SPIDERS (ARANEAE) OF SELECTED SINKHOLES OF MORAVSKÝ KRAS PROTECTED LANDSCAPE AREA (CZECH REPUBLIC)

V. Hula, O. Košulič, P. Šťastná

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Abstract


In this study, we present faunistic data about spiders in selected sinkholes of northern part of Moravský krás Protected Landscape Area. Time of collection was established in the following terms: 24 March 2010 – 22 September 2010. We collected altogether 5742 adult specimens which were determined to 59 species of 14 families. We found two very rare spiders (critically endangered Porrhomma errans and endangered Walckenaeria monoceros) and several interesting, rarely collected bioindicator species (Alopecosa trabalis, Mecopistes silus, Zelotes longipes). From the bioindicative evaluation point of view, 44% of found species belong to species with connection to natural habitats, 37% belong to species preferring semi-natural habitats, and 19% belong to species of disturbed habitats. From the relictness point of view, majority of species was of the expansive category (53%), 40% of class II relicts, and only 7% of class I relicts. Sink holes did not increase total biodiversity of agricultural land too much because of their relative small size.

Araneae, faunistics, sinkholes, Moravský krás PLA

Nature in central Europe is under a very strong pressure. Over the last 100 years, there have been very significant changes in the landscape use. One of them was the connection of field plots to large areas. This caused a loss of landscape heterogeneity and a significant loss of biodiversity. In fact, there