamt wurden 149 Nester von neun Vogelarten, ein Maulwurfsbau, 14 Bauten von drei Nagetierarten, ein Kaninchenbau und vier kombinierte Vogel-Nagel-Nester untersucht. Es wurden fünf Pseudoskorpionfamilien nachgewiesen, am häufigsten die Chernetidae mit acht Taxa und 770 Individuen. Neun Taxa wurden aus Vogelnestern extrahiert, *Neobisium carcinoides* (Hermann, 1804) und *Dendrochernes cyrneus* (L. Koch, 1873) wurden ausschließlich in diesem Habitat gefunden. In Säugerbauten wurden fünf Arten nachgewiesen, *Neobisium sylvaticum* (C.L. Koch, 1835) und *Lasiochernes pilosus* (Ellingsen, 1910) ausschließlich dort. Zwei Arten wurden in kombinierten Vogel-Nagel-Nestern gefangen und zwei Arten waren phoretisch. *Cheiridium museorum* (Leach, 1817) wurde ausschließlich im synanthropen Bereich und zwei sehr seltene Arten, *Microbisium suecicum* Lohmander, 1945 und *Chernes vicinus* (Beier, 1932), wurden aus Ameisenhügeln von *Formica rufibarbis* Fabricius, 1793 extrahiert. Insgesamt wurden fünf Arten erstmals in der Slowakei in Ameisenhügeln gefangen. Der vorliegende Beitrag enthält die ersten genauen Daten von *Chernes vicinus* und den zweiten Fundort von *Microbisium suecicum* in der Slowakei. *Allochernes peregrinus* Lohmander, 1939 wurde in der Slowakei erstmals phoretisch (an einer Fliege) erfasst.

Bird nests offer shelter and suitable conditions for reproduction of pseudoscorpions (Jones 1975, Christophoryová et al. 2011a). Based on small quantities of collected specimens, some authors considered the occurrence of pseudoscorpions in nests as random, without any specific relation to this habitat (Beier 1948, Cyprich et al. 1992, Krištofík et al. 1994, 1995, 1996, 2003, 2005). On the contrary, other authors assumed that pseudoscorpions have a specific relationship to the nest environment or the hosts (Ressl & Beier 1958, Krumpál & Cyprich 1988, Krumpál et al. 2001, Christophoryová 2010, Turienzo et al. 2010, Christophoryová et al. 2011a). Recently, Turienzo et al. (2010) elaborated a compilation of pseudoscorpion data from bird nests and they recorded 14 families with 85 species worldwide. In Slovakia, several detailed studies on pseudoscorpion occurrence in the bird nests have been published. Krumpál & Cyprich (1988) examined 162 bird nests and found more than 900 pseudoscorpion specimens. Christophoryová (2010) recorded 118 pseudoscorpions of eight species from bird nests. Christophoryová et al. (2011a) studied the association of pseudoscorpions with bird nests on the basis of an analysis of 480 specimens. *Larca lata* (Hansen, 1884) was firstly recorded for the fauna of Slovakia from a tree hollow containing a nest of *Strix aluco* Linnaeus, 1758 (Christophoryová et al. 2011b). Krajčovičová et al. (2015) found three species in open nests of *Turdus merula* Linnaeus, 1758 and *T. philomelos* Brehm, 1831 in Slovakia.

Many pseudoscorpion species are presumed to be associated with mammals, they occur predominantly in Africa, Asia and Australia (Beier 1948). In Europe, species from the genus *Lasiochernes* Beier, 1932 were found in caves probably related to bat guano and in mammal nests (Beier 1948, 1963). *Lasiochernes pilosus* (Ellingsen, 1910) inhabits nests of the mole *Talpa europaea* Linnaeus, 1758 in Slovakia (Krumpálová & Krumpál 1993). Another three species, *Chelifer cancroides* (Linnaeus, 1758), *Dinocheirus panzeri* (C. L. Koch, 1837) and *Allochernes wideri* (C.L. Koch, 1843), were recorded in mammal nests in Slovakia, but they occurred accidentally in this habitat type (Christophoryová 2010).

Besides birds and mammals, pseudoscorpions colonize nests of social insects, mainly termites, ants and bees (Beier 1948, 1963, Weygoldt 1969). Beier (1948) recorded 21 myrmecophilous pseudoscorpion species from anthills. Several faunistic data about pseudoscorpions from anthills from neighbouring countries have been published, from Austria (Ressl & Beier 1958, Ressl 1974), the Czech Republic (Šťáhlavský 2001), Poland (Rafalski 1967) and Germany (Drogla & Lippold 2004). In Slovakia, Jászayová et al. (2015) published the first records of pseudoscorpions in nests of *Formica polyctena* Förster, 1850.

Phoresy represents a generally known phenomenon in certain pseudoscorpion groups (Beier 1948, Kaisila 1949). Poinar et al. (1998) reviewed phoresy in pseudoscorpions and

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listed ten pseudoscorpion families associated with at least 44 insect families and three arachnid families in the world. In Slovakia, two specimens of *Lamprochernes nodosus* (Schrank, 1803) were found phoretic on flies – on a male of *Hydrotaea similis* Meade, 1887 and on a male of *Lucilia caesar* (Linnaeus, 1758) (Mašán & Krištofík 1992). Christophoryová et al. (2011c) recorded one male of *L. chyzeri* (Tömösváry, 1882) from Slovakia attached to the leg of a true fly.

A number of pseudoscorpions are synanthropic; they inhabit buildings, barns or could be found in old libraries (Weygoldt 1969). In Slovakia, only pseudoscorpions from bird nests in synanthropic habitats were collected (Krumpál & Cyprich 1988, Christophoryová et al. 2011a).

The aim of this study was to identify pseudoscorpion species associated with animals (birds, mammals, ants and true flies) and human habitats (synanthropic species) in Slovakia and the Czech Republic.

Material and methods

Pseudoscorpions were collected over 23 years (1989–1991, 1996–2007 and 2009–2016) at 35 localities in the Czech Republic and in Slovakia (Fig. 1, Tab. 1). Altogether, 149 nests of nine bird species (one not identified), one mole nest, 14 nests of three rodent species, one lagomorph nest and four combined bird-rodent nests were examined (Tab. 2). The majority of bird nests were collected immediately after the fledging of chicks; some nests were collected during the winter or early in the spring. All bird and mammal nests were packed into plastic bags and extracted in Tullgren funnels. The collected bird and mammal nests were divided into seven categories according to the build type and their particular location in the environment, as in Christophoryová et al. (2011a) (Tab. 2). Pseudoscorpions were also extracted from samples from winter nests of two ant species (Tab. 3) and found phoretic on true flies (Diptera, species not identified). Several specimens were individually collected in flats and family houses.

