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EPIGEIC SPIDERS (ARANEAE) FROM THE MALÁ DOHODA QUARRY (MORAVIAN KARST PROTECTED LANDSCAPE AREA, CZECH REPUBLIC)

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Abstract

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This publication makes a faunistic contribution to knowledge of the epigeic spider species composition in the limestone quarry Malá Dohoda which is located in Moravian Karst PLA. The spiders were collected by pitfall trapping between catching period 19. 3.–1. 11. 2012. We chose 6 plots all around the quarry – in the inner part, edges of quarry and outside part of quarry. A total of 1 474 adult specimens were collected and determined as 78 species of 21 families. The most significant finding is vulnerable species (VU) *Parapelecopsis nemoralis* (Blackwall, 1841) which is the second record for Moravia. Among the other significant findings, both in term of rarity and bioindication, were *Ceratinella major* Kulczynski, 1894, *Micaria formicaria* (Sundevall, 1831), *Ozyptila claveata* (Walckenaer, 1837), *Pelecopsis parallela* (Wider, 1834), *Zelotes longipes* (L. Koch, 1866) and *Zodarion rubidum* Simon, 1914. Also, we present finding of an invasive species *Mermessus trilobatus* (Emerton, 1882) which is spreading in the Czech Republic since 2007. Together, we found 13 species as a novelty for studied faunistic square 6666 and we extended knowledge about new recorded species for the area of the Moravian Karst.

spiders, faunistics, limestone quarry, Moravian Karst PLA, Czech Republic

Moravian Karst is a typical karst area with numerous surface and underground karst phenomena, such as sinkholes, abyss, karst valleys, limestone fields, cave systems and quarries. Specific environmental conditions of karst areas (limestone substrate, moisture, border of thermophyticum and mesophyticum, hot rock outcrops, cold glens) enable the presence of characteristic plant and animal communities. Very specific habitats include inactive quarries, where there is natural succession and restoration of natural potential of these xerothermic refugia in the landscape. Regarding arachnological research in Moravian Karst, one of the first basic summaries of spiders is the work by Kratochvíl and Miller (1940) who described a new species of *Lepthyhphantes speleomoravicus* from the cave called Býčí skála (later it was discovered that this is the species of *Lepthyhphantes imbropulus*). Before them, Böhm (1925) briefly mentions the spiders from the vicinity of Moravian Karst. In 1990–1992 a research was conducted on epigeic invertebrates (including spiders) in different parts of the karst. Summary of spiders in this research (2 faunistic squares contained and a total of 107 species detected) was published by Majkus (1995). Papers devoted to Araneae species found directly in the caves (Absolon, 1912; Růžička, 1999a, 1999b) cannot be omitted. The most recent published data are on the composition of the arachnofauna from the hillsides of Vilémovická and Macošská stráň (Niedobová *et al.*, 2011) and in various sinkhole habitats (Horáková, 2005; Hula *et al.*, 2012). Habitats

in quarries were generally rather neglected by arachnologists and there are no faunistic data from Moravian Karst. Some authors suggest that quarries host major types of rare and remarkable xerothermophilous spider species (Tropek 2007; Tropek and Konvička, 2008; Tropek *et al*., 2010; Kůrka, 2000; Kůrka *et al*., 2010). All of these works are focused on arachnofauna in quarries in Bohemia (Bohemian Karst, Blanský les), while from Moravia one work only is known to be focused on spiders the quarry called Lesní lom Hády (Hula & Šťastná, 2010) which lies below the southern border of Moravian Karst PLA.

In this contribution we present first faunistic records of spiders from the quarry habitats in the Moravian Karst Protected Landscape Area. Among them, we mention and discuss rare and remarkable spider species found in our explored area.

Investigated Area

The survey was conducted in the quarry called Malá dohoda where mining started in the 30s of the 20th century. The quarry is still active and mining takes place in some parts of it. It is located in a protected landscape area in the northern part of Moravian Karst, 2 km to the north from Ostrov u Macochy and 1 km to the southwest from the village of Holštejn (GPS: 49°24'0.881"N, 16°46'5.815"E, faunistic square 6666 (Pruner & Míka, 1996). The location is situated at an altitude of 500 m.a.s.l. The outside landscape with border of the studied locality is showed in Fig. 1. In order to capture spiders, formaldehyde pitfall traps with a detergent as a wetting agent were used. In the quarry, pitfall traps were placed in three lines at six sites. Three sites were in habitats with early succession: one line directly in the quarry (location 4), one at the edge of the quarry (location 5) and one in the vicinity of the quarry (location 6); and three sites in habitats with advanced succession: one line again directly in the quarry (location 1), one at the edge of the quarry (location 2) and one in the vicinity of the quarry (location 3). Samples were collected in monthly intervals in the growing season in 2012. The pitfall traps were installed in March (19 March, 2012), collections took place then on (dd.mm.yyyy) 19. 4. 2012, 25. 5. 2012, 19. 6. 2012, 24. 7. 2012, 24. 8. 2012, 25. 9. 2012, 1. 11. 2012. After collection, the material was preserved in 70% alcohol.

Description of collecting sites

- Location 1 was basically a mudslide and stones, the total coverage was 45%. *Artemisia vulgaris*, *Agrostis*

1: *The outside landscape with border of the studied locality Malá Dohoda quarry. Grid map of the Czech Republic with marked faunistic square 6666 is designed in the right down corner (www.mapy.cz).*

2: *Individual transects used for collecting of spiders (www.mapy.cz).*

capillaris, and *Arrhenatherum elatius* were rather strongly represented.

- Location 2 was situated in continuous ruderal grassland, soil was partially torn down and there was a rocky backfill. The total coverage was 75%. Rather abundant were *Crepis biennis*, *Lotus corniculatus*, and *Poa pratensis*.
- Location 3 was covered by natural seeding and vegetation of forest edges. The total coverage was 95%. *Carpinus betulus*, *Galium mollugo*, and *Arrhenatherum elatius* were in greater proportions.
- Location 4 was represented by the initial stage of ruderal vegetation. The total coverage was 20%. There was a greater proportion of *Tussilago farfara* only.
- Location 5 was situated at the quarry edge, soil was partially removed here, it was ruderal herbal vegetation. The total coverage was 45%. *Agrostis capillaris*, *Achillea millefolium*, and *Artemisia vulgaris* were in significant proportions here.
- Location 6 was an edge of a meadow and an unpaved road. The total coverage was 95%.

