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Spiders and pseudoscorpions (Arachnida: Araneae, Pseudoscorpiones) in old oaks of a Central European floodplain

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Abstract. Spiders and pseudoscorpions on old pedunculate oaks (*Quercus robur*) with tree cavities were studied in a Central European floodplain (South Moravia, Czech Republic). Altogether 322 specimens from 47 spider taxa and 71 specimens of six pseudoscorpion species were collected during 2010 and 2011 from tree cavities using two methods. More specimens and species of spiders were obtained from flight interception traps and more specimens and species of pseudoscorpions were obtained from pitfall traps. Remarkable records represent typical cavity dwellers, i.e. the spider *Midia midas* (Simon, 1884), the pseudoscorpions *Larca lata* (Hansen, 1884) and *Apocheiridium ferum* (Simon, 1879), the latter occurs mostly under tree bark. Five arachnid species are listed in the Czech red list: *Midia midas*, *Leptorchestes berolinensis* (C. L. Koch, 1846), *Dipoena erythropus* (Simon, 1881), *Larca lata* and *Dendrochernes cyrneus* (L. Koch, 1873).

Keywords: arboreal, Czech Republic, ecology, faunistics, solitary trees, tree cavity

Zusammenfassung. Spinnen und Pseudoskorpione (Arachnida: Araneae, Pseudoscorpiones) in alten Eichen eines mitteleuropäischen Auwalds. Spinnen und Pseudoskorpione alter Stieleichen (*Quercus robur*) mit Baumhöhlen wurden in einer mitteleuropäischen Aue (Südmähren, Tschechische Republik) untersucht. Insgesamt wurden 322 Individuen aus 47 Spinnentaxa und 71 Individuen aus sechs Pseudoskorpionarten in den Jahren 2010 und 2011 mit zwei Methoden erfasst. Spinnen wurden in höhere Individuen- und Artenzahl mit Kreuzfensterfallen und Pseudoskorpione zahl- und artenreicher in Bodenfallen in Baumhöhlen gefangen. Bemerkenswerte Artnachweise betreffen typischer Baumhöhlenbewohner: die Spinne *Midia midas* (Simon, 1884) sowie die Pseudoskorpione *Larca lata* (Hansen, 1884) und *Apocheiridium ferum* (Simon, 1879), letztere kommt vor allem unter Baumrinde vor. Fünf Arten sind in der Tschechischen Roten Liste enthalten: *Midia midas*, *Leptorchestes berolinensis* (C. L. Koch, 1846), *Dipoena erythropus* (Simon, 1881), *Larca lata* und *Dendrochernes cyrneus* (L. Koch, 1873).

Old trees provide important microhabitats for arachnids, such as foliage, branches, trunk and hollows; bark cracks and cavities offer specific microclimatic and structural conditions (e.g. Wunderlich 1982, Nikolai 1986). Some arachnid species live on trees throughout the year, whereas others use trees only for certain periods, mainly for overwintering (e.g. Horváth & Szinetár 2002, Horváth et al. 2004). Some facultative bark-dwelling arachnids that usually live in the canopy are found on trunks and in cavities only from late autumn to early spring, i.e. while deciduous trees are without their leaves (Szinetár & Horváth 2006).

In Europe, spiders living in tree hollows have been studied sporadically (Martínez De Murguía et al. 2007, Nițu et al. 2009), but no detailed study focusing on this topic has been published yet. From Czechia, only a single study dealing specifically with spiders (and some other invertebrate groups) in tree hollows has been published so far (Růžička et al. 1991).

In contrast, pseudoscorpion occurrence in tree hollows is generally known (Beier 1963, Weygoldt 1969, Ranius 2002, Christophoryová et al. 2017b). In Europe, obligate hollow-dwelling pseudoscorpions belong mainly to the families Cheliferidae and Chernetidae (Beier 1963). The first contribution about pseudoscorpions from tree hollows in Czechia was published by Ducháč (1993a); pseudoscorpions were collected using pitfall traps installed in hollow trees in the Třeboňsko Protected Landscape Area. Šťáhlavský (2001) carried out systematic research in Prague and its surroundings, where pseudoscorpions were obtained from the mould of 101 tree hollows of 16 tree species. Šťáhlavský (2001) categorized the species found according to their relationship to tree hollows and defined *Mundochthonius styriacus* Beier, 1971, *Dinocheirus panzeri* (C.L. Koch, 1837), *Allochernes wideri* (C.L. Koch, 1843), and *Anthrenochernes stellae* Lohmander, 1939 as species with a close relationship to this microhabitat. Later several additional records of pseudoscorpions from tree hollows across the country were mentioned in further faunistic publications (Šťáhlavský 2006a, 2006b, 2011, Šťáhlavský & Krásný 2007, Šťáhlavský & Tuf 2009, Šťáhlavský & Chytil 2013).

Various methods have been used to collect arboricolous arachnids. The most popular and effective are arboreal eclectors situated on trunks (e.g. Albrecht 1995, Blick 2011) or on branches (e.g. Koponen 2004). Pocket traps attached to the tree bark represent another effective method (e.g. Bogya et al. 1999, Horváth & Szinetár 2002, Isaia et al. 2006). Pitfall traps have been used to sample arachnids in tree hollows (e.g. Růžička et al. 1991, Ranius & Jansson 2002) and on tree trunks (e.g. Pinzon & Spence 2008, Machač & Tuf 2016). Canopy-dwelling arachnids have been also sampled by canopy fogging (e.g. Otto & Floren 2007). Sweeping and hand collecting were used as a simple method for collecting specimens from branches (Hansen 1992). Flight interception traps have been developed mainly to collect flying insects, those of the window trap type being employed in particular for catching beetles in flight (e.g. Økland 1996). Flight interception traps have not been used primarily for sampling arachnids until now.

The aim of the present paper was to collect original data about spiders and pseudoscorpions of old oaks growing in a Central European floodplain on the northern margin of the Pannonian basin, obtained by pitfall traps installed in tree

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cavities and by flight interception traps installed near their openings. The material was collected within a study primarily focused on saproxylic beetles associated with tree hollows.

Material and methods

Study area

The study was carried out in the Lower Dyje (Thaya) floodplain (48°43'10"N, 16°54'27"E, 150 to 165 m a.s.l.) south to southeast of the Pohansko hunting chateau and archaeological site, which is located ca. 3 km south of the town of Břeclav (South Moravia, CZECH REPUBLIC). This area had been historically used as a wood pasture; during the last two hundred years, the more open areas were partially changed to hay meadows and the rest mostly to high forest for timber production. There is a high number of old trees, particularly pedunculate oaks (*Quercus robur*), both in the meadows and within smaller woods and larger forest stands, that had grown for a long time in open or semi-open conditions (Fig. 1). The study area, sampling design and sampling methods are described in detail in Schlaghamerský (2011) and Miklín et al. (2017).

