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SPIDERS (ARACHNIDA: ARANEAE) FROM FOREST ECOSYSTEMS OF TŘESÍN NATIONAL NATURE MONUMENT (LITOVELSKÉ POMORAVÍ, CZECH REPUBLIC) WITH SUGGESTIONS TO CONSERVATION MANAGEMENT OF THE LOCALITY

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Abstract

KOŠULIČ ONDŘEJ. 2015. Spiders (Arachnida: Araneae) from Forest Ecosystems of Třesín National Nature Monument (Litovelské Pomoraví, Czech Republic) with Suggestions to Conservation Management of the Locality. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* 63(3): 751–767.

This paper presents faunistic records of spiders in the forest ecosystems of the Třesín National Nature Monument. Spiders were surveyed from 29 April 2013 to 25 October 2013. A total of 1012 individual spiders were collected from eight sites by pitfall traps, individual collection, sweeping grasses and herb vegetation, beating shrubs and trees, and shifting leaf litters. Spiders were identified as 146 species from 94 genera and 27 families. The families Linyphiidae, Lycosidae, Gnaphosidae, and Thomisidae exhibited high species diversity. Three species listed on the Red List of Threatened Species in the Czech Republic were recorded: *Dysdera moravica* (Řezáč, Gasparo, Král & Heneberg, 2014), *Megalepthyphantes pseudocollinus* (Saaristo, 1997), and *Nusoncus nasutus* (Schenkel, 1925). The finding of *N. nasutus* is among the first reports of this spider in the Moravia region. Several findings represent the northernmost occurrences of rare thermophilous spiders in Moravia and even the Czech Republic. The great richness of araneofauna and the occurrence of rare and poorly known spider species confirm the high biotic value of Třesín within the agriculturally intensified landscape of Moravia.

Keywords: Araneae, conservation, faunistics, forest, habitat management, Czech Republic

INTRODUCTION

The Třesín National Nature Monument (NNM) is located in the western part of the Litovelské Pomoraví Protected Landscape Area (PLA) which is characterized by the presence of various forest ecosystems along the Drahany Highlands. The Třesín NNM is located on the border of faunistic squares 6267 and 6268 of the faunistical zoological grid mapping system (Pruner & Mika, 1996). The whole area is of limestone origin which determines the formation of interesting communities of rare fauna and flora (Šafář, 2003). Several inventory surveys have been carried out within the area, focused mainly on insects (Bezděčka, 2002; Hrnčíř, 2012; Jeniš, 2013), small mammals (Losík, 2013), and lichens (Halda, 2013).

Spiders, an important component of terrestrial ecosystems (Buchar, 1983, 1991; Marc *et al*., 1999), have never been studied within the area of the Třesín NNM. To date, only unpublished findings of several common spider species are known. These specimens were collected during several ecological excursions organized by the Palacký University in Olomouc (Machač, pers. comm.). From the surrounding territory (in the same faunistical

squares), the araneofauna of forest ecotones have been studied (Klimeš & Špičáková, 1984). Furthermore, there is a great deal of unpublished data from different habitats (fields, forests, houses) (Machač, pers. comm.). To date, we know of the presence of 89 spider species within faunistic squares 6267 and 6268, which include the study area of the Třesín NNM (Czech Arachnological Society, 2015). In general, it can be conclude that the araneofauna of the Litovelské Pomoraví PLA and its surroundings is understudied, with only older findings (Miller, 1974; Klimeš & Špičáková, 1984) and with no recent faunistical reports.

The aim of the present paper was to make a faunistic investigation of spiders in the forest ecosystems of the Třesín NNM. I anticipate that the recorded faunistic findings will significantly extend the knowledge of araneofauna in the Litovelské Pomoraví PLA, and even across the entire region of Moravia. In addition, I expect that the possibly interesting faunistic findings might draw attention to the importance of forest habitats and their management for maintaining biodiversity in the agriculturally intensified landscape of the Moravia region.

MATERIALS AND METHODS

Study Area

The Třesín NNM is located in the district of Olomouc in the Mladeč cadastral area, about 4 km west from the town of Litovel (Fig. 1). Třesín was declared a protected area in 1933 and transferred into the NNM category in 1993. With its area of 143 ha, it is a small protected site. This area predominantly consists of afforested karst hills with fragments of native oak, oak-hornbeam, and beech forests. Some locations have been converted into uniform spruce monocultures. The south-western part of the area consists of a former limestone quarry which is now abandoned and overgrown with dense xero- to mesophilic vegetation. Limestone sinkholes and small caves have formed across the entire territory of the protected area. The territory climatically lies on the border between the thermophyticum and mesophyticum (Quitt, 1971). The protected area is situated at an altitude of 290–343 m a.s.l. The geologic substrate is Devonian limestone, sometimes covered by loess. The prevailing soil types are brown earths, rendzinas, and fluvisoils (Šafář, 2003). The surrounding landscape is made up of small fragments of deciduous and mixed forests and agricultural fields dominated by cultivated cereals and oilseed rape.

Sampling Methods and Study Sites

Research on araneofauna was carried out in 2013 from 29 April to 25 October. Spiders were collected using different collecting methods: pitfall traps, individual collection under stones and in grass, sweeping of herb vegetation, shifting leaf litters, and beating shrubs and trees 50–200 cm in height. Herb vegetation was swept along each sampling plot (100 sweeps in each plot) at a maximum distance of 3 m from pitfall traps. Individual collections and beating of shrubs and trees with shifting leaf litters took place at randomly selected patches along each sampling plot. Samples were collected at monthly intervals. Pitfall traps were installed on 29 April 2013 with subsequent collections on 7 June 2013, 5 July 2013, 22 August 2013, 25 September 2013, and 25 October 2013. As pitfall traps, 0.5-liter jars 9 cm in diameter and 12 cm in length were used, one-third filled with a 4% formaldehyde solution with a drop of added detergent. The traps were placed in sites 1–5 in lines of three traps ca. 5 m apart, with altogether 15 pitfall traps installed per study location Třesín. On sites 6–8, all of the aforementioned collection methods were used except for the pitfall traps. After collection, the material was preserved in 70% alcohol. Individual sites used for collecting spiders were identified by GPS coordinates (mentioned below) and are shown in Fig. 1. The entire area falls within faunistic squares 6267 and 6268 (Pruner & Míka, 1996).

Site 1 – Debris forest of beech and hornbeam with presence of limestone blocks (49°42'39"N, 17°0'47"E). Spiders were collected using all collection methods.

Site 2 – Oak forest stand (*Quercion pubescenti-petraeae* plant communities) with south exposure on the upper edge of a former limestone quarry (49°42'19"N, 16°59'22"E), very sparse canopy, and diverse vegetation in the undergrowth. Spiders were collected using all collection methods.