Individual locations used for collecting of spiders are designed in Fig. 2.

MATERIAL AND METHODS

Evaluation of collected material

All spider material was determined to species level by means of Miller (1971), Heimer & Nentwig (1991), Roberts (1995), Nentwig *et al.* (2011).

Assessment of spider communities was carry out by bioindication classification by Buchar & Růžička (2002) supplemented by Růžička & Buchar (2008) and Řezáč (2009). This assessment classified individual species into categories according to the occupied habitat: climax habitats (C), secondary, semi-natural habitats (SN), regularly disturbed habitats (D) and category of artificial habitats (A). The advantage of this methodology is that individual species can be in several categories (in percentage). We transferred these categories into number scale and from this we computed our analyses. Thermopreference assessment of the species is based on Buchar & Růžička (2002) who applied division of our arachnofauna into thermophilic (T), mesophilic (M) and psychrophilic (O) species which occur mainly in our oreophyticum area. We used the percentage calculation as well the classification. Conservation status follows by Růžička (2005) according the Red List of the Invertebrates of the Czech Republic.

Nomenclature and arrangement of families, genera and species follow the Catalogue of Spiders of the Czech Republic (Buchar & Růžička, 2002) and the most recent version of the World Spider Catalog 13.5 (Platnick, 2013), with extention of name Clerck, where we accept the Art 3.1 of ICZN (1999). Most of the species were determinated by Ondřej Košulič. Taxonomically complicated taxa were revised and determinated by Vladimír Hula. All of the examinted material is deposited in collection of Ondřej Košulič.

RESULTS AND DISCUSSION

Faunistics

During the collection period, from 19 March, to 1 November, 2012, a total of 1 474 adult specimens belonging to 78 species and 21 families were collected. Dominance of families can be expressed by the number of species and number of specimens (Tab. I). In terms of number of species, Linyphiidae family is clearly dominant with 18 species, but the most species were found only sporadically with several specimens at each monitored location (except location 5). Other eudominant families include typically epigeic species representing the families of Lycosidae, Gnaphosidae, and Thomisidae. In particular the family of Lycosidae was significantly the most abundant (984 specimens, 67%). However, it is important to point out that this high abundance was caused by species *Pardosa lugubris* (very abundant species of deciduous forests) and *Pardosa palustris* (very abundant species of wet meadow habitats). The first mentioned species was detected abundantly in particular at location 3 (deciduous forest edge) and the latter one at location 6 (the edge of a wet meadow and a field). At other locations, these eudominant species were detected only sporadically in a far lesser extent. Another very abundant species of Lycosidae is *Xerolycosa nemoralis* which was found repeatedly at location 1 (xerothermic conditions, landslide and rock). The remaining eudominant families of Gnaphosidae and Thomisidae were represented by abundant xerothermophilous species of *Drassyllus praeficus*, *Xysticus audax*, and *Xysticus kochi* that mainly prefer rocky habitats directly in the center and at the edges of the quarry. In habitats of quarries and rocks, a relatively unusual finding is a typically forest species *Coelotes terrestris* (41 specimens). However, the species was found only at location 3, which included a deciduous forest habitat. In this line of pitfall traps (location 3) the highest number of species (29) and a very high abundance (451) was detected. The examined habitat created ecotone between forest habitats and rocky habitats of quarries. A similar situation is found also at location 6 which created the transition between a wet meadow and xerothermic quarry edge (28 species,

I: *Composition of araneofauna of the Malá Dohoda Quarry*

Family	species		specimens	
	n	%	n	%
Pholcidae	1	1.28	2	0.14
Dysderidae	1	1.28	5	0.34
Theridiidae	2	2.56	2	0.14
Linyphiidae	18	23.08	39	2.65
Tetragnathidae	4	5.13	12	0.81
Lycosidae	13	16.67	984	66.76
Pisauridae	1	1.28	5	0.34
Agelenidae	3	3.85	18	1.22
Hahniidae	1	1.28	1	0.07
Dictynidae	1	1.28	3	0.20
Amaurobiidae	1	1.28	41	2.78
Miturgidae	1	1.28	1	0.07
Liocranidae	2	2.56	6	0.41
Clubionidae	1	1.28	1	0.07
Corinnidae	1	1.28	3	0.20
Zodariidae	1	1.28	48	3.26
Gnaphosidae	12	15.38	127	8.62
Zoridae	2	2.56	3	0.20
Philodromidae	1	1.28	1	0.07
Thomisidae	6	7.69	160	10.85
Salticidae	5	6.41	12	0.81
SUM	78	100	1 474	100

480 specimens). At these locations, the influence of ecotonic effect with increasing species diversity and the total number of specimens is evident. The lowest number of species (13) and specimens (25) was detected at location 4, in the scree slope of the quarry. However, despite the low abundance of 25 specimens, as much as 13 species were found here, among them a rare species of *Zelotes longipes*, *Micaria formicaria*, and scarce *Micaria fulgens* which which were not detected at any other surveyed location. At the edge of the quarry (location 5), there were detected 18 species in 135 specimens. The other two sites (locations 1 and 2) are very similar in terms of species diversity (27 and 28) as well as collected number of specimens (223 and 168). At both sites, eudominant species of *Xerolycosa nemoralis* and *Xysticus audax* occured in significant proportions. Species typical for quarry habitats were represented in several findings, namely: *Harpactea rubicunda, Liocranum rupicola, Pholcus opilionoides, Tegenaria atrica, Tegenaria agrestis*, *Zelotes aeneus*, and *Zodarion rubidum*. They are strongly thermophilous species, often directly with synanthropic occurrence in human settlements (*Liocranum rupicola*, *Pholcus opilionoides*, *Tegenaria atrica, Z. aeneus*). This confirms the idea that these can often represent refugia for thermophilous species in otherwise cooler landscape of mesophyticum and oreophyticum (Beneš *et al*., 2003; Tropek & Konvička, 2008).