Sampling design

Sampling was conducted in 2010 and 2011 (leg. J. Budka, J. Schlaghamerský). In 2010, 22 old oaks (*Quercus robur*) with cavities were studied. Ten (five live and five dead) were solitary trees in meadows. Twelve trees (seven live and five dead) were in close-canopy forest stands. All of the dead trees were standing. In 2011, a selection of 11 of these trees was resampled (traps remained on the same positions); only two of them were solitary trees in meadows (one dead), the rest growing in close-canopy forest (six live, three dead). Two sampling methods were used (their primary purpose was the sampling of saproxylic beetles associated with tree hollows). On each tree a flight interception trap (FIT) and a pitfall trap (PT) were installed. FITs hung near the opening of a selected cavity on a tree trunk. Cavity openings had to be at a height between 1.5 and 7 m above ground (Fig. 2a). Cavities with contact to the ground or entirely hollow trees were excluded. The FIT position was thus determined by the position of the opening of the cavity (into which a pitfall trap was also installed) and its distance from the tree crown varied substantially – in some cases it hung within the lowest part of the crown, often substantially below it (due to the primary objective of their installation). FITs were of the vane type, made of two crossing sheets (50 cm × 25 cm) of transparent plastic, with a roof above and a funnel (24 cm in diameter) connected to a collecting bottle attached below. As killing and preserving agent, an aqueous 50% ethylene glycol solution with a drop of detergent was used. Inside each tree cavity a pitfall trap was buried into the wood mould with its opening (6 cm in diameter) level with the mould surface (Fig. 2b). FITs and pitfall traps were exposed simultaneously from the 21th April 2010 to 4th October 2010 and from the 5 May 2011 to 23 August 2011 with three week sampling intervals. Spiders were identified using the key of Nentwig et al. (2018). Pseudoscorpions were identified using the key by Christophoryová et al. (2011c). Nomenclature for all taxa follows the World Spider Catalog (2018) and the catalogue Pseudoscorpions of the World (Harvey 2013). The material of spiders and pseudoscorpions is deposited in the collection of the Department of Botany and Zoology at the Masaryk University in Brno.

Results

Spiders (Araneae)

A total of 322 specimens representing 47 taxa from 15 families were identified (Tab. 1). FITs yielded 165 specimens belonging to 40 taxa and 14 families. None of the species captured by the FITs were particularly abundant, only some species were present in relatively high numbers: *Parasteatoda lunata* (Clerck, 1757) (9 specimens), *Anyphaena accentuata* (Walckenaer, 1802) (8), *Porrhomma oblitum* (O. P.-Cambridge, 1871) (8), *Leptorchestes berolinensis* (C. L. Koch, 1846) (8) and *Platnickina tincta* (Walckenaer, 1802) (8) (Tab. 1). FITs exclusively yielded 27 spider taxa. Most species captured by FITs were Linyphiidae with nine species and a group of species

Fig. 1: Closed-canopy forest with interspersed old oaks at the Pohansko study site (photo J. Schlaghamerský)

Fig. 2: Sampling methods used during the current study. **a.** Flight interception trap (FIT) (photo J. Schlaghamerský); **b.** Pitfall trap (PT) inside a tree hollow (photo J. Budka)

identified only to family level (Tab. 1). Pitfall traps placed in tree hollows yielded 157 specimens belonging to 20 taxa and 11 families (Fig. 4a). The most abundant species trapped in the tree hollows were *Tegenaria ferruginea* (Panzer, 1804) and *Midia midas* (Simon, 1884). The most species-rich family in the pitfall traps was Linyphiidae with six species and a group of species identified only to family level. Most spiders collected in hollows are horizontal web builders. Seven spider taxa were obtained exclusively by pitfall traps. A total of 226 specimens belonging to 41 taxa were obtained from trees in forests and 96 specimens from 27 taxa from solitary trees in meadows. Twenty taxa were obtained exclusively from oak hollows situated in forests, six taxa were obtained exclusively from solitary trees in meadows. Traps installed on dead and live trees yielded 139 specimens belonging to 34 taxa and 183 specimens from 40 taxa, respectively. Seven species were obtained exclusively from dead trees. Exclusively in live trees, 13 taxa were present (Tab. 1).

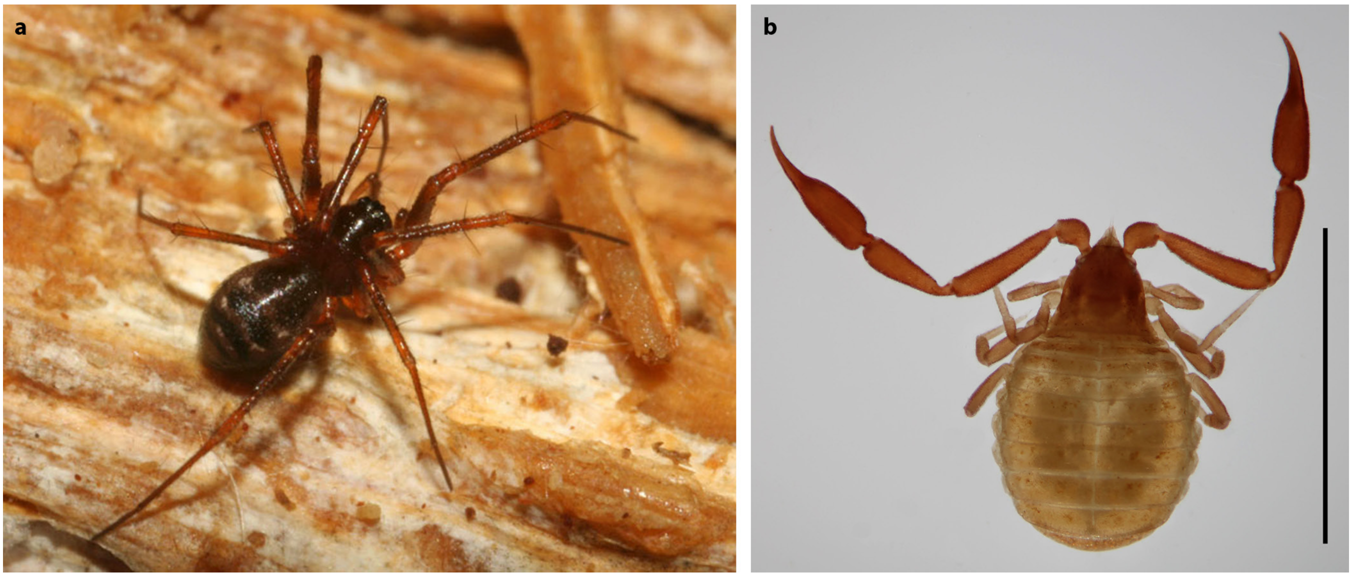

Fig. 3: Typical hollow dwellers. **a.** *Midia midas*, body length 3.5 mm (photo R. Macek); **b.** *Larca lata*, scale bar 2 mm (photo J. Christophoryová)