Some specimens were mounted as permanent slide mounts using Liquide de Swann mounting medium. Some were studied as temporary slide mounts using lactic acid and afterward preserved in 70 % ethanol. Photographs were made using EOS Utility software and a digital camera (Canon EOS 1100D) connected to a Zeiss Stemi 2000-C stereomicroscope and using a Leica ICC50 camera connected to a Leica DM1000 stereomicroscope using LAS EZ 1.8.0 software. Pseudoscorpions were identified using the key by Christophoryová et al. (2011d). The identification of *Chthonius te-*

Tab. 1: List of localities. Abbreviations: CZ – Czech Republic, E – longitude, N – latitude, NR – Nature Reserve, SK – Slovakia

Code	Country	Locality	N	E	a.s.l. (m)	Environment
1	SK	Borinka	48°15'44"	17°05'10"	307	forest-meadow ecotone
2	SK	Bratislava	48°09'10.57"	17°07'27.36"	140	flat in inner city
3	SK	Bratislava	48°09'27"	17°09'46"	138	flat in inner city
4	SK	Bratislava	48°10'56"	17°02'39"	202	flat in inner city
5	SK	Bratislava, Selendorf	48°10'29.31"	17°04'15.07"	195	oak-hornbeam forest fragment
6	SK	Bratislava, Zoological garden	48°09'36.86"	17°04'20.64"	180	horse stable
7	SK	Bratislava, Železná studnička	48°11'25"	17°04'56"	240	oak-hornbeam forest
8	CZ	Břeclav	48°43'53.89"	16°48'52.33"	203	oak-hornbeam forest
9	CZ	Břeclav	48°44'04.74"	16°49'14.04"	211	oak-hornbeam forest
10	CZ	Břeclav	48°44'10.56"	16°49'14.82"	197	oak-hornbeam forest
11	CZ	Břeclav	48°44'16.14"	16°49'58.10"	180	oak-hornbeam forest
12	CZ	Břeclav	48°44'18.12"	16°49'51.18"	183	oak-hornbeam forest
13	CZ	Břeclav	48°44'18.18"	16°49'43.50"	178	oak-hornbeam forest
14	SK	Chotuč	49°04'17.92"	18°10'14.05"	629	beech forest
15	SK	Devínske jazero	48°15'44"	16°57'52"	140	family house garden
16	SK	Devínske jazero	48°15'44"	16°57'52"	140	family house
17	SK	Duplín	49°14'	21°37'	211	oak-hornbeam forest edge
18	SK	Dvorčiansky les	48°16'14.77"	18°06'52.75"	135	oak forest
19	SK	Gajary	48°28'04.85"	16°53'35.81"	147	grove
20	SK	Horné Orešany	48°28'58.08"	17°26'39.84"	216	oak-hornbeam forest
21	SK	Hubová	49°07'01"	19°11'28"	460	family house
22	SK	Imeľ	47°54'18"	18°08'09"	110	forest
23	SK	Kaňapka	48°42'39.82"	21°21'37.23"	227	allotted garden
24	SK	Kľak	48°34'53.91"	18°38'32.34"	600	family house
25	SK	Lakšárska Nová Ves	48°34'56.85"	17°10'34.55"	217	pine-forest
26	SK	Malá Fatra, Veľký Kriváň	49°11'27.36"	19°02'07.32"	1541	meadow between dwarf pine
27	SK	Nána	47°48'56.33"	18°41'35.07"	107	rural living zone
28	SK	NR Dunajské trstiny, Veľké Kosihy	47°46'01.18"	17°52'00.28"	108	forester's lodge
29	SK	NR Šúr, Biologická stanica	48°13'40.08"	17°12'20.88"	131	oak forest
30	SK	NR Šúr, Jelšový les	48°13'55.62"	17°12'31.80"	131	alder forest
31	SK	NR Šúr, Panónsky háj	48°13'21.54"	17°13'07.25"	135	oak-hornbeam forest
32	SK	Obid	47°46'40.33"	18°38'45.87"	116	rural living zone
33	SK	Snilovské sedlo	49°11'40.26"	19°02'24.18"	1434	meadow saddleback
34	SK	Stropkov	49°12'	21°40'	264	woodland near pasture
35	SK	Vozokany	48°06'02.46"	17°41'09.67"	117	family house

Tab. 2: List of bird and mammal hosts. Abbreviations: LC – locality code, see Tab. 1; NC – nest category: A – nest in hollow, B – nest in box, C – nest in the ground, D – open nest on the ground, E – open nest in vegetation, F – open nest in tree and shrub, G – nest in synanthropic habitat; N – number of nests

LC	Host	NC	N
1	*Talpa europaea* Linnaeus, 1758	C	1
6	*Hirundo rustica* Linnaeus, 1758	G	1
7	*Troglodytes troglodytes* Linnaeus, 1758	A	3
7	*Motacilla cinerea* Tunstall, 1771	D	1
7	*Turdus merula* Linnaeus, 1758	F	1
8	*Sitta europaea* Linnaeus, 1758, *Apodemus flavicollis* (Melchior, 1834)	B	1
9	*Parus major* Linnaeus, 1758, *A. flavicollis*	B	1
10	*Ficedula albicollis* (Temminck, 1815)	B	1
11	*F. albicollis*, *A. flavicollis*	B	1
12	*F. albicollis*, *A. flavicollis*	B	1
13	*F. albicollis*	B	1
14	*A. flavicollis*	B	1
17	*Micromys minutus* (Pallas, 1771)	E	5
17	*Muscardinus avellanarius* Linnaeus, 1758	E	5
18	*Parus major* Linnaeus, 1758	B	1
22	Bird nests, hosts not identified	F	2
23	*Oryctolagus cuniculus* f. *domesticus*	B	1
26	*Anthus spinoletta* (Linnaeus, 1758)	D	1
27	*Ciconia ciconia* (Linnaeus, 1758)	G	1
29	*Passer montanus* (Linnaeus, 1758)	B	22
30	*P. montanus*	B	58
32	*C. ciconia*	G	1
33	*A. spinoletta*	D	1
34	*M. minutus*	E	3

Tab. 3: List of ant hosts. Abbreviations: LC – locality code, see Tab. 1; N – number of anthills

LC	Host	N
5	*Formica rufa* Linnaeus, 1761	1
19	*Formica rufibarbis* Fabricius, 1793	1
20	*F. rufa*	1
25	*F. rufa*	1
31	*F. rufa*	1

trachelatus (Preyssler, 1790) was checked and confirmed by Dr. Giulio Gardini (Italy). Nomenclature for all taxa follows Harvey (2013). The material is deposited in the zoological collections of Department of Zoology, Comenius University in Bratislava, Slovakia.

