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ARANEOFAUNA OF THE KŘÉBY NATIONAL NATURE MONUMENT (EASTERN MORAVIA, CZECH REPUBLIC) WITH SOME NOTES TO CONSERVATION MANAGEMENT OF THE LOCALITY

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Abstract

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This paper makes a faunistic contribution to knowledge of spider composition in the xerothermic habitats of the Kŕéby National Nature Monument which is located in Kroměříž district, eastern Moravia. Spiders were collected by four different methods during 25 April–28 October 2013: pitfall traps, sweeping of herb vegetation, individual collecting and beating the branches of shrubs and trees. In total, 1070 individuals (865 adult spiders) were collected and identified as 114 species of 19 families. The species diversity in the Kŕéby area is rather high, representing approximately 13% of Czech araneofauna. Of the identified species, five are listed in the Red List of Threatened Species in the Czech Republic. These included critically endangered *Dysdera hungarica* Kulczynski 1897, endangered *Alopecosa solitaria* (Herman, 1879), *Cheiracanthium montanum* (C. L. Koch, 1877) and vulnerable *Lathys stigmatisata* (Menge, 1869) and *Haplodrassus dalmatensis* (L. Koch, 1866). The findings of *Alopecosa solitaria* and *Dysdera hungarica* belong to the northernmost occurrence of these rare species in the Czech Republic. In general, the great richness of spider fauna and the occurrence of rare and threatened species for Czech region confirm the high biotic value of the investigated area. In addition, the author discussed management methods of the locality and suggest management conservation system for slowing down the succession rate on overgrown places.

Keywords: spiders, Araneae, faunistics, habitat management, eastern Moravia, Czech Republic

INTRODUCTION

The Kŕéby National Nature Monument (NNM) is one of the oldest protected areas in the district Kroměříž and with its geographical location it is the northernmost xerotherm location in eastern Moravia. In the past, the area was used for extenzive grazing, as a fruit orchard and, in the individual parts of the locality, even the gravel-sand mining took place for a constructional using in the surrounding villages (Mackovčin *et al*., 2002). After the declaration of protected area, Kŕéby served as an important botanical and entomological locality with the occurrence of several significant xerothermophilic species. Several inventory surveys were carried there out (Grüll, 1985; Bezděčka, 2004; Darebník, 2005; Chládek, 2005). Spiders, an important component of xerothermic fauna, are used as bioindicators of environmental quality (Buchar 1983, 1991; Clausen, 1986; Pearce & Venier, 2006) and for evaluation of biota changes in relation to the landscape management (Isaia *et al*., 2006; Benítez & Méndez, 2011; Miyashita *et al*., 2012). This type of bio-indication, which is based on the investigation of species diversity and community composition, is called the ecological indication (Blandin, 1986).

From the arachnological point of view, no attention has been devoted to the territory of the Kŕéby NNM. Although the araneofauna

in the southern Moravia is well explored (e.g. Růžička, 1998; Bryja *et al.*, 2005; Růžička & Buchar, 2008; Niedobová *et al.*, 2011), xerothermic habitats and the surrounding agriculture landscape around Křéby were rather neglected by arachnologists. The closest arachnologically explored localities are located in the Vyškov district and include the xerothermic sites Malhotky NNR (Růžička, 1998; Hula, 2004a) and NNR Větrníky (Hula, 2004b). The surrounding area has also never been explored and the faunistic square of 6769 (which the surveyed locality belongs to) shows only a single record. This was carried out by Dr. Rozsypal in the 30th of 20th century. Later, the spider was determined by our famous arachnologist Prof. F. Miller as *Marpissa muscosa* and the record was published by Kůrka (2001). Since then, any spider species has not been registered in the examined area. Therefore, the recorded faunistic findings significantly extend the knowledge of the araneofauna of Křéby NNM and the adjacent territory.

MATERIAL AND METHODS

Study Area

The Křéby NNM is located in the district of Kroměříž in the Prasklice cadastral area, about 0.6 km east of the village of Kovalovice-Osíčany. Křéby was declared a protected area in 1956 and with its area of 4.73 ha it belongs to small-area protected sites. This small area consists of three refuges of grass steppe meadows on the right slope of the creek river Tištínka. The territory lies in the warm climate region (Quitt, 1971). The conservation area is situated at the altitude of 228–277 meters above the sea level. The geologic substrate is neogene calcareous sands and gravels. The soil types are brown earths and black soils, soils are sandy to loamy, highly permeable and highly drying up (Mackovčin *et al.*, 2002). The surrounding landscape is made up of agricultural fields with a predominance of cultivation of cereals and oilseed rape.

Sampling and Study Sites

Research on the spider fauna was carried out in 2013 during 25 April to 28 October. The spiders were collected using different sampling methods: pitfall trapping, individual collecting under stones and in grass, sweeping of herb vegetation and beating the shrubs and trees from the height of 30 to 200 cm. Sweeping of herb vegetation took place alongside each of the sampling plot (100 sweeps in each plot) at a maximum distance of 3 m from the line of pitfall traps. The sweep-net had a diameter of 40 cm and was fitted with a heavy cloth suitable for sampling spiders in the vegetation. After collection, the obtained material was preserved in 70% ethanol. As pitfall traps, 0.5-liter-jars with

1: *Design of collecting transects (for collecting methods used in every site see Material and Methods) (yellow line – borders of the locality, according to AOPK, Czech Republic)*

9 cm in diameter and 12 cm length, were used, one-third filled with a 4% formaldehyde solution with a drop of added detergent. The traps were emptied approximately once a month. The traps were placed in pairs at site *ca*. 10 m apart, except the site 2 and 6 where three pitfall traps were used, altogether 12 pitfall traps per studied locality were installed. Individual sites used for collecting spiders were identified by GPS coordinates (information below) and are shown in Fig. 1. The entire locality is located in faunistic square 6769 (Pruner & Míka, 1996).

St. 1 – Approximately 2 m high wall from sandstone and gravels, in the upper part overgrown by shrubs, lower part without connected vegetation. Spiders were collected by individual collecting on the rock wall and in crevices of the wall (49°17'8"N, 17°11'0"E).

St. 2 – Transect of three pitfall traps were placed in the south exposed xeric grassland with association *Cirsio Brachypodion pinnati* formed by dominant representation of *Brachypodium pinnatum*, *Peucedanum cervaria* and *Adonis vernalis*. Spiders were collected by pitfall traping and sweeping of herb vegetation (49°17'8"N, 17°10'53"E).

St. 3 – Steppe grassland with sparse vegetation on the bare surface of the sandstone rock. The slope is very steep, however with more dense vegetation structure at the bottom of slope. In addition to the exposure of the two pitfall traps was used method of sweeping and individual collecting. The entire area of the vegetation was mowed in August within the reservation management (49°17'10"N, 17°10'50"E).