Remarkable spider species

Linyphiidae

***Midia midas* (Simon, 1884)** (Fig. 3a)

This species is rare and associated with ancient deciduous trees. It lives in tree hollows, where it builds small horizontal webs (Russell-Smith 2002). It is known to occur from the Iberian Peninsula to Turkey, reaching Denmark, Great Britain and Poland in the north (Nentwig et al. 2018). Within Czechia it has been found in eastern Bohemia around Pardubice (Dolanský 1998), South Bohemia (Růžička et al. 1991) and South Moravia near Lednice (Buchar & Růžička 2002, Kubcová & Schlaghamerský 2002). The species is listed in the Czech red list as endangered (Řezáč et al. 2015). Its perceived rarity might be partially due to the lack of arachnological studies focusing on its habitat, although this habitat – old trees with cavities – has definitely become scarce and threatened.

Salticidae

***Leptorchestes berolinensis* (C. L. Koch, 1846)**

Leptorchestes berolinensis is considered as a rare species, living on vegetation on sun-exposed forest edges, on rock outcrops (Buchar & Růžička 2002), as well as on sun-exposed bark of solitary trees and on wooden fences (Bryja et al. 2005, Machač & Niedobová 2015). It is known to occur widely in Europe, except North Europe and Great Britain (Nentwig et al. 2018). The species is listed in the Czech red list as vulnerable (Řezáč et al. 2015).

Theridiidae

***Dipoena erythropus* (Simon, 1881)**

This species is very rare, living on trees and known within Czechia only from South Moravia (Buchar & Růžička 2002), but it might have been overlooked. It lives on branches in the crowns of deciduous trees, mainly oaks. It is known to occur widely in Europe, except the northern part of Europe (Nentwig et al. 2018). Four specimens were obtained from FITs in the present study. This species is listed in the Czech red list as critically endangered (Řezáč et al. 2015).

Pseudoscorpions (Pseudoscorpiones)

In total, 71 specimens belonging to six species from four families were identified (Tab. 1). More specimens were collected in pitfall traps than in FITs (Fig. 4b). The most abundant species, *Larca lata*, was found exclusively in pitfall traps. Also, all specimens of *Allochernes wideri* were found in pitfall traps. On the other hand, *Apocheiridium ferum* (Simon, 1879) and *Dendrochernes cyrneus* (L. Koch, 1873) were collected only in FITs. *Chelifer cancroides* (Linnaeus, 1758) and *Chernes hahnii* (C. L. Koch, 1839) were captured in both trap types. Markedly more specimens were present in hollows in trees situated in forest stands than in those growing in meadows (Tab. 1). Remarkably, all pseudoscorpions were collected on live trees, not a single specimen on a dead one (Tab. 1).

Remarkable pseudoscorpion species

Larcidae

***Larca lata* (Hansen, 1884)** (Fig. 3b)

This species appears to be rare and vulnerable and is a typical cavity dweller (Judson & Legg 1996, Ranius & Wilander 2000). It occurs only in Europe, where it has been found in 13 countries until now (Harvey 2013). Recently it was reported for the first time from Slovakia and Hungary (Christophoryová et al. 2011a, Novák 2013). Within Czechia it has been found in the Třeboňsko Protected Landscape Area (South Bohemia) and in the Lower Morava Biosphere Reserve, which covers also the present study site (Ducháč 1993a, Šťáhlavský 2011, Šťáhlavský & Chytil 2013). In the Czech red list, it is listed as vulnerable (Šťáhlavský 2017).

Cheiridiidae

***Apocheiridium ferum* (Simon, 1879)**

This species is distributed in Europe and has also been found in Asian Turkey, Azerbaijan and Uzbekistan (Harvey 2013). Beier (1963) reported that the species lives under tree bark, especially of fruit trees. According to Weygoldt (1966) it occurs even in the tightest spaces under bark. Ducháč (1997) reported *A. ferum* from South Moravia as new for Czechia, without providing information about its habitat. Later it was found in the same region in the village of Lednice (Šťáhlavský & Ducháč 2001) and also close-by at Valtice and Hlohovec, in both cases under *Platanus* bark (Šťáhlavský & Chytil 2013).

Chernetidae

***Dendrochernes cyrneus* (L. Koch, 1873)**

This species is distributed in Asia and Europe (Harvey 2013). It is one of the pseudoscorpions that regularly occurs in bird nests, but it has also been found under tree bark and

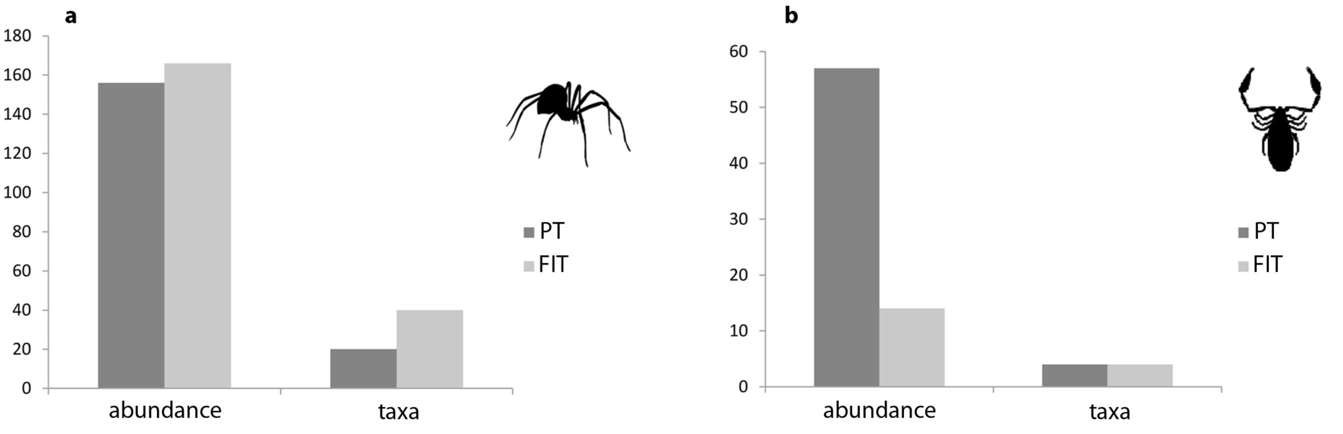

Fig. 4: Abundance and species numbers of spiders (**a**) and pseudoscorpions (**b**) in different types of traps. Abbreviations: FIT – flight interception trap, PT – pitfall trap