Results

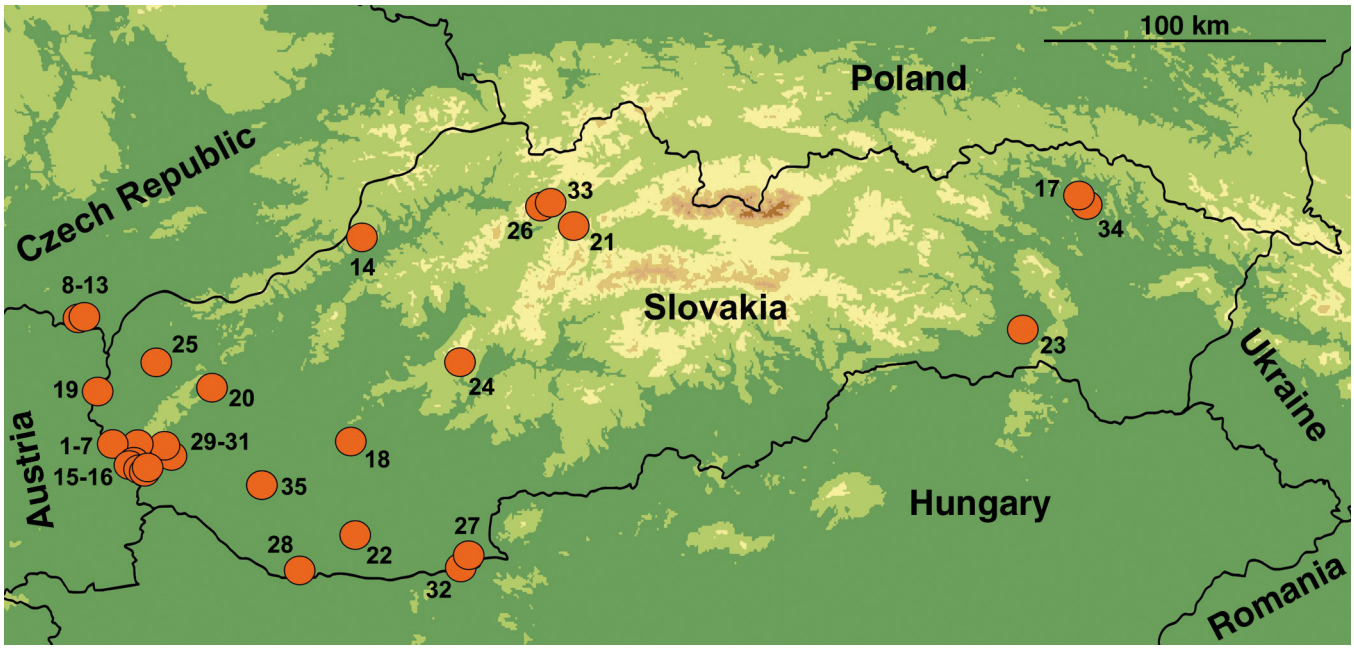
Altogether 872 specimens belonging to 15 taxa were identified (Tab. 4). The specimens of *Lamprochernes* spp. were identified only to genus level. Five families were found, of which the Chernetidae was ranked first, with eight taxa and 770 specimens. Only one species was identified from each of the families Chthoniidae and Cheiridiidae (Tab. 4). Most specimens belong to the species *Allochernes wideri*; single specimens were recorded from the species *Microbisium suecicum*, *Chernes vicinus* and *A. peregrinus* (Tab. 4).

From bird nests 191 specimens were extracted (Tab. 5). The largest numbers of pseudoscorpion species were collected in nests situated in boxes. During the present study *Neobisium carcinoides* and *Dendrochernes cyrneus* were recorded only in this habitat type. Only *C. tetrachelatus* was found in nests in hollows (Tab. 5). Five species were recorded in mammal nests; *N. sylvaticum* and *L. pilosus* were present only in this habitat type (Tab. 4). Two species were collected in combined bird-mammal nests and two taxa were phoretic (Tab. 4). Only one female of *A. peregrinus* was recorded during the study and was phoretic on a true fly. *C. museorum* was recorded only in synanthropic habitats and two quite rare species *M. suecicum* and *C. vicinus* were extracted only from a *Formica rufibarbis* anthill (Tab. 4).

List of recorded taxa

The list of recorded taxa is given below with locality code (see Tab. 1), date, sample type, number of developmental stages (♀: female, ♂: male, A: adult without sex determination, T: tritonymph, D: deutonymph, P: protonymph) and collector name.

Fig. 1: Studied localities in the Czech Republic and Slovakia. For locality code see Tab. 1



Tab. 4: Pseudoscorpions associated with animals and human habitats. Abbreviations: BN – bird nest, MN – mammal nest, BMN – combined bird and mammal nest, AH – anthill, PH – phoresy, SY – synanthropic habitat

Taxa	BN	MN	BMN	AH	PH	SY	Σ
Chthoniidae							
Chthonius tetrachelatus	9	.	.	1	.	.	10
Neobisiidae							
Microbisium suecicum	.	.	.	1	.	.	1
Neobisium carcinoides	3	.	.	.	.	.	3
Neobisium sylvaticum	.	10	.	.	.	.	10
Cheiridiidae							
Cheiridium museorum	.	.	.	.	.	15	15
Cheliferidae							
Chelifer cancroides	13	.	3	.	.	8	24
Dactylochelifer latreillii	33	6	.	.	.	.	39
Chernetidae							
Chernes hahnii	16	.	.	93	.	.	109
Chernes vicinus	.	.	.	1	.	.	1
Dendrochernes cyrneus	91	.	.	.	.	.	91
Allochernes peregrinus	.	.	.	.	1	.	1
Allochernes wideri	21	3	5	462	.	.	491
Lamprochernes spp.	4	.	.	.	3	.	7
Lasiochernes pilosus	.	63	.	.	.	.	63
Pselaphochernes scorpioides	1	1	.	5	.	.	7
Σ	**191**	**83**	**8**	**563**	**4**	**23**	**872**

Tab. 5: Abundance of pseudoscorpions in bird nest categories. For nest categories (NC) see Tab. 2. Abbreviations: *Ct – Chthonius tetrachelatus*, *Nc – Neobisium carcinoides*, *Cc – Chelifer cancroides*, *Dl – Dactylochelifer latreillii*, *Ch – Chernes hahnii*, *Dc – Dendrochernes cyrneus*, *Aw – Allochernes wideri*, *Lsp – Lamprochernes* sp., *Ps – Pselaphochernes scorpioides*

NC	Host/ Taxon	*Ct*	*Nc*	*Cc*	*Dl*	*Ch*	*Dc*	*Aw*	*Lsp*	*Ps*	Σ
A	*Troglodytes troglodytes*	4	.	.	.	.	.	.	.	.	4
B	*Ficedula albicollis*	.	.	3	.	2	.	.	.	.	5
	Parus major	.	.	.	.	.	.	2	.	.	2
	Passer montanus	.	.	1	18	14	91	19	.	1	144
D	*Anthus spinoletta*	.	3	.	.	.	.	.	.	.	3
	Motacilla cinerea	1	.	.	.	.	.	.	.	.	1
F	*Turdus merula*	4	.	.	.	.	.	.	.	.	4
	unidentified	.	.	.	15	.	.	.	.	.	15
G	*Ciconia ciconia*	.	.	.	.	.	.	.	4	.	4
	Hirundo rustica	.	.	9	.	.	.	.	.	.	9
Σ		**9**	**3**	**13**	**33**	**16**	**91**	**21**	**4**	**1**	**191**

Chthoniidae Daday, 1888

***Chthonius* (*Ephippiochthonius*) *tetrachelatus* (Preyssler, 1790)** (Fig. 2a)

Bird nest: 7: 27.06.1989, *M. cinerea*, 1♀, leg. J. Krištofík; 25.06.1990, *T. troglodytes*, 1♀, leg. J. Krištofík; 25.06.1990, *T. merula*, 2♀♀, 2♂♂, leg. J. Krištofík; 25.07.1990, *T. troglodytes*, 1♀, leg. J. Krištofík; 23.07.1991, *T. troglodytes*, 1♀, 1♂, leg. J. Krištofík.

Anthill: 5: 16.01.2015, *F. rufa*, 1♂, leg. O. Majzlan.

Neobisiidae Chamberlin, 1930

***Microbisium suecicum* Lohmander, 1945** (Fig. 2b)

Anthill: 19: 27.02.2015, *F. rufibarbis*, 1♀, leg. O. Majzlan.

