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A FAUNISTIC STUDY ON SPIDERS (ARANEAE) FROM VINEYARD TERRACES IN THE MUNICIPALITIES OF MORKŮVKY AND MUTĚNICE (SOUTH MORAVIA, CZECH REPUBLIC)

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Abstract

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Records of spiders of the vineyard terraces from the vicinity of the villages Morkůvky and Mutěnice Jesličky (South Moravia, Czech Republic) are published in the presented work. Spiders were collected by pitfall traping during 30 April – 28 October 2011 and by day and night sweeping of herb vegetation in different dates of 2011. In total 2719 individuals were collected, and identified as 139 species of 23 families. Eighteen species listed in the Red List of threatened species in the Czech Republic were recorded. In vineyard terraces in the vicinity of Morkůvky, 12 threatened species (CR – 2 species, EN – 3 species, VU – 7 species) were found altogether. In the vineyard terraces at Mutěnice, we found 13 threatened spider species (CR – 2 species, EN – 6 species, VU – 5 species). The most significant findings are *Alopecosa solitaria* (Herman, 1879), *Cheiracanthium pennyi* O.P.-Cambridge, 1873; *Dipoena coracina* (C. L. Koch, 1837)*; Dysdera hungarica* Kulczyński, 1897*; Eresus kollari* Rossi, 1846; *Euryopis quinqueguttata* Thorell, 1875; *Sibianor tantulus* (Simon, 1868) and *Haplodrassus minor* (O.P.-Cambridge, 1879). Besides of these threatened species, we discovered rich spectra of rare spiders related to the well preserved xeric grasslands. Our faunistic results indicate that artificial habitats, such as vineyard terraces, are important refuges for wide spectra of xerothermophilous spiders.

Keywords: spiders, faunistics, artificial habitats, agriculture, vineyard terraces, South Moravia, Czech Republic

INTRODUCTION

Vineyard terraces were formed in a period of so called agricultural intensification (from 1950s to 1980s), when the xeric slopes and grasslands were transformed for the production of grapes and fruits. Their steepness, thermal potential and basic loessial substrate resulted in initiation of the succession on the terraces and creating microclimatic conditions suitable for rare steppe species. Nowadays, the important question is whether artificial man-made habitats – like studied terraces – may partially act as the refuges and/or substitute habitats for rare species of disappearing seminatural and natural locations (Beneš *et al*., 2003; Tropek *et al*., 2010). Although araneofauna in the Czech Republic is well explored (Buchar & Růžička, 2002; Růžička & Buchar, 2008), vineyard habitats and adjacent terraces were generally rather neglected by arachnologists. Despite the fact that agriculture habitats have been studied in several researches

very well (Miller, 1974; Pekár *et al*., 1997; Pekár & Kocourek, 2004; Horáková, 2005; Pekár, 2005; Hula *et al*., 2012), vineyard terraces were not studied or faunistic data were never published. The situation becomes favourable since beginning of the 21st century. Bryja *et al*. (2005) published faunistic data from vineyards and adjacent slopes from Pálava region and mentioned presence of several rare species of spiders related to xerothermic slopes of vineyard terraces. From Slovakia, arachnofauna research from the vineyards located in the vicinity of Svätý Jur near Bratislava was performed (Gajdoš & Dankaninová, 2010). Nowadays, there are rising up some researches which mention presence and ecological characteristics of rare and endangered spider species from vineyard terraces in Southern Moravia (Hula *et al*., 2009; Košulič *et al*., 2011; Košulič & Hula, 2013).

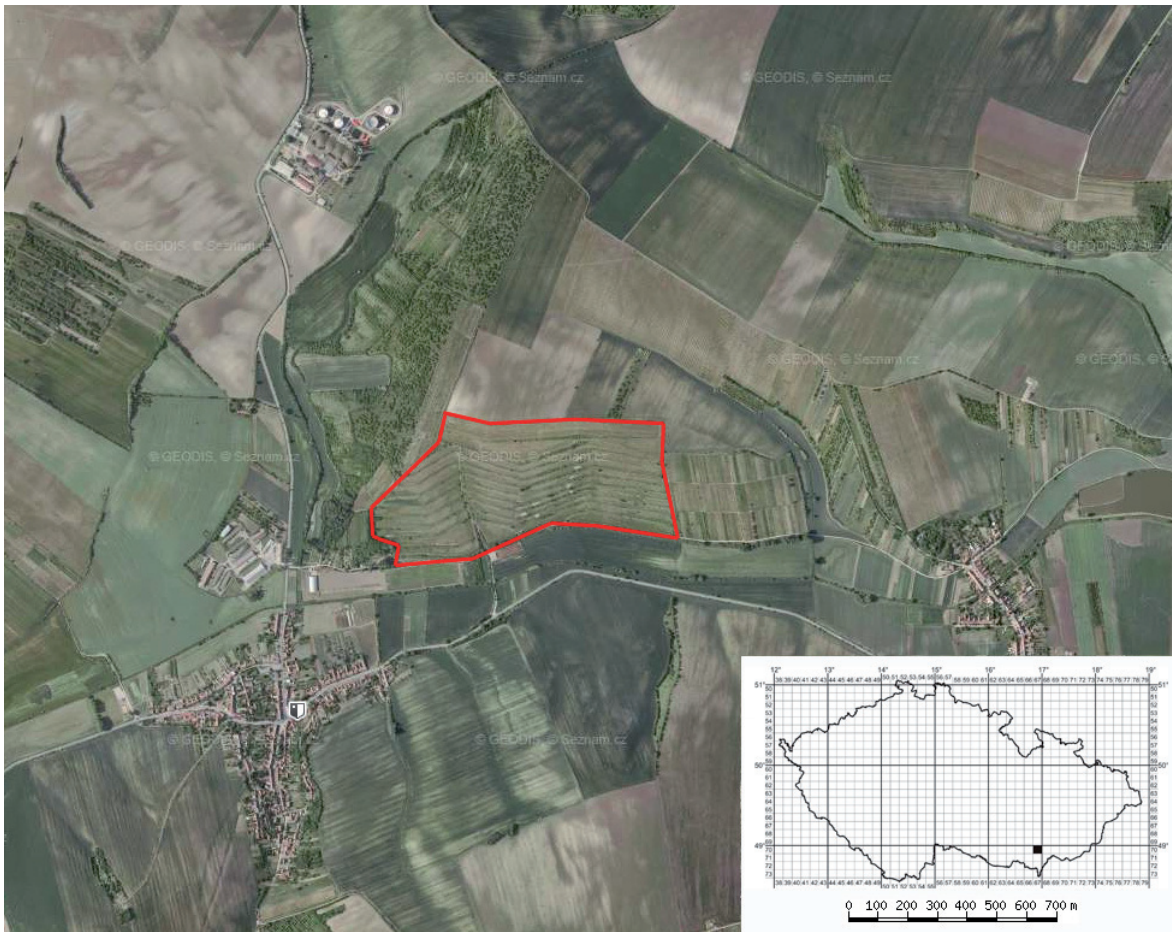
In this contribution, continuing to the work of Košulič & Hula (2013), we present the first records of spiders from the vineyard terraces in the municipalities of the villages of Morkůvky and Mutěnice. Among them, we mention and discuss rare and remarkable spider species found in the explored area.