Tab. 1: List of taxa collected on old oaks at Pohansko; Abbreviations: FIT– flight interception traps close to cavity openings, PT – pitfall traps in hollows, for – trees in close-canopy forest, sol – solitary trees in meadows, dead – dead trees, live – live trees

Taxa	FIT	PT	for	sol	dead	live
SPIDERS (ARANEAE)						
Agelenidae						
Tegenaria ferruginea (Panzer, 1804)	3	66	42	27	31	38
Anyphaenidae						
Anyphaena accentuata (Walckenaer, 1802)	8	.	8	.	3	5
Araneidae						
Araneus triguttatus (Fabricius, 1775)	1	.	1	.	1	.
Araneus sp.	2	.	.	2	.	2
Clubionidae						
Clubiona comta C. L. Koch, 1839	1	.	1	.	.	1
Clubiona pallidula (Clerck, 1757)	3	.	2	1	1	2
Clubiona sp.	6	2	4	4	5	3
Dictynidae						
Cicurina cicur (Fabricius, 1793)	1	5	5	1	3	3
Dictyna uncinata Thorell, 1856	2	.	1	1	.	2
Lathys humilis (Blackwall, 1855)	7	1	5	3	2	6
Nigma flavescens (Walckenaer, 1830)	2	.	.	2	2	.
Dysderidae						
Harpactea rubicunda (C. L. Koch, 1838)	3	2	5	.	4	1
Gnaphosidae						
Drassodes sp.	1	.	1	.	.	1
Scotophaeus quadripunctatus (Linnaeus, 1758)	.	15	8	7	4	11
Linyphiidae						
Araeoncus humilis (Blackwall, 1841)	2	.	2	.	.	2
Diplocephalus picinus (Blackwall, 1841)	3	.	2	1	1	2
Drapetisca socialis (Sundevall, 1833)	.	1	1	.	.	1
Erigone atra Blackwall, 1833	2	.	1	1	2	.
Hypomma cornutum (Blackwall, 1833)	3	3	3	3	1	5
Lepthyphantes minutus (Blackwall, 1833)	7	7	11	3	7	7
Linyphia triangularis (Clerck, 1757)	5	.	5	.	.	5
Linyphiidae gen. spp.	19	5	18	6	7	17
Midia midas (Simon, 1884)	.	38	31	7	24	14
Neriene montana (Clerck, 1757)	1	1	2	.	1	1
Pelecopsis mengei (Simon, 1884)	1	.	.	1	.	1
Porrhomma oblitum (O. P.-Cambridge, 1871)	8	.	8	.	3	5
Trematocephalus cristatus (Wider, 1834)	.	1	1	.	1	.
Liocranidae						
Agroeca brunnea (Blackwall, 1833)	.	1	.	1	1	.
Lycosidae						
Pardosa sp.	1	.	1	.	.	1
Trochosa robusta (Simon, 1876)	.	1	.	1	.	1
Philodromidae						
Philodromus albidus Kulczyński, 1911	6	.	6	.	.	6
Philodromus spp.	.	1	1	.	.	1
Salticidae						
Ballus chalybeius (Walckenaer, 1802)	1	.	1	.	1	.
Leptorchestes berolinensis (C. L. Koch, 1846)	8	.	1	7	5	3
Salticus zebraneus (C. L. Koch, 1837)	7	.	6	1	2	5
Tetragnathidae						
Metellina segmentata (Clerck, 1757)	1	.	.	1	1	.
Tetragnatha pinicola L. Koch, 1870	3	.	3	.	2	1
Theridiidae						
Dipoena erythropus (Simon, 1881)	2	2	4	.	1	3
Enoplognatha ovata (Clerck, 1757)	3	.	3	.	1	2
Parasteatoda lunata (Clerck, 1757)	9	2	8	3	4	7
Parasteatoda simulans (Thorell, 1875)	3	.	3	.	2	1
Platnickina tincta (Walckenaer, 1802)	8	.	7	1	2	6
Robertus lividus (Blackwall, 1836)	2	.	1	1	1	1
Steatoda bipunctata (Linnaeus, 1758)	2	2	3	1	3	1
Theridion mystaceum L. Koch, 1870	1	.	1	.	.	1
Theridion spp.	11	.	4	7	7	4
Thomisidae						
Ozyptila praticola (C. L. Koch, 1837)	6	1	5	2	3	4
PSEUDOSCORPIONS (PSEUDOSCORPIONES)						
Larcidae						
Larca lata (Hansen, 1884)	.	41	37	4	.	41
Cheiridiidae						
Apocheiridium ferum (Simon, 1879)	7	.	6	1	.	7
Cheliferidae						
Chelifer cancroides (Linnaeus, 1758)	3	7	5	5	.	10
Chernetidae						
Chernes hahnii (C. L. Koch, 1839)	1	1	1	1	.	2
Dendrochernes cyrneus (L. Koch, 1873)	3	.	2	1	.	3
Allochernes wideri (C. L. Koch, 1843)	.	8	8	.	.	8

in tree hollows, though rarely (Christophoryová et al. 2011b, Krajčovičová & Christophoryová 2014). The Lower Morava Biosphere Reserve, which covers also our present study site, represents the only area within Czechia, from where *D. cyrneus* has been recorded; it was found in oak litter, under tree bark and phoretic on a longhorn beetle (Ducháč 1993b; Šťáhlavský & Chytil 2013). Šťáhlavský (2017) listed the species as vulnerable in the Czech red list.