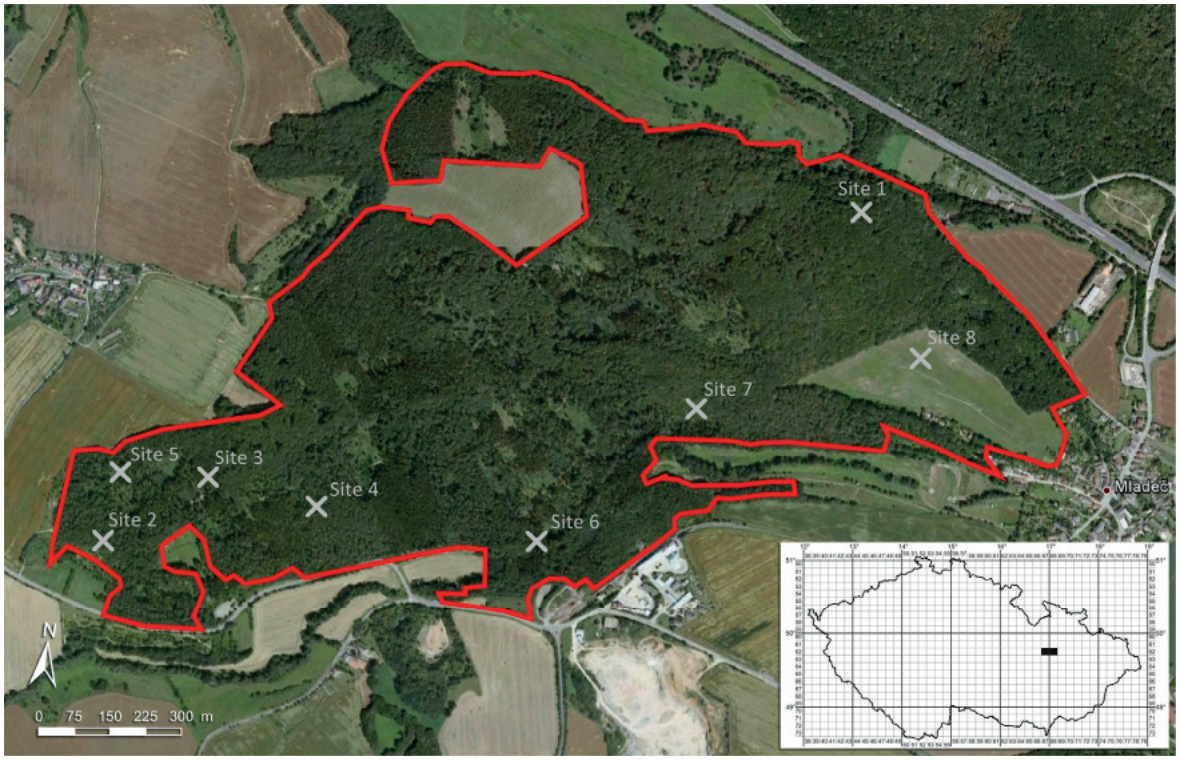
Site 3 – Oak-hornbeam forest with shrubs and rich undergrowth (49°42'23"N, 16°59'30"E) as well as presence of sinkholes. Spiders were collected using all collection methods.

Site 4 – Spruce monoculture forest stand with presence of non-native trees (*Larix decidua*, *Robinia pseudoacacia*) (49°42'19"N, 16°59'33"E). Spiders were collected using all collection methods.

Site 5 – Beech forest stand with presence of sinkholes and limestone blocks (49°42'22"N, 16°59'18"E). Spiders were collected using all collecting methods.

Site 6 – Oak-hornbeam forest stand along the Hradečka stream with presence of trees typical of floodplain forests (49°42'21"N, 17°0'6"E). Spiders were collected using individual collection and sweeping of herb vegetation along the stream.

Site 7 – Hornbeam forest stand (*Quercus pubescens–Quercus petraea* and *Carpinus* spp. plant communities) on a slope towards the upper part of Třesín Hill (49°42'30"N, 17°0'10"E), with the southern part containing transition to thermophilous oak forest. Spiders were collected using all collection methods except for pitfall traps.



1: *Marked border of the studied location with collecting sites. In the right corner showing the grid map of the Czech Republic with marked faunistic squares*
(orig. www.mapy.cz).

Site 8 – Periodically mowed meadow with southeast exposure used as pasture, presence of ruderal herb vegetation with dominant representation of *Rumex* spp., *Dactylis glomerata*, and *Arrhenatherum elatius* (49°42'31"N, 17°0'48"E). Spiders were collected using individual collection, sweeping of herb vegetation, and beating of shrubs along the edge of the meadow.

Species Identification

All spider material was determined to the species level using the identification keys of Heimer & Nentwig (1991), Roberts (1995), and Nentwig *et al.* (2014).

Nomenclature of families, genera, and species follow the most recent version of the World Spider Catalog (2015). Most species were determined by the author (OK). Some morphologically complicated taxa were revised and determined by Vladimír Hula (VH) and Vlastimil Růžička (VR).

All of the examined material has been deposited in the collection of Ondřej Košulič (Mendel University, Brno). For each determined species, the following characteristics (according to Buchar & Růžička, 2002; Růžička, 2005; Růžička & Buchar, 2008) are recorded:

- originality of habitat: climax preferences (C), semi-natural habitats (SN), disturbed (D), artificial (A);
- occurrence level: very abundant (VA), abundant (A), scarce (S), rare (R), very rare (VR);
- conservation status: critically endangered (CR), endangered (EN), vulnerable (VU).

The abbreviations of protected locations and collecting methods are as follows:
PLA ..... Protected Landscape Area,
NNR..... National Nature Reserve,
NNM.... National Nature Monument,
NR ..... Nature Reserve,
NM ..... National Monument,
pt..... pitfall traps,
sw..... sweeping vegetation,
bst..... beating shrubs and trees,
ic ..... individual collection under stones and in grass.

RESULTS AND DISCUSSION

Faunistic Overview

A total of 1012 spiders (890 adults, 122 juveniles) were collected, representing 146 species in 94 genera of 27 families (Tabs. I and II). The majority of spiders came from pitfall traps (827 specimens belonging to 134 species from 16 families). The using of remaining collecting methods (see Materials and Methods) resulted in 185 specimens belonging to 41 species from 14 families. Only four families were not recorded using pitfall traps but only through individual collection (Pholcidae and Nesticidae) or beating shrubs and branches (Anyphaenidae and Philodromidae).

I: *List of recorded species with ecological indicators, in taxonomical order. Explanations: Occurrence level: VA (very abundant), A (abundant), S (scarce), R (rare), VR (very rare); Habitat preference: C (climax), SN (seminatural), D (disturbed), A (artificial); Conservation status: CR (critically endangered), EN (endangered), VU (vulnerable).*

Family	Species	Occurence level	Habitat preference	Conservation value
Pholcidae	*Pholcus opilionoides* (Schrank, 1781)	VA	C, SN, A	
Segestridae	*Segestria senoculata* (Linné, 1758)	VA	C, SN	
Dysderidae	*Dysdera moravica* (Řezáč *et al*., 2014)	R	C	VU
	Dysdera lantosquensis (Simon, 1882)	S	C, A	
	Harpactea lepida (C. L. Koch, 1838)	VA	C, SN	
	Harpactea rubicunda (C. L. Koch, 1838)	VA	C, SN, A	
Nestidicidae	*Nesticus cellulanus* (Clerck, 1757)	VA	C, SN, A	
Theridiidae	*Cryptachaea riparia* (Blackwall, 1834)	A	C, SN	
	Dipoena torva (Thorell, 1875)	R	SN	
	Enoplognatha ovata (Clerck, 1757)	S	SN, D	
	Enoplognatha thoracica (Hahn, 1833)	A	C, SN, D	
	Episinus angulatus (Blackwall, 1836)	A	C, SN	
	Neottiura bimaculata (Linné, 1767)	VA	C, SN, D	
	Phylloneta impressa (L. Koch, 1881)	VA	C, SN, D	
	Platnickina tincta (Walckenaer, 1802)	A	C, SN	
	Robertus arundineti (O. P.-Cambridge, 1871)	VA	C, SN	
	Robertus lividus (Blackwall, 1836)	VA	C, SN	
	Robertus neglectus (O.P.-Cambridge, 1871)	S	C, SN	
Linyphiidae	*Abacoproeces saltuum* (L. Koch, 1872)	S	C, SN	
	Agyneta saxatilis (Blackwall, 1844)	A	C, SN, D	
	Bathyphantes gracilis (Blackwall, 1841)	VA	C, SN, D	
	Bathyphantes parvulus (Westring, 1851)	VA	C, SN	
	Centromerus sylvaticus (Blackwall, 1841)	VA	C, SN, D	
	Ceratinella brevipes (Westring, 1851)	S	C, SN	
	Ceratinella scabrosa (O. P.-Cambridge, 1871)	S	C, SN	
	Diplocephalus latifrons (O. P.-Cambridge, 1863)	VA	C, SN	
	Diplocephalus picinus (Blackwall, 1841)	VA	C, SN	
	Diplostyla concolor (Wider, 1834)	VA	C, SN, D	
	Entelecara acuminata (Wider, 1834)	A	C, SN	
	Erigone atra Blackwall, 1833	VA	C, SN, D	
	Erigone dentipalpis (Wider, 1834)	VA	C, SN, D	
	Gonatium rubellum (Blackwall, 1841)	VA	C, SN	
	Helophora insignis (Blackwall, 1841)	A	C	
	Lepthyphantes minutus (Blackwall, 1833)	A	C, SN	
	Linyphia hortensis Sundevall, 1830	A	C, SN	
	Linyphia triangularis (Clerck, 1757)	VA	C, SN, D	
	Maso sundevalli (Westring, 1851)	VA	C, SN	
	Megalepthyphantes pseudocollinus Saaristo, 1997	VR	C	EN
	Micrargus subaequalis (Westring, 1851)	VA	C, SN	
	Microlinyphia pusilla (Sundevall, 1830)	VA	C, SN, D	
	Microneta viaria (Blackwall, 1841)	VA	C, SN	
	Neriene clathrata (Sundevall, 1830)	VA	C, SN	
	Nusoncus nasutus (Schenkel, 1925)	VR	C, SN	VU
	Oedothorax apicatus (Blackwall, 1850)	VA	C, SN, D	
	Panamomops mengei Simon, 1926	S	C, SN	
	Pelecopsis elongata (Wider, 1834)	S	C	