MATERIAL AND METHODS

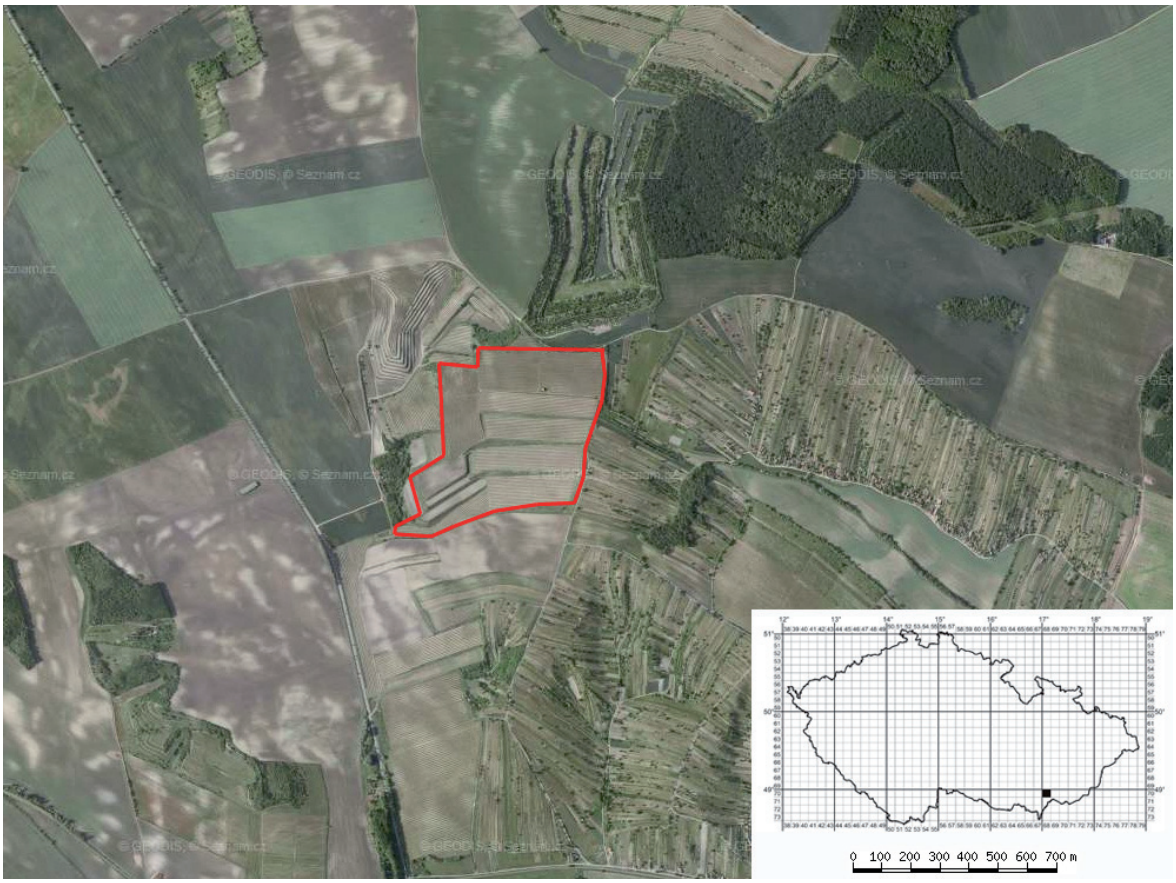
Description of study area and sites

The study area falls within the South Moravian Region: Districts of Břeclav and Hodonín which occupy the southernmost part of Moravia. This area belongs to the Pannonian biogeographical province which hosts the best examples of thermophilous fauna and flora of the Czech Republic (Mackovčin *et al*., 2007).

The study sites of vineyard terraces are located in the vicinity of the villages of Morkůvky and Mutěnice. Terraces in Morkůvky (Fig. 1) are situated 1000 m to the northeast from the village (GPS 48°58'17"N, 16°52'15"E, faunistic square 7067, Pruner & Míka, 1996). The vineyard is under integrated way of the pest management and its total area is 24,31 ha. Vineyard terraces in Mutěnice (Fig. 2) are situated 2000 m to the northwest from the village (GPS 48°55'40"N, 17°0'42"E, faunistic square 7068, Pruner & Míka, 1996). As well as in Morkůvky, the vineyard is under integrated way of the pest management and its total area is 17,94 ha. All sites are faced to the south-southeast, south, or south-southwest and have similar wide of slopes with different age of the origin.



1: *Marked border of the vineyard terraces in Morkůvky with a location on the grid map of the Czech Republic (www.mapy.cz)*



2: *Marked border of the vineyard terraces in Mutěnice with a location on the grid map of the Czech Republic (www.mapy.cz)*

3: *Locality Morkůvky. Position of collecting transects (white line – transect of three pitfall traps, red dashed line – area used for sweeping method). (www.mapy.cz)*

4: *Locality Mutěnice. Position of collecting transects (white line – transect of three pitfall traps, red dashed line – area used for sweeping method). (www.mapy.cz)*

Collecting of material

Pitfall traps were used as a primary collecting method supplemented by day and night sweeping of herb vegetation. Traps were filled with 4% formaldehyde solution as a killing and preserving agent. We have chosen four lines of three pitfall traps in each of the examined localities. Two lines were placed on the slopes with a disturbed grass turf and sparse vegetation (Plot 1 and Plot 3). Other two lines were placed on the relatively overgrown slopes with continuous vegetation cover (dense grass turf) (Plot 2 and Plot 4). Pitfall traps were situated on each plot in the centre of the slope and in the lower and upper bottom of it (Figs. 3–4). The traps were installed on 30 April 2011 and emptied at regular monthly intervals from May to October 2011 (29 May, 30 June, 29 July, 26 August, 25 September and 25 October). Sweeping of herb vegetation took place alongside of the each of the plots (100 sweeps in every plot) in distance of maximally 3 m from the line of pitfall traps. We used this method in 2011 in the following dates: day sweeping – 30 April, 24 May, 1 July, 30 July, 26 August, 25 September, 28 October; night sweeping – 22 May, 5 July, 7 July and 23 August. After collection, the obtained material was preserved in 70% ethanol.

Species classification

All spider material was determined to species level by means of Miller (1971), Heimer & Nentwig (1991), Roberts (1995), Nentwig *et al.* (2013).

Nomenclature and arrangement of families, genera and species follow the most recent version of the World Spider Catalog 14.0 (Platnick, 2013) except of the family Agelenidae where we follow the work of Bolzern *et al.* (2013). Most of the species were determined by the first author. Morphologically complicated taxa were revised and determined by the second author. Specimens of family Miturgidae, Dysderidae and Eresidae were revised and determined by Jan Dolanský (JD) and Milan Řezáč (MŘ). Specimens of *Zelotes gracilis* were revised and determination confirmed by Vítězslav Bryja (VB).

All of the examined material is deposited in the collection of Ondřej Košulič. For each of the recorded species the following characteristics (according to Buchar & Růžička, 2002; Růžička & Buchar, 2008; Růžička, 2005) are mentioned:

Originality of habitat: C (climax preferences), SN (seminatural habitats), D (disturbed), A (artificial); Thermopreference: T (thermophilous), M (mesophilous), O (oreophilous); Occurrence level: VA (very abundant), A (abundant), S (scarce), R (rare), VR (very rare); Conservation status: CR (critically endangered), EN (endangered), VU (vulnerable), LR (lower risk).

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 trapping), ds (day sweeping), ns (night sweeping).

RESULTS AND DISCUSSION

A total of 2719 specimens of spiders were collected, representing 139 species from 79 genera and 23 families (Tab. I). Most species with a total number of 1982 specimens (73%) were found using the

I: *Summary of species recorded. Explanations: Habitat preference: C (climax), SN (seminatural), D (disturbed), A (artificial); Thermopreferences: T (thermophilous), M (mesophilous), O (oreophilous); Occurrence level: VA (very abundant), A (abundant), S (scarce), R (rare), VR (very rare); Conservation status: CR (critically endangered), EN (endangered), VU (vulnerable). Bold means main preference, bracket means minority preference.*

Species	Terraces		Ecological indicators			
	Morkůvky	Mutěnice	Rareness status	Habitat preferences	Thermo-preferences	Conservation status
Dysderidae						
Dysdera hungarica Kulczyński, 1897	2	2	VR	C	T	CR
Mimetidae						
Ero aphana (Walckenaer, 1802)		2	R	**C**	**T**	
Ero furcata (Villers, 1789)		7	VA	C, SN	T, **M**	
Eresidae						
Eresus kollari Rossi, 1846		3	R	**C**	**T**	
Theridiidae						
Asagena phalerata (Panzer, 1801	23	3	A	C, SN	T, M, O	
Dipoena coracina (C. L. Koch, 1837)		1	R	**C**	**T**	EN
Enoplognatha ovata (Clerck, 1757)	14	6	A	C, **SN**, D	T, M	
Enoplognatha latimana Hippa & Oksala, 1982	41	8	S	SN, **D**	T, M	
Enoplognatha thoracica (Hahn, 1833)	10	12	A	C, SN, D	T, **M**	
Episinus truncatus Latreille, 1809	9		S	**C**, SN	**T**	
Euryopis quinqueguttata Thorell, 1875	3	38	R	**C**	**T**	EN
Neottiura bimaculata (Linné, 1767)	3	7	VA	C, SN, D	T, M	
Phylloneta impressa (L. Koch, 1881)	24	29	VA	C, SN, D	T, M, O	
Robertus arundineti (O. P.-Cambridge, 1871)	6	8	A	C, SN, D	(T), **M**	
Robertus lividus (Blackwall, 1836)	6	1	VA	C, SN, D	T, M, O	
Steatoda albomaculata (De Geer, 1778)	23	1	R	**C**	M	
Linyphiidae						
Centromerus sylvaticus (Blackwall, 1841)		1	VA	C, SN, D	T, M, O	
Diplostyla concolor (Wider, 1834)	20	84	VA	C, SN	T, M, O	
Erigone atra Blackwall, 1833	2	15	VA	C, SN, D	T, M, O	
Erigone dentipalpis (Wider, 1834)	3	7	VA	C, SN, D	T, M, O	
Ipa keyserlingi (Ausserer, 1867)	13	13	R	**C**	T, (M)	
Lepthyphantes leprosus (Ohlert, 1865)		1	VA	C, SN, D	(T), **M**	
Linyphia triangularis (Clerck, 1757)	1		VA	C, SN, D	T, **M**	
Meioneta rurestris (C. L. Koch, 1836)	6	11	VA	C, SN, D	T, M, O	
Mermessus trilobatus (Emerton, 1882)	3		-	-	-	
Micrargus herbigradus (Blackwall, 1854)		9	VA	C, SN	(T), **M**, O	
Micrargus subaequalis (Westring, 1851)	2		A	C, SN, D	T, M	
Oedothorax apicatus (Blackwall, 1850)		2	VA	C, SN, D	T, M	
Palliduphantes insignis (O. P.-Cambridge, 1913)	3	7	R	**C**, SN	T	VU
Palliduphantes pallidus (O. P.-Cambridge, 1871)	2	8	VA	C, N	T, **M**	
Pelecopsis radicicola (L. Koch, 1872)		1	A	**C**, SN	**M**, (O)	
Silometopus elegans (O. P.-Cambridge, 1872)		1	S	**C**	**M**	
Stemonyphantes lineatus (Linné, 1758)	1		A	C, SN, D	(T), **M**	
Tenuiphantes alacris (Blackwall, 1853)	11		A	C, SN	M, **O**	
Tenuiphantes cristatus (Menge, 1866)		1	VA	C, SN	**M**, (O)	
Tenuiphantes flavipes (Blackwall, 1854)	4	5	VA	C, N	T, **M**	
Tiso vagans (Blackwall, 1834)		1	A	C, SN, (D)	**M**, (O)	