Overall, in the studied faunistic square 6666, we recorded 13 new species that are represented by the following (taxonomic order): *Cnephalocotes obscurus*, *Parapelecopsis nemoralis*, *Pelecopsis parallela*, *Stemonyphantes lineatus*, *Tegenaria agrestis*, *Cheiracanthium erraticum*, *Liocranum rupicola*, *Clubiona trivialis*, *Zodarion rubidum*, *Micaria fulgens*, *Zelotes aeneus*, *Thanatus striatus*. From this square, in total 298 species are reported: Buchar & Růžička (2002) report 153 species, Horáková (2005) 117 species, Majkus (1995) 107 species, and most recently, Niedobová *et al*., (2011) 171 species. Through our research, the number of known species from faunistic square is increased to a total of 311 species. For comparison, the highest number of recorded species by Bryja *et al*. (2005) in the faunistic square is 7165 (405 species), 7166 (393 species), 5949 (383 species), and 6863 (360 species), (Buchar & Růžička, 2002; Růžička & Buchar, 2008). From these results it is clear that the surveyed square 6666 is among the most explored areas in the Czech Republic in terms of arachnological research.

Summary of all species found with their conservation status, thermopreferences and bioindication value is given in Tab. II.

Presence of rare and endangered species of spiders

In the explored locality, we found only one species which belong to the category (VU) under the Red List of Invertebrates of the Czech Republic (Růžička, 2005) – *Parapelecopsis nemoralis.* Two specimens belonging to this species were recorded – an adult female and a male at location 3 which was characterized by thick vegetation structure with a continuous herb layer and tree layer consisting of *Carpinus betulus*. It is a species of vague environmental preferences and distribution in the Czech Republic, as it has already been reported from xerothermic habitats of the České středohoří Mountains (Kůrka & Buchar, 2010), the Bohemian Karst (Suchomasty), and the Křivoklátsko region (Šmaha, 1990). From Moravia, only a single record

II: *Summary of species recorded. Explanations: Habitat preference (Buchar & Růžička, 2002; Řezáč, 2009): C (climax), SN (seminatural), D (disturb), A (artificial); Thermopreferences (Buchar & Růžička, 2002): T (thermophilous), M (mesophilous), O (oreophilous); Conservation status (Růžička, 2005): VU (Vulnerable). Bold means main preference, bracket means minority preference.*

	1. Plot	2. Plot	3. Plot	4. Plot	5. Plot	6. Plot	Habitat preferences	Thermopreferences	Conservation status
Pholcidae									
Pholcus opilionoides (Schrank, 1781)					2		C, SN, D	x	
Dysderidae									
Harpactea rubicunda (C. L. Koch, 1838)			5				C, SN, A	T, M	
Theridiidae									
Robertus arundineti (O. P. -Cambridge, 1871)					1		C, SN, D	T, **M**	
Neottiura bimaculata (Linnaeus, 1767)				1			C, SN, D	T, M	
Linyphiidae									
Centromerus sylvaticus (Blackwall, 1841)		1					C, SN, D	T, M, O	
Ceratinella brevipes (Westring, 1851)			1				**C**, SN	M	
Ceratinella major Kulczynski, 1894			1				C	T, M	

	1. Plot	2. Plot	3. Plot	4. Plot	5. Plot	6. Plot	Habitat preferences	Thermopreferences	Conservation status
Cnephalocotes obscurus (Blackwall, 1834)						1	C, SN	M, O	
Diplocephalus cristatus (Blackwall, 1833)	1			1			C, SN, D	**M**, (O)	
Diplostyla concolor (Wider, 1834)	1		3			2	C, SN	T, M, O	
Lepthyphantes alacris (Blackwall, 1853)		1					C, SN	M, **O**	
Lepthyphantes flavipes (Blackwall, 1854)	1	2	4	3		2	C, SN	T, **M**	
Lepthyphantes tenebricola (Wider, 1834)		1					C, SN	**M**, O	
Linyphia triangularis (Clerck, 1758)				1			C, SN, D	T, **M**	
Meioneta rurestris (C. L. Koch, 1836)				1		2	C, SN, D	T, M, O	
Mermessus trilobatus (Emerton, 1882)			1				x	x	
Microneta viaria (Blackwall, 1841)			1				C, SN	T, **M**, O	
Oedothorax apicatus (Blackwall, 1850)				1			C, SN, D	T, M	
Parapelecopsis nemoralis (Blackwall, 1841)			2				C	T, M	VU
Pelecopsis parallela (Wider, 1834)			1				**C**, SN, D	M	
Pelecopsis radicicola (L. Koch, 1872)			1	1			**C**, SN	**M**, (O)	
Stemonyphantes lineatus (Linnaeus, 1758)		1					C, SN, D	(T), **M**	
Tetragnathidae									
Metellina mengei (Blackwall, 1870)			1				C, SN	T, **M**, O	
Pachygnatha clercki Sundevall, 1823			1			1	C, SN D	T, **M**	
Pachygnatha degeeri Sundevall, 1830						8	C, SN, D	T, M, O	
Pachygnatha listeri Sundevall, 1830			1				C, SN	(T), **M**	
Lycosidae									
Alopecosa cuneata (Clerck, 1758)				1		7	C, SN, D	T, M, O	
Alopecosa pulverulenta (Clerck, 1758)	1	4	6		1	30	C, SN, D	T, M, O	
Aulonia albimana (Walckenaer, 1805)		1	5		1	1	C, SN	T, **M**	
Pardosa agrestis (Westring, 1861)					4		SN, D	T, **M**	
Pardosa amentata (Clerck, 1758)	1						C, SN, D	T, M, O	
Pardosa hortensis (Thorell, 1872)						1	C, SN, D	T	
Pardosa lugubris (Walckenaer, 1802)	21	12	339	5	16	11	C, SN, D	T, M, O	
Pardosa palustris (Linnaeus, 1758)		1	1		4	252	C, SN, D	T, M, O	
Pardosa pullata (Clerck, 1758)	1					40	C, SN, D	T, M, O	
Pardosa riparia (C. L. Koch, 1833)			1			11	C, SN	T, M, O	
Trochosa ruricola (De Geer, 1778)		1					C, SN, D	T, M	
Trochosa terricola Thorell, 1856	12	5	2	2		12	C, SN, D	T, M, (O)	
Xerolycosa nemoralis (Westring, 1861)	116	35			10	10	C, SN	T, M, O	
Pisauridae									
Pisaura mirabilis (Scopoli, 1763)	1	1	1	1		1	C, SN, D	T, **M**	
Agelenidae									
Agelena gracilens (C. L. Koch, 1841)						1	C, SN, A	T, M	
Tegenaria agrestis (Walckenaer, 1802)	1	1		1			C, SN, D	**T**, M	
Tegenaria atrica C. L. Koch, 1843	2	2	2	4	1	3	SN, **A**	x	
Hahniidae									
Hahnia nava (Blackwall, 1841)		1					**C**, SN	T, M	
Dictynidae									
Cicurina cicur (Fabricius, 1793)			3				C, SN, D	(T), **M**	