St. 4 – Abandoned orchards with remnants of several fruit trees (*Malus domestica* and *Primus avium*) and shrubs (*Crataegus laevigata*, *Primus spinosa* and *Sambucus nigra*). In addition to the exposure of the two pitfall traps, method of sweeping and beating from trees and shrubs was used. The traps were overshadowed by trees and shrubs for most of the day (49°17'11"N, 17°10'46"E).

St. 5 – Gravel sand quarry outside the boundaries of protected area, 5 m deep quarry used for mining of sand and gravel with southern exposure, now abandoned. Spiders were collected by individual collecting in rock fissures and directly on the rock wall (49°17'11"N, 17°10'53"E).

St. 6 – Former mining pit for extraction of sand and gravel, now overgrown with dense xero- to mesophilic vegetation, presence of shrubs – *Cornus mas* and *Cornus sanguinea*. In addition to the exposure of three pitfall traps, sweeping and beating from trees and shrubs were used. The entire area of the vegetation was mowed in August within the reservations management (49°17'14 "N, 17°11'0"E).

St. 7 – Periodically disturbed meadow with southern exposure, presence of ruderal herb vegetation with dominant representation of *Urtica dioica*, *Taraxacum officinale* and *Elytrigia repens* (49°17'11 "N, 17 °11'14"E). Spiders were collected by pitfall traping and sweeping of herb vegetation

Species Classification

All adult spiders were determined to species level in accordance with Heimer & Nentwig (1991), Roberts (1995) and Nentwig *et al*. (2013).

Nomenclature and arrangement of families, genera and species follow the most recent version of the World Spider Catalog 15 (Platnick, 2014). Most of the species were determinated by the author (OK). Morphologically complicated taxons were revised and determinated by Vladimír Hula. Specimens of family Eutichuridae and Dysderidae were revised and determined by Jan Dolanský (JD) and Milan Řezáč (MŘ), respectively.

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); Occurrence level: VA (very abundant), A (abundant), S (scarce), R (rare), VR (very rare); Thermopreference: T (thermophilous), M (mesophilous), O (oreophilous) Conservation status: CR (critically endangered), EN (endangered), VU (vulnerable).

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); Pitfall traps (pt), Sweeping of herb vegetation (sw), Individual collecting under stones and in grass (ic).

RESULTS AND DISCUSSION

During the arachnological research of Křéby area from 25 April 2013 to 28 October 2013, a total number of 1070 spiders (865 adults, 205 juveniles) were collected. Out of this number, 114 species belonging to 19 families were determined. The majority of spiders comes from the pitfall traps (550 specimens belonging to 79 species from 16 families). The highest representation of species was found in the families Lycosidae (17 species), Thomisidae (16 species) and Gnaphosidae (13 species). These families were also the most numerous ones, since from the Lycosidae, Gnaphosidae, and Thomisidae families up to 384, 102, and 90 specimens respectively were collected.

Assemblages of spiders include mainly species typical for open (partly shaded) xeric grasslands, herein, represented by species of nature habitats (C), semi-natural habitats (SN), disturbed (D) and also

artificial habitats (Buchar & Růžička, 2002; Řezáč, 2009). Among the most numerous representatives in the surveyed area belong epigeic species typical for xerothermal open habitats – *Alopecosa cuneata* (Clerck, 1758), *Alopecosa pulverulenta* (Clerck, 1758) and *Haplodrassus signifer* (C. L. Koch, 1839). The dominant representation was found in euryvalent species *Pardosa lugubris* (Walckenaer, 1802) which has an abundant occurrence in shaded habitats with presence of shrubs and trees.

Rare epigeic species of spiders preferring undisturbed habitats belong to the significant findings: thermophilous ground dwellers *Gnaphosa lucifuga* (Walckenaer, 1802), *Haplodrassus dalmatensis* (L. Koch, 1866) and *Zelotes pygmaeus* Miller, 1943, crab spiders *Ozyptila scabricula* (Westring, 1851), *Xysticus acerbus* Thorell, 1872 and *Xysticus striatipes* L. Koch, 1870 and other xerothermophilous spider species. Most of these thermophilous species are strictly depended to the xeric grasslands with low vegetation structure and presence of barren surfaces (Bryja *et al.*, 2005; Košulič & Hula, 2013). These species belong to the major bioindication elements of well-preserved xerothermal habitats. Unfortunately, such habitats are diminishing in the constantly intensified landscape of southern Moravia due to intensified agriculture and poorly-led interventions into the landscape (Konvička *et al.*, 2005; Čížek *et al.*, 2013).

According to the evaluation of occurrence level in the Czech Republic (Buchar & Růžička, 2002), two species belonging to the category very rare (VR) were found. They are also registered in the Red List of Threatened Species in the Czech Republic (Růžička, 2005). It includes themophilous *Dysdera hungarica* Kulczyński 1897 in the category of critically endangered (CR) and endangered (EN) *Alopecosa solitaria* (Herman, 1879) and *Cheiracanthium montanum* (C. L. Koch, 1877).

The very rare *Alopecosa solitaria* was found only on the south-facing slopes with sparse vegetation with presence of barren surfaces and non continuous vegetation coverage. Findings of the *A. solitaria* and *D. hungarica* belong to the second northernmost occurrence of these rare species in the Czech Republic.

Ten representatives from the category rare species (R) were found (Tab. I). These species usually prefer nature habitats (C) and require stable and suitable microclimatic conditions of habitat. In the Czech Republic, they are present locally at suitable xeric localities (Buchar & Růžička, 2005; Růžička & Buchar, 2008).

Concerning the Red List of Threatened Species in the Czech Republic (Růžička, 2005), five species belonging to categories CR (critically endangered), EN (endangered) and VU (vulnerable) were found. These species include the following: above mentioned *D. hungarica* (CR), *A. solitaria* (EN), *Cheiracanthium montanum* (EN) and further *H. dalmatensis* (VU) and *Lathys stigmatisata* (Menge, 1869) (VU).

Several important bioindicative species of natural to semi-natural habitats were found on the wall comprised of gravel and sand of the former quarry located outside the protected site and lined only by a conservation zone. *Gnaphosa lucifuga* (Walckenaer, 1802), *Salticus zebraneus* (C. L. Koch, 1837) and *Xysticus striatipes* L. Koch, 1870 belong to these rare species. Therefore, I suppose it would be suitable to include this habitat into the protected territory, so that it will be subject of the recommended management methods. In contrast, very abundant expansive species typical for man-disturbed habitats were detected in high abundances in the eastern part of the territory in a south-facing meadow. This part of investigated area was ploughed up in the year preceding the research, which was subsequently repeated this year again (September 2013).