Family	Species	Occurence level	Habitat preference	Conservation value
	Pelecopsis radicicola (L. Koch, 1872)	A	C, SN	
	Saloca diceros (O.P.-Cambridge, 1871)	A	C	
	Stylotector stativus (Simon, 1881)	S	C, SN	
	Tapinocyba insecta (L. Koch, 1869)	A	C, SN	
	Tenuiphantes alacris (Blackwall, 1853)	A	C, SN	
	Tenuiphantes cristatus (Menge, 1866)	VA	C, SN	
	Tenuiphantes flavipes (Blackwall, 1854)	VA	C, SN	
	Tenuiphantes tenebricola (Wider, 1834)	VA	C, SN	
	Trematocephalus cristatus (Wider, 1834)	A	C, SN	
	Walckenaeria alticeps (Denis, 1952)	A	C	
	Walckenaeria atrotibialis (O. P.-Cambridge, 1878)	VA	C, SN	
	Walckenaeria dysderoides (Wider, 1834)	VA	C, SN	
	Walckenaeria furcillata (Menge, 1869)	VA	C, SN	
Tetragnathidae	*Meta menardi* (Latreille, 1804)	VA	C, SN, A	
	Metellina mengei (Blackwall, 1870)	VA	C, SN	
	Metellina segmentata (Clerck, 1757)	VA	C, SN, D	
	Tetragnatha montana Simon, 1874	A	C, SN	
	Tetragnatha pinicola L. Koch, 1870	VA	C, SN	
Araneidae	*Araneus alsine* (Walckenaer, 1802)	S	C, SN	
	Araneus angulatus Clerck, 1757	S	C, SN	
	Araneus quadratus Clerck, 1757	VA	C, SN	
	Araniella cucurbitina (Clerck, 1757)	VA	C, SN, D	
	Araniella opisthographa (Kulczynski, 1905)	S	C, SN	
	Cyclosa conica (Pallas, 1872)	VA	C, SN	
	Mangora acalypha (Walckenaer, 1802)	VA	C, SN, D	
	Nuctenea umbratica (Clerck, 1757)	A	C, SN, A	
Lycosidae	*Alopecosa cuneata* (Clerck, 1757)	VA	C, SN, D	
	Alopecosa pulverulenta (Clerck, 1757)	VA	C, SN, D	
	Alopecosa taeniata (C. L. Koch, 1835)	A	C, SN	
	Aulonia albimana (Walckenaer, 1805)	A	C, SN	
	Pardosa agrestis (Westring, 1861)	VA	SN, D	
	Pardosa alacris (C. L. Koch, 1833)	S	C, SN	
	Pardosa lugubris (Walckenaer, 1802)	VA	C, SN, D	
	Pardosa palustris (Linné, 1758)	VA	C, SN, D	
	Trochosa ruricola (De Geer, 1778)	VA	C, SN, D	
	Trochosa terricola Thorell, 1856	VA	C, SN, D	
	Xerolycosa nemoralis (Westring, 1861)	VA	C, SN	
Pisauridae	*Pisaura mirabilis* (Clerck, 1757)	VA	C, SN, D	
Miturgidae	*Zora nemoralis* (Blackwall, 1861)	A	C, SN	
	Zora silvestris Kulczyński, 1897	A	C, SN	
	Zora spinimana (Sundevall, 1833)	VA	C, SN, D	
Agelenidae	*Coelotes terrestris* (Wider, 1834)	VA	C, SN	
	Histopona torpida (C. L. Koch, 1834)	VA	C, SN	
	Inermocoelotes inermis (L. Koch, 1855)	VA	C, SN	
	Tegenaria campestris (C. L. Koch, 1834)	S	C, SN	
	Tegenaria ferruginea (Panzer, 1804)	VA	C, SN, A	
Cybaeidae	*Cybaeus angustiarum* L. Koch, 1868	A	C, SN	
Hahniidae	*Hahnia ononidum* Simon, 1875	S	C, SN	

Family	Species	Occurence level	Habitat preference	Conservation value
Dictynidae	*Cicurina cicur* (Fabricius, 1793)	VA	C, SN, D	
	Nigma flavescens (Walckenaer, 1830)	A	C, SN	
Amaurobiidae	*Amaurobius fenestralis* (Ström, 1768)	VA	C, SN	
	Amaurobius ferox (Walckenaer, 1830)	S	A	
	Amaurobius jugorum L. Koch, 1868	S	C	
	Callobius claustrarius (Hahn, 1833)	A	C, SN	
Titanoecidae	*Titanoeca quadriguttata* (Hahn, 1833)	A	C, SN	
Anyphaenidae	*Anyphaena accentuata* (Walckenaer, 1802)	S	C, SN	
Liocranidae	*Agroeca brunnea* (Blackwall, 1833)	VA	C, SN	
	Agroesa cuprea Menge, 1873	S	C	
Clubionidae	*Clubiona caerulescens* L. Koch, 1867	A	C, SN	
	Clubiona neglecta O. P.-Cambridge, 1862	VA	C, SN	
	Clubiona pallidula (Clerck, 1757)	A	C, SN	
	Clubiona terrestris Westring, 1851	VA	C, SN	
Phrurolithidae	*Phrurolithus festivus* (C. L. Koch, 1835)	VA	C, SN	
Zodariidae	*Zodarion germanicum* (C. L. Koch, 1837)	S	C, SN	
Gnaphosidae	*Drassodes pubescens* (Thorell, 1856)	VA	C, SN	
	Drassyllus praeficus (L. Koch, 1866)	A	C, SN	
	Drassyllus pumilus (C. L. Koch, 1839)	R	C	
	Drassyllus pusillus (C. L. Koch, 1833)	A	C, SN, D	
	Haplodrassus signifer (C. L. Koch, 1839)	VA	C, SN, D	
	Haplodrassus silvestris (Blackwall, 1833)	A	C, SN	
	Micaria pulicaria (Sundevall, 1831)	VA	C, SN	
	Trachyzelotes pedestris (C. L. Koch, 1837)	S	C, SN	
	Zelotes apricorum (L. Koch, 1876)	S	C, SN	
	Zelotes electus (C. L. Koch, 1839)	S	C, SN	
	Zelotes erebeus (Thorell, 1871)	S	T, M	
Sparassidae	*Micrommata virescens* (Clerck, 1757)	VA	C, SN	
Philodromidae	*Philodromus albidus* Kulczyński, 1911	A	C, SN, D	
	Philodromus aureolus (Clerck, 1757)	VA	C, SN, D	
	Philodromus cespitum (Walckenaer, 1802)	VA	C, SN, D	
	Philodromus collinus C. L. Koch, 1835	VA	C, SN	
	Philodromus dispar Walckenaer, 1826	S	C, SN	
Thomisidae	*Diaea dorsata* (Fabricius, 1777)	VA	C, SN	
	Ebrechtella tricuspidata (Fabricius, 1775)	S	C, SN	
	Misumena vatia (Clerck, 1757)	VA	C, SN	
	Ozyptila claveata (Walckenaer, 1837)	S	C	
	Ozyptila praticola (C. L. Koch, 1837)	S	C, SN	
	Ozyptila trux (Blackwall, 1846)	VA	C, SN, D	
	Pistius truncatus (Pallas, 1772)	R	C, SN	
	Synema globosum (Fabricius, 1775)	R	C, SN	
	Xysticus cristatus (Clerck, 1757)	VA	C, SN, D	
	Xysticus kochi Thorell, 1872	A	C, SN	
	Xysticus lanio C. L. Koch, 1835	S	C, SN	
	Xysticus luctuosus (Blackwall, 1836)	A	C, SN	
Salticidae	*Euophrys frontalis* (Walckenaer, 1802)	A	C, SN	
	Evarcha arcuata (Clerck, 1757)	VA	C, SN	
	Evarcha laetabunda (C. L. Koch, 1846)	S	C	