	1. Plot	2. Plot	3. Plot	4. Plot	5. Plot	6. Plot	Habitat preferences	Thermopreferences	Conservation status
Amaurobiidae									
Coelotes terrestris (Wider, 1834)			41				C, SN	(T), M, O	
Miturgidae									
Cheiracanthium erraticum (Walckenaer, 1802)					1		C, SN	(T), **M**	
Liocranidae									
Agroeca brunnea (Blackwall, 1833)	1		4				C, SN	T, **M**	
Liocranum rupicola (Walckenaer, 1830)					1		C, A	x	
Clubionidae									
Clubiona trivialis C. L. Koch, 1843						1	C, SN	**M**, (O)	
Corinnidae									
Phrurolithus festivus (C. L. Koch, 1835)		1				2	C, SN	T, **M**	
Zodariidae									
Zodarion rubidum Simon, 1914	1	19			26	2	C, SN	T	
Gnaphosidae									
Drassodes lapidosus (Walckenaer, 1802)	2	6	1		21	2	C, SN	T, M	
Drassodes pubescens (Thorell, 1856)	1	8	3		12	2	C, SN	T, M	
Drassyllus praeficus (L. Koch, 1866)	15	8			1	14	C, SN	T, **M**	
Drassyllus pusillus (C. L. Koch, 1833)						3	C, SN, (D)	T, M	
Haplodrassus signifer (C. L. Koch, 1839)	4	2	2			6	C, SN, D	T, M, O	
Micaria formicaria (Sundevall, 1831)				1			C, SN	T, (M)	
Micaria fulgens (Walckenaer, 1802)				1			C, SN	T, M	
Micaria pulicaria (Sundevall, 1831)			2		1	1	C, SN	T, M, O	
Trachyzelotes pedestris (C. L. Koch, 1837)	1		2				**C**, SN	**T**, (M)	
Zelotes aeneus (Simon, 1878)			3				C, SN, D	(T), M	
Zelotes latreillei (Simon, 1878)		1					C, SN, D	(T), **M**	
Zelotes longipes (L. Koch, 1866)				1			C	T, (M)	
Zoridae									
Zora nemoralis (Blackwall, 1861)						1	C, SN	(T), **M**	
Zora spinimana (Sundevall, 1833)	1					1	C, SN, D	T, **M**, (O)	
Philodromidae									
Thanatus striatus C. L. Koch, 1845						1	C, SN	(T), M	
Thomisidae									
Ozyptila claveata (Walckenaer, 1837)		1					C	T, M	
Ozyptila praticola (C. L. Koch, 1837)		1	2				C, SN	T, M	
Xysticus audax (Schrank, 1803)	26	29	3		7	33	C, SN	T, **M**, (O)	
Xysticus bifasciatus C. L. Koch, 1837						1	C, SN, D	T, **M**, (O)	
Xysticus cristatus (Clerck, 1758)	2	1			3	6	C, SN, D	T, **M**, (O)	
Xysticus kochi Thorell, 1872	3	14			20	8	C, SN, D	T, M	
Salticidae									
Ballus chalybeius (Walckenaer, 1802)	1						C, SN	**T**, M	
Euophrys frontalis (Walckenaer, 1802)	1	1					C, SN	T, M	
Heliophanus cupreus (Walckenaer, 1802)	3				2		C, SN	T, M	
Phlegra fasciata (Hahn, 1826)		2					C, SN	T, M	
Talavera aequipes (O. P.-Cambridge, 1871)	1	1					**C**, SN	T, M	

is reported from a completely different habitat of cold debris in a cave on the banks of the Dyje in the vicinity of Vrané (Růžička, 1996). Other significant discoveries include rare species of *Ceratinella major*, *Micaria formicaria*, *Ozyptila claveata*, *Pelecopsis parallela*, *Zelotes longipes*, and *Zodarion rubidum*. These species prefer natural undisturbed habitats, often various steppe grasslands of xerothermic character and unshaded open habitats (Buchar & Růžička, 2002). Thus the detected species are able to colonize habitats of quarries and adjacent grasslands (edges, slopes, inner parts of quarries) in the initial successional stages that meet the required conditions of these rare species of spiders by their microhabitat properties. Discovery of the species of *Mermessus trilobatus* in the studied area (location 3) is another faunistic indication of expansion of this invasive species in the Czech Republic. Within our territory, it was first discovered only in 2007 (Dolanský *et al*., 2009), and since then it has gradually spread and is found in new territories and locations within the Czech Republic (Košulič & Hula, 2011; Řezníček, 2012; Hula, pers. comm.). Comments and reported findings of the individual specimens of rare species are listed below in an annotated list.