***Neobisium* (*Neobisium*) *carcinoides* (Hermann, 1804)** (Fig. 2e)

Bird nest: 26: 13.10.2010, *A. spinoletta*, 2D, leg. M. Baláž; **33:** 06.07.2009, *A. spinoletta*, 1T, leg. M. Baláž.

***Neobisium* (*Neobisium*) *sylvaticum* (C.L. Koch, 1835)** (Figs 2c, 2d)

Mammal nest: 17: 15.05.2010, *M. minutus*, 1♂, leg. A. Čanády; 30.10.2010, *M. minutus*, 1♀, leg. A. Čanády; 21.07.2011, *M. minutus*, 1D, leg. A. Čanády; 24.08.2011, *M. avellanarius*, 1T, leg. A. Čanády; 16.09.2011, *M. avellanarius*, 1T, leg. A. Čanády; 19.11.2011, *M. avellanarius*, 1♀, 1T, leg. A. Čanády; 03.06.2012, *M. minutus*, 1♂, leg. A. Čanády; **34:** 15.05.2010, *M. minutus*, 2♂♂, leg. A. Čanády.

Cheiridiidae Hansen, 1894

***Cheiridium museorum* (Leach, 1817)** (Fig. 2f)

Synanthropic habitat: 21: February 2014, interior, 1♂, leg. M. Baláž; **24:** 1.7.2012, under the statuette, 7♀♀, 6♂♂, 1A, leg. Z. Kosejová.

Cheliferidae Risso, 1827

***Chelifer cancroides* (Linnaeus, 1758)** (Fig. 3a)

Bird nest: 6: 26.08.2010, *H. rustica*, 1♀, 1♂, 1T, 6P, leg. J. Jamriška, R. Zamec; **13:** 14.03.2009, *F. albicollis*, 3♂♂, leg. P. Berka, J. Jamriška, J. Plachý; **30:** 01.06.2001, *P. montanus*, 1T, leg. P. Puchala, K. Sobeková.

Bird-mammal nest: 8: 14.03.2009, *S. europaea* and *A. flavicollis*, 3D, leg. P. Berka, J. Jamriška, J. Plachý.

Synanthropic habitat: 2: 02.03.2013, dead on window parapet, 1♂, leg. B. Lipták; **3:** 18.09.2012, interior, 1♀, 2♂♂, 2T, leg. M. Semelbauer; **4:** 29.05.2013, interior, 1♂, leg. B. Mangová; **16:** 09.06.2013, on the human body, 1♀, leg. V. Stloukalová.

***Dactylochelifer latreillii* (Leach, 1817)** (Fig. 3b)

Bird nest: 22: 16.01.2010, unidentified species, 1♀, 1♂, 6T, 7D, leg. H. Imrichová; **29:** 27.05.2001, *P. montanus*, 1D, leg. P. Puchala, K. Sobeková; 26.06.2001, *P. montanus*, 1T, leg. Z. Országhová, K. Sobeková; 20.08.2003, *P. montanus*, 1T, leg. P. Puchala, K. Sobeková; 19.05.2004, *P. montanus*, 1T, leg. V. Jánošková, K. Sobeková; 06.10.2009, *P. montanus*, 1T, leg. D. Cyprich; **30:** 08.03.2000, *P. montanus*, 1♂, leg. V. Jánošková, K. Sobeková; 22.05.2000, *P. montanus*, 1D, leg. Z. Országhová, K. Sobeková; 04.06.2001, *P. montanus*, 1T, leg. V. Jánošková, K. Sobeková; 22.07.2001, *P. montanus*, 1T, leg. K. Sobeková; 21.06.2002, *P. montanus*, 1T, leg. Z. Országhová, K. Sobeková; 28.07.2004, *P. montanus*, 1♂, 1P, leg. P. Puchala, K. Sobeková; 27.06.2006, *P. montanus*, 1T, leg. K. Sobeková; 01.07.2006, *P. montanus*, 1T, leg. K. Sobeková; 04.07.2006, *P. montanus*, 1♂, 1D, leg. K. Sobeková; 06.10.2009, *P. montanus*, 1♀, 1♂, leg. D. Cyprich.

Mammal nest: 17: 17.05.2010, *M. minutus*, 1♂, leg. A. Čanády; 30.10.2010, *M. minutus*, 1♀, leg. A. Čanády; 26.08.2011, *M. avellanarius*, 2♂♂, 1D, leg. A. Čanády; **34:** 15.05.2010, *M. minutus*, 1♂, leg. A. Čanády.

Chernetidae Menge, 1855

***Chernes hahnii* (C.L. Koch, 1839)** (Figs 3c, 3d)

Bird nest: 10: 14.03.2009, *F. albicollis*, 2T, leg. P. Berka, J. Jamriška, J. Plachý; **29:** 23.07.1996, *P. montanus*, 1♂, 1T, leg. K. Sobeková; 08.03.2000, *P. montanus*, 1♀, leg. Z. Országhová, K. Sobeková; 25.05.2000, *P. montanus*, 1T, leg. Z. Országhová, P. Puchala; **30:** 11.06.1997, *P. montanus*, 1♂, leg. K. Sobeková; 02.07.1997, *P. montanus*, 1♀, leg. Z. Országhová, P. Puchala; 24.05.1998, *P. montanus*, 1♂, leg. P. Puchala, K. Sobeková; 16.06.1999, *P. montanus*, 2♀♀, 1D, leg. K. Sobeková; 24.05.2000, *P. montanus*, 1♀, leg. P. Puchala, K. Sobeko-