Family	Species	Occurence level	Habitat preference	Conservation value
	Heliophanus cupreus (Walckenaer, 1802)	A	C, SN	
	Heliophanus flavipes (Hahn, 1832)	A	C	
	Phlegra fasciata (Hahn, 1826)	A	C, SN	
	Salticus cingulatus (Panzer, 1797)	S	C, SN	

II: *The total numbers of specimens of spiders at individual collecting sites (in alphabetical order, for description of sites see Material and Methods)*

	Species	Sum	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
1.	*Abacoproeces saltuum*	2						1		1
2.	*Agroeca brunnea*	4		1		1				2
3.	*Agroeca cuprea*	2		2						
4.	*Agyneta saxatilis*	2			1			1		
5.	*Alopecosa cuneata*	9		3						6
6.	*Alopecosa pulverulenta*	10								10
7.	*Alopecosa taeniata*	3		1			1		1	
8.	*Amaurobius fenestralis*	6	2					3		1
9.	*Amaurobius ferox*	2				2				
10.	*Amaurobius jugorum*	1	1							
11.	*Anyphaena accentuata*	10	2	1	1	2	1	1	2	
12.	*Araneus alsine*	1				1				
13.	*Araneus angulatus*	1					1			
14.	*Araneus diadematus*	1		1						
15.	*Araniella cucurbitina*	12	3	2	3		2	1	1	
16.	*Araniella opisthographa*	1					1			
17.	*Aulonia albimana*	3		3						
18.	*Bathyphantes gracilis*	1					1			
19.	*Bathyphantes parvulus*	3			3					
20.	*Callobius claustrarius*	5	3			1			1	
21.	*Centromerus sylvaticus*	4	1	1			2			
22.	*Ceratinella brevipes*	1			1					
23.	*Ceratinella scabrosa*	2		2						
24.	*Cicurina cicur*	5			1		3	1		
25.	*Clubiona caerulescens*	1		1						
26.	*Clubiona neglecta*	2		1		1				
27.	*Clubiona pallidula*	1					1			
28.	*Clubiona terestris*	14		1	1	9	3			
29.	*Coelotes terrestris*	48	2	1		3	42			
30.	*Cryptachaea riparia*	3		1				1		1
21.	*Cybaeus angustiarum*	3							3	
32.	*Cyclosa conica*	4	2			2				
33.	*Diaea dorsata*	6		1	2		2			1
89.	*Diplocephalus latifrons*	1						1		
35.	*Diplocephalus picinus*	7		3		2	1	1		
36.	*Diplostyla concolor*	15		7	4	1	3			
37.	*Dipoena torva*	2		1		1				
38.	*Drassodes pubescens*	3		1						2
39.	*Drassyllus praeficus*	2		2						
40.	*Drassyllus pumilus*	1		1						

	Species	Sum	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
41.	*Drassyllus pusillus*	4		1			1	2		
42.	*Dysdera lantosquensis*	5	1	2		1	1			
43.	*Dysdera moravica*	2	1	1						
44.	*Ebrechtella tricuspidata*	2		1				1		
45.	*Enoplognatha ovata*	43	10	3	9	3	18			
46.	*Enoplognatha thoracica*	1	1							
47.	*Entelecara acuminata*	1		1						
48.	*Episinus angulatus*	6	1		2	2	1			
49.	*Erigone atra*	1		1						
50.	*Erigone dentipalpis*	3		2			1			
51.	*Euophrys frontalis*	1				1				
52.	*Evarcha arcuata*	4		1						3
53.	*Evarcha laetabunda*	1					1			
54.	*Gonatium rubellum*	3				3				
55.	*Hahnia ononidum*	1			1					
56.	*Haplodrassus signifer*	3								3
57.	*Haplodrassus silvestris*	12		7	4		1			
58.	*Harpactea lepida*	20	2		3	4	11			
59.	*Harpactea rubicunda*	11	1	1	1	1	5	1	1	
60.	*Heliophanus cupreus*	10	4	6						
61.	*Heliophanus flavipes*	3		3						
62.	*Helophora insignitis*	2					2			
63.	*Histopona torpida*	37	7	3	4	4	16	2	1	
64.	*Inermcoelotes inermis*	29	2	1	2	3	15	3	1	2
65.	*Lepthyphantes minusus*	1	1							
66.	*Linyphia hortensis*	20	4	2	6	6	2			
67.	*Linyphia triangluaris*	25	3	5		6	11			
68.	*Mangora acalypha*	7	3	1		3				
69.	*Maso sundevalli*	1		1						
70.	*Megalepthyphantes pseudocollinus*	1			1					
71.	*Meta menardi*	2	1						1	
72.	*Metellina mengei*	7	3		2	2				
73.	*Metellina segmentata*	15	1	12		2				
74.	*Micaria pulicaria*	2		1						1
75.	*Micrargus subaequalis*	2					1	1		
76.	*Microlinyphia pusilla*	5			1	1		1		2
77.	*Micromatta virescens*	2		1						1
78.	*Microneta viaria*	4	2	1	1					
79.	*Misumena vatia*	4	2			2				
80.	*Neon reticulatus*	2	1				1			
81.	*Neottiura bimaculata*	6		2	1	2	1			
82.	*Neriene clathrata*	1					1			
83.	*Nesticus cellulanus*	7	7							
84.	*Nigma flavescens*	2	1	1						
85.	*Nuctenea umbratica*	2		1						1
86.	*Nusoncus nasutus*	1					1			
87.	*Oedothorax apicatus*	2		1	1					
88.	*Ozyptila claveata*	3	2							1
89.	*Ozyptila praticola*	7		2		2	3			