Bioindication evaluation

According to the preferences of habitat disturbance (Buchar & Růžička, 2002; Růžička & Buchar, 2008; Řezáč, 2009), a significant proportion of species (45%) belong to species preferring climax habitats (C – climax habitat, little disturbed by man). Species inhabiting semi-natural habitats (SN) cover 38%. Among the species preferring human disturbed habitats with a higher degree of disturbance (D), there are 15% among the detected species. It should be noted that members of this latter class numerically dominated in the material collected at the studied locations. Species preferring only natural undisturbed habitats were found only in one or several adult specimens. The remaining proportion of species (2%) are among the species inhabiting artificial, man-made habitats (A). However, at this assessment it is necessary to point out the misleading and quite inaccurate classification of habitats. Habitats of quarries (as well as meadow and grassland habitats) can never be in the Czech Republic climax and neither can they be classified as undisturbed, since there was mining and human activity taking place.

In terms of thermopreference evaluation (Buchar & Růžička, 2002), representatives of all three thermopreference classes were detected, including several species that have not been classified (5% – non-specific entirely synanthropic species and invasive species of *Mermessus trilobatus*). An abundant mesophilous group covered almost half of the studied material (48%). Thermophilous species are represented by 34% and the species occurring in oreophyticum represented 13%. We can therefore say the araneocenosis of the explored quarry belongs to significantly mesophilous community that is enriched by the thermophilous species living in thermophyticum (limestone quarries and xerothermic adjacent grasslands provide a very suitable habitat).

Annoted list of significant species found

Linyphiidae

Ceratinella major Kulczynski, 1894

Rare species occurring among detritus in deciduous forests, often associated with scree slopes. We found one adult female in forest habitat which passed to the edge of the quarry. From examinated faunistic square (6666) this species has been already collected by Vlastimil Růžička in Sluneční skály (Růžička, pers. comm.). However, the first record, even for Moravia, was made by Majkus (1995) who found one specimen in the Suchý žleb valley.

Data: 1♀, 19. 4.–25. 5. 2012, plot 3.

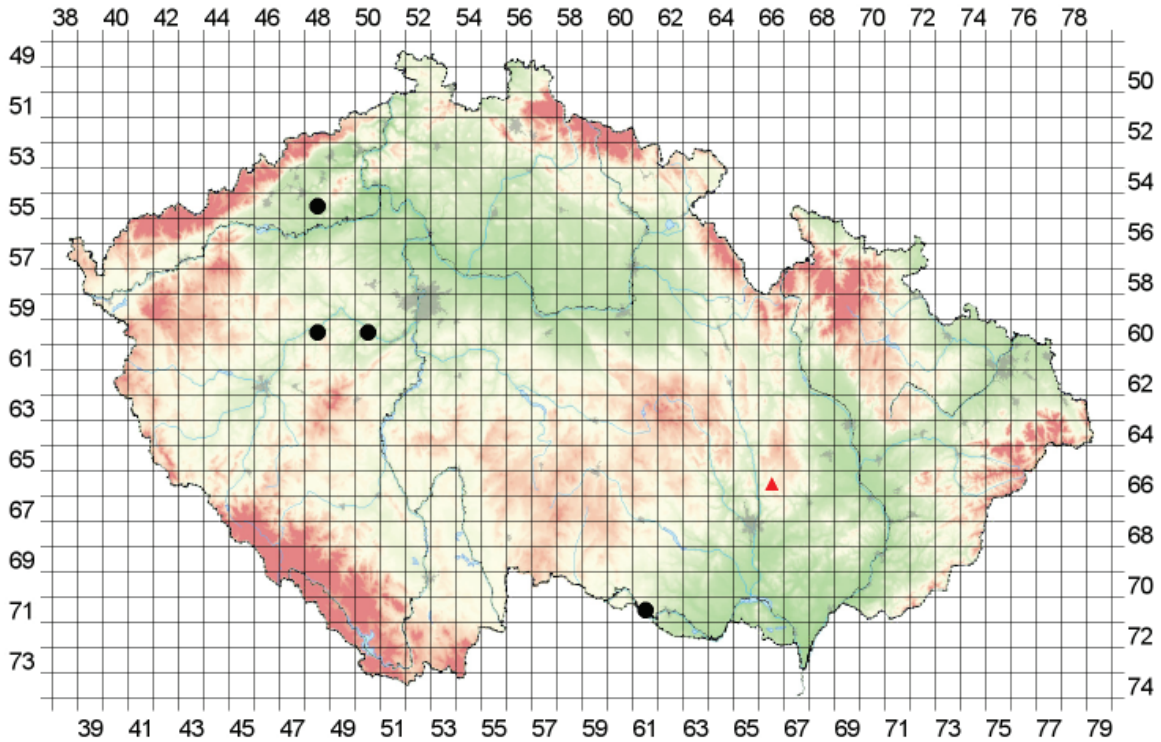
Mermessus trilobatus (Emerton, 1882)

An invasive spider species which was introduced to Europe from North America in the 80s of the 20th century. The first discovery in Europe comes from southern Germany near Karlsruhe (Blick *et al*., 2005). In the Czech Republic, it was first found in 2007 in sandy areas around Bezděkov in eastern Bohemia (Dolanský *et al*., 2009). In addition, several specimens were found in wetlands of Bohemian Karst (Kůrka *et al*., 2010) and the nature reserve of Kleneč pod Řípem (Řezáč, pers. comm.). From the territory of Moravia, data from vineyard terraces (Košulič & Hula, 2011) and sandy areas around Hodonín are known, where it occurred in relatively abundant numbers (Hula, pers. comm.). In Moravian Karst, it was reported from sinkholes (meadow habitats) which almost border on our explored site (Řezníček, 2012). *Mermessus trilobatus* is able to successfully spread in the air (by so called ballooning). It is likely 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* (Růžička, 1995).

Data: 1♂, 24. 7.–22. 8. 2012, plot 3.

Parapelecopsis nemoralis (Blackwall, 1841)

A rare species of a small money spider with unclear ecological requirements. According to Buchar & Růžička (2002), species living among moss, lichens and detritus on scree slopes. This species has been found in three faunistic squares in Bohemia: south faced xerothermic meadows (Oblík Nature Reserve) in the České středohoří Mountains (Kůrka & Buchar, 2010), the Křivoklátsko region (Šmaha, 1990) and around municipality of Suchomasty in the Bohemian Karst (Kůrka *et al*., 2010). From this distribution in Bohemia is significant presence of this species largely in xerothermic steppe and forest steppe habitats. However, finding from Moravia (one faunistic square) becomes from scree slopes in cold cave near Vrané, around river bank of Dyje (Růžička, 1996). We found adult male and female in forest habitat near the edge and rocky slopes of the



3: *Distribution of Parapelecopsis nemoralis (Blackwall, 1841) in the Czech Republic (red triangle – faunistic square 6666 with our studied locality Malá Dohoda)*

studied quarry. Second record of this remarkable species in Moravia. Distribution map of this spider is designed in Fig. 3.