With regard to small size of the territory, the overall diversity recorded (114 species) is very high and significantly exceeds that of xerothermal sites in the vicinity (Větrníky NNR – 42 species, Malhotky NNR – 70 species). In addition, several species typical for the best preserved sites of south and southeast Moravia (Pouzdřany NNR, Dunajovické kopce NNR, Mohelenská hadcová step NNR) were found, which is, in respect to nature conservation, a very important piece of information for future management planning in relation to this site.

Annotated list of Significant Species

Dysderidae

Dysdera hungarica Kulczyński, 1897 C, T, VR, CR

A very rare species distributed exclusively in the warmest parts of southern Moravia (Řezáč & Bryja, 2002). Its findings are reported from warm habitats of Podyjí NP, Pálava PLA, Pouzdřanská step NNR, Dunajovické kopce NNR, around Brno and from vineyard terraces around Břeclav and Hodonín (Řezáč, 2012; Košulič & Hula, 2013). 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 man (Řezáč, 2012). The finding of *D. hungarica* in the surveyed locality belongs to the northernmost occurrence of this species in Moravia (Fig. 2).

Data: Site 6, 25. 9.–28. 10. 2013, pt, 1♀, det. MŘ.

Linyphiidae

Nematogmus sanguinolentus (Walckenaer, 1841) C, T, R

A rare species typical by orange colour of the body. In the Czech Republic, this species is known from steppe and forest steppe habitats in the warmest regions. According to Bryja *et al.* (2005), it is quite common in Pálava region, on dry and sunny stands where it prefers localities on sandy or loess soils. The species was found at a nearby locality Větrníky NNR (Hula, 2004b).

Data: Site 3, 25. 5.–10. 6. 2013, sw, 1♀, det. OK.

Lycosidae

Alopecosa solitaria (Herman, 1879) C, T, VR, EN

A very rare thermophilic species occurring in rocky steppes and edges of thin forests, it has not been found in Bohemia at all and it is mapped only at a few locations in Moravia (Buchar & Růžička, 2002). More frequent findings are reported by Bryja *et al.* (2005) in Pálava PLA and Dunajovické kopce NNR. Individual findings are published from rather small Kamenný vrch NR near Kurdějov and Louky pod Kumstátem NR near Krumvíř in the district of Břeclav (Košulič & Hula, 2011a, 2011b). Other localities of its occurrence include location at Krumlovsko-Rokytenské slepence (Bryja, 2002). It is a significant element of the Pannonian araneofauna in the Czech Republic. An important element for its presence is disturbed-sparse grass turf, in which it digs burrows, higly important components of its development. The finding of *A. solitaria* in the surveyed locality (Fig. 3) belongs to the northernmost occurrence of this species in the Czech Republic (with unpublished findings in Prostějov region, O. Machač, pers comm.).

Data: Site 1, 25. 4.–25. 5. 2013, pt, 1♂; 25. 5.–10. 6. 2013, pt, 2♀; Site 2, 25. 5.–10. 6. 2013, ic, 1♀; 10. 6.–14. 7. 2013, pt, 3♀, det. OK.

Dictynidae

Lathys stigmatisata (Menge, 1869) C, T, R, VU

A rare species living at ground level of rock steppes and other xerotherms. According to Bryja *et al.* (2005), it is a scarce/rare species, occurring in suitable habitats of southern Moravia. The finding in the area of Křéby belongs to the first information about this species in eastern Moravia and the sixth record for region of Moravia (Fig. 4). The spider is threatened by overgrowing of herb vegetation and establishing of dense grass turf.

Data: Site 2, 25. 5.–10. 6. 2013, pt, 1♂; Site 3, 25. 5.–10. 6. 2013, pt, 1♂; Site 6, 14. 7.–24. 8. 2013, pt, 1♀, leg. OK.

Eutichuridae

Cheiracanthium montanum (C. L. Koch, 1877) C, T, VR, EN

A very rare thermophilic species inhabiting xeric grasslands and meadows. Majority of faunistic squares of this species belong to Moravia, while in Bohemia there is only one record from Lovoš at Lovosice (Dolanský, 2011). Most findings are recorded from valuable nature localities, very often located in small protected areas (Dolanský, 2011). Hula *et al.* (2009) and Košulič *et al.* (2011) points out the link to the empty shells of land snails of the genus *Xerolenta* used by subadult specimens for hibernation during the winter months. Significant information about the expansion of this rare thermophilic spider (Fig. 5).

Data: Site 2, 10. 6. 2013, sw, 1♂, det. JD; Site 3, 25. 5. 2013, sw, 1♀, det. JD.

Gnaphosidae

Haplodrassus dalmatensis (L. Koch, 1866) C, R, T, VU

A rare species occurring among grass and stones on steppes, forest-steppes and another undisturbed xeric habitats. Also found in limestone quarries of Bohemia (Kůrka *et al.*, 2010) and Moravia (Hula & Šťastná, 2010) and in xeric slopes of vineyard terraces around southern Moravia (Košulič & Hula, 2013). Růžička (1998) mentioned one finding from sandy habitats of Vojenské cvičiště Bzenec NM in southern Moravia. The presence of sufficient number of loose stones which are used by these spiders as their shelter is an important factor. According to Bryja *et al.* (2005), it is quite common in Pálava region, on dry and sunny stands where it prefers localities on sandy or loess soils. The second finding of this species for region of eastern Moravia (Fig. 6).

Data: Site 2, 25. 5.–10. 6. 2013, ic, 1♀; Site 3, 25. 4.–25. 5. 2013, pt, 1♂, leg. OK.

Notes to Conservation Management of the Studied Locality

Arachnological survey of the Křéby NNM revealed unique spider species composition which can be characterized by the presence of steppe (incl. pannonian) elements typical for the best preserved xeric habitats of southern Moravia. In accordance with the obtained results, the most valuable part of Křéby NNM are steep south-facing slopes of steppe grasslands (association of *Cirsio-Brachypodion pinnati*).