Species	Terraces		Ecological indicators			
	Morkůvky	Mutěnice	Rareness status	Habitat preferences	Thermo-preferences	Conservation status
Walckenaeria atrotibialis O. P.-Cambridge, 1878	1		VA	C, SN	T, M, O	
Walckenaeria capito (Westring, 1861)		2	S	**C**, SN	M	
Walckenaeria dysderoides (Wider, 1834)		1	VA	C, SN	(T), **M**	
Tetragnathidae						
Pachygnatha degeeri Sundevall, 1830		3	VA	C, SN, D	(T), **M**, O	
Tetragnatha pinicola L. Koch, 1870	2	3	VA	C, SN	T, M	
Araneidae						
Agalenatea redii (Scopoli, 1763)	3	2	S	**C**	**T**, M	
Araneus diadematus (Clerck, 1757)	1	1	VA	C, **SN**, D	T, M	
Araneus quadratus Clerck, 1757		2	VA	C, SN	(T), M	
Argiope bruennichi (Scopoli, 1772)	7	59	A	C, **SN**, D	T, M	
Hypsosinga albovittata (Westring, 1851)		2	S	**C**, SN	T, M	
Hypsosinga pygmaea (Sundevall, 1831)		2	S	**C**, SN	**M**	
Hypsosinga sanguinea (C. L. Koch, 1844)	2	3	A	C, SN	T, M	
Mangora acalypha (Walckenaer, 1802)	31	19	VA	C, SN, D	T, M	
Nuctenea umbratica (Clerck, 1757)	1		A	C, SN, A	(T), **M**	
Lycosidae						
Alopecosa accentuata (Latreille, 1817)	39	12	A	C, SN	T, M	
Alopecosa cuneata (Clerck, 1757)	2	4	VA	C, SN, D	T, M, O	
Alopecosa pulverulenta (Clerck, 1757)		15	VA	C, SN, D	T, M, O	
Alopecosa solitaria (Herman, 1879)	3	48	VR	**C**	**T**	EN
Aulonia albimana (Walckenaer, 1805)	20	29	A	C, SN	T, **M**	
Pardosa agrestis (Westring, 1861)	21	74	VA	SN, D	T, **M**	
Pardosa alacris (C. L. Koch, 1833)	3	1	S	C,SN	**T**, M	
Pardosa bifasciata (C. L. Koch, 1834)		1	S	C	**T**	
Pardosa hortensis (Thorell, 1872)	8	4	S	C, SN, D	T	
Pardosa lugubris (Walckenaer, 1802)		3	VA	C, SN, D	T, M, O	
Pardosa monticola (Clerck, 1757)	3	1	A	C, SN	(T), **M**	
Pardosa riparia (C. L. Koch, 1833)	3	3	A	C, SN	T, M, O	
Trochosa ruricola (De Geer, 1778)		20	VA	C, SN, D	T, M	
Trochosa terricola Thorell, 1856	90	114	VA	C, SN, D	T, M, (O)	
Xerolycosa miniata (C. L. Koch, 1834)	4	6	S	C, SN	**T**, M	
Xerolycosa nemoralis (Westring, 1861)	11	15	VA	C, SN	T, M, O	
Pisauridae						
Pisaura mirabilis (Clerck, 1757)	3	12	VA	C, SN, D	**M**, (O)	
Zoridae						
Zora nemoralis (Blackwall, 1861)		5	A	C, SN	(T), **M**	
Zora spinimana (Sundevall, 1833)	5	6	VA	C, SN, D	T, **M**, (O)	
Agelenidae						
Allagelena gracilens (C. L. Koch, 1841	4		A	C, SN, (A)	T, M	
Tegenaria campestris (C. L. Koch, 1834)	3	1	S	C, SN	T, M	
Eratigena agrestis (Walckenaer, 1802)	9	6	S	C, SN, D	**T**, M	
Eratigena atrica (C. L. Koch, 1843)	2	4	A	SN, **A**	-	

Species	Terraces		Ecological indicators			
	Morkůvky	Mutěnice	Rareness status	Habitat preferences	Thermo-preferences	Conservation status
Hahniidae						
Hahnia nava (Blackwall, 1841)	9	9	S	**C**, SN	T, M	
Dictynidae						
Dictyna arundinacea (Linné, 1758)	29	9	VA	C, SN, D	(T), **M**	
Titanoecidae						
Titanoeca schineri L. Koch, 1872	1		R	**C**	**T**	VU
Miturgidae						
Cheiracanthium campestre Lohmander, 1944	1	3	VR	SN	T	
Cheiracanthium pennyi O. P.-Cambridge, 1873	14	40	VR	**C**	**T**	CR
Cheiracanthium punctorium (Villers, 1789)		9	VR	**C**	T	EN
Liocranidae						
Agroeca cuprea Menge, 1873	8	7	S	**C**	**T**, M	
Agroeca lusatica (L. Koch, 1875)	2	4	R	**C**	T	VU
Scotina celans (Blackwall, 1841)	1		R	**C**	**T**	VU
Clubionidae						
Clubiona neglecta O. P.-Cambridge	4	1	VA	C, SN	(T), **M**	
Corinnidae						
Phrurolithus festivus (C. L. Koch, 1835)	3	13	VA	C, SN	T, **M**	
Phrurolithus pullatus Kulczyński, 1897	2	2	R	**C**	**T**	
Zodaridae						
Zodarion rubidum Simon, 1914	1	2				
Gnaphosidae						
Drassodes lapidosus (Walckenaer, 1802)	11	17	VA	C, SN	T, M	
Drassodes pubescens (Thorell, 1856)	10	2	VA	C, SN	T, M	
Drassyllus praeficus (L. Koch, 1866)	6	5	A	C, SN	T, **M**	
Drassylus pumilus (C. L. Koch, 1839)	5	8	R	C	**T**, M	
Drassylus pussilus (C. L. Koch, 1833)	11	16	A	C, SN, (D)	T, M	
Gnaphosa lucifuga (Walckenaer, 1802)	75	41	S	**C**	**T**	
Haplodrassus dalmatensis (L. Koch, 1866)	26	26	R	**C**	**T**	VU
Haplodrassus kulczynskii Lohmander, 1942	3		S	**C**	**T**	
Haplodrassus minor (O. P.-Cambridge, 1879)		13	VR	C, D	(T, M)	EN
Haplodrassus signifer (C. L. Koch, 1839)	64	83	VA	C, SN, D	T, M, O	
Micaria dives (Lucas, 1846)		2	VR	**C**	T, M	EN
Micaria formicaria (Sundevall, 1831)	11	7	R	C, SN	T, (M)	
Micaria fulgens (Walckenaer, 1802)	5	5	A	C, SN	T, M	
Micaria pulicaria (Sundevall, 1831)	6	5	VA	C, SN	T, M, O	
Trachyzelotes pedestris (C. L. Koch, 1837)	15	4	S	C, SN	**T**, (M)	
Zelotes electus (C. L. Koch, 1839)	2	6	S	**C**, SN	T, M	
Zelotes gracilis (Canestrini, 1868)		32	VR	C, SN	T	
Zelotes latreillei (Simon, 1878)	5	1	VA	C, SN, D	T, **M**	
Zelotes longipes (L. Koch, 1866)	190	18	R	**C**	T, (M)	
Zelotes pygmaeus Miller, 1943	48	27	R	**C**	**T**	
Philodromidae						
Philodromus aureolus (Clerck, 1757)		2	VA	C, SN, D	T, **M**	
Philodromus cespitum (Walckenaer, 1802)	2	5	VA	C, SN, D	T, **M**	

Species	Terraces		Ecological indicators			
	Morkůvky	Mutěnice	Rareness status	Habitat preferences	Thermo-preferences	Conservation status
Philodromus collinus C. L. Koch, 1835	2	3	VA	C, SN	T, **M**, O	
Thanatus arenarius Thorell, 1872		16	R	**C**	**T**	
Tibellus maritimus (Menge, 1875)	2		R	C, SN	M	
Tibellus oblongus (Walckenaer,1802)	17	142	S	C, SN	T, M	
Thomisidae						
Ebrechtella tricuspidata (Fabricius, 1775)		1	S	C, SN	**T**, (M)	
Misumena vatia (Clerck 1757)	4	5	VA	C, SN	T, M	
Ozyptila atomaria (Panzer, 1801)	1	1	S	C, SN	T, M	
Ozyptila pullata (Thorell, 1875)	19		R	**C**	**T**	VU
Ozyptila scabricula (Westring, 1851)	15	17	R	**C**	**T**, M	
Synema globosum (Fabricius, 1775)	4		R	C, SN	**T**, M	
Xysticus acerbus Thorell, 1872	2	1	R	**C**	**T**, M	
Xysticus audax (Schrank, 1803)		3	VA	C, SN	(T), M, (O)	
Xysticus cristatus (Clerck, 1757)	4	1	VA	C, SN, D	T, **M**, (O)	
Xysticus kochi Thorell, 1872	8	1	A	C, SN, (D)	T, M	
Xysticus striatipes L. Koch, 1870	24	8	R	**C**	T, M	
Salticidae						
Euophrys frontalis (Walckenaer, 1802)		1	A	C, SN	T, M	
Evarcha arcuata (Clerck, 1757)	6		VA	C, SN	T, M	
Evarcha laetabunda (C. L. Koch, 1846)		2	S	C	T, M	
Heliophanus auratus C. L. Koch, 1835	2	3	S	C, SN	T, M	
Heliophanus cupreus (Walckenaer, 1802)	9	10	A	C, SN	T, M	
Heliophanus flavipes (Hahn, 1832)	13	18	A	**C**	**T**, M	
Marpissa nivoyi (Lucas, 1846)		1	R	**C**	**T**	VU
Pellenes nigrociliatus (Simon, 1875)		1	R	**C**	**T**	VU
Phlegra fasciata (Hahn, 1826)	10	3	A	C, SN	T, M	
Salticus scenicus (Clerck, 1757)	2		VA	C, SN, A	T, M	
Sibianor tantulus (Simon, 1868)	1	1	-	-	-	
Sitticus penicillatus (Simon, 1875)	2		R	C, SN	**T**	VU
Synageles hilarulus (C. L. Koch, 1846)	1		R	**C**	**T**	EN
Synageles venator (Lucas, 1836)	1		A	C, SN, A	T, M	
Talavera aequipes (O. P.-Cambridge, 1871)	13	30	A	**C**, SN	T, M	