Data: 1♂1♀, 25. 5.–19. 6. 2012, plot 3.

Pelecopsis parallela (Wider, 1834)

Scarce species founded mainly among detritus in various contrasting open habitats – wet meadows, on sand dunes, in lucerne fields. Majority of faunistic squares of this species belong to the Bohemian part, while in Moravia, especially in southern Moravia, there are only few records from Mohelno (Miller, 1947) and sand dunes in Bzenec (Růžička & Bezděčka, 2000). There is only one recent finding from reeds of the Ovčovské louky Nature Reserve near Hodonín (Bryja *et al.*, 2005). First record of this species for the area of the Moravian Karst.

Data: 1♂, 19. 6.–24. 7. 2012, plot 3.

Zodariidae

Zodarion rubidum (Simon, 1914)

Scarce species of different habitats, more abundant on artificial habitats like motorway verges, railway embankments, vineyard terraces and so on. Found as a very common in the quarry of Lesní lom Hády (Hula & Šťastná, 2010) and all over the Pálava region (Bryja *et al.*, 2005). These abundant findings are in contrary to Buchar & Růžička (2002) which reported this species as a relatively rare. There are also records from sandy habitats around Bzenec (Růžička & Bezděčka, 2000). The increasing number of records strongly support the theory about its spreading to the northern Europe (Pekár & Král, 2001). Anyway, record of this species in Malá Dohoda quarry is the first finding for the area of Moravian Karst. *Z. rubidum* was most abundant on the places with bare soil and vegetation cover around 45–75%, on the edge of quarry and xerothermic slopes around inner part of quarry.

Data: 1♂, 24. 7.–22. 8. 2012, plot 1; 15♂1♀, 19. 4.–25. 5. 2012, 1♂, 25. 5.–19. 6. 2012, 2♀, 24. 7.–22. 8. 2012; 6♂, 19. 4.–25. 5. 2010, 10♂2♀, 25. 5.–19. 6. 2012, 2♂5♀, 19. 6.–24. 7. 2012, 1♀, 24. 7.–22. 8. 2012, plot 5; 1♂1♀, 19. 4.–25. 5. 2012, plot 6.

Gnaphosidae

Micaria formicaria (Sundevall, 1831)

A rare species of rocky steppes and forest edges where it lives under rocks and grass. Its appearance as well as movement reminds of ants. In the Czech Republic, it occurs sporadically throughout the territory in the lower to mid elevations. The recent findings of this species include the same faunistic square at Macošská stráň slope (Niedobová *et al.*, 2011) and the nature reserve of Balcarka (Hula *et al.*, 2009). Earlier findings from Moravian Karst are reported by Majkus (1995) and Miller (1967). In the explored area, the species was discovered directly in the scree slope in the inner part of the quarry.

Data: 1♂, 19. 6.–24. 7. 2012, plot 4.

Zelotes aeneus (Simon, 1878)

Rare species which occurs under stones on dry habitats – rock steppes, forest steppes and on spoil heaps in early stages of succession. It was recorded only from synanthropic habitats in Moravia (Bryja

et al. 2005). We found three adult specimens around forest edge between forest and quarry habitat. The record of *Z. aeneus* in our studied locality is an important contribution to faunistic knowledge of this rare species and also create first record for the area of the Moravian Karst.

Data: 2♂1♀, 19. 4.–25. 5. 2012, plot 3.

Zelotes longipes (L. Koch, 1866)

Rare species which mainly occurs in dry to very dry habitats, such as rocky steppes, forest steppes, and various xerothermic graslands. Bryja *et al.* (2005) report this species as common around Pálava with autumn activity which is also mentioned by Košulič & Hula (2011) in vineyard terraces habitat where the species was found to be very abundant. In the area of Moravian Karst, this species was already found by Miller (1967) and Majkus (1995). Recently, from faunistic square 6666 *Z. longipes* was reported from Vilémovická stráň slope by Niedobová *et al.* (2011) and from sinkholes in very close proximity to our explored locality by Hula *et al.* (2012).

Data: 1♂, 22. 8.–25. 9. 2012, plot 4.

SUMMARY

Collection of spiders was conducted in a limestone quarry of Malá Dohoda which is located in a protected landscape area of Moravian Karst. Mining is still active there at several places. Spiders were collected using formaldehyde traps at 6 different locations in the period from 19 March to 1 November, 2012. In total, 1474 adult specimens belonging to 78 species and 21 families were determined. The highest species diversity and abundance were found at ecotonic sites between the quarry and forest and meadow habitats. The occurrence of the most abundant species – *Pardosa lugubris* and *P. pullata* was detected here. Directly in the quarry, there was the lowest abundance of species and specimens, however, rather rare and more important bioindication species dominated. In the periphery of the quarry, we found higher species diversity with more abundant presence of several rather rare species of spiders (*Zodarion rubidium*). Major findings include rare species of *Ceratinella major, Mermessus trilobatus, Pelecopsis paralella, Zelotes aeneus*, and *Z. longipes*. In the explored area, the species of *Parapelecopsis nemoralis* included in the Red List of Invertebrates of the Czech Republic as a vulnerable species (VU) was detected. Due to that, Malá dohoda quarry is the second locality in Moravia where this rare species was discovered. In total, we discovered 13 new species for one of the most explored faunistic squares of the Czech Republic (6666). These species include typical representatives of rocky habitats and biotopes in the initial stages of succession: *Tegenaria agrestis*, *Liocranum rupicola, Zodarion rubidum*, and *Zelotes aeneus*. In terms of bioindication evaluation, 45% of the species prefer climax habitats, 38% semi-natural habitats, 15% disturbed habitats and 2% of species occur in man-made habitats. The largest proportion of species of the spectrum belongs to the species dwelling in mesophyticum (48%) and thermophyticum (34%). Also species inhabiting oreophyticum (13%) and non-specific, often synanthropic (5%) species, were detected. Thus it can be concluded that, in the explored area, valuable community of spiders was found including a few rare species that enrich the arachnofauna in Moravian Karst. Simultaneously, importance of post-industrial sites, such as quarries, for increasing and maintaining biodiversity in the intensively used landscape of the Czech Republic is significant.