The most endangered species, requiring specific microhabitat conditions formed by disturbed grass turf and non continuous vegetation structure with exposed soil substrate, were found at those sites. Therefore, specific management interventions should be introduced there to enhance density and distribution of the microhabitat scale sites. The proposed methods definitely include grazing management (controlled grazing) with systematic monitoring of its impact on local fauna of invertebrates (Batáry *et al.*, 2013). After grazing, it would be necessary to keep the whole area under protection, otherwise it will be quickly settled by a variety of nitrophilous plant species from the surroundings. Grazing should be carried out in a manner where the entire area of the reserve is not grazed. Small non-grazed fences (generally 2 × 2 m) should be kept separately within the grazed area. These places would serve as refuges for invertebrates which grazing is not suitable for (Hula, 2004a; Konvička *et al.*, 2005). Moreover, grazing which prevented gradual succession had already been carried out at Křéby in the past (Mackovčin *et al.*, 2002). Nowdays, the locality is mowed at an annual basis and subsequently, mowed vegetation is collected (mowing was performed in September during the surveyed period). Although this type of management prevents gradual overgrowing, it leads to condensing vegetation at the soil surface,

I: *Summary of 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); Thermopreferences: T (thermophilous), M (mesophilous), O (oreophilous); Conservation status: CR (critically endangered), EN (endangered), VU (vulnerable).*

Family	Species	Occurence level	Habitat preferences	Thermo-preferences	Conservation status
Pholcidae	*Pholcus opilionoides* (Schrank, 1781)	VA	C, SN, A	-	
Dysderidae	*Dysdera hungarica* Kulczynski 1897	VR	C	T	CR
Theridiidae	*Asagena phalerata* (Panzer, 1801)	A	C, SN	(T), M, (O)	
	Cryptachaea riparia (Blackwall, 1834)	A	C, SN	(T), M	
	Enoplognatha latimana Hippa & Oksala, 1982	A	C, SN, D	T, M	
	Enoplognatha thoracica (Hahn, 1833)	A	C, SN, D	T, M	
	Euryopis flavomaculata (C. L. Koch, 1836)	A	C, SN	T, M	
	Neottiura bimaculata (Linné, 1767)	VA	C, SN, D	T, M	
	Paidiscura pallens (Blackwall, 1834)	S	C, SN	M	
	Parasteatoda lunata (Clerck, 1757)	A	C, SN	(T), M	
	Platnickina tinctum (Walckenaer, 1802)	A	C, SN	T, M	
	Phylloneta impressa (L. Koch, 1881)	VA	C, SN, D	T, M, O	
	Robertus lividus (Blackwall, 1836)	VA	C, SN	T, M, O	
	Theridion varians Hahn, 1833	VA	C, SN, D	T, M	
Linyphiidae	*Agyneta rurestris* (C. L. Koch, 1836)	VA	C, SN, D	T, M, O	
	Diplostyla concolor (Wider, 1834)	VA	C, SN, D	T, M, O	
	Erigone atra Blackwall, 1833	VA	C, SN, D	T, M, O	
	Linyphia triangularis (Clerck, 1757)	VA	C, SN, D	T, M	
	Nematogmus sanguinolentus (Walckenaer, 1841)	R	C	T	
	Oedothorax apicatus (Blackwall, 1850)	A	C, SN	T, M	
	Stemonyphantes lineatus (Linné, 1758)	A	C, SN, D	(T), M	
	Tenuiphantes cristatus (Menge, 1866)	VA	C, SN	M, (O)	
	Tenuiphantes flavipes (Blackwall, 1854)	VA	C, SN	T, M	
	Walckenaeria atrotibialis (O. P.-Cambridge, 1878)	VA	C, SN	T, M, O	
Tetragnathidae	*Pachygnatha degeeri* Sundevall, 1830	VA	C, SN, D	T, M, (O)	
	Tetragnatha pinicola L. Koch, 1870	VA	C, SN	T, M	
Araneidae	*Aculepeira ceropegia* (Walckenaer, 1802)	VA	C, SN, D	(T), M	
	Araneus diadematus Clerck, 1757	VA	C, SN, A	T, M, O	
	Araneus quadratus Clerck, 1757	VA	C, SN	(T), M	
	Araniella cucurbitina (Clerck, 1757)	VA	C, SN, D	(T), M	
	Araniella opisthographa (Kulczyński, 1905)	S	C, SN	T, M	
	Argiope bruennichi (Scopoli, 1772)	A	C, SN, D	T, M	
	Cercidia prominens (Westring, 1851)	A	C, SN	T, M	
	Hypsosinga albovittata (Westring, 1851)	S	C, SN	T, M	
	Hypsosinga sanguinea (C. L. Koch, 1844)	A	C, SN	(T), M	
	Mangora acalypha (Walckenaer, 1802)	VA	C, SN, D	T, M	
	Nuctenea umbratica (Clerck, 1757)	A	C, SN, A	(T), M	
	Singa hamata (Clerck, 1757)	A	C, SN	T, M	
Lycosidae	*Alopecosa accentuata* (Latreille, 1817)	A	C, SN	T, M	
	Alopecosa cuneata (Clerck, 1757)	VA	C, SN, D	T, M, (O)	
	Alopecosa pulverulenta (Clerck, 1757)	VA	C, SN, D	T, M, O	
	Alopecosa solitaria (Herman, 1879)	VR	C	T	EN
	Aulonia albimana (Walckenaer, 1805)	A	C, SN	T, M	
	Pardosa agrestis (Westring, 1861)	VA	SN, D	T, M	
	Pardosa hortensis (Thorell, 1872)	S	C, SN, D	T	
	Pardosa lugubris (Walckenaer, 1802)	VA	C, SN, D	T, M, O	