	Species	Sum	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
90.	*Ozyptila trux*	1				1				
91.	*Panamomops mengei*	1			1					
92.	*Pardosa agrestis*	5								5
93.	*Pardosa alacris*	44		40			4			
94.	*Pardosa lugubris*	189		130	6	12	35	2	2	2
95.	*Pardosa palustris*	3								3
96.	*Pelecopsis elongata*	1			1					
97.	*Pelecopsis radicicola*	4				4				
98.	*Philodromus albidus*	13	4	6			1	2		
99.	*Philodromus aureolus*	6		2	2	1		1		
100.	*Philodromus cespitum*	1				1				
101.	*Philodromus collinus*	6		2			4			
102.	*Philodromus dispar*	13	4	4	1	2	2			
103.	*Phlegra fasciata*	1		1						
104.	*Pholcus opilionoides*	1		1						
105.	*Phrurolithus festivus*	4	1			1	1			1
106.	*Phylloneta impressa*	4				2			1	1
107.	*Pistius truncatus*	1		1						
108.	*Platnickina tincta*	6			1	3	1		1	
109.	*Robertus arundineti*	5	3					1		1
110.	*Robertus lividus*	5			3	1	1			
111.	*Robertus neglectus*	1	1							
112.	*Saloca diceros*	1							1	
113.	*Salticus cingulatus*	1		1						
114.	*Segestria senoculata*	5	1			2	1			1
115.	*Stylotector stativus*	1					1			
116.	*Synema globosum*	5		2	1					2
117.	*Tapinocyba insecta*	1					1			
118.	*Tegenaria campestris*	2		2						
119.	*Tegenaria ferruginea*	2	2							
120.	*Tenuiphantes alacris*	1				1				
121.	*Tenuiphantes cristatus*	1					1			
122.	*Tenuiphantes flavipes*	14	1	3	4	2		1	2	1
123.	*Tenuiphantes tenebricola*	2					1			1
124.	*Tetragnatha montana*	2	1					1		
125.	*Tetragnatha pinicola*	2		2						
126.	*Titanoeca quadriguttata*	4		4						
127.	*Trachyzelotes pedestris*	7		1			2	1		3
128.	*Trematocephalus cristatus*	2						1		1
129.	*Trochosa ruricola*	4							1	3
130.	*Trochosa terricola*	35	2	9	7	7	6	1	1	2
131.	*Walckenaeria alticeps*	2					2			
132.	*Walckenaeria atrotibialis*	2			1		1			
133.	*Walckenaeria dysderoides*	3		1	1		1			
134.	*Walckenaeria furcillata*	2			1		1			
135.	*Xerolycosa nemoralis*	15		15						
136.	*Xysticus cristatus*	4		1		1	1			1
137.	*Xysticus kochi*	2		1						1
138.	*Xysticus lanio*	1			1					

	Species	Sum	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8
139.	*Xysticus luctuosus*	1		1						
140.	*Zelotes apricorum*	7		6		1				
141.	*Zelotes electus*	1		1						
142.	*Zelotes erebeus*	1					1			
143.	*Zodarion germanicum*	3		2					1	
144.	*Zora nemoralis*	3		3						
145.	*Zora silvestris*	6	1		2			2		1
146.	*Zora spinimana*	9		3		5		1		

III: *Family count with recorded species*

	Family	Species number
1.	**Pholcidae**	1
2.	**Segestridae**	1
3.	**Dysderidae**	4
4.	**Nestidicidae**	1
5.	**Theridiidae**	11
6.	**Linyphiidae**	41
7.	**Tetragnathidae**	5
8.	**Araneidae**	8
9.	**Lycosidae**	11
10.	**Pisauridae**	1
11.	**Miturgidae**	3
12.	**Agelenidae**	5
13.	**Cybaeidae**	1
14.	**Hahniidae**	1
15.	**Dictynidae**	2
16.	**Amaurobiidae**	4
17.	**Titanoecidae**	1
18.	**Anyphaenidae**	1
19.	**Liocranidae**	2
20.	**Clubionidae**	4
21.	**Phrurolithidae**	1
22.	**Zodariidae**	1
23.	**Gnaphosidae**	11
24.	**Sparassidae**	1
25.	**Philodromidae**	5
26.	**Thomisidae**	12
27.	**Salticidae**	7
	SUM	**146**

In terms of number of species, the Linyphiidae was clearly dominant with 41 species (Tab. III). However, most of these species were found only sporadically with a few specimens at those sites where presence was recorded. The exceptions were only two abundant linyphiid species – *Linyphia hortensis* Sundevall, 1830 and *Linyphia triangularis* (Clerck, 1757). Other eudominant families were the Lycosidae and Gnaphosidae (Tab. III) including typically epigeic species.

In particular, the Lycosidae were significantly the most abundant (322 specimens, 32% of all specimens). However, it is important to note that this high abundance was caused by the dominant species *Pardosa lugubris* (Walckenaer, 1802), which is a very common species in deciduous forests, and by the relative species *Pardosa alacris* (C. L. Koch, 1833), which is typical for forest stands with sparse canopies. Among the other abundant species (Tab. II), *Coelotes terrestris* (Wider, 1834) and *Histopona torpida* (C. L. Koch, 1837) were the common forest ground-dwelling species as well as *Enoplognatha ovata* (Clerck, 1757), which occurs dominantly in herb vegetation.

Assemblages of spiders include mainly species typical for deciduous forest habitats (shaded, partly shaded), represented in this collection by species of natural (C), semi-natural (SN), disturbed (D), and artificial (A) habitats (Buchar & Růžička, 2002; Řezáč, 2009), see Tab. I. Numerous species inhabiting open dry forest-steppe habitats (C and SN habitats) were also discovered. These species occurred mainly in protected territory's south-western section in sparse oak forest near the former limestone quarry. Such species included mainly rare and threatened spiders typical for forest-steppe and steppe habitats categorized as very rare to scarce in the Czech Republic (Buchar & Růžička, 2002), namely *Dipoena torva* (R), *Drassyllus pumilus* (R), *Dysdera moravica* (R), *Megalepthyphantes pseudocollinus* (VR), *Pistius truncatus* (R), *Salticus cingulatus* (S), *Synema globosum* (R), *Xysticus lanio* (S), and *Zelotes electus* (S). For some of these species, the studied location represents the northernmost territory of their distribution in the whole Czech Republic or at least Moravia. The findings of *Megalepthyphantes pseudocollinus* and *Dysdera moravica* represent the northernmost occurrence of these rare species in the Czech Republic. The findings of *Dipoena torva* and *Drassyllus pumilus* represent the northernmost occurrence of these rare species in the Moravia region. Most of these thermophilous species are strictly dependent on xeric and semi-xeric habitats (C and SN) with low vegetation structures, open canopies, and presence of barren surfaces (Bryja *et al.*, 2005; Košulič & Hula, 2013; Košulič *et al.*, 2014). These species are among the major bioindicators of xeric and semi-xeric habitats in native forest-steppe and steppe locations (Buchar, 1983; Buchar

& Růžička, 2002; Růžička & Buchar, 2008). Unfortunately, such habitats are diminishing in the constantly intensifying landscape of southern Moravia due to overgrowth of such suitable places as well as intensified agriculture and forestry (Čížek *et al*., 2013; Spitzer *et al*., 2008).

The finding of *Nusoncus nasutus* was among the very interesting discoveries. This species is known only from coniferous forests at higher elevations in the Šumava PLA, Krušné Mountains (Buchar & Růžička, 2002), Krkonoše Mountains (Kůrka & Vaněk, 2013) and from xeric locations in Oblík (Kůrka & Dolejš, 2010) and forest habitats around Kolín (Kůrka, 2012). The finding of this psychrophilous species of spider is among the first indications in the Moravia region. This species is also categorized as vulnerable (VU) according to the Red List of Threatened Species in the Czech Republic (Růžička, 2005). *Megalepthyphantes pseudocollinus* and *Dysdera moravica* are also on the Red List (Růžička, 2005) as EN (endangered) and VU (vulnerable), respectively.