method of pitfall traps. Using the sweeping method, 737 adult specimens belonging to 50 species were collected. Out of these, however, 20 species were not recorded using the pitfall traps. Logically, they are especially web-building and arboreal spiders belonging to the families Araneidae, Philodromidae and Theridiidae. The overall composition of araneofauna was on both localities very similar and did not differ significantly. We recorded 108 species of spiders (1249 specimens) in the vineyard terraces around Morkůvky and 119 species of spiders (1470 specimens) from the terraces in Mutěnice. Six species group among the unique rare species found only in a separate location: *Zelotes gracilis* (Canestrini, 1868), *Eresus kollari* Rossi, 1846 and *Thanatus arenarius* Thorell, 1872 – terraces in Mutěnice; *Ozyptila pullata* (Thorell, 1875), *Mermessus trilobatus* (Emerton, 1882) and *Synageles hilarulus* (C. L. Koch, 1846) – terraces in Morkůvky. The highest number of species among families belonged to Linyphiidae (24 species), Gnaphosidae (20 species) and Lycosidae (16 species).

Three families were well-represented in terms of specimens: Gnaphosidae (811 specimens – 30%), Lycosidae (557 specimens – 20.5%), and Theridiidae (276 specimens – 10.2%). The most abundant species were *Zelotes longipes* (L. Koch, 1866), *Trochosa terricola* Thorell, 1856 and *Tibellus oblongus*

(Walckenaer, 1802). The first mentioned species was found very abundant only in Morkůvky with total number of 190 specimens. On the other hand, *Tibellus oblongus* was recorded in high abundances only in terraces in Mutěnice, which is possibly caused by an overgrown vegetation coverage creating suitable conditions for this herbal layer inhabitating species. The other most abundant species found in the surveyed locations are the ground dwelling spiders typical for xerothermal (natural as well as disturbed) open habitats – *Zelotes longipes* (L. Koch, 1866) and *Gnaphosa lucifuga* (Walckenaer, 1802). Further, we found rich composition of species adapted to the modern agriculture landscapes occurring in the various types of the disturbed agroecosystems where the agrotolerant assemblages of spiders are forming (Samu & Szinetár, 2002) – *Dictyna arundinacea* (Linné, 1758), *Pardosa agrestis* (Westring, 1861), *Phylloneta impressa* (L. Koch, 1881), and another species typical for disturbed and man-made habitats.

More than half of all species recorded are known to be xerothermophilous (75 species). In some cases, we noted very rare and rare species restricted to well preserve open xeric grasslands. These, especially epigeic, spiders prefer the initial stages of succession here represented by slopes of the terraces with sparse vegetation on barren surfaces and not continuous vegetation cover. These species were represented by *Alopecosa solitaria* (Herman, 1879) (terraces in Mutěnice), *Haplodrassus dalmatensis* (L.Koch, 1866) (scarce species at both localities), *Ozyptila pullata* (Thorell, 1875) (terraces in Morkůvky), *Thanatus arenarius* Thorell, 1872 (terraces in Mutěnice), *Zelotes pygmaeus* Miller, 1943 (abundant at both localities) and *Zelotes gracilis* (Canestrini, 1868) (terraces in Mutěnice). The last mentioned species, very rare *Zelotes gracilis,* was found in the highest abundances (32 specimens) in comparison with all findings from the Czech Republic (Růžička & Buchar, 2008). Besides these species restricted to sparse vegetation on barren surfaces, we found several regionally important rare species associated with the later succession stages represented by continuous vegetation cover with dense grass turfs and the presence of shrubs – *Agroeca lusatica* (L. Koch, 1875) (terraces at both localities), *Cheiracanthium pennyi* O.P.-Cambridge, 1873 (abundant occurrence at both localities), *Cheiracanthium punctorium* (Villers, 1789) (abundant in Mutěnice) and *Xysticus striatipes* L. Koch, 1870 (scarce occurrence at both locations).

The discovery of a bioindicative significant species *Eresus kollari* is a very interesting finding. We found three adult males in the sparse vegetation-slopes of the terraces in Mutěnice. This species is restricted to well preserve xeric grasslands and shrubs (Řezáč & Kubcová, 2002), thus our finding belongs to the first records of this species from an artificial habitat such as the vineyard terraces. At the same location, we discovered several specimens of a very rare endangered gnaphosid *Haplodrassus minor* (O.P.-Cambridge, 1879). This species is recorded from salt marshes (Miller & Buchar, 1977; Majkus & Svatoň, 1995) and limestone quarries in Bohemia (Kůrka, 1999; Kůrka *et al*., 2010) and Moravia (Hula & Šťastná, 2010). From these findings, it seems that *Haplodrassus minor* is preferring artificial habitats with occasional small scale disturbances (Kůrka, 2000; Tropek & Konvička, 2008).

The indication of an invasive species *Mermessus trilobatus* in the terraces near Morkůvky is another important contribution to faunistics. Within the Czech Republic, it was discovered for the first time in 2007 (Dolanský *et al*., 2009), and since then it has gradually spread and is found in new territories and locations within the whole Czech Republic (Hula, unpubl.; Řezníček, 2012). *Mermessus trilobatus* is able to successfully spread in the air (by the so called ballooning). It is able to colonize suitable sites throughout the territory of the Czech Republic soon (Dolanský *et al*., 2009) just like its related species from the same family, *Ostearius melanopygius* (O. P.-Cambridge, 1879) (Růžička, 1995).

Concerning the Red List of threatened species in the Czech Republic (Růžička, 2005), 18 species belonging to categories CR (critically endangered), EN (endangered) and VU (vulnerable) were found. These species include the following: CR – *Dysdera hungarica* Kulczyński, 1897 and *Cheiracanthium pennyi* O.P.-Cambridge, 1873; EN – *Alopecosa solitaria* (Herman, 1879), *Dipoena coracina* (C. L. Koch, 1837), *Euryopis quinqueguttata* Thorell, 1875, *Haplodrassus minor* (O.P.-Cambridge, 1879), *Cheiracanthium punctorium* (Villers, 1789), *Micaria dives* (Lucas, 1846) and *Synageles hilarulus* (C. L. Koch, 1846); VU – *Agroeca lusatica* (L. Koch, 1875), *Haplodrassus dalmatensis* (L. Koch, 1866), *Palliduphantes insignis* (O. P.-Cambridge, 1913), *Marpissa nivoyi* (Lucas, 1846), *Ozyptila pullata* (Thorell, 1875), *Pellenes nigrociliatus* (Simon, 1875), *Scotina celans* (Blackwall, 1841), *Sitticus penicillatus* (Simon, 1875) and *Titanoeca schineri* L. Koch, 1872.

The rich findings of regionally and faunistically significant species support the hypothesis that the studied vineyard terraces and their slopes can act as a refuge and a substitute habitat for steppe and forest steppe species, which almost disappeared from central Europe during the long-term agriculture intensification (Schuch *et al*., 2013). Suitable conditions of vineyard terraces (steep slopes with exposed substrate, low vegetation structure, sparse vegetation coverage) enable to occur many rare endangered species. In congruence with current knowledge, these species largely depend to the steppes formed on loessial soils only in Moravia (Buchar & Růžička, 2002; Růžička & Buchar, 2008; Bryja *et al*., 2005, Košulič & Hula, 2013). Comments and reported findings of the individual specimens of rare regionally important species are listed below in an annotated list.

Annotated list of significant species

Dysderidae

Dysdera hungarica Kulczyński, 1897

A very rare species distributed exclusively in the warmest parts of Southern Moravia (Řezáč & Bryja, 2002). Its findings are reported from warm habitats in rugged areas of Podyjí, Pálava, Pouzdřany Forest-Steppe, Dunajovice Hills and from around Brno (Obřanská stráň NM, Kavky NM) (Řezáč, 2011). From Bohemia, only one finding of an isolated population in extensive apple orchard at Prague-Ruzyně has been reported. The spider was probably brought here by a man (Řezáč, 2011). In the surveyed locations, it was recorded only in the slopes with sparse vegetation. Košulič & Hula (2013) confirmed this species in the vineyard terraces around Pálava region.