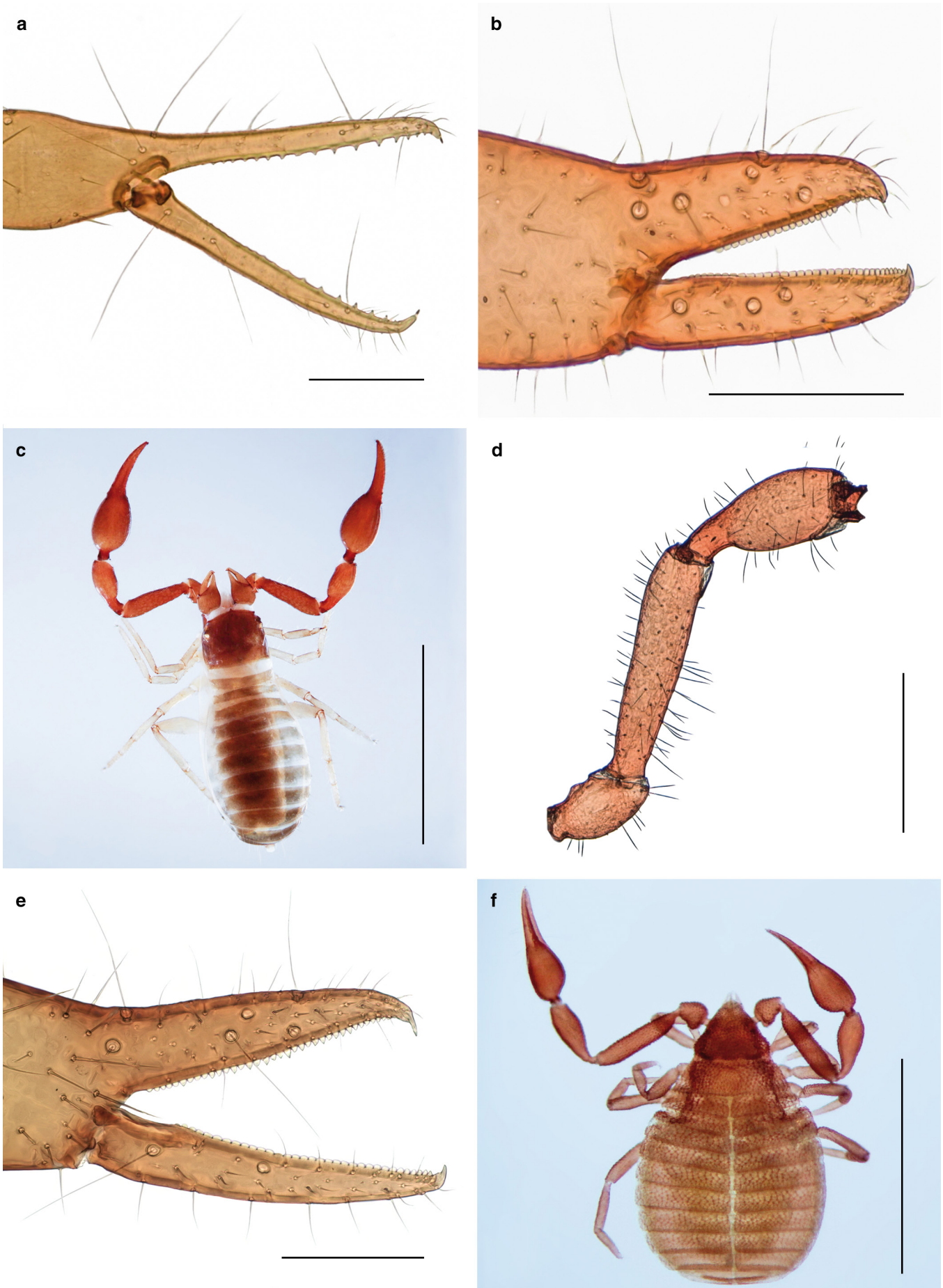


Fig. 2: Recorded pseudoscorpions and their main taxonomic characters from the families of Chthoniidae, Neobisiidae and Cheiridiidae. **a.** Chelal fingers of *Chthonius tetrachelatus* adult, scale: 0.2 mm. **b.** Chelal fingers of *Microbisium suecicum* adult, scale: 0.2 mm. **c.** *Neobisium sylvaticum* adult, scale: 3 mm. **d.** Palpal segments of *N. sylvaticum* adult, scale: 1 mm. **e.** Chelal fingers of *Neobisium carcinoides* deutonymph, scale: 0.2 mm. **f.** Adult of *Cheiridium museorum*, scale: 1 mm

vá; 20.05.2002, *P. montanus*, 1♂, leg. P. Puchala, K. Sobeková; 21.06.2002, *P. montanus*, 1D, leg. Z. Országhová, K. Sobeková; 04.07.2006, *P. montanus*, 1T, leg. P. Puchala, K. Sobeková. **Anthill: 5:** 16.01.2015, *F. rufa*, 1♀, 1♂, leg. O. Majzlan; **19:** 27.02.2015, *F. rufibarbis*, 7♀♀, 3♂♂, leg. O. Majzlan; **20:** 08.01.2015, *F. rufa*, 13♀♀, 29♂♂, 20T, 11D, 8P, leg. P. Fenďa, K. Hrúzová.

***Chernes vicinus* (Beier, 1932)** (Fig. 3e)
Anthill: 19: 27.02.2015, *F. rufibarbis*, 1♂, leg. O. Majzlan.

***Dendrochernes cyrneus* (L. Koch, 1873)** (Fig. 4a)
Bird nest: 29: 05.07.1996, *P. montanus*, 1T, leg. Z. Országhová, K. Sobeková; 14.08.1996, *P. montanus*, 1♀, leg. P. Puchala, K. Sobeková; 26.08.1997, *P. montanus*, 1D, leg. Z. Országhová, M. Šuplatová; 01.03.2000, *P. montanus*, 1D, leg. P. Puchala, K. Sobeková; 22.05.2000, *P. montanus*, 2♀♀, leg. P. Puchala, K. Sobeková; 02.06.2001, *P. montanus*, 2♀♀, leg. P. Puchala, K. Sobeková; 04.07.2001, *P. montanus*, 2T, leg. P. Puchala, K. Sobeková; 23.05.2002, *P. montanus*, 1♀, leg. P. Puchala, K. Sobeková; 02.06.2002, *P. montanus*, 1♀, leg. P. Puchala, K. Sobeková; 17.07.2002, *P. montanus*, 1♂, leg. P. Puchala, K. Sobeková; 24.06.2005, *P. montanus*, 1♀, leg. K. Sobeková; 21.05.2006, *P. montanus*, 1♀, leg. K. Sobeková; 25.05.2006, *P. montanus*, 1♂, leg. K. Sobeková; 26.03.2010, *P. montanus*, 1P, leg. D. Cyprich; **30:** 08.07.1996, *P. montanus*, 1T, leg. P. Puchala, K. Sobeková; 14.08.1996, *P. montanus*, 1♀, 1♂, 3D, leg. Z. Országhová, K. Sobeková; 11.06.1997, *P. montanus*, 1♂, leg. K. Sobeková; 02.07.1997, *P. montanus*, 1♀, 3T, leg. Z. Országhová, P. Puchala; 12.08.1997, *P. montanus*, 3D, 2P, leg. Z. Országhová, P. Puchala; 01.03.2000, *P. montanus*, 1T, 1P, leg. Z. Országhová, K. Sobeková; 01.07.2000, *P. montanus*, 1T, leg. Z. Országhová, P. Puchala; 28.05.2001, *P. montanus*, 1♀, leg. Z. Országhová, K. Sobeková; 30.05.2001, *P. montanus*, 1D, leg. Z. Országhová, K. Sobeková; 02.07.2001, *P. montanus*, 1♂, leg. P. Puchala, K. Sobeková; 09.07.2001, *P. montanus*, 1♂, leg. K. Sobeková; 10.07.2001, *P. montanus*, 1T, leg. P. Puchala, K. Sobeková; 22.07.2001, *P. montanus*, 2T, leg. K. Sobeková; 21.08.2001, *P. montanus*, 1♂, leg. Z. Országhová, K. Sobeková; 20.05.2002, *P. montanus*, 1D, leg. Z. Országhová, P. Puchala; 20.06.2002, *P. montanus*, 1♀, leg. Z. Országhová, K. Sobeková; 01.07.2002, *P. montanus*, 1♂, leg. V. Jánošková, P. Puchala, K. Sobeková; 17.07.2002, *P. montanus*, 1♂, leg. P. Puchala, K. Sobeková; 19.09.2002, *P. montanus*, 1♀, leg. P. Puchala, K. Sobeková; 20.03.2003, *P. montanus*, 1T, leg. Z. Országhová, P. Puchala; 21.05.2003, *P. montanus*, 1♀, leg. K. Sobeková; 22.05.2003, *P. montanus*, 1♀, 14P, leg. Z. Országhová, K. Sobeková; 18.06.2004, *P. montanus*, 2♀♀, 6P, leg. P. Puchala, K. Sobeková; 28.07.2004, *P. montanus*, 1♀, 1P, leg. P. Puchala, K. Sobeková; 03.07.2005, *P. montanus*, 1♀, 1♂, leg. K. Sobeková; 24.07.2005, *P. montanus*, 1♀, leg. K. Sobeková; 31.07.2005, *P. montanus*, 2♀♀, 1♂, leg. K. Sobeková; 23.05.2006, *P. montanus*, 1♀, leg. K. Sobeková; 26.05.2006, *P. montanus*, 1♀, leg. K. Sobeková; 01.07.2006, *P. montanus*, 1♀, 2♂♂, 3P, leg. K. Sobeková; 04.07.2006, *P. montanus*, 1♀, leg. K. Sobeková.