Family	Species	Occurence level	Habitat preferences	Thermo-preferences	Conservation status
Lycosidae	*Pardosa palustris* (Linné, 1758)	VA	C, SN, D	T, M, O	
	Pardosa prativaga (L. Koch, 1870)	VA	C, SN, D	T, M	
	Pardosa pullata (Clerck, 1757)	VA	C, SN, D	T, M, O	
	Pardosa riparia (C. L. Koch, 1833)	A	C, SN	T, M, O	
	Trochosa robusta (Simon, 1876)	S	C, SN	T, M	
	Trochosa ruricola (De Geer, 1778)	VA	C, SN, D	T, M	
	Trochosa terricola Thorell, 1856	VA	C, SN, D	T, M, (O)	
	Xerolycosa miniata (C. L. Koch, 1834)	S	C, SN	T, M	
	Xerolycosa nemoralis (Westring, 1861)	VA	C, SN	T, M, O	
Pisauridae	*Pisaura mirabilis* (Clerck, 1757)	VA	C, SN, D	T, M	
Miturgidae	*Zora nemoralis* (Blackwall, 1861)	A	C, SN	(T), M	
	Zora spinimana (Sundevall, 1833)	VA	C, SN, D	T, M, (O)	
Agelenidae	*Allagelena gracilens* (C. L. Koch, 1841)	A	C, SN, A	T, M	
	Eratigena agrestis (Walckenaer, 1802)	S	C, SN, D	T, M	
	Tegenaria campestris (C. L. Koch, 1834)	S	C, SN	T, M	
Dictynidae	*Dictyna arundinacea* (Linné, 1758)	VA	C, SN, D	(T), M	
	Dictyna uncinata Thorell, 1856	A	C, SN, D	(T), M	
	Lathys stigmatisata (Menge, 1869)	R	C	T	VU
	Nigma flavescens (Walckenaer, 1830)	A	C, SN	T, M	
Eutichuridae	*Cheiracanthium montanum* (C. L. Koch, 1877)	VR	C	T	EN
Anyphaenidae	*Anyphaena accentuata* (Walckenaer, 1802)	S	C, SN	T, M	
Liocranidae	*Agroeca brunnea* (Blackwall, 1833)	VA	C, SN	T, M	
	Agroeca cuprea Menge, 1873	A	C, SN	T, M	
Clubionidae	*Clubiona lutescens* Westring, 1851	A	T, M	(T), M	
	Clubiona neglecta O. P.-Cambridge, 1862	VA	C, SN	(T), M	
Gnaphosidae	*Drassodes lapidosus* (Walckenaer, 1802)	VA	C, SN	T, M	
	Drassodes pubescens (Thorell, 1856)	VA	C, SN	T, M	
	Drassyllus praeficus (L. Koch, 1866)	A	C, SN	T, M	
	Drassyllus pumilus (C. L. Koch, 1839)	R	C	T, M	
	Drassyllus pusillus (C. L. Koch, 1833)	A	C, SN, D	T, M	
	Gnaphosa lucifuga (Walckenaer, 1802)	S	C	T	
	Haplodrassus dalmatensis (L. Koch, 1866)	R	C	T	VU
	Haplodrassus signifer (C. L. Koch, 1839)	VA	C, SN, D	T, M, O	
	Haplodrassus silvestris (Blackwall, 1833)	A	C, SN	(T), M	
	Trachyzelotes pedestris (C. L. Koch, 1837)	A	C, SN, D	T, (M)	
	Zelotes apricorum (L. Koch, 1876)	S	C, SN	T, M	
	Zelotes latreillei (Simon, 1878)	VA	C, SN, D	(T), M	
	Zelotes pygmaeus Miller, 1943	R	C	T	
Philodromidae	*Philodromus albidus* Kulczyński, 1911	A	C, SN, D	T, M	
	Philodromus cespitum (Walckenaer, 1802)	VA	C, SN, D	T, M	
	Philodromus collinus C. L. Koch, 1835	VA	C, SN	(T), M, (O)	
Thomisidae	*Diaea dorsata* (Fabricius, 1777)	VA	C, SN	T, M	
	Ebrechtella tricuspidata (Fabricius, 1775)	S	C, SN	T, (O)	
	Ozyptila atomaria (Panzer, 1801)	S	C, SN	T, M	
	Ozyptila claveata (Walckenaer, 1837)	S	C	T, M	
	Ozyptila praticola (C. L. Koch, 1837)	S	C, SN	T, M	
	Ozyptila scabricula (Westring, 1851)	R	C	T, M	
	Ozyptila trux (Blackwall, 1846)	VA	C, SN, D	M, (O)	

Family	Species	Occurence level	Habitat preferences	Thermo-preferences	Conservation status
Thomisidae	*Synema globosum* (Fabricius, 1775)	R	C, SN	T, M	
	Xysticus acerbus Thorell, 1872	R	C	T, (M)	
	Xysticus audax (Schrank, 1803)	VA	C, SN	(T), M, (O)	
	Xysticus cristatus (Clerck, 1757)	VA	C, SN, D	T, M, (O)	
	Xysticus erraticus (Blackwall, 1834)	A	C, SN	(T), M	
	Xysticus kochi Thorell, 1872	A	C, SN	T, M	
	Xysticus lanio C. L. Koch, 1835	S	C, SN	T, M	
	Xysticus striatipes L. Koch, 1870	R	C	T, M	
	Xysticus ulmi (Hahn, 1831)	A	C, SN	(T), M	
Salticidae	*Euophrys frontalis* (Walckenaer, 1802)	A	C, SN	T, M	
	Evarcha arcuata (Clerck, 1757)	VA	C, SN	T, M	
	Evarcha laetabunda (C. L. Koch, 1846)	S	C	T, (M)	
	Heliophanus auratus C. L. Koch, 1835	S	C, SN	T, M	
	Heliophanus cupreus (Walckenaer, 1802)	A	C, SN	T, M	
	Heliophanus flavipes (Hahn, 1832)	A	C	(T), M	
	Phlegra fasciata (Hahn, 1826)	A	C, SN	T, M	
	Pseudeuophrys erratica (Walckenaer, 1826)	A	C, SN	T, M	
	Salticus scenicus (Clerck, 1757)	VA	A	T, M	
	Salticus zebraneus (C. L. Koch, 1837)	A	C, SN	(T), M	
	Talavera aperta (Miller, 1971)	R	C, SN	T, M	

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

	Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Sum
1.	*Agroeca brunnea*							2	2
2.	*Agroeca cuprea*		1						1
3.	*Agyneta rurestris*				1		2		3
4.	*Allagelena gracilens*			1			1		2
5.	*Alopecosa accentuata*		8	4	2			13	27
6.	*Alopecosa cuneata*		5	1	12	1	43	12	74
7.	*Alopecosa pulverulenta*		3	3	21		10	44	81
8.	*Alopecosa solitaria*		3	4					7
9.	*Anyphaena accentuata*						5		5
10.	*Araneus diadematus*				1				1
11.	*Araneus quadratus*				1				1
12.	*Araniella cucurbitina*						2		2
13.	*Araniella opistographa*				1		1		2
14.	*Argiope bruennichi*							2	2
15.	*Asagena phalerata*		2	1					3
16.	*Aulonia albimana*		1	1	6		7	11	26
17.	*Cercidia prominens*		1	1			1		3
18.	*Cheiracanthium montanum*			2					2
19.	*Clubiona lutescens*				2				2
20.	*Clubiona neglecta*	1		1				1	3
21.	*Cryptachaea riparia*		2						2
22.	*Diaea dorsata*			2	2		2		6
23.	*Dictyna arundinacea*		3				1		4
24.	*Dictyna uncinata*				11		4		15
25.	*Diplostyla concolor*		2	2	5				9