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REFERENCES

ABSOLON, K., 1912: *Průvodce Moravským krasem*. Brno: Barvič & Novotný, 210 p.

BENEŠ, J., KEPKA, P., KONVIČKA, M., 2003: Limestone quarries as refuges for european xerophilous butterflies. *Conserv. Biol.*, 17, 4: 1058–1069. ISSN 0888-8892.

BLICK, T., HÄNGGI, A., WITTENBERG, R., 2005: Spiders and Alliens – Arachnida. In: WITTENBERG, R.: *An inventory of alien species and their threat to biodiversity and economy in Switzerland*. CABI Bioscience Switzerland Centre, report to The Swiss Agency for Environment, Forests and Landscape SAEFL. Delémont: Switzerland, p. 213–229. ISBN N.

BÖHM, L., 1925: Beitrag zur Kenntnis der Spinnenfauna im Brunner Bezirk. In: BAYER, E., JAROŠ, Z., (eds): *Osmá výroční zpráva Komise na přírodovědecký výzkum Moravy a Slezska (žup moravských a slezských) v Brně za léta 1914–1924*. Brno: Komise na přírodov. výzkum Moravy a Slezska, p. 30–31.

BRYJA, V., SVATOŇ, J., CHYTIL, J., MAJKUS, Z., RŮŽIČKA, V., KASAL, P., DOLANSKÝ, J., BUCHAR, J., CHVÁTALOVÁ, I., ŘEZÁČ, M., KUBCOVÁ, L., ERHART, J., FENCLOVÁ, I., 2005: Spiders (Araneae) of the Lower Morava Biosphere Reserve and closely adjacent localities (Czech republic). *Acta Mus. Moraviae, Sci. Biol. (Brno)*, 90: 13–184. ISSN 1211-8788.

BUCHAR, J., RŮŽICKA, V., 2002: *Catalogue of Spiders of the Czech Republic*. Praha: Peres, 351 pp. ISBN 80-86360-25-3.

DOLANSKÝ, J., ŘEZÁČ, M., KŮRKA, A., 2009: *Mermessus trilobatus* (Emerton, 1882) (Araneae, Linyphiidae) – nový druh pavučenky v České republice. *Vč. Sb. Přír. – Práce a studie*, 16: 143–144. ISSN 1212-1460.

HEIMER, S., NENTWIG, W., 1991: *Spinnen Mitteleuropas: ein Bestimmungbusch*. Berlin und Hamburg: Verlag Paul Parey, 544 pp. ISBN 3489535340.

HORÁKOVÁ, J., 2005: *Vybrané skupiny epigeické fauny závrtů CHKO Moravský kras a jejich antropogenní ovlivnění*. Brno: MZLU v Brně. Ph.D. Thesis. MZLU v Brně, Agronomická fakulta, Ústav zoologie, rybářství, hydrobiologie a včelařství, 248 pp.

HULA, V., ŠŤASTNÁ, P. 2010: Spiders (Araneida) from the Lesní lom Quarry (Brno–Hády). *Acta univ. agric. et silvic. Mendel. Brun.*, 58, 5: 191–202. ISSN 1211-8516.

HULA, V., NIEDOBOVÁ, J., KOŠULIČ, O., 2009: Overwintering of spiders in land-snail shells in South Moravia (Czech Republic). *Acta Mus. Moraviae, Sci. Biol.*, 94, 1: 1–12. ISSN 1211-8788.

HULA, V., KOŠULIČ, O., ŠŤASTNÁ, P., 2012: Spiders (Araneae) of selected sinkholes of Moravský kras Protected Landscape Area (Czech Republic). *Acta univ. agric. et silvic. Mendel. Brun.*, 60, 1: 57–69. ISSN 1211-8516.

ICZN, 1999: *International code of Zoological Nomenclature*. 4th ed. London: International Trust for Zoological Nomenclature, 306 pp. ISBN 0-85301-006-4.

KOŠULIČ, O., HULA, V., 2011: Spiders of vineyard terraces in northern part of Pannonian region (South Moravia, Czech Republic) – a preliminary results. In: LUBIN *et al.* (eds.): *26th ECA European Congress of Arachnology Israel, 3–8 September 2011 – Book of Abstracts.* 1st ed. Negev: Ben-Gurion University of the Negev, p. 135. ISBN N.

KRATOCHVÍL, J., MILLER, F., 1940: *Lepthyphantes spelaeomoravicus* n. sp. (Aran.) z jeskyně „Býčí skála" na Moravě. *Sborník Klubu přírodovědeckého v Brně za rok 1939*, 22[1939]: 60–66.

KŮRKA, A., 2000: Sukcese arachnocenóz v povrchových vápencových lomech v Českém krasu (pavouci – Araneae). *Český kras*, 26: 22–27. ISSN 1211-1643.

KŮRKA, A., BUCHAR, J., 2010: Pavouci (Araneae) vrchu Oblík v Českém středohoří (severozápadní Čechy). (Spiders (Araneae) of the Oblík Hill in the České středohoří Highlands (Northwestern Bohemia, Czech Republic). *Acta Mus. Bohem. Boreal., Sci. Nat.*, 28: 71–106. ISSN 0375-1686.

KŮRKA, A., BUCHAR, J., KUBCOVÁ, L., ŘEZÁČ, M., 2010: Pavouci (Araneae) chráněné krajinné oblasti Český kras. (Spiders (Araneae) of the Bohemian Karst Protected Landscape Area (Czech Republic). *Bohem. Cent.*, 30: 5–100. ISSN 0231-5807.