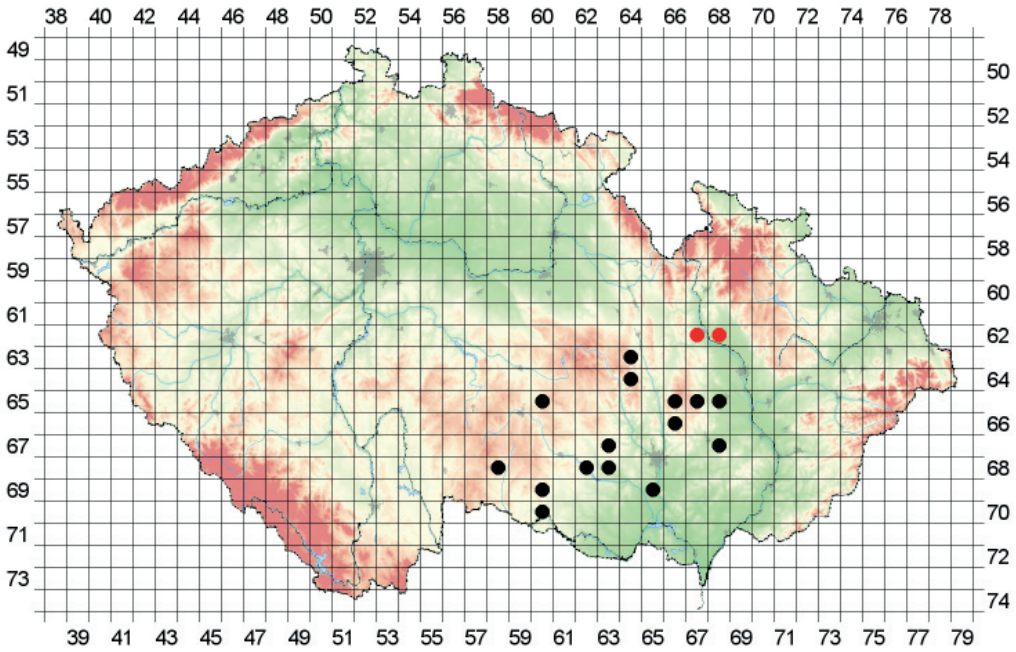
Total spider diversity (146 species – approximately 16% of araneofauna in the Czech Republic) was very high and significantly enriches the surveyed area with new faunistic findings. The rich occurrence of a wide spectrum of species also confirms the importance of different forest ecosystems within the Třesín NNM as refuges for forest and forest-steppe communities of spiders in the intensified agriculture landscape of central Moravia. The locality also creates an important refuge for thermophilic spiders in the colder region on the border between the thermophytic and mesophytic areas. The findings of several psychrophilous species of spiders typical for the mesophyticum and oreophyticum (e.g. *Hahnia ononidum, N. nasutus, Styloctetor stativus*) are also important. All significant species of spiders found in this study are described below.

Faunistically Remarkable Species

Dysderidae

Dysdera moravica Řezáč, Gasparo, Král & Heneberg, 2014 C, R, VU

This spider belongs to *Dysdera ninni* complex since it was described as a new species native to the Pannonian province (Řezáč *et al*., 2014). It is a thermophilous species of spider and the distribution the in Czech Republic represent the northernmost border of the distribution area. *Dysdera moravica* was found in the warmest regions in the Czech Republic (21 localities, 15 faunistic squares) where it occurs in xeric habitats such as south exposed slopes of thermophilous oak forest, vineyards terraces, rocky steppe etc. (Řezáč, 2012). Only one finding becomes from the Bohemia region. Here, the species was found in Dubová stráň NM near Dačice (Křivan & Jelínek, 2008). In the explored locality, the species was found in beech and oak forest in two separated sites (western and eastern part of locality). *Dysdera moravica* is one of the threatened spider species in the Czech Republic (VU). The species is endangered by overgrowing of forest-steppe and steppe habitats due to absence of traditional management (coppice, mowing, pasture etc.). Finding in Třesín NNM is among the northernmost occurrence in the Czech



2: *Distribution of Dysdera moravica (Řezáč, Gasparo, Král and Heneberg, 2014) in the Czech Republic (red dots – studied locality Třesín)*
(orig. www.biolib.cz)

Republic, even in the whole distribution area of this Pannonian spider species (Fig. 2).

Data: Site 1, 25. 9.–25. 10. 2013, pt, 1♀, det. OK; Site 2, 7. 6.–5. 7. 2013, pt, 1♀, det. OK.

Theridiidae

Dipoena torva (Thorell, 1875) SN, R

A rare species of spider known only from three localities in Bohemia (Miller, 1967; Kůrka, 1999) and two locations in Moravia (Kůrka, 2003; Bryja *et al.*, 2005). Almost all findings were made on tree trunks, canopies, branches and occasionally on fallen dead trees. Otto & Floren (2007) and Stańska *et al.* (2010) mentioned that this type of microhabitat (tree trunks of old trees with cracks and holes, tree canopies) is preferred by this species and the species is thus not as rare as it was assumed. Two specimens in two types of forest habitat were found in the surveyed locality – an adult female in a spruce monoculture (presence of fallen dead trees for harvesting) and an adult male in oak forest with sparse canopy. Finding in the Třesín is among the northernmost occurrence of this spider in the region of Moravia (Fig. 3). This spider is supposed to specialize on ants as a prey, mainly *Formica* spp. which are very abundant in forest ecosystems (Simon, 1997).

Data: Site 4, 7. 6.–5. 7. 2013, pt, 1♂, det. OK; Site 2, 25. 9. 2013, ic, 1♀, det. OK.

Linyphiidae

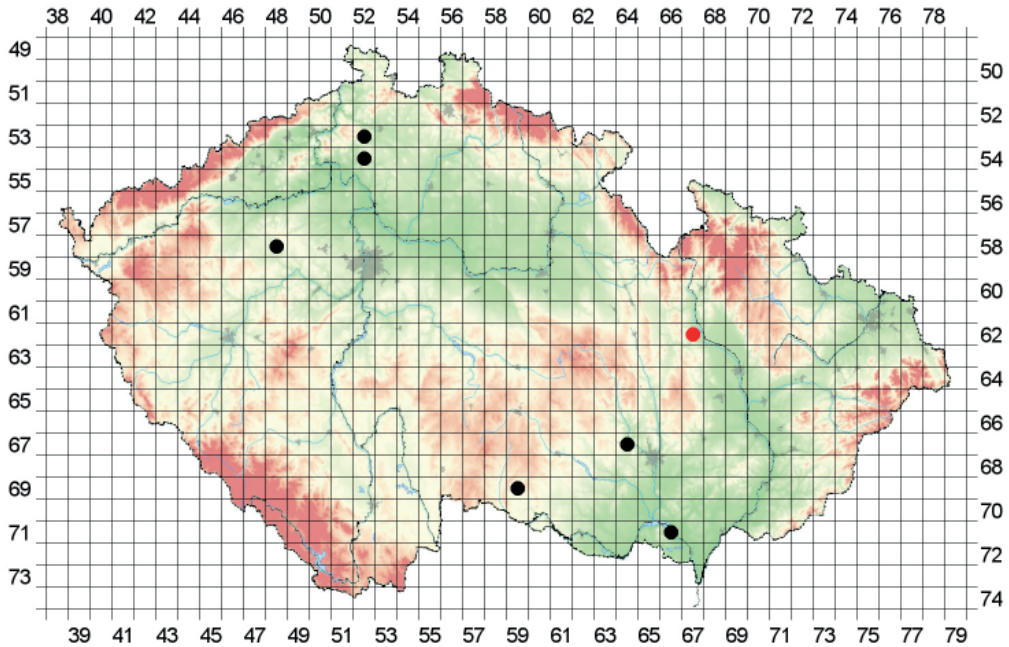
Megalepthyphantes pseudocollinus Saaristo, 1997 C, VR, EN

A very rare species occurring at ground level in xerothermic habitats. This species is mapped only from a several locations of Pannonian region of south Moravia (Buchar & Růžička, 2002; Dolejš & Kůrka, 2013). Bryja *et al.* (2005) reported findings in Pálava PLA (forest steppe around Milovice and Klentnice). Svatoň & Jelínek (1998) found this species in semixeric habitats in Brtnice-Střížov (the most western location). In the surveyed locality it was recorded in oak-hornbeam forest which followed sparse oak forest stands from the southern part of locality (plant communities of *Carpinion* and *Quercion pubescenti-petraeae*). The discovery of this species in the Třesín area is among the northernmost finding of this spider in the Czech Republic (Fig. 4). *Megalepthyphantes pseudocollinus* is one of the threatened spider species in the Czech Republic (EN).