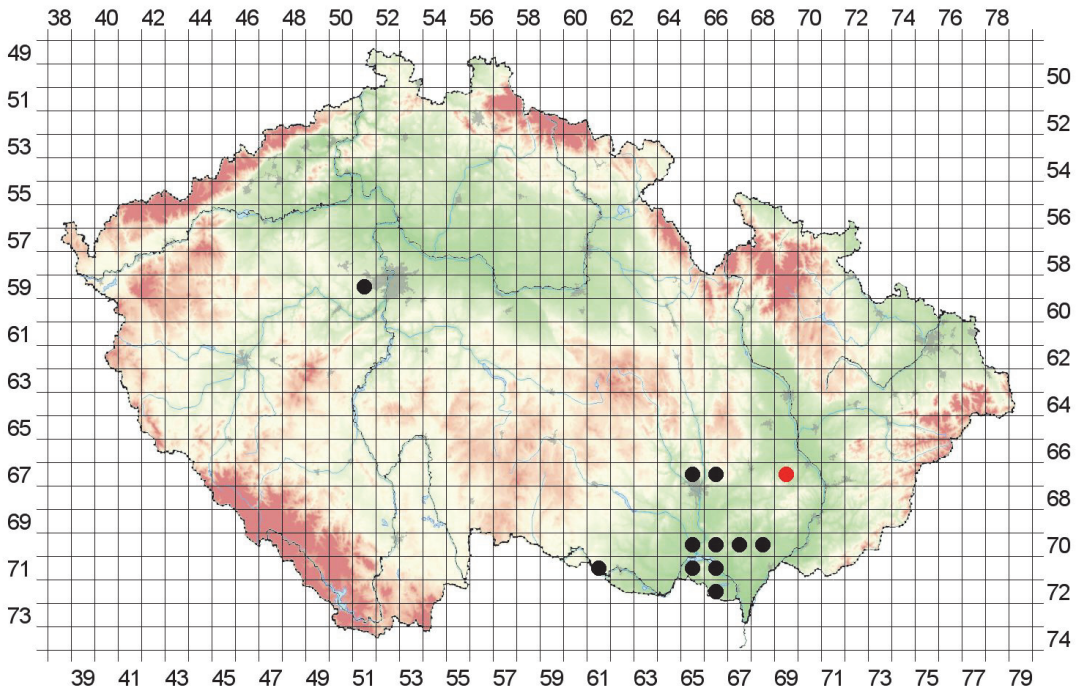
	Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Sum
26.	*Drassodes lapidosus*			2					2
27.	*Drassodes pubescens*		1	3			1		5
28.	*Drassyllus praeficus*		1		3		1		5
29.	*Drassyllus pumilus*			1					1
30.	*Drassyllus pusillus*		1		4		1	2	8
21.	*Dysdera hungarica*						1		1
32.	*Ebrechtella tricuspidata*						3		3
33.	*Enoplognatha latimana*						4	1	5
89.	*Enoplognatha thoracica*				1				1
35.	*Eratigena agrestis*			3					3
36.	*Erigone atra*			2	4		2		8
37.	*Euophrys frontalis*		2						2
38.	*Euryophys flavomaculata*			2					2
39.	*Evarcha arcuata*		5			2	8		15
40.	*Evarcha laetabunda*		1				1		2
41.	*Gnaphosa lucifuga*		3			3			6
42.	*Haplodrassus dalmatensis*		1	1					2
43.	*Haplodrassus signifer*		8	27	5		4	14	58
44.	*Haplodrassus silvestris*				1				1
45.	*Heliophanus auratus*		2		1				3
46.	*Heliophanus cupreus*		5						5
47.	*Heliophanus flavipes*			2			1		3
48.	*Hypsosinga albovittata*		5				3		8
49.	*Hypsosinga sanguinea*		8	5			10		23
50.	*Lathys stigmatisata*		1	1			1		3
51.	*Linyphia triangularis*				3		2		5
52.	*Mangora acalypha*		3	4			20		27
53.	*Nematogmus sanguilentus*			1					1
54.	*Neottiura bimaculata*		2				1		3
55.	*Nigma flavescens*						1		1
56.	*Nucteanea umbratica*				2				2
57.	*Oedothorax apicatum*					1		2	3
58.	*Ozyptila atomaria*		1				1		2
59.	*Ozyptila clavaeta*			1		1			2
60.	*Ozyptila praticola*			1	3		1	4	9
61.	*Ozyptila scabricula*	1	2	5	1		3		12
62.	*Ozyptila trux*						1	1	2
63.	*Paidiscurra pallens*				1				1
64.	*Pachygnatha degeeri*							3	3
65.	*Parasteatoda lunata*			1					1
66.	*Pardosa agrestis*							27	27
67.	*Pardosa hortensis*	1	2			2			5
68.	*Pardosa lugubris*				45				45
69.	*Pardosa palustris*							30	30
70.	*Pardosa prativaga*							12	12
71.	*Pardosa pullata*						1	8	9
72.	*Pardosa riparia*						1	10	11
73.	*Philodromus albidus*				1		2		3
74.	*Philodromus cespitum*			1			4		5

	Species	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Sum
75.	*Philodromus collinus*				2				2
76.	*Phlegra fasciata*		2	1			1		4
77.	*Pholcus opilionoides*	6				2			8
78.	*Phylloneta impressa*			2		1	7	2	12
79.	*Pisaura mirabilis*		4				2		6
80.	*Platnickina tincta*				1			3	4
81.	*Pseudophrys erratica*				2		1		3
82.	*Robertus lividus*		1					1	2
83.	*Salticus scenicus*	3							3
84.	*Salticus zebraneus*				3	1			4
85.	*Singa hamata*						1		1
86.	*Stemonyphantes lineatus*						1		1
87.	*Synema globosum*				1		1		2
88.	*Talavera aperta*						1		1
89.	*Tegenaria campestris*						1		1
90.	*Tenuiphantes cristatus*			1	2				3
91.	*Tenuiphantes flavipes*				2			1	3
92.	*Tetragnatha pinicola*						1		1
93.	*Theridion varians*						3		3
94.	*Tibellus oblongus*		5	1	2		5		13
95.	*Trachyzelotes pedestris*				1			3	4
96.	*Trochosa robusta*		2	1					3
97.	*Trochosa rurricola*				1			7	8
98.	*Trochosa terricola*		1		1	1	3	3	9
99.	*Walckenaeria atrotibialis*			1			1		2
100.	*Xerolycosa miniata*		1	1					2
101.	*Xerolycosa nemoralis*				2			6	8
102.	*Xysticus acerbus*		1	1			2		4
103.	*Xysticus audax*		1		1				2
104.	*Xysticus cristatus*			2			5	6	13
105.	*Xysticus erraticus*				1				1
106.	*Xysticus kochi*		9	3			3	7	22
107.	*Xysticus lanio*	1			1				2
108.	*Xysticus striatipes*					2	3		5
109.	*Xysticus ulmi*			1	2		2		5
110.	*Zelotes apricorum*						3		3
111.	*Zelotes latrellei*						2		2
112.	*Zelotes pygmaeus*			1					1
113.	*Zora nemoralis*		1	1			3		5
114.	*Zora spinnimana*				4	1		1	6
	Total sum	13	113	103	169	18	210	239	865