Data: Morkůvky, 30. 4.–29. 5. 2011: plot 3, pt, 1♀; det. MŘ; 29. 5.–30. 7. 2011: plot 1, pt, 1♀; det. MŘ; Mutěnice, 29. 5.–30. 6. 2011: plot 3, pt, 1♀, det. MŘ; 30. 6.–30. 7. 2011: plot 1, pt, 1♀, det. MŘ.

Eresidae

Eresus kollari Rossi, 1846

A rare species restricted to xeric grasslands. Due to its longevity and strict relation to xerothermal habitats, it is a significant species indicating a nature conservation value of the habitats. Findings have been recorded mainly in the Czech thermophyticum – Český kras PLA, České středohoří PLA, and in the vicinity of Prague (Růžička & Buchar, 2008). In Moravia, it is often found at xerothermal sites of Pálava PLA, Bzenec, Pouzdřany and Moravian Karst (Řezáč & Kubcová, 2002). The first record of this species from the artificial habitat such as vineyard terraces.

Data: Mutěnice, 30. 7.–26. 8. 2011: plot 1, pt, 1♂; det. MŘ; 26. 8. 2011–25. 9. 2011: plot 1, pt, 1♂; det. MŘ; 25. 9. 2011–28. 10. 2011: plot 1, pt, 1♂; det. MŘ.

Theridiidae

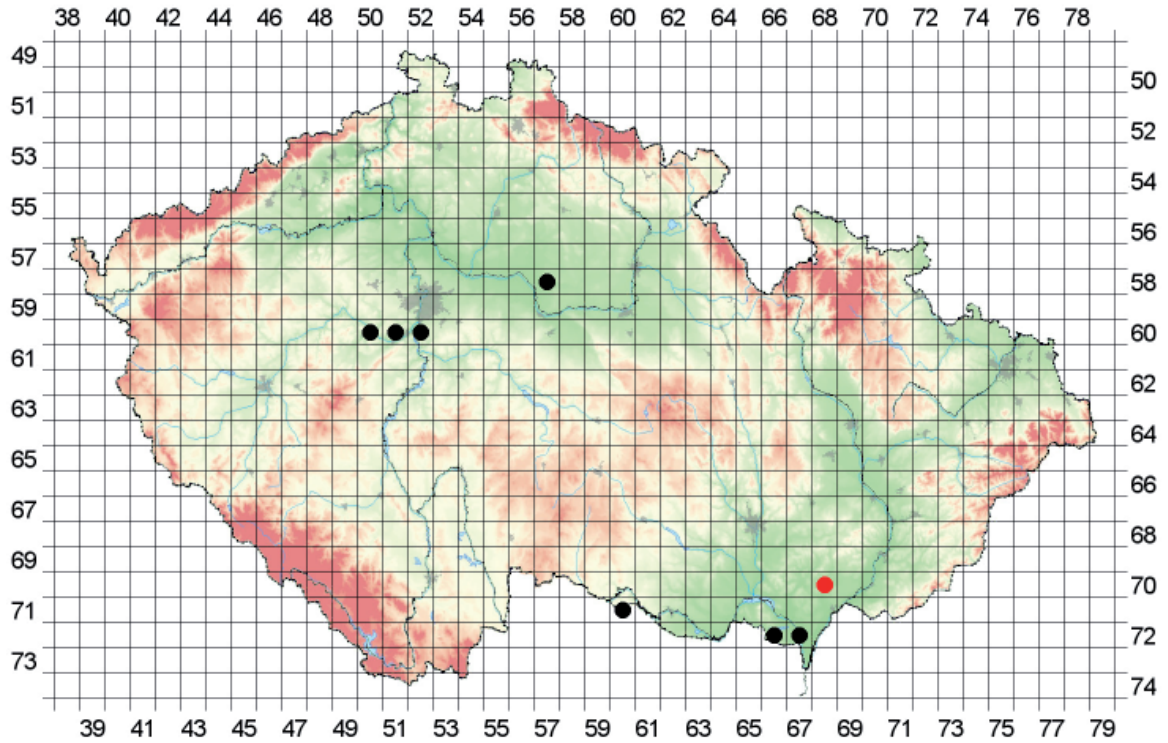
Dipoena coracina (C. L. Koch, 1837)

A rare species which occurs mainly in dry to very dry habitats, such as rocky steppes and various xerothermic grasslands. From a historical point of view, only a few records are known from the Mohelno Serpentine Steppe NNR and Říčky by Prof. Miller (Kůrka, 2003). Confirmed by Bryja *et al.* (2005) recently, who suggested an association of the species with habitats had arisen on sandy soil. Kůrka *et al.* (2010) report more findings from rock steppes in the Bohemian Karst Protected Landscape Area. We found one specimen in habitat with sparse vegetation at terraces near Mutěnice. The fourth record of this remarkable species in South Moravia (Fig. 5)

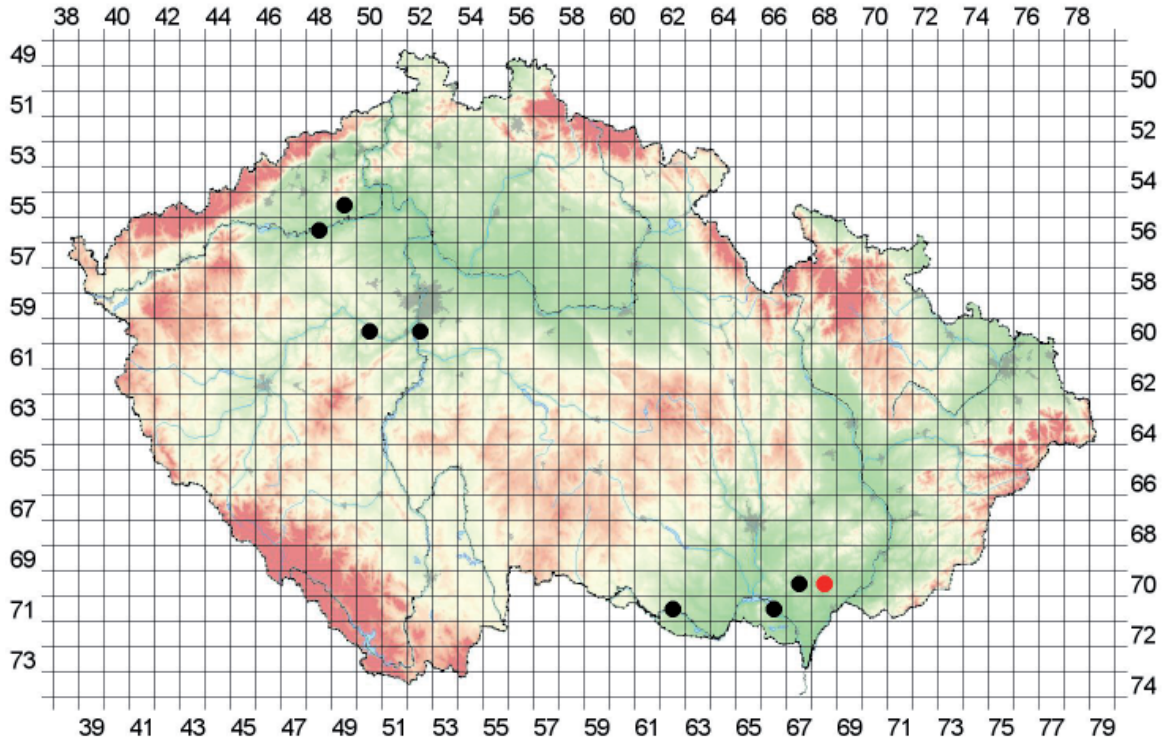
Data: Mutěnice, 25. 9.–30. 6. 2011: plot 1, pt, 1♂.

Euryopis quinqueguttata Thorell, 1875

A very rare species related to the well preserved xeric grasslands and rock steppes. Miller (1947) reported findings from the NNR Mohelno serpentine steppe, but the finding was not confirmed later by Buchar (1997), who conducted research



5: *Distribution of Dipoena coracina in the Czech Republic (red dot – locality Mutěnice)*



6: *Distribution of Euryopis quinqueguttata in the Czech Republic (red dot – location Mutěnice)*

here in 1993–1995. Bryja *el al.* (2005) report several findings in the Lower Morava Biosphere Reserve around Pálava region. Hula *et al.* (2009) and Košulič *et al.* (2011) point out the link to the empty shells of land snails of the genus *Xerolenta* used by specimens for hibernation during the winter months. This species was found as relatively abundant in terraces in Mutěnice in all study plots. The finding in the area of vineyard terraces in Mutěnice belongs among the first information for 7068 faunistic square (Fig. 6).

Data: Morkůvky, 30. 6.–30. 7. 2011: plot 2, pt, 1♂1♀; 30. 7.–26. 8. 2011: plot 2, pt, 1♀; Mutěnice, 30. 4.–29. 5. 2011: plot 2, pt, 3♂4♀; plot 3, pt, 3♂; plot 4, pt, 2♂1♀; 29. 5.–30. 6. 2011: plot 3, pt, 1♂3♀; plot 4, pt, 3♀; 30. 6.–30. 7. 2011: plot 1, pt, 3♂1♀; plot 2, pt, 2♂2♀; Mutěnice, 30. 7.–26. 8. 2011: plot 1, pt, 2♂; plot 2, pt, 5♂2♀; plot 3, pt, 1♂.