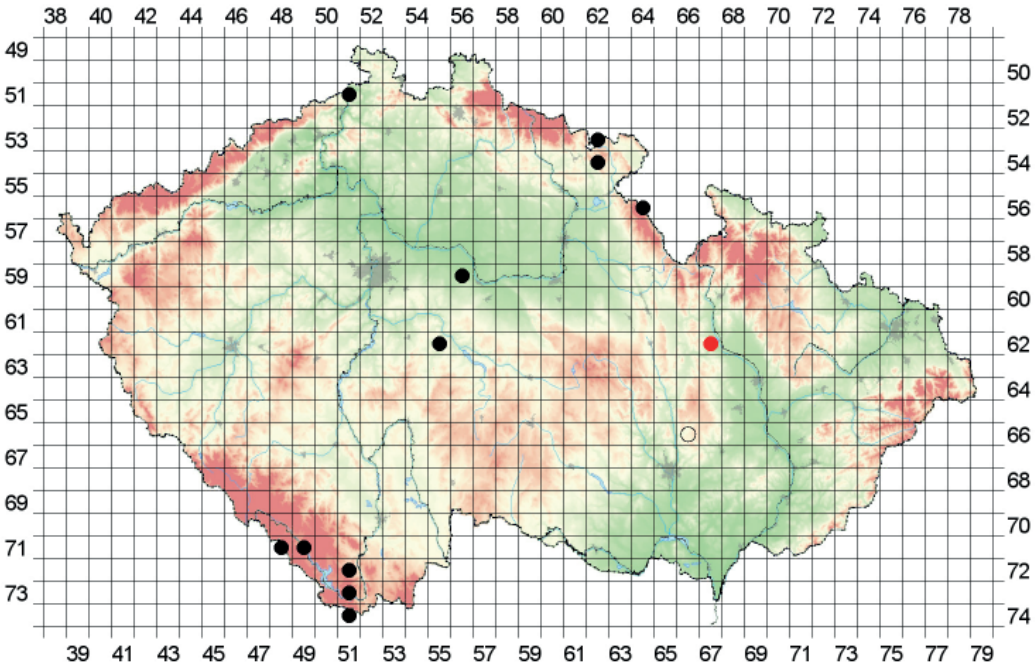
Data: Site 3, 25. 10. 2013, sw, 1♂, det. VR.

Nusoncus nasutus (Schenkel, 1925) C, SN, VR, VU

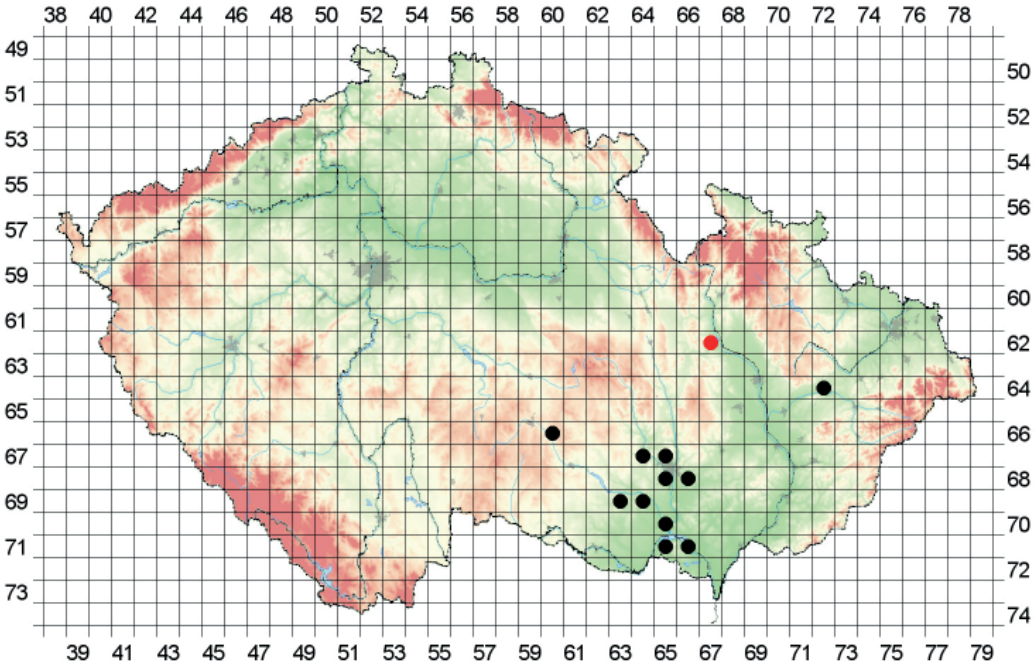
A very rare species of spider occurring mainly in mountain areas of Bohemian oreophyticum. Buchar & Růžička (2002) reported findings from beech and coniferous forests in the Šumava Mts., Krušné hory Mts. and Orlické hory Mts. (altogether 7 faunistic squares). Concerning recent findings, this species is known from coniferous forest in Krkonoše PLA (Kůrka & Vaněk, 2013) and also from xeric steppe habitats in Oblík NNR located in České středohoří PLA (Kůrka & Buchar, 2010) and from forest habitats around Kolín (Kůrka, 2012). During this study, one adult specimen was found in beech forest with sinkholes and limestone blocks in the western part of locality. This finding is among the first report of this very rare and vulnerable (VU) species from the Moravia region (Fig. 5). In general, *Nusoncus nasutus* is poorly known species without any precise information about its biology and with



3: *Distribution of Dipoena torva (Thorell, 1875) in the Czech Republic (red dot – studied locality Třesín)* (orig. www.biolib.cz)



4: *Distribution of Nusoncus nasutus (Schenkel, 1925) in the Czech Republic (empty dot – unpublished finding, red dot – studied locality Třesín)*
(orig. www.biolib.cz)