***Allochernes peregrinus* Lohmander, 1939** (Figs 3f, 5a, 5b)
Phoresy: 15: 29.05.2013, phoretic on Diptera, 1♀, leg. E. Stloukal, V. Stloukalová.

***Allochernes wideri* (C.L. Koch, 1843)** (Figs 4c, 4d)
Bird nest: 18: 06.03.2012, *P. major*, 2♀♀, leg. Z. Krumpálová; **29:** 23.07.1996, *P. montanus*, 2♂♂, leg. K. Sobeková; 24.06.2005, *P. montanus*, 1♂, leg. K. Sobeková; **30:** 15.07.1997, *P. montanus*, 1♀, leg. Z. Országhová, K. Sobeková; 01.03.2000, *P. montanus*, 1♀, leg. P. Puchala, K. Sobeková; 08.07.2001, *P. montanus*, 1T, leg. Z. Országhová, K. Sobeková; 27.06.2002, *P. montanus*, 1♀, leg. P. Puchala, K. Sobeková; 30.06.2002, *P. montanus*, 1♀, leg. P. Puchala, K. Sobeková; 22.06.2003, *P. montanus*, 2♀♀, leg. P. Puchala, K. Sobeková; 16.05.2004, *P. montanus*, 1♀, leg. P. Puchala, K. Sobeková; 28.07.2004, *P. montanus*, 1♂, leg. P. Puchala, K. Sobeková; 27.07.2005, *P. montanus*, 1♀, leg. K. Sobeková; 01.07.2006, *P. montanus*, 2♀♀, leg. K. Sobeková; 04.07.2006, *P. montanus*, 3♀♀, leg. K. Sobeková; 21.07.2006, *P. montanus*, 1♂, leg. K. Sobeková.
Mammal nest: 14: 28.10.2009, *A. flavicollis*, 1♀, 2T, leg. M. Filípek, J. Plachý.
Bird-mammal nest: 9: 14.03.2009, *P. major* and *A. flavicollis*, 2♂♂, leg. P. Berka, J. Jamriška, J. Plachý; **11:** 14.03.2009, *F. albicollis* and *A. flavicollis*, 1♀, leg. P. Berka, J. Jamriška, J. Plachý; **12:** 14.03.2009, *F. albicollis* and *A. flavicollis*, 2♀♀, leg. P. Berka, J. Jamriška, J. Plachý.
Anthill: 19: 27.02.2015, *F. rufibarbis*, 1♀, leg. O. Majzlan; **20:** 08.01.2015, *F. rufa*, 60♀♀, 44♂♂, 111T, 80D, 35P, leg. P. Fenďa, K. Hrúzová; **25:** 15.01.2015, *F. rufa*, 46♀♀, 23♂♂, 10T, 10D, 1P, leg. M. Holecová; **31:** 22.01.2016, *F. rufa*, 9♀♀, 5♂♂, 9T, 9D, 9P, leg. P. Fenďa, A. Purkart.

***Lamprochernes* spp.** (Fig. 4e)
Bird nest: 27: 29.06.2009, *C. ciconia*, 1♂, leg. V. Hošek; **32:** 29.06.2009, *C. ciconia*, 2♀♀, 1♂, leg. V. Hošek.
Phoresy: 28: 18.07.2013, phoretic on Diptera, 1♀, leg. V. Hulejová-Sládkovičová, P. Miklós, D. Žiak; **35:** 04.08.2007, phoretic on Diptera, 2♀♀, leg. E. Énekesová.

***Lasiochernes pilosus* (Ellingsen, 1910)** (Fig. 4b)
Mammal nest: 1: 20.01.1990, *T. europaea*, 1T, 50D, 12P, leg. O. Majzlan.

***Pselaphochernes scorpioides* (Hermann, 1804)** (Fig. 4f)
Bird nest: 30: 31.05.2001, *P. montanus*, 1♀, leg. P. Puchala, K. Sobeková.
Mammal nest: 23: 01.05.2013, *O. cuniculus* f. *domesticus*, 1D, leg. P. Ľuptáčik.
Anthill: 5: 16.01.2015, *F. rufa*, 1♀, 1♂, leg. O. Majzlan; **19:** 27.02.2015, *F. rufibarbis*, 1♀, 1♂, leg. O. Majzlan; **20:** 08.01.2015, *F. rufa*, 1♀, leg. P. Fenďa, K. Hrúzová.

Discussion
Christophoryová et al. (2011a) classified 22 Central European pseudoscorpion species (including previously published resources) as nidixenous and nidiphilous species, according to their association with bird nests. Fourteen species were classified as nidixenous. They occur accidentally in bird nests and their nymphal stages are present only sporadically (Christophoryová 2011a). During the current research, three taxa were found from this category: *C. tetrachelatus*, *N. carcinoides* and species of the genus *Lamprochernes*. They were present in nests as adults. *Neobisium carcinoides* was present as nymphal stages, but they were found in the nest situated on the ground. The species is considered to be eurytopic, mainly epigeic, present in the nests accidentally and in low numbers (Krumpál & Cyprich 1988, Fenďa et al. 1998, Christophoryová et al. 2011a). Species of the genus *Lamprochernes* as well as *C. tetrachelatus*