Discussion

Most of the obtained 40 spider species represent arboreal ones (Szinetár & Horváth 2005). Only six taxa were epigeic: *Cicurina cicur* (Fabricius, 1793), *Drassodes* sp., *Harpactea rubicunda* (C. L. Koch, 1838), *Diplocephalus picinus* (Blackwall, 1841), *Pardosa* sp. and *Trochosa robusta* (Simon, 1876). The most abundant species in the FITs were *Anyphaena accentuata*, *Leptorchestes berolinensis* and *Parasteatoda lunata*. *Anyphaena accentuata* lives during the vegetation season on tree branches, *L. berolinensis* and *P. lunata* dwell on tree trunks (Buchar & Růžička 2002). Several small linyphiid spiders were obtained from FITs, including juvenile specimens, which disperse by ballooning. The majority of the species captured by FITs live on tree trunks or branches.

Tegenaria ferruginea and *Midia midas* were most abundant in the pitfall traps. Both species are typical cavity dwellers (Růžička et al. 1991, Buchar & Růžička 2002). The money spider *M. midas* is rare and endangered in the whole of Europe (Russell-Smith 2002, Řezáč et al. 2015). Another typical hollow dweller is *Scotophaeus quadripunctatus* (Linnaeus, 1758), which we obtained only from pitfall traps. The record from Pohansko represents a new locality for Czechia, but not far from its nearest known locality close to Lednice (Kubcová & Schlaghamerský 2002). All specimens were obtained from pitfall traps. The number of spider species and family composition obtained by pitfall trapping was similar to other studies from tree hollows in Spain and Romania (Martínez De Murguía et al. 2007, Nițu et al. 2009), but the species composition differed. Other remarkable spider species were the jumping spider *L. berolinensis* and the theridiid *Dipoena erythropus*, listed in the Czech red list as vulnerable and critically endangered, respectively (Řezáč et al. 2015). Significantly more spiders were obtained from trees in the forest than from solitary trees in meadows. Forests have a high species pool of arboricolous spider species (Samu et al. 2014). More species and specimens were present on live trees than on dead ones.

All of the collected pseudoscorpion species, except *Chelifer cancroides*, represent typical inhabitants of tree microhabitats. *C. cancroides* is considered to be cosmopolitan and synanthropic (Beier 1963), which may be related to its frequent occurrence in the nests of Hirundinidae (Turienzo et al. 2010). Nevertheless, its occurrence under tree bark and in tree cavities is also known (Mahnert 2011, Krajčovičová & Christophoryová 2014). Šťáhlavský & Chytil (2013) recorded the species in tree hollows within Czechia, in the south Moravian floodplains at Lednice and Břeclav. During the present study, *C. cancroides* was found in both trap types. The same numbers of individuals were found in hollows of solitary trees as well as of trees situated in forest stands. Two specimens of *Chernes hahnii* were obtained in the present study, one in FIT one in a pitfall trap. The species shows a strong association with the microhabitat under tree bark (Šťáhlavský 2001, Drogla & Lippold 2004, Krajčovičová & Christophoryová 2014). Its presence in FIT could have been caused by its upwards migration on the tree trunks or by zoophoresy. Krajčovičová & Christophoryová (2014) collected 11 specimens of *Chernes hahnii* in photoeclectors installed on tree trunks which can also be related with upwards migration on the tree trunks. A surprisingly low number of *Allochernes wideri* was found in tree hollows in the present study. In a study conducted in Prague and its surroundings, *A. wideri* represented the second most abundant species found in tree hollows (Šťáhlavský 2001). The species was reported in all of the subsequent faunistic papers dealing with pseudoscorpions from tree microhabitats in Czechia (Šťáhlavský 2006a, 2006b, 2011, Šťáhlavský & Krásný 2007, Šťáhlavský & Tuf 2009, Šťáhlavský & Chytil 2013). Three species *Larca lata*, *Apocheiridium ferum* and *Dendrochernes cyrneus* are presented as remarkable records in the current paper. Two of them, *L. lata* and *D. cyrneus*, are listed in the Czech red list as vulnerable (Šťáhlavský 2017).

In conclusion, looking at the obtained data, one has to bear in mind that whereas the pitfall traps collected specimens living in tree hollows or actively visiting them, the trapping of spiders and pseudoscorpions in free-hanging FITs was a rather accidental process. Both groups do not fly, though some passive air-born transport does occur (ballooning and zoophoresy) (Decae 1987, Christophoryová et al. 2017a). However, other non-flying invertebrates have also been obtained from FITs (own unpublished observation). In the present case one has to assume that many individuals falling down from the canopy, possibly taken by wind, ended up in the traps despite the trap roofs (meant to prevent flooding by rainwater and accumulation of debris in the trap funnel). We also observed spiders building their webs between the panes or between pane and roof.

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Electronic Appendix (pdf format): Supplementary file with detailed collection data of each specimen.

Supplementary file

Spiders

Agelenidae

***Tegenaria ferruginea* (Panzer, 1804)**

Material examined: PT (21.IV.–17.V.2010): three dead trees in forest, 3 ♂♂, 2 ♀♀; five live trees in forest, 4 ♂♂, 1 juv.; four dead solitary trees, 2 ♂♂, 1 ♀, 2 juv.; four live solitary trees, 6 ♂♂, 5 ♀♀. PT (17.V.–3.VI.2010): two dead trees in forest, 2 ♂♂, 1 ♀; one live tree in forest, 1 ♂; two dead solitary trees, 1 ♂, 2 ♀♀. FIT (3.VI.–28.VI.2010): one dead tree in forest, 1 ♂; one live tree in forest, 1 ♂. PT (3.VI.–28.VI.2010): one dead tree in forest, 2 ♀♀; one live tree in forest, 1 ♀; two dead solitary trees, 1 ♂, 1 ♀. PT (28.VI.–16.VII.2010): two dead trees in forest, 1 ♂, 1 ♀; two dead solitary trees, 1 ♂, 1 ♀; one live solitary tree, 2 ♂♂. FIT (16.VII.–6.VIII.2010): one live tree in forest, 1 ♂. PT (16.VII.–6.VIII.2010): one dead tree in forest, 1 ♀. PT (4.X.–19.X.2010): one dead tree in forest, 1 juv.; one live solitary tree, 1 juv. PT (5.V.–2.VI.2011): two live trees in forest, 2 ♂♂, 2 ♀♀, 1 juv. PT (2.VI.–20.VI.2011): one dead tree in forest, 1 ♂; two live trees in forest, 5 ♂♂. PT (20.VI.–11.VII.2011): one dead tree in forest, 1 ♂; one live tree in forest, 1 ♂. PT (11.VII.–8.VIII.2011): one dead tree in forest, 1 juv.; one dead solitary tree, 1 juv. PT (8.VIII.–23.VIII.2011): one live tree in forest, 1 ♀, 3 juv.