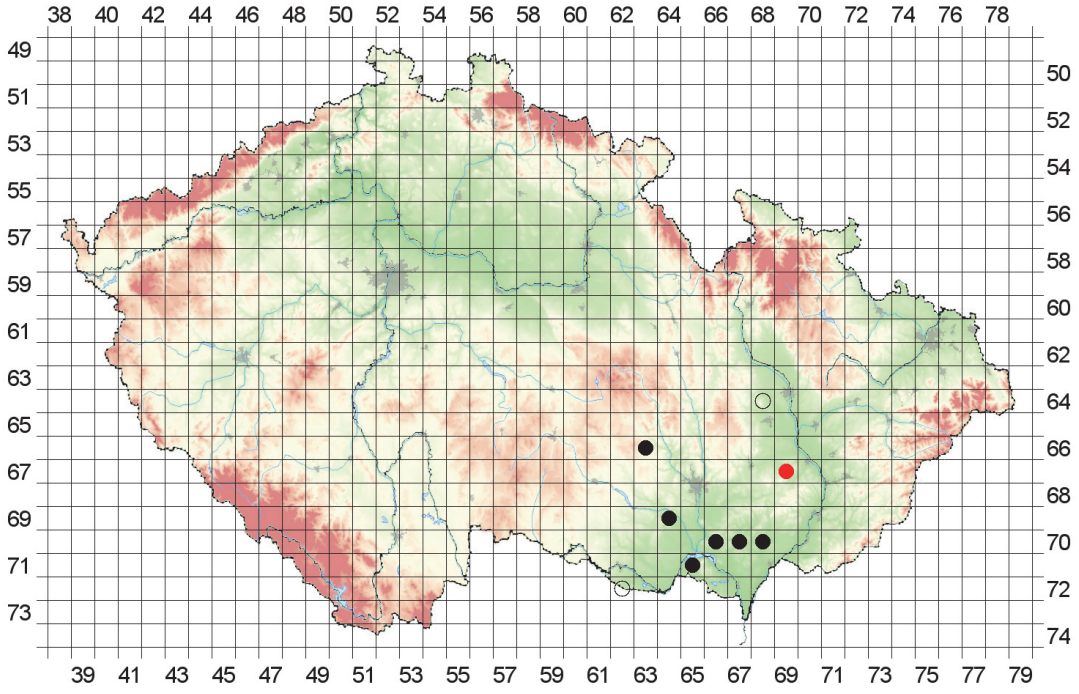
thereby changing the microclimatic conditions (Noordijka *et al*., 2010). Unlike grazing, mowing fails to create places with barren surface favorable for rare steppe species of spiders and other invertebrates.

Further, the former gravel-sand quarry (at the nature protection zone) should be included into the western part (site 5) of the NNM. Thus, the abandoned grawel-sand quarry would be protected as well. This proposal is based on observation that rare species of spiders were found even in this anthropogenically originated habitat and it is likely that other species of invertebrates occur there as well. At the same time, the importance of abandoned quarries is reported by a number of other authors (e.g. Beneš *et al*., 2003; Tropek *et al*., 2010).

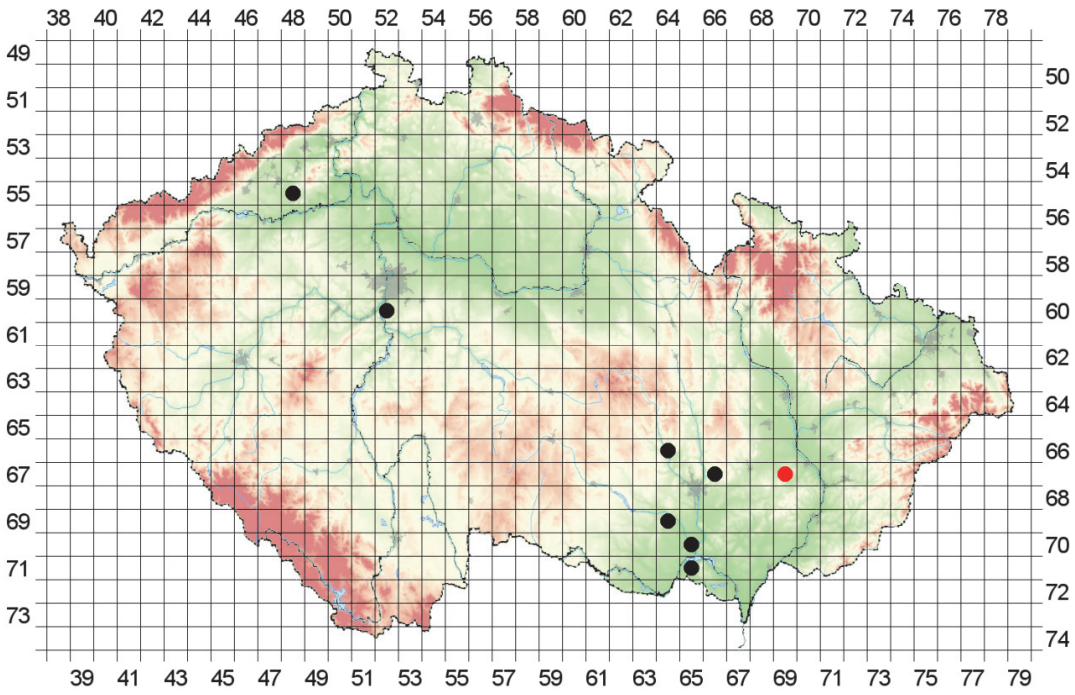
I evaluated the eastern part of the site (site 7) strongly negatively. This grassland meadow was