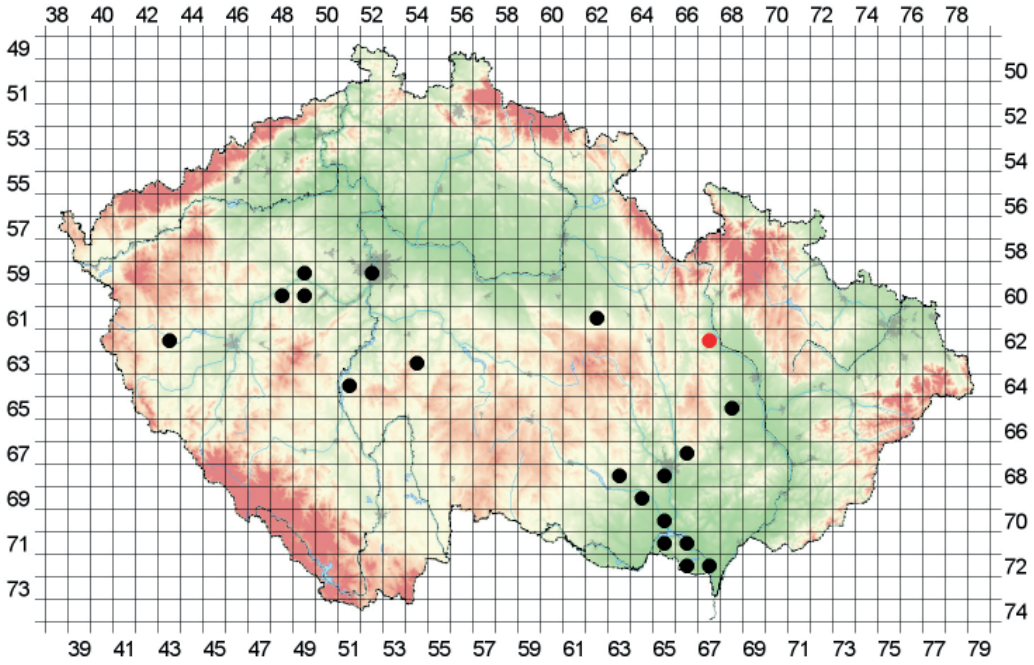
5: *Distribution of Megalepthyphantes pseudocollinus Saaristo, 1997 in the Czech Republic (red dot – studied locality Třesín*
(orig. www.biolib.cz)

faunistical reports from very different kinds of habitats (mountain coniferous forest, steppe xeric habitats, beech forest etc.).

Data: Site 5, 25. 10. 2013, sw, 1♂, det. VH.

Styloctetor stativus Simon, 1881 C, SN, S

A scarce species of spiders occuring among moss and grass in waterlogged meadows, and is mapped only at a several locations in Moravia and Bohemia (Buchar & Růžička, 2002). In our material, an adult male was captured in a pitfall trap in beech forest



6: *Distribution of Drassyllus pumilus (C. L. Koch, 1839) in the Czech Republic (red dot – studied locality Třesín)* (orig. www.biolib.cz)

in the western part of locality. The discovery of this species in the Třesín area is among the important recent findings in Moravia region.

Data: Site 5, 25. 9. 2013, pt, 1♂, det. VH.

Gnaphosidae

Drassyllus pumilus (C. L. Koch, 1839) C, T, R

A xerothermophilous spider species typical for rocky steppe habitats, forest-steppes, very abundant on the slope of vineyard terraces (Košulič & Hula, 2013). Bryja *et al.* (2005) mentioned relatively rich occurrence in south Moravia, however, only from habitats on calcareous and limestone soil. The species is threatened by overgrowing of forest-steppe and steppe habitats due to absence of appropriate management. This finding represents one of the northernmost occurrences of this rare species of spider from the Moravia region (Fig. 6).

Data: Site 2, 25. 9.–25. 10. 2013, pt, 1♀, det. OK.

Zelotes electus (C. L. Koch, 1839) C, SN, S

A rare epigeic species living under stones on rocky steppes and forest-steppes habitats such as thermophilous oak forest stands (Buchar & Růžička, 2002). The presence of sufficient number of stones which are used by these spiders as their shelter is an important factor. According to Bryja *et al.* (2005), quite common in the south Moravia region, on dry and sunny stands where it prefers localities on sandy or loess soils.

Both of the gnaphosid spiders (*D. pumilus* and *Z. electus*) were found in sunny and dry habitats of sparse oak forest in the southwestern part of locality.

Data: Site 2, 29. 4.–7. 6. 2013, pt, 1♂, det. OK.

Salticidae

Salticus cingulatus (Panzer, 1797) C, SN, S

A scarce species of jumping spider occurring on the trunk of solitary trees in forest edges, clearings and forest-steppe habitats across thermo to oreophyticum (Buchar & Růžička, 2002; Bryja *et al.*, 2005). It is likely that this species occurs mainly in oak forest stands along the edge of the former mining limestone quarry. Here, an adult male was found by beating lower branches.

Data: Site 2, 7. 6. 2013, bst, 1♂, det. OK.

Suggestions on Conservation Management of the Studied Location

An arachnological survey of the Třesín NNM revealed rich species diversity, which can be characterized as a spider community of common forest species with the presence of several regionally significant species characteristic of natural and undisturbed forest ecosystems (*D. torva*, *N. nasutus*, *S. stativus*, *X. lanio*). An important element is the presence of several steppe and forest-steppe thermophilous species typical of the xeric habitats of southern Moravia including the Pannonian area (*D. moravica*, *M. pseudocollinus*, *D. pumilus*, *Z. electus*). For some of these species, the Třesín NNM represents their northernmost occurrence in Moravia, and even the Czech Republic (cf. Bryja *et al.*, 2005; Buchar & Růžička, 2002).

In accordance with the obtained results, the most valuable parts of the Třesín NNM include the oak and hornbeam forest stands (*Quercion pubescenti-petraeae* plant communities with *Carpinus* spp.) characterized by sparse canopies and high

volumes of light conditions. These sites contained the most endangered species which require specific microhabitat conditions formed by disturbed grass turf and non-continuous vegetation structure with exposed soil. I conclude that specific management interventions should be introduced in such locations to enhance the density and distribution of the microhabitat-scale sites. These important conditions, crucial for a wide spectrum of rare spiders, can be promoted through coppice management, which positively influences the diversity, abundance, and presence of important bioindicator species of invertebrates (Beneš *et al*., 2006; Spitzer *et al*., 2008). It is also necessary to keep old, dead, and fallen trees as important shelters for these Invertebrates, e.g. cerambycid beetles (Vodka *et al*., 2009), or rare spiders as *Dipoena torva* (Stańska *et al*., 2010). Similar interventions would support species diversity and microhabitat conditions, especially for thermophilous xeric spiders and other Invertebrates.

The coniferous (mixture of spruce and larch) non-native monoculture forest habitats which are present mainly in the south-western section of the area contained very low spider diversity. This community of spiders mainly contains euryvalent species without any specific requirements as is typical for monoculture spruce and larch stands (Purchart *et al*., 2013). As a part of the proposed management, it would be useful to propose the gradual replacement of spruce stands by deciduous forest stands (*Quercus* spp., *Carpinus* spp., *Ulmus* spp.), thereby supporting the natural species composition of trees (*Quercion pubescenti-petraeae* plant communities) in the southern part of the protected area.

CONCLUSION

Spiders from forest ecosystems in the Třesín NNM were investigated during the year 2013. Pitfall traps were placed on 29 April 2013 and emptied on 7 June 2013, 5 July 2013, 22 August 2013, 25 September 2013, and 25 October 2013. Beside the traps, additional collection methods were used (sweeping vegetation, individual collection, beating branches and shrubs). Altogether, 1012 specimens belonging to 146 species from 27 families were recorded. Species diversity within the Třesín NNM is rather high, with representatives of approximately 16% of araneofauna in the Czech Republic. Several remarkable spider species typical for xeric and semi-xeric habitats in the Pannonian area were found. Three species are listed in the Red List of Threatened Species in the Czech Republic (*M. pseudocollinus* – EN, *D. moravica* – VU, *N. nasutus* – VU). The interesting finding of psychrophilous *N. nasutus* is among the first records of this spider in the Moravia region. The great richness of araneofauna and the occurrence of rare and thermophilous species of spiders confirm the high biotic value of the Třesín NNM in the agriculturally intensified landscape of Moravia. Moreover, the Třesín NNM acts as a crucial point for thermophilic species in a transition zone between the thermophyticum and mesophyticum.

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