Anyphaenidae

***Anyphaena accentuata* (Walckenaer, 1802)**

Material examined: FIT (17.V.–3.VI.2010): one live tree in forest, 4 ♂♂. FIT (28.VI.–16.VII.2010): one dead tree in forest, 1 ♂, 1 ♀. FIT (6.VIII.–31.VIII.2010): one live tree in forest, 1 juv. FIT (2.VI.–20.VI.2011): one dead tree in forest, 1 ♂.

Araneidae

***Araneus triguttatus* (Fabricius, 1775)**

Material examined: FIT (2.VI.–20.VI.2011): one dead tree in forest, 1 ♀.

***Araneus* sp.**

Material examined: FIT (2.VI.–20.VI.2011): one live solitary tree, 2 juv.

Clubionidae

***Clubiona comta* C. L. Koch, 1839**

Material examined: FIT (5.V.–2.VI.2011): one live tree in forest, 1 ♂.

***Clubiona pallidula* (Clerck, 1757)**

Material examined: FIT (28.VI.–16.VII.2010): one dead tree in forest, 1 ♂; one live solitary tree, 1 ♂. FIT (11.VII.–8.VIII.2011): one live tree in forest, 1 ♀.

***Clubiona* sp.**

Material examined: FIT (31.VIII.–4.X.2010): one dead solitary tree, 1 juv. PT (31.VIII.–4.X.2010): one dead tree in forest, 1 juv. FIT (5.V.–2.VI.2011): one dead solitary tree, 2 juv. FIT (2.VI.–20.VI.2011): two live trees in forest, 2 juv. PT (2.VI.–20.VI.2011): one dead solitary tree, 1 juv. FIT (8.VIII.–23.VIII.2011): one live tree in forest, 1 juv.

Dictynidae

***Cicurina cicur* (Fabricius, 1793)**

Material examined: PT (21.IV.–17.V.2010): one dead tree in forest, 1 ♀; one live tree in forest, 1 ♀. PT (16.VII.–6.VIII.2010): one solitary dead tree, 1 ♂. PT (5.V.–2.VI.2011): one live tree in forest, 2 ♀♀. FIT (2.VI.–20.VI.2011): one dead tree in forest, 1 ♀.

***Dictyna uncinata* Thorell, 1856**

Material examined: FIT (3.VI.–28.VI.2010): one live solitary tree, 1 ♂. FIT (8.VIII.–23.VIII.2011): one live tree in forest, 1 ♂.

***Lathys humilis* (Blackwall, 1855)**

Material examined: FIT (17.V.–3.VI.2010): one live tree in forest, 2 ♂♂. FIT (5.V.–2.VI.2011): one live tree in forest, 1 ♂; one live solitary tree, 1 ♂, 2 ♀♀. PT (5.V.–2.VI.2011): one dead tree in forest, 1 ♀. FIT (8.VIII.–23.VIII.2011): one dead tree in forest, 1 ♂.

***Nigma flavescens* (Walckenaer, 1830)**

Material examined: FIT (8.VIII.–23.VIII.2011): one dead solitary tree, 2 ♂♂.

Dysderidae

***Harpactea rubicunda* (C. L. Koch, 1838)**

Material examined: PT (17.V.–3.VI.2010): one dead tree in forest, 1 ♂. FIT (28.VI.–16.VII.2010): two dead trees in forest, 2 ♂♂; one live tree in forest, 1 ♀. PT (31.VIII.–4.X.2010): one dead tree in forest, 1 ♀.

Gnaphosidae

***Drassodes* sp.**

Material examined: FIT (21.IV.–17.V.2010): one live tree in forest, 1 juv.

***Scotophaeus quadripunctatus* (Linnaeus, 1758)**

Material examined: PT (28.VI.–16.VII.2010): one live tree in forest, 2 ♂♂. PT (16.VII.–6.VIII.2010): one dead solitary tree, 1 ♂. PT (6.VIII.–31.VIII.2010): one dead solitary tree, 1 ♂. PT (31.VIII.–4.X.2010): one live tree in forest, 1 ♀; one dead solitary tree, 1 ♀; one live solitary tree, 2 ♂♂. PT (4.X.–19.X.2010): one live solitary tree, 1 ♀. PT (2.VI.–20.VI.2011): two live trees in forest, 1 ♂, 1 ♀; one dead solitary tree, 1 ♀. PT (11.VII.–8.VIII.2011): one live tree in forest, 1 ♂. PT (8.VIII.–23.VIII.2011): one live tree in forest, 2 ♂♂.

Linyphiidae

***Araeoncus humilis* (Blackwall, 1841)**

Material examined: FIT (2.VI.–20.VI.2011): one live tree in forest, 1 ♂. FIT (20.VI.–11.VII.2011): one live tree in forest, 1 ♂.

***Diplocephalus picinus* (Blackwall, 1841)**

Material examined: FIT (17.V.–3.VI.2010): one live tree in forest, 1 ♂. FIT (28.VI.–16.VII.2010): one dead tree in forest, 1 ♀. FIT (20.VI.–11.VII.2011): one live solitary tree, 1 ♂.

***Drapetisca socialis* (Sundevall, 1833)**

Material examined: PT (28.VI.–16.VII.2010): one live tree in forest, 1 ♂.

Erigone atra **Blackwall, 1833**
Material examined: FIT (6.VIII.–31.VIII.2010): one dead solitary tree, 1 ♂. FIT (5.V.–2.VI.2011): one dead tree in forest, 1 ♂.

Hypomma cornutum **(Blackwall, 1833)**
Material examined: FIT (21.IV.–17.V.2010): one dead tree in forest, 1 ♂. PT (3.VI–28.VI.2010): one live solitary tree, 2 ♂♂, 1 ♀. FIT (5.V.–2.VI.2011): one live tree in forest, 1 ♂. FIT (8.VIII.–23.VIII.2011): one live tree in forest, 1 ♂.

Lepthyphantes minutus **(Blackwall, 1833**
Material examined: FIT (21.IV.–17.V.2010): two live trees in forest, 2 ♂♂. FIT (17.V.–3.VI.2010): one live tree in forest, 1 ♂. FIT (3.VI.–28.VI.2010): one dead tree in forest, 2 ♀♀; one dead solitary tree, 1 ♀. PT (28.VI.–16.VII.2010): two live trees in forest, 2 ♂♂; two dead solitary trees, 2 ♂♂. FIT (16. VII.–6.VIII.2010): one dead tree in forest, 1 ♀. PT (6.VIII.–31.VIII.2010): one dead tree in forest, 1 ♀; one live tree in forest, 1 ♀. PT (11.VII.–8.VIII.2011): one live tree in forest, 1 ♂.