Lycosidae

Alopecosa solitaria (Herman, 1879)

A very rare relict species of xeric shrubs and grasslands. It prefers xerotherm habitats without trees and with sparse vegetation. Only few findings recorded (Bryja *et al.*, 2005), however, more abundant presence in suitable xeric habitats of South Moravia can be assumed. Individual findings are published from rather small Nature Reserves in the district of Břeclav (Košulič & Hula, 2011a, 2011b). Other localities of its occurrence include Krumlov-Rokytná Conglomerates (Bryja, 2002). *Alopecosa solitaria* formed a dominant component of local araneofauna on terraces near Mutěnice. The first record of this species for grid mapping square 7068 (Fig. 7).

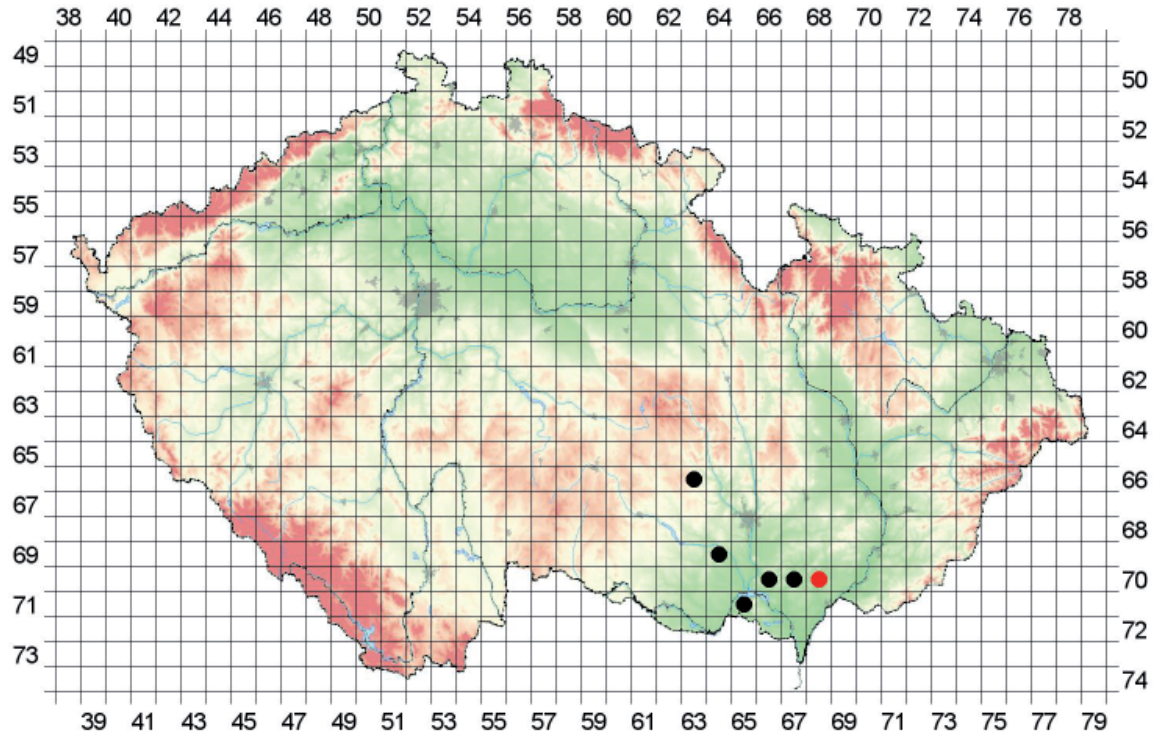
Data: Morkůvky, 26. 8.–25. 9. 2011: plot 3, pt, 1♂; 26. 8.–25. 9. 2011: plot 3, pt, 1♂; plot 4, pt, 1♂; Mutěnice, 30. 4.–29. 5. 2011: plot 3, pt, 3♀; 29. 5.–30. 6. 2011: plot 3, pt, 5♀; 26. 8.–25. 9. 2011: plot 1, pt, 4♂; plot 2, pt, 10♂; plot 3, pt, 6♂1♀; plot 4, pt, 5♂2♀; 25. 9.–28. 10. 2011: plot 1, pt, 5♂; plot 2, pt, 4♂1♀; plot 3, pt, 2♂.

Miturgidae

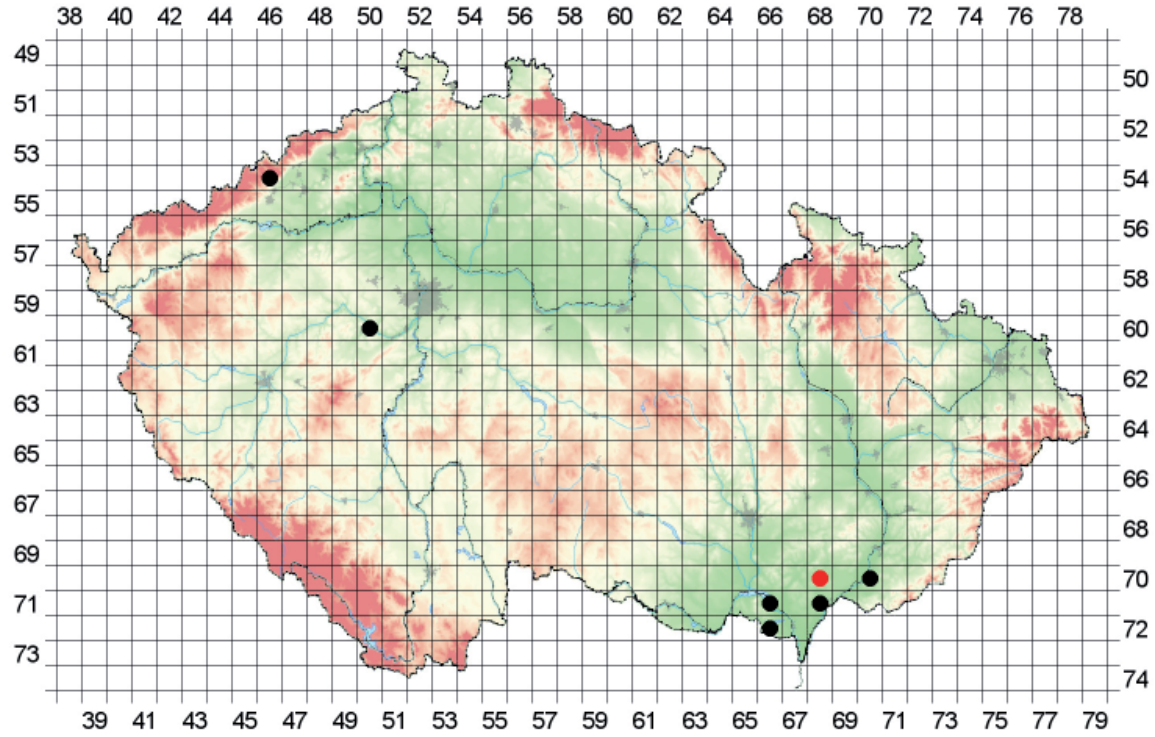
Cheiracanthium pennyi O. P.-Cambridge, 1873

A very rare thermophilic species. Within the Czech Republic, it is reported only from southern Moravia. Historically, two males are known from Pouzdřanská step-Kolby NNR in the 1960s by Prof. Miller (Kůrka, 1996). Dolanský (2011) reported several findings from different xeric grasslands in south Moravia. Hula *et al.* (2009) mentioned a link to the empty shells of land snails of the genus *Xerolenta* used by subadult specimens for hibernation during the winter months. We discovered this species as very abundant on terraces in Mutěnice. Several adult specimens were also found on terraces in Morkůvky. Košulič & Hula (2013) also found adult specimens in vineyard terraces around Pálava region. From our results, vineyard terraces seem to be a suitable habitat for this ecologically significant spider species.

Data: Morkůvky, 7. 5. 2011: plot 4, ds, 1♂, det. JD; 22. 5. 2011: plot 2, ns, 3♀, det. JD; plot 4, ns, 2♀, det. JD; 24. 5. 2011: plot 3, ds, 1♂1♀, det. JD; plot 4, ds, 1♂, det. JD; 5. 7. 2011: plot 1, ns, 1♀, det. JD; plot



7: *Distribution of Alopecosa solitaria in the Czech Republic (red dot – location Mutěnice)*



8: *Distribution of Haplodrassus minor in the Czech Republic (red dot – location Mutěnice)*

2, ns, 3♀, det. JD; plot 3, ns, 1♀, det. JD; Mutěnice, 22. 5. 2011: plot 1, ns, 1♂1♀, det. JD; plot 2, ns, 5♂3♀, det. JD; plot 3, ns, 7♂, det. JD; plot 4, ns, 2♂, det. JD; 24. 5. 2011: plot 2, ds, 2♂1♀, det. JD; 1. 7. 2011: plot 1, ds, 4♀, det. JD; plot 3, ds, 2♀, det. JD; 7. 7. 2011: plot 1, ns, 7♀, det. JD; plot 3, ns, 1♀, det. JD; plot 4, ns, 3♀, det. JD; 30. 6.–30. 7. 2011: plot 1, pt, 1♀, det. JD.