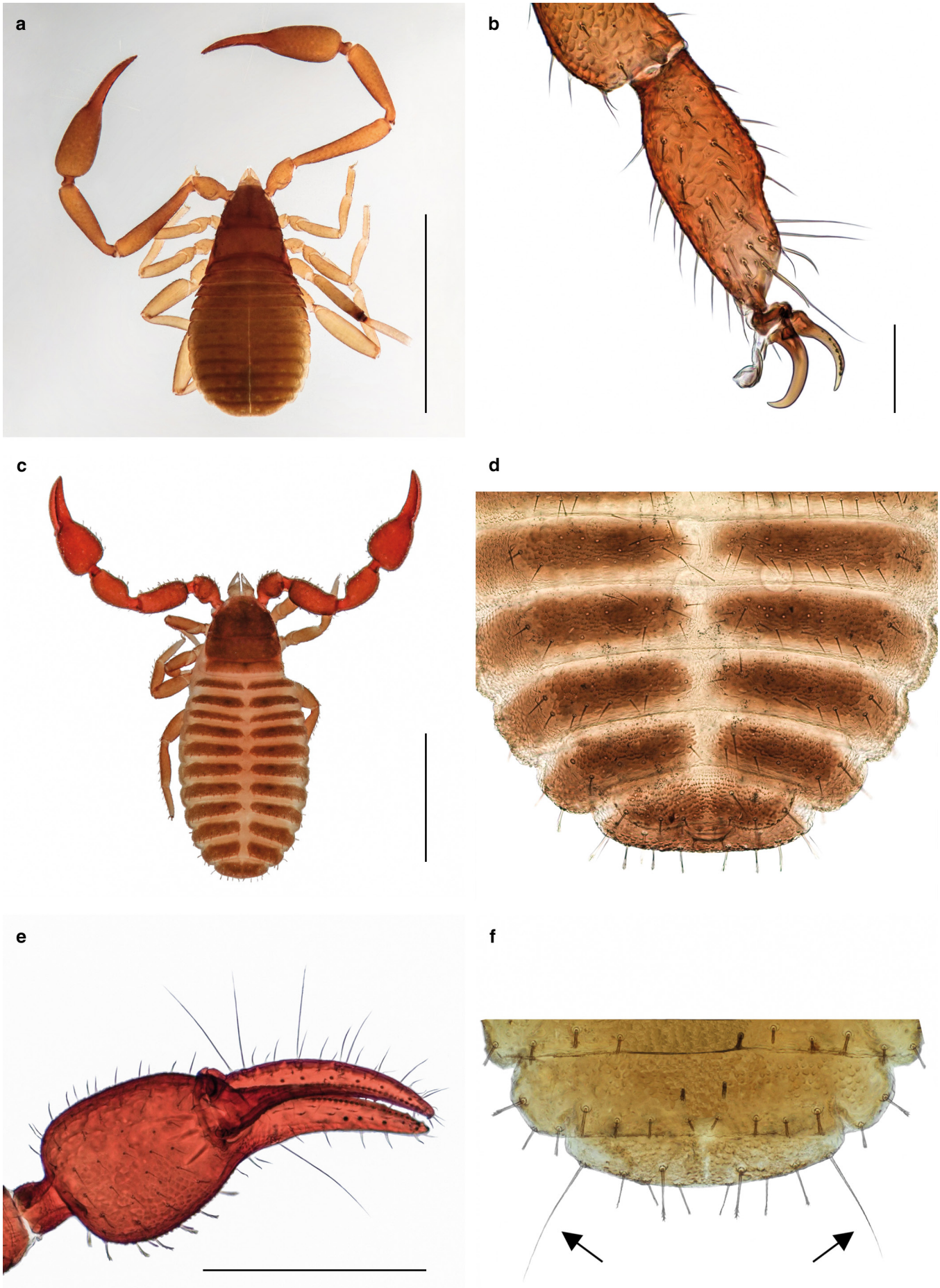


Fig. 3: Recorded pseudoscorpions and their main taxonomic characters from the families of Cheliferidae and Chernetidae. **a.** Adult of *Chelifer cancroides*, scale: 3 mm. **b.** Male tarsus of leg I of *Dactylochelifer latreillii*, scale: 0.1 mm. **c.** Adult of *Chernes hahnii*, scale: 1 mm. **d.** Tergite XI of *C. hahnii* adult. **e.** Palpal chela of *Chernes vicinus* adult, scale: 0.5 mm. **f.** Tergite XI of *Allochernes peregrinus* adult, arrows point to tactile setae

were found in bird nests occasionally (Krumpál & Cyprich 1988, Krištofík et al. 1995, 1996, Fenďa et al. 1998, Christophoryová 2010, Turienzo et al. 2010, Christophoryová et al. 2011a, Krajčovičová et al. 2015).

Pseudoscorpions from the category of nidiphilous species were also collected. They occur regularly in bird nests, are also present as nymphal stages and seem to prefer bird nests situated in certain habitats, as mentioned in the classification by Christophoryová et al. (2011b). *Chelifer cancroides* prefers bird nests situated in synanthropic habitats (Ressl & Beier 1958, Jones 1975, Krumpál & Cyprich 1988, Cyprich et al. 1992, Christophoryová 2010, Turienzo et al. 2010, Christophoryová et al. 2011a); during the present study, the majority of specimens were collected in a barn swallow nest in a horse stable. *Allochernes wideri* occurs in hollow nests and nests situated in boxes (Krumpál & Cyprich 1988, Christophoryová et al. 2011a, Krajčovičová et al. 2015), the recorded specimens were found in boxes with nests of the great tit and the Eurasian tree sparrow. According to Christophoryová et al. (2011a) *D. cyrneus* occurs regularly with all nymphal stages in hollow nests and in the Eurasian tree sparrow nest boxes. In nests in Slovakia, the species was found only in flooded forest and alder forest in the Šúr National Reserve (Krumpál & Cyprich 1987, Christophoryová et al. 2011a). All examined specimens in our study were collected at the same locality and hosts, and the species was present as all developmental stages. *Dactylochelifer latreillii* and *C. hahnii* live in open and hollow nests in the trees and shrubs (Krumpál & Cyprich 1988, Krištofík et al. 1993, 1996, Krumpál et al. 2001, Christophoryová 2010, Christophoryová et al. 2011a, Krajčovičová et al. 2015). Records of both species from the current study correspond with the ecological requirements of the species. *Pselaphochernes scorpioides* was characterized as a nidiphilous species that occurred in nests with decomposed substrate and was found in the hollow nests of the hoopoe and wood nuthatch (Christophoryová et al. 2011a). We did not confirm this categorization; only one specimen was collected from a Eurasian tree sparrow nest in box.

Beier (1948) mentioned that typical inhabitations of this habitat type could live in mammal nests. In Slovakia, we have the example of *L. pilosus* which was recorded during our research. Krumpálová & Krumpál (1993) extracted this species from a mole nest for the first time from Slovakia (at Borinka, the same locality as in the present paper). Most interestingly, two *L. pilosus* females were sifted from leaf litter in the Šúr Nature reserve (Christophoryová & Krumpál 2010). *Neobisium sylvaticum* was recorded during the study in nests of the hazel dormouse and the Eurasian harvest mouse situated in the vegetation. The species has previously been reported as able to climb on herbs and shrubs, even on tree trunks (Rafalski 1967, Krajčovičová & Christophoryová 2014). *Allochernes wideri* and *D. latreillii* were present in rodent nests during our research and the synanthropic species *C. cancroides* in a rabbit hutch. Christophoryová (2010) recorded *C. cancroides*, *D. panzeri* and *A. wideri* in mammal nests and characterized them as occasionally occurring in mammal nests, which corresponded with our obtained data.

Pseudoscorpions live in anthills because of suitable temperature within the nests and their ability to feed on other animals living there (Beier 1948, Weygoldt 1969). Six species were collected from anthills during the current research; of these only *P. scorpioides* was found in an anthill in Slovakia before (Jászayová et al. 2015). Beier (1948) recorded eight species from anthills of *F. rufa*, common species were *A. wideri* and *P. scorpioides*. Both species were also recorded from anthills by Drogla & Lippold (2004). More interesting were the records of *M. suecicum* and *C. vicinus* from a *F. rufibarbis* anthill. The occurrence of both species in anthills was known before (Drogla & Lippold 2004). Until now, the occurrence of *C. vicinus* was mentioned in two papers from Slovakia (Krumpál & Cyprich 1988, Krumpál et al. 2001) from bird nests without concrete faunistic data; the current paper describes the first one. *Microbisium suecicum* was found only once in Slovakia, sieved from leaf litter and clumps in the Cerová vrchovina upland (Christophoryová 2009).