Linyphia triangularis **(Clerck, 1757)**
Material examined: FIT (11.VII.–8.VIII.2011): three live trees in forest, 5 ♂♂.

Linyphiidae gen. spp.
Material examined: PT (21.IV.–17.V.2010): one live solitary tree, 2 juv. PT (3.VI.–28.VI.2010): one live solitary tree, 1 juv. FIT (3.VI.–28.VI.2010): one dead solitary tree, 1 juv. FIT (16.VII.–6.VIII.2010): one live solitary tree, 1 juv. PT (16.VII.–6.VIII.2010): one dead tree in forest, 1 juv. FIT (5.V.–2.VI.2011): one dead tree in forest, 1 juv. FIT (20.VI.–11.VII.2011): one dead tree in forest, 3 juv.; four live trees in forest, 8 juv.; one live solitary tree, 1 juv. FIT (11.VII.–8. VIII.2011): two live trees in forest, 4 juv. PT (11.VII.–8. VIII.2011): one dead tree in forest, 1 juv.

Midia midas **(Simon, 1884)**
Material examined: PT (21.IV.–17.V.2010): one dead solitary tree, 1 ♂. PT (17.V.–3.VI.2010), one dead tree in forest, 1 ♂; one dead solitary tree, 1 ♀. PT (3.VI.–28.VI.2010): one dead tree in forest, 1 ♀; one live tree in forest, 1 ♀. PT (28.VI.–16. VII.2010): two dead trees in forest, 1 ♂, 3 ♀♀; two live trees in forest, 2 ♂♂, 2 ♀♀; one live solitary tree, 2 ♀♀. PT (16.VII.–6.VIII.2010): one dead tree in forest, 1 ♀. PT (6.VIII.–31. VIII.2010): one live solitary tree, 1 ♀. PT (5.V.–2.VI.2011): three dead trees in forest, 2 ♂♂, 3 ♀♀. PT (2.VI.–20.VI.2011): two dead trees in forest, 1 ♂, 5 ♀♀; two live trees in forest, 1 ♂, 1 ♀; one live solitary tree, 1 ♀. PT (20.VI.–11.VII.2011): two dead trees in forest, 1 ♂, 1 ♀; one live tree in forest, 1 ♂, 1 ♀. PT (11.VII.–8.VIII.2011): one live solitary tree, 1 ♀. PT (8.VIII.–23.VIII.2011): one dead tree in forest, 2 ♀♀.

Neriene montana **(Clerck, 1757)**
Material examined: PT (21.IV.–17.V.2010): one dead tree in forest, 1 ♂. FIT (28.VI.–16.VII.2010): one live tree in forest, 1 ♀.

Pelecopsis mengei **(Simon, 1884)**
Material examined: FIT (2.VI.–20.VI.2011): one live solitary tree, 1 ♂.

Porrhomma oblitum **(O. P.-Cambridge, 1871)**
Material examined: FIT (21.IV.–17.V.2010): one dead tree in forest, 2 ♀♀. FIT (3.VI.–28.VI.2010): two live trees in forest, 3 ♀♀. FIT (6.VIII.–31.VIII.2010): one live tree in forest, 1 ♀. FIT (5.V.–2.VI.2011): one live tree in forest, 1 ♀. FIT (2.VI.–20.VI.2011): one dead tree in forest, 1 ♂.

Trematocephalus cristatus **(Wider, 1834)**
Material examined: PT (16.VII.–6.VIII.2010): one dead tree in forest, 1 ♀.

Liocranidae
Agroeca brunnea **(Blackwall, 1833)**
Material examined: PT (17.V.–3.VI.2010): one dead solitary tree, 1 ♂.

Lycosidae
Pardosa **sp.**
Material examined: FIT (20.VI.–11.VII.2011): one live tree in forest, 1 juv.

Trochosa robusta **(Simon, 1876)**
Material examined: PT (21.IV.–17.V.2010): one live solitary tree, 1 ♀.

Philodromidae
Philodromus albidus **Kulczyñski, 1911**
Material examined: FIT (6.VIII.–31.VIII.2010): one live tree in forest, 1 ♀. FIT (2.VI.–20.VI.2011): two live trees in forest, 2 ♂♂. FIT (20.VI.–11.VII.2011): three live trees in forest, 3 ♀♀.

Philodromus **sp.**
Material examined: PT (6.VIII.–31.VIII.2010): one live tree in forest, 1 juv.

Salticidae
Ballus chalybeius **(Walckenaer, 1802)**
Material examined: FIT (5.V.–2.VI.2011): one dead tree in forest, 1 ♂.

Leptorchestes berolinensis **(C. L. Koch, 1846)**
Material examined: FIT (3.VI.–28.VI.2010): one dead solitary tree, 1 ♂. FIT (28.VI.–16.VII.2010): two dead solitary trees, 2 ♂♂, 1 ♀. FIT (16.VII.–6.VIII.2010): one live tree in forest, 1 ♀; one dead solitary tree, 1 ♀. FIT (20.VI.–11.VII.2011): one live solitary tree, 2 ♀♀.

Salticus zebraneus **(C. L. Koch, 1837)**
Material examined: FIT (3.VI.–28.VI.2010): one dead tree in forest, 1 ♂; one live tree in forest, 2 ♂♂; one dead solitary tree, 1 ♂. FIT (20.VI.–11.VII.2011): three live trees in forest, 3 ♀♀.

Tetragnathidae
Metellina segmentata **(Clerck, 1757)**
Material examined: FIT (8.VIII.–23.VIII.2011): one dead solitary tree, 1 ♀.

Tetragnatha pinicola **L. Koch, 1870**
Material examined: FIT (6.VIII.–31.VIII.2010): one dead tree in forest, 1 ♀; one live tree in forest, 1 ♀. FIT (11.VII.–8. VIII.2011): one dead tree in forest, 1 ♀.

Theridiidae

***Dipoena erythropus* (Simon, 1881)**
Material examined: FIT (5.V.–2.VI.2011): one live tree in forest, 1 ♂. PT (2.VI.–20.VI.2011): one live tree in forest, 1 ♂, 1 ♀. FIT (8.VIII.–23.VIII.2011): one dead tree in forest, 1 ♀.