Cheiracanthium punctorium (Villers, 1789)

An expansive species occurring in xerotherm meadows as well as in wet habitats. According to

Buchar & Růžička (2002) and Bryja *et al.* (2005), a very rare species with only a few records from various xeric grasslands. In the area of the Czech Republic species has expanded since the beginning of the 20th century. It is moderately thermophilic, now known from southern Moravia, České středohoří Mts. and some parts of Polabí (Dolanský, 2011). It was found as an abundant species in terraces in Mutěnice where was detected especially in July to August by sweeping method. Due to the rapid expansive spreading and occuring in more disturbed habitats, we suggest reassessment of the conservation status of this species.

Data: Mutěnice, 30. 7. 2011: plot 1, ds, 1♀; 23. 8. 2011: plot 1, ns, 3♀; plot 2, ns, 2♀; plot 4, ns, 1♀; 25. 9. 2011: plot 1, ds, 2♀.

Gnaphosidae

Haplodrassus minor (O. P.-Cambridge, 1879)

A very rare species found on salt marshes (Majkus & Svatoň, 1995), in limestone quarries (Hula & Šťastná, 2010; Kůrka, 2000; Kůrka *et al.*, 2010), in field on sandy soil grassland (Hula, Niedobová & Šefrová, *in press*), in protected grassland (NM Terasy – Vinohradné near Prakšice, Majkus, 2005), in a field or in steppe protected area (Buchar & Růžička, 2002). An interesting record which confirmed affinity to the artificial-disturbed habitats. It is possible that this species needs special conditions (sparse vegetation, barren surfaces) maintained by small scaled disturbances in this kindof biotopes. The finding in the area of vineyard terraces in Mutěnice belongs to the first information for 7068 faunistic square (see Fig. 8).

Data: Mutěnice, 30. 4.–29. 5. 2011: plot 1, pt, 1♂1♀; plot 2, pt, 3♂1♀; plot 4, pt, 5♂; 29. 5.–30. 6. 2011: plot 4, pt, 2♀.

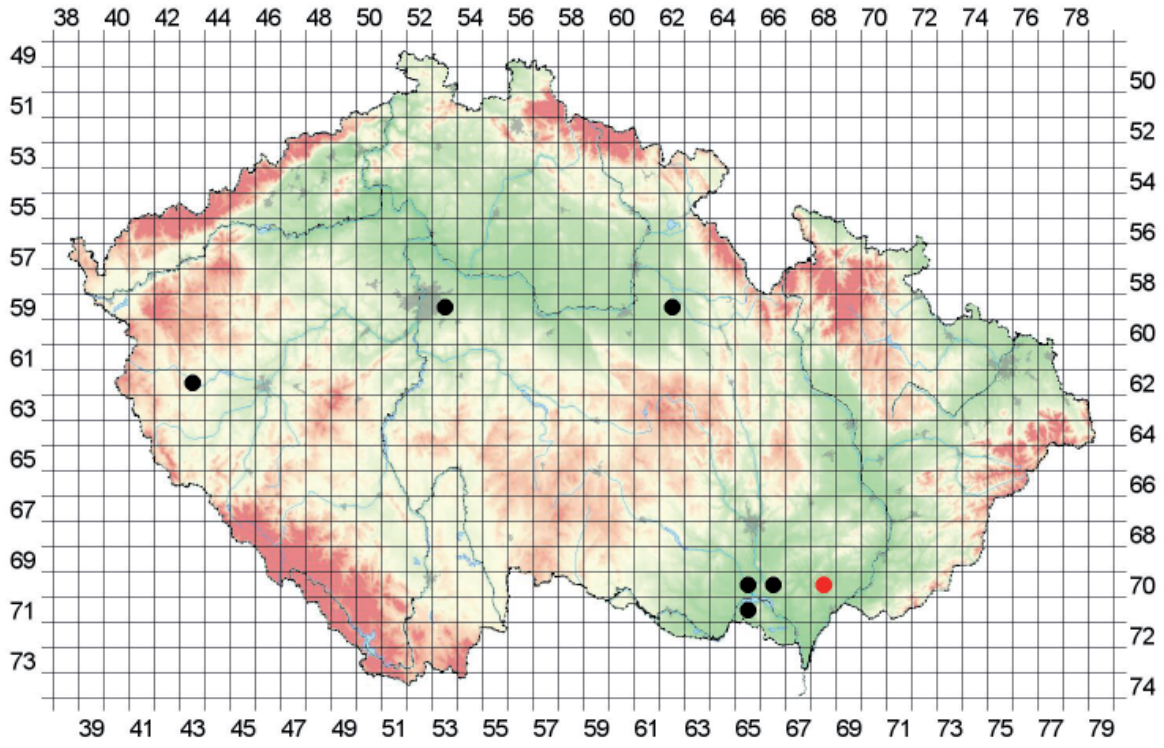
Micaria dives (Lucas, 1846)

A very rare species occurring among grass and stones on steppes and forest-steppes. From a historical point of view, only a few records from Southern Moravia are known from the Czech Republic (Miller, 1947; Kůrka, 1994; Buchar, 1997). Recently confirmed by Bryja *et al.* (2005) and Košulič & Hula (2013). We found two specimens by pitfall trapping in vineyard terraces in Mutěnice. The first record of this species for grid mapping square 7068 (Fig. 9).

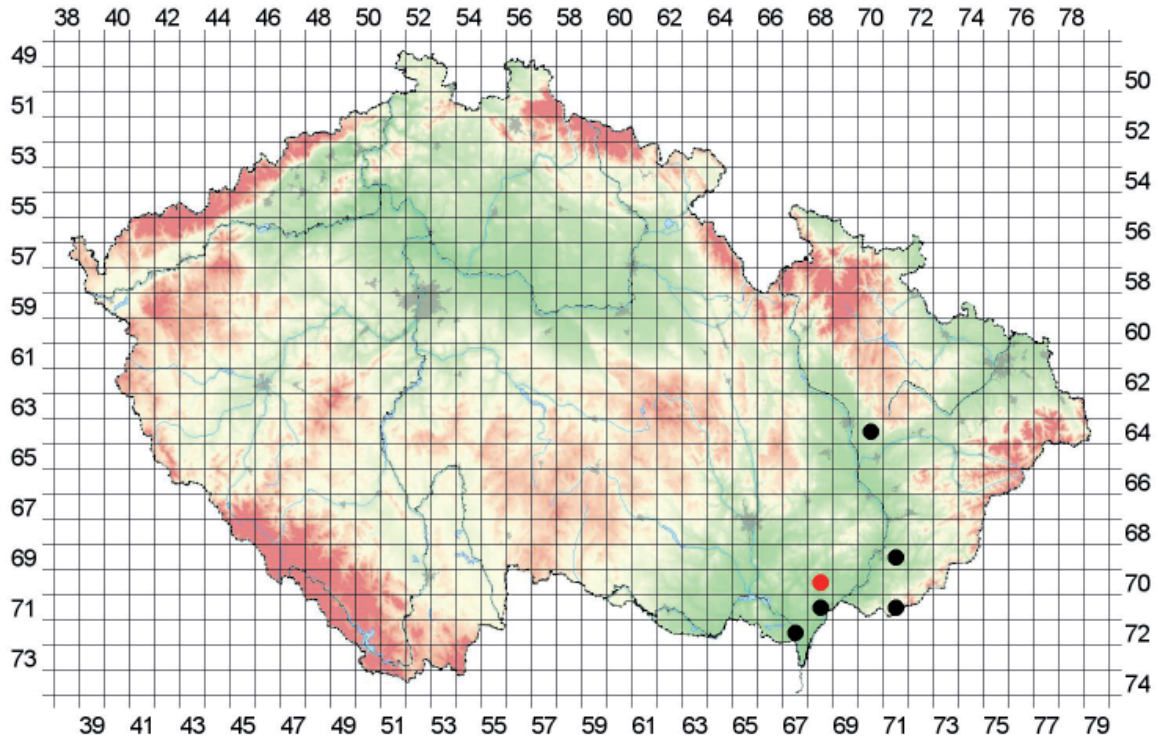
Data: Mutěnice, 30. 4.–29. 5. 2011: plot 3, pt, 1♂; 29. 5.–30. 6. 2011: plot 3, pt, 1♀.