During the current research, species from the genus *Lamprochernes* and *A. peregrinus* were found phoretic on true flies. The phoresy of the genus *Lamprochernes* is quite known (Beier 1948, Mašán & Krištofík 1992, Poinar et al. 1998, Christophoryová et al. 2011c). *Allochernes peregrinus* was described by Lohmander (1939) from Sweden based on one phoretic female attached to the leg of a fly *Delia floralis* (Fallén, 1824) (syn. *Hylemyia floralis*). In Germany, several specimens were found phoretic on the harvestmen *Opilio canestrinii* (Thorell, 1876), *Leiobunum rupestre* (Herbst, 1799) and *L. rotundum* (Latreille, 1798) (Drogla & Lippold 2004). In Slovakia, *A. peregrinus* was found until now in leaf litter, under stones, in anthills and in Malaise traps (Krumpálová & Krumpál 1993, Christophoryová & Krumpál 2010, Christophoryová 2013, Jászayová et al. 2015).

The occurrence of *C. museorum* and *C. cancroides* in synanthropic habitats represents a well-known, worldwide phenomenon (Beier 1963, Weygoldt 1969, Drogla & Lippold 2004). In Slovakia, both of them are recorded from bird nests in synanthropic habitats (Krumpál & Cyprich 1988, Christophoryová et al. 2011a).

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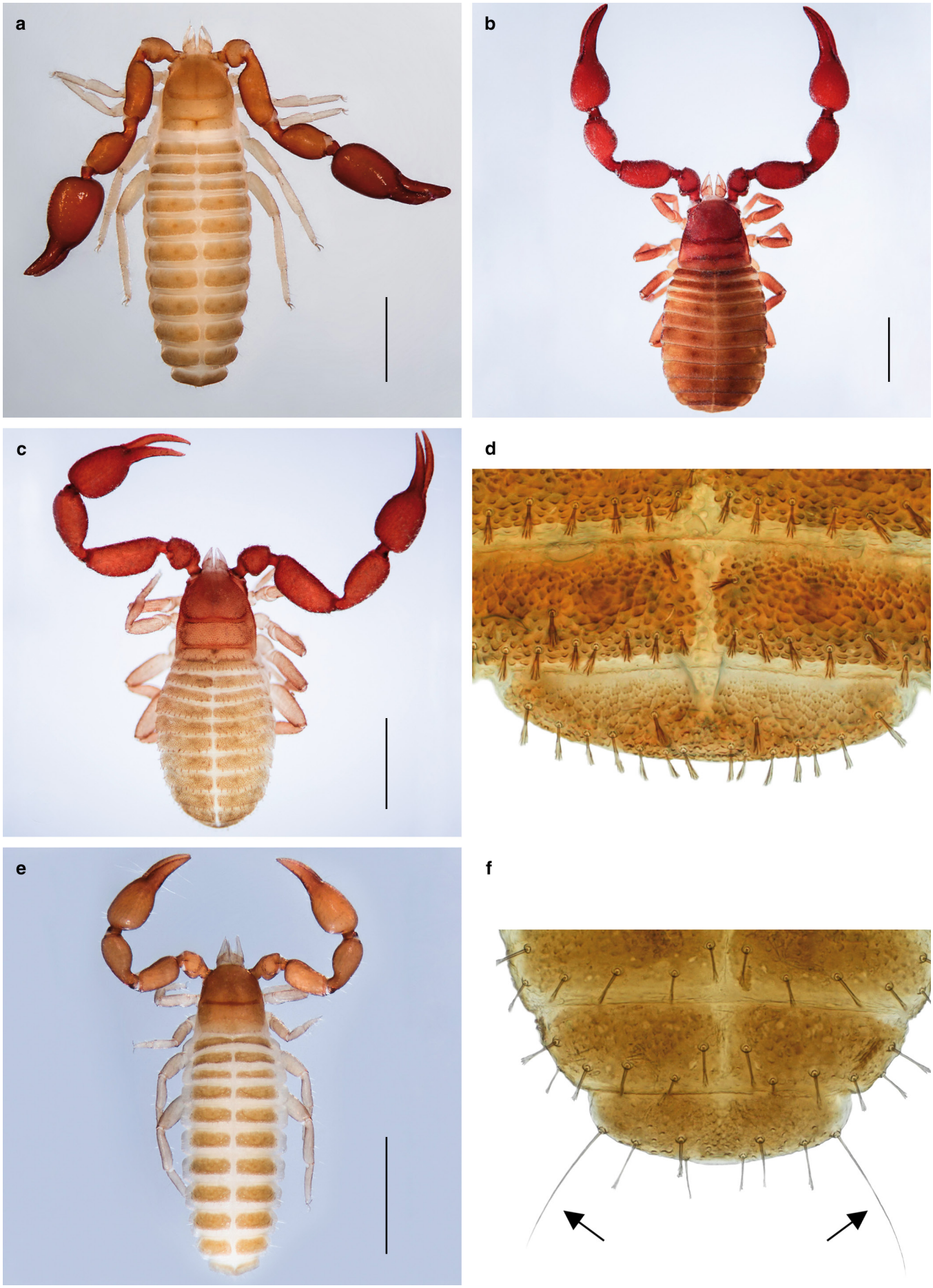

Fig. 4: Recorded pseudoscorpions and their main taxonomic characters from the family of Chernetidae. **a.** *Dendrochernes cyrneus* adult. **b.** *Lasiochernes pilosus* adult. **c.** *Allochernes wideri* adult. **d.** Tergite XI of *A. wideri* adult. **e.** *Lamprochernes* sp. adult. **f.** Tergite XI of *Pselaphochernes scorpioides* adult, arrows point to tactile setae. Scales: 1mm

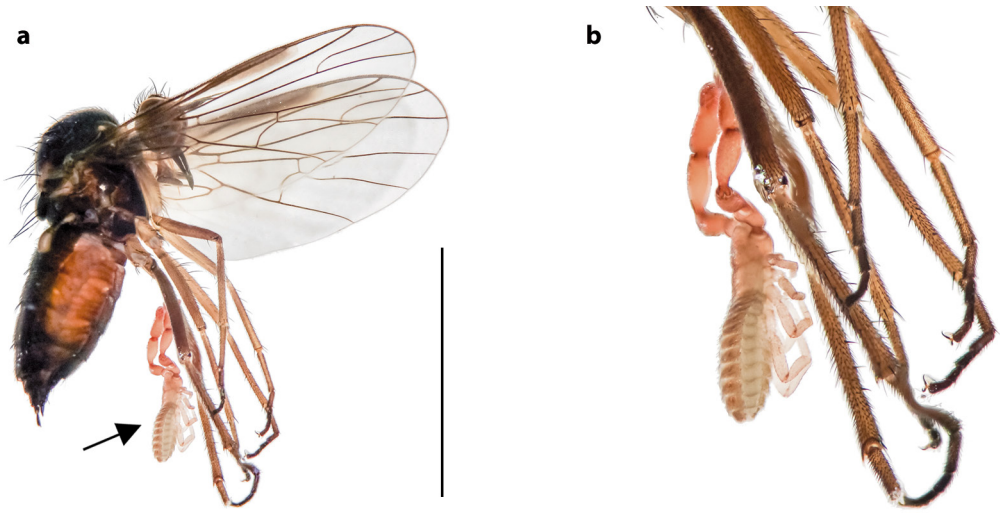

Fig. 5: *Allochernes peregrinus* phoretic on true fly. **a.** Arrow points to pseudoscorpion. **b.** Detail of attached pseudoscorpion. Scale for **a:** 5 mm.

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