***Enoplognatha ovata* (Clerck, 1757)**
Material examined: FIT (5.V.–2.VI.2011): two live trees in forest, 2 ♂♂. FIT (2.VI.–20.VI.2011): one dead tree in forest, 1 ♀.

***Parasteatoda lunata* (Clerck, 1757)**
Material examined: FIT (3.VI.–28.VI.2010): one live tree in forest, 2 ♂♂; one dead solitary tree, 1 ♂. PT (28.VI.–16.VII.2010): one live tree in forest, 1 ♀. FIT (5.V.–2.VI.2011): one live tree in forest, 1 ♂. PT (5.V.–2.VI.2011): one dead tree in forest, 1 ♂. FIT (20.VI.–11.VII.2011): one dead solitary tree, 2 ♀♀. FIT (11.VII.–8.VIII.2011): one live tree in forest, 1 ♀. FIT (8.VIII.–23.VIII.2011): two live trees in forest, 2 ♀♀.

***Parasteatoda simulans* (Thorell, 1875)**
Material examined: FIT (20.VI.–11.VI.2011): two dead trees in forest, 2 ♀♀; one live tree in forest, 1 ♀.

***Platnickina tincta* (Walckenaer, 1802)**
Material examined: FIT (5.V.–2.VI.2011): one dead solitary tree, 1 ♂. FIT (2.VI.–20.VI.2011): one live tree in forest, 1 ♂. FIT (11.VII.–8.VIII.2011): one dead tree in forest, 1 ♀; one live tree in forest, 1 ♂, 1 ♀. FIT (8.VIII.–23.VIII.2011): two live trees in forest, 3 ♀♀.

***Robertus lividus* (Blackwall, 1836)**
Material examined: FIT (3.VI.–28.VI.2010): one live tree in forest, 1 ♂; one dead solitary tree, 1 ♂.

***Steatoda bipunctata* (Linnaeus, 1758)**
Material examined: PT (28.VI.–16.VII.2010): one dead tree in forest, 1 ♀. PT (8.VIII.–23.VIII.2011): one live tree in forest, 1 ♀. FIT (5.V.–2.VI.2011): one dead tree in forest, 1 ♂. FIT (11.VII.–8.VIII.2011): one dead solitary tree, 1 ♀.

***Theridion mystaceum* L. Koch, 1870**
Material examined: FIT (2.VI.–20.VI.2011): one live tree in forest, 1 ♀.

***Theridion* spp.**
Material examined: FIT (3.VI.–28.VI.2010): one dead tree in forest, 1 juv. FIT (28.VI.–16.VII.2010): one live tree in forest, 1 juv.; two dead solitary trees, 3 juv; one live solitary tree, 1 juv. FIT (16.VII.–6.VIII.2010): one solitary dead tree, 1 juv.; one live solitary tree, 1 juv. FIT (5.V.–2.VI.2011): one live solitary tree, 1 juv. FIT (8.VIII.–23.VIII.2011): one dead tree in forest, 2 juv.

Thomisidae

***Ozyptila praticola* (C. L. Koch, 1837)**
Material examined: FIT (3.VI.–28.VI.2010): one dead tree in forest, 1 ♀. PT (3.VI.–28.VI.2010): one live solitary tree, 1 ♂; one dead solitary tree, 1 ♀; one live tree in forest, 1 ♀. FIT (28.VI.–16.VII.2010): one live tree in forest, 2 ♀♀. FIT (6.VIII.–31.VIII.2010): one dead tree in forest, 1 ♀.

Pseudoscorpiones

Larcidae

***Larca lata* (Hansen, 1884)**
Material examined: PT (21.IV.–17.V.2010): two live trees in forest, 3 ♀♀, 1 deutonymph; one live solitary tree, 3 ♂♂. PT (17.V.–3.VI.2010): one live tree in forest, 2 ♂♂. PT (3.VI.–28.VI.2010): three live trees in forest, 4 ♂♂, 2 ♀♀, 2 deutonymphs. PT (28.VI.–16.VII.2010): four live trees in forest, 2 ♀♀, 1 deutonymph, 1 protonymph. PT (16.VII.–6.VIII.2010): two live trees in forest, 1 ♀, 1 deutonymph, 1 nymph. PT (6.VIII.–31.VIII.2010): two live trees in forest, 1 ♂, 1 ♀, 1 deutonymph. PT (5.V.–2.VI.2011): one live tree in forest, 2 ♀♀, 1 tritonymph; one live solitary tree, 1 ♀. PT (23.VIII.–19.X.2010): three live trees in forest, 2 ♂♂, 7 ♀♀, 1 tritonymph.

Cheiridiidae

***Apocheiridium ferum* (Simon, 1879)**
Material examined: FIT (8.VIII.–23.VIII.2011): one live tree in forest, 4 ♂♂, 2 ♀♀. FIT (8.VIII.–23.VIII.2011): one live solitary tree, 1 ♀.

Cheliferidae

***Chelifer cancroides* (Linnaeus, 1758)**
Material examined: FIT (17.V.–3.VI.2010): one live tree in forest, 1 ♀. PT (3.VI.–28.VI.2010): one live tree in forest, 2 ♀♀; one live solitary tree, 1 tritonymph. PT (6.VIII.–31.VIII.2010): one live tree in forest, 1 ♀. FIT (6.VIII.–31.VIII.2010): one live tree in forest, 1 ♀. FIT (5.V.–2.VI.2011): one live solitary tree, 1 ♀. PT (20.VI.–11.VII.2011): one live solitary tree, 1 deutonymph. PT (11.VII.–8.VIII.2011): one live solitary tree, 1 deutonymph, 1 protonymph.

Chernetidae

***Chernes hahnii* (C.L. Koch, 1839)**
Material examined: PT (21.IV.–17.V.2010): one live tree in forest, 1 tritonymph. FIT (3.VI.–28.VI.2010): one live solitary tree, 1 ♀.

***Dendrochernes cyrneus* (L. Koch, 1873)**
Material examined: FIT (17.V.–3.VI.2010): one live tree in forest, 1 ♀. FIT (3.VI.–28.VI.2010): one live tree in forest, 1 ♀. FIT (4.X.–19.X.2010): one live solitary tree, 1 ♂.

***Allochernes wideri* (C.L. Koch, 1843)**
Material examined: PT (21.IV.–17.V.2010): one live tree in forest, 1 ♂, 1 ♀, 3 tritonymphs. PT (16.VII.–6.VIII.2010): one live tree in forest, 2 ♂♂, 1 ♀.