Zelotes gracilis (Canestrini, 1868)

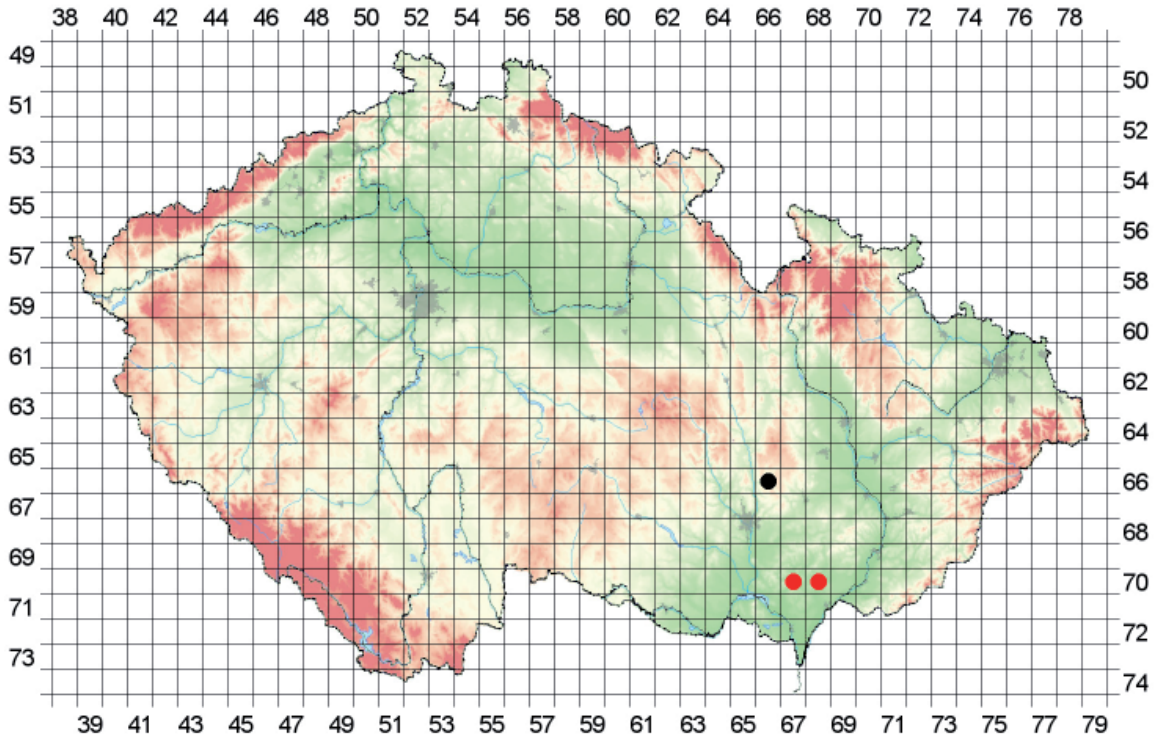
A very rare species recorded from the Czech Republic quite recently (Bryja *et al.*, 2005). According to Růžička & Buchar (2008), a species inhabiting south faced abandoned vineyards, rock steppes and open sands in pine forests mostly in Pálava region. However, it has not been detected in the area in Pálava by previous researches of vineyard terraces (Košulič & Hula, 2013). Also, one unpublished finding is known from Bílé Karpaty PLA (Hula, 2008). From neighbouring countries, this species is known only from Slovakia (Gajdoš *et al.*, 1999). A very small gnaphosid spider distinctive by morphological differences from related *Zelotes pygmaeus*. The finding of *Z. gracilis* on the vineyard terraces in Mutěnice is



9: *Distribution of Micaria dives in the Czech Republic (red dot – location Mutěnice)*



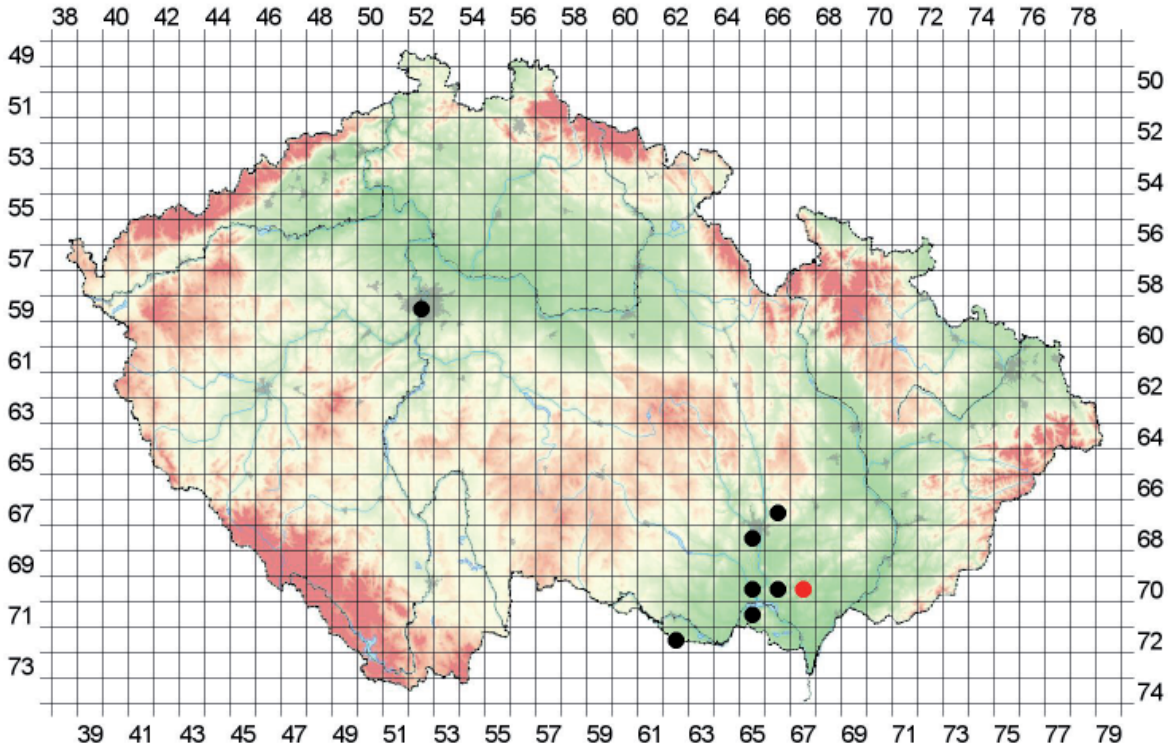
10: *Distribution of Zelotes gracilis in the Czech Republic (red dot – location Mutěnice)*



11: *The provisional distribution map of Sibianor tantulus in the Czech Republic (red dots – location Morkůvky and Mutěnice). The species seems to be more common and there will be more localities (Hula, in prep.).*

the sixth finding in the Czech Republic and it greatly enriches faunistic information and the distribution (Fig. 10) of this very rare thermophilic species.

Data: Mutěnice, 29. 5.–30. 6. 2011: plot 1, pt, 5♂2♀, det. VB; plot 2, pt, 2♂3♀, det. VB; plot 3, pt, 2♀, det. VB; plot 4, pt, 4♂5♀, det. VB; 30. 6.–30. 7. 2011: plot 1, pt, 2♀, plot 2, pt, 5♂; plot 4, 1♂1♀.



12: *Distribution of Synageles hilarulus in the Czech Republic Republic (red dot – location Morkůvky)*

Salticidae

Sibianor tantulus (Simon, 1868)

This species is reported from the territory of the Czech Republic only once (Macošská stráň, Moravský Kras PLA – Niedobová *et al.*, 2011). The species has a trans-Palaearctic temperate range, from France to central Mongolia, although in Europe, the species had previously been collected only in Poland (Logunov, 2000), Germany (Blick *et al.* 2004), Greece (Bosmans & Chatzaki, 2005), France (Le Peru, 2007), Slovakia (Franc & Korenko, 2008), Caucasus (Otto & Tramp, 2011) and Spain (Farrández *et al.*, 2006). It seems that species is scarce in thermophilic regions of the Czech Republic (Hula, pers. obs.). The whole genus *Sibianor* needs a revision in the Czech Republic. We found three adult specimens in both studied localities (Fig. 11).

Data: Morkůvky, 30. 6.–30. 7. 2011: plot 1, pt, 1♀; 25. 9.–28. 10. 2011: plot 1, pt, 1♂; Mutěnice, 30. 7.–26. 8. 2011: plot 2, pt, 1♀.

Synageles hilarulus (C. L. Koch, 1846)

A rare species occurring among grass on rock steppes and open xeric grasslands. Majority of the faunistic squares with occurrence of this species are in Moravia (Bryja *et al.*, 2005; Košulič & Hula, 2013), while in Bohemia, there is only one record from Prokopské údolí valley in Prague (Kůrka *et al.*, 2007). Our finding is the first record for the area of the faunistic square 7067 (terraces in Morkůvky) and significant information of the extension of this rare thermophilic jumping spider (Fig. 12).

Data: Morkůvky, 30. 4. 2011: plot 1, ds, 1♀.

SUMMARY

This paper provides information about spiders of the vineyard terraces around the villages of Morkůvky and Mutěnice, which are situated in the Hodonín and Břeclav districts in South Moravia, Czech Republic. Spiders were collected by pitfall trapping and by day and night sweeping of the herb vegetation in 2011. A total number of 2719 adult specimens of spiders were collected. Out of this number, 139 species from 79 genera and 23 families were determined. According to the number of species collected, the families Linyphiidae and Gnaphosidae were dominant in epigeon and family Araneidae and Theridiidae were dominant in higher vegetation. Eighteen species listed in the Red List of threatened species in the Czech Republic were discovered. In vineyard terraces in the vicinity of Morkůvky, 12 threatened species (CR – 2 species, EN – 3 species, VU – 7 species) were found altogether. In the vineyard terraces in Mutěnice, 13 threatened spider species were found (CR – 2 species, EN – 6 species, VU – 5 species). The crucial records are as follows: *Alopecosa solitaria, Dysdera hungarica, Euryopis quinqueguttata, Cheiracanthium pennyi, Dipoena coracina, Haplodrassus minor, Synageles hilarulus* and *Zelotes gracilis*. Some of the species collected are of Pannonian origin, reaching

the northern limit of their distribution range in this region. In total, we found a rich spectrum of the thermophilic species living only in the undisturbed steppe habitats and other small xerothermic areas that are gradually disappearing from the landscape of Southern Moravia. From our findings of rare and endangered spider species, we hypothesise that vineyard terraces are significant refuge for xerothermophilous spiders in an intensively used agriculture landscape of South Moravia in the Czech Republic. To prevent losses of rare and endangered xeric species, we suggest some small scaled agriculture interventions to preserve different succession stages and thus retain important diversity of microhabitats.

Acknowledgement

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