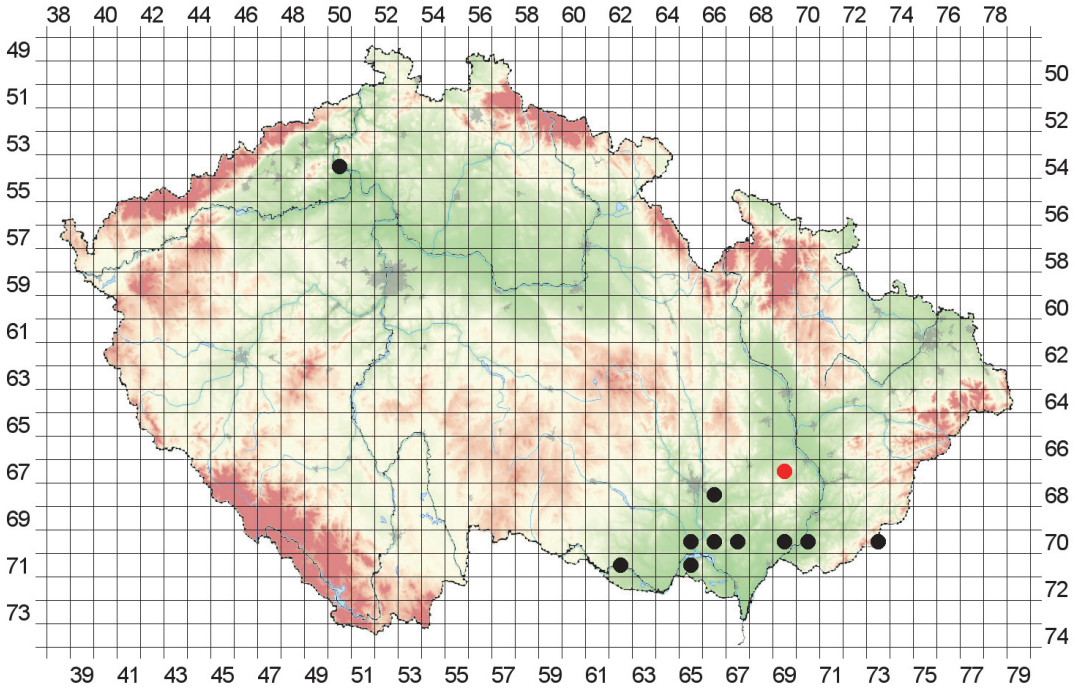
2: *Distribution of Dysdera hungarica Kulczynski 1897 in the Czech Republic (red dot – studied locality Křéby)*



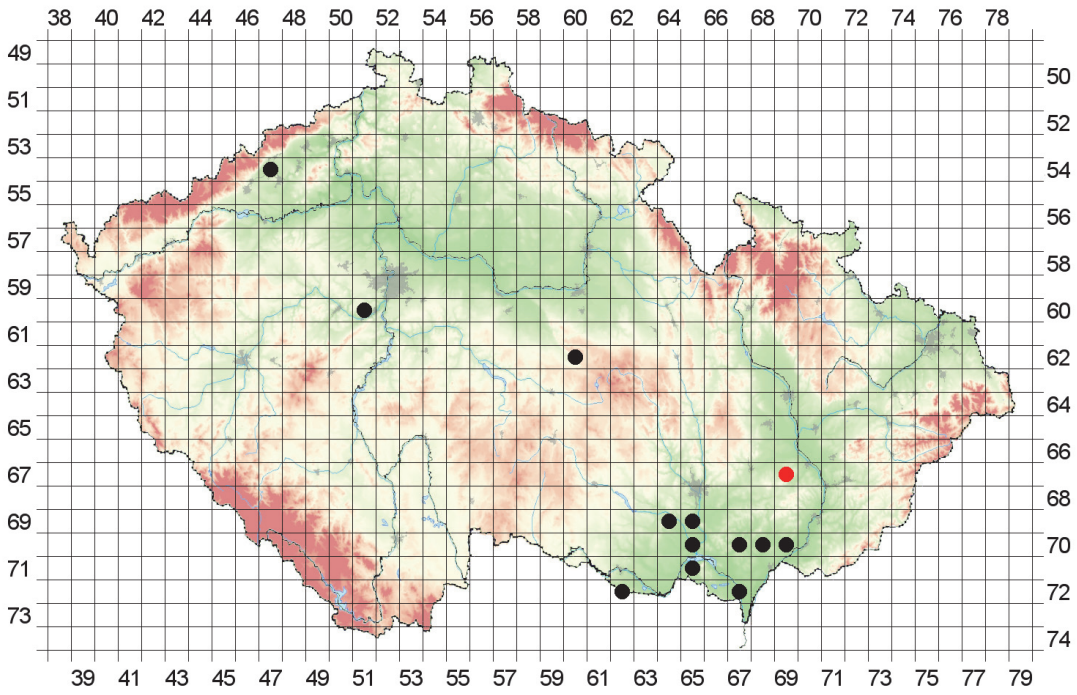
3: *Distribution of Alopecosa solitaria (Herman, 1879) in the Czech Republic (empty dot – unpublished data, red dot – studied locality Křéby)*



4: *Distribution of Lathys stigmatisata (Menge, 1869) in the Czech Republic (red dot – studied locality Křéby)*



5: *Distribution of Cheiracanthium montanum (C. L. Koch, 1877) in the Czech Republic (red dot – studied locality Křéby)*



6: *Distribution of Haplodrassus dalmatensis (L. Koch, 1866) in the Czech Republic (red dot – studied locality Křéby)*

apparently ploughed up last year (2012) and it was reploughed in autumn of 2013 again. As a consequence, a ruderal community of expansive euryvalnt spiders (*Pardosa agrestis, P. prativaga, P. pullata*) formed there, indicating disturbed and degraded habitats. Within the proposed management, it is necessary to determine the causes of such disturbance of the locality and to introduce appropriate methods to prevent similar destruction. It is necessary to leave the destructed site to the process of spontaneous succesion with occasional management interventions (removal of pioneer trees and expansive grasses).

SUMMARY

In 2013 a research of araneofauna of the Křéby National Nature Monument was performed on seven study sites (on five of them by pitfall trapping). Altogether, 1070 specimens belonging to 114 species were captured. The species diversity in the Křéby area is rather high, representing approximately 13% of araneofauna of the Czech Republic. Among the identified species, five are listed in the Red List of Threatened Species in the Czech Republic. These included critically endangered *Dysdera hungarica* Kulczynski 1897, endangered *Alopecosa solitaria* (Herman, 1879), *Cheiracanthium montanum* (C. L. Koch, 1877) and vulnerable *Lathys stigmatisata* (Menge, 1869) and *Haplodrassus dalmatensis* (L. Koch, 1866). In total, a rich spectrum of xerothermophilous species was found, living mainly in the well preserved steppe habitats and other small xerothermic areas that are gradually disappearing from the landscape of the Czech Republic. In terms of the conservation management proposal, the most important points include introduction of grazing management in appropriate parts of the site and limiting mowing of vegetation to stripes and in small areas only. Due to the occurrence of rare species of spiders (and presumably other rare invertebrates as well), I propose to include the gravel and sand quarry into the protected territory. Another important suggestion is the prevention of periodic disturbance (ploughing) of the third part of the site which can also be performed from the legal point of view. My findings confirm a high importance of Křéby as a refuge for xerothermophilous communities of spiders in the agriculturally intensified landscape of Kroměříž region. The Křéby NNM thus acts as a crucial point for thermophilic species as a transition zone between thermophyticum and mesophyticum.

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