MAJKUS, Z., 1995: Příspěvek k poznání arachnofauny Moravského krasu. (An contribution to the arachnofauna knowledge of Moravský kras). *Acta Fac. Rer. Nat. Univ. Ostraviensis, Biologica – Ecologica (Ostrava)*, 3: 119–136. ISSN 1213-8401.

MILLER, F., 1947: *Pavoučí zvířena hadcových stepí u Mohelna.* Brno: Svaz na výzkum a ochranu přírody i krajiny v zemi Moravskoslezské, 128 pp.

MILLER, F., 1967: Studien über die Kopulationsorgane der Spinnengattung *Zelotes*, *Micaria*, *Robertus* und *Dipoena* nebst Beschreibung einiger neuen oder unvollkommen bekannten Spinnenarten. *Acta Sc. Nat. Brno*, 1, 7: 251–298. ISSN 0065-1648.

MILLER, F., 1971: Řád Pavouci – Araneida (Order Spiders – Araneida), pp. 51–306. In: DANIEL, M., ČERNÝ, V., (eds.): *Klíč zvířeny ČSSR, díl IV* (*Key to the fauna of Czechoslovakia IV*). Praha: ČSAV, 603 p.

NENTWIG, W., HÄNGGI, A., KROPF, C., BLICK, T., 2011: Spinnen Mitteleuropas / Central European Spiders. An internet identification key. Available online: http://www.araneae.unibe.ch Version of 6.12.2011. (cited: 28.12.2012).

NIEDOBOVÁ, J., HULA, V., ŠŤASTNÁ, P., 2011: Spiders (Araneida) from the slopes of Macošská stráň and Vilémovická stráň (Moravský kras Protected Landscape Area, Czech Republic). *Acta Mus. Moraviae, Sci. Biol.*, 96, 1: 1–27. ISSN 1211-8788.

PEKÁR, S., KRÁL, J., 2001: A comparative study of the biology and karyotypes of two central European zodariid spiders (Araneae, Zodariidae). *J. Arachnol.*, 29: 345–353. ISSN 0161-8202.

PLATNICK, N. I., 2013: *The World Spider Catalog, Version 13.5*. American Museum of Natural History. Available online: http://research.amnh.org/iz/spiders/catalog/INTRO1.html (cited: 28.12.2012).

PRUNER, L., MÍKA, P., 1996: Seznam obcí a jejich částí v České republice s čísly mapových polí pro síťové mapování fauny. *Klapalekiana*, 32: 1–175. ISSN 1210-6100.

ROBERTS, M., 1995: *Spiders of Britain & Northern Europe*. London: Harper Collins Publishers, 383 pp. ISBN 00-021-9981-5.

RŮŽIČKA, V., 1995: The spreading of *Ostearius melanopygius* (Araneae: Linyphiidae) through Central Europe. *Eur. J. Entomol.*, 92: 723–726. ISSN 1210-5759.

RŮŽIČKA, V., 1996: Pavouci kamenitých sutí a pseudokrasových jeskyní Národního parku Podyjí. *Příroda, Sborník prací z ochrany přírody,* 3: 123–132. ISSN 1211-3603.

RŮŽIČKA, V., 1999a: Spiders (Araneae) of scree slopes in the Moravian Karst. *Acta Mus. Moraviae, Sci. Biol.*, 84: 205–210. ISSN 1211-8788.

RŮŽIČKA, V., 1999b: The first steps in subterranean evolution of spiders (Araneae) in Central Europe. *J. Nat. Hist.*, 33: 255–265. ISSN 0022-2933.

RŮŽIČKA, V., 2005: Araneae (pavouci), p. 76–82. In: FARKAČ, J., KRÁL, D., ŠKORPÍK, M. [eds.]: *Červený seznam ohrožených druhů České republiky. Bezobratlí.* (Red list of threatened species in the Czech Republic. Invertebrates). Praha: AOPK ČR, 760 p. ISBN 80-86064-96-4.

RŮŽIČKA, V., BEZDĚČKA, P., 2000: *Pavouci (Araneae) vátých písků u Bzence.* (Spiders (Araneae) of sand dunes near Bzenec). Uherské Hradiště: Přírodovědecký klub, 5: 208–213. ISBN 80-902213-7-8.

RŮŽIČKA, V., BUCHAR, J., 2008: Dodatek ke katalogu pavouků České republiky 2001–2007. (Supplement to the Catalogue of Spiders of the Czech Republic 2001–2007). *Sborník Okresního muzea v Mostě, řada přírodovědná*, 29/30: 3–32. ISSN 1214-2573.

ŘEZÁČ, M., 2009: *Metodika inventarizace druhů pavouků*. (Methodology for inventarization of spiders). Unpublished manuscript. Deposited in: Praha: Agentura ochrany přírody a krajiny ČR, 12 pp.

ŘEZNÍČEK, M., 2012: *Zjišťování druhového a početního zastoupení pavouků (Araneida) v závrtech CHKO Moravský kras*. Brno: MENDELU. Thesis. MENDELU, Agronomická fakulta, Ústav zoologie, rybářství, hydrobiologie a včelařství, 82 pp.

ŠMAHA, J., 1990: Faunistic records from Czechoslovakia. Araneae. *Acta Entomol. Bohemoslov.*, 87: 232. ISSN 0001-5601.

TROPEK, R., 2007: Pavouci (Araneae) xerotermních travníků a lomů Chráněné krajinné oblasti Blanský les. *Klapalekiana*, 43: 65–77. ISSN 1210-6100.

TROPEK, R., KONVIČKA, M., 2008: Can querries supplement rare xeric habitat in a Piedmont region? Spiders of the Blanský Les Mts., Czech Republic. *Land Degrad. Dev.*, 19, 1: 104–114. ISSN 1099-145X.

TROPEK, R., KADLEC, T., KAREŠOVÁ, P., SPITZER, L., KOČÁREK, P., MALENOVSKÝ, I., BANAŘ, P., TUF, I. H., HEJDA, M., KONVIČKA, M., 2010: Spontaneous succession in limestone quarries as an effective restoration tool for endangered arthropods and plants. *J. Appl. Ecol.*, 47: 139–147. ISSN 0021-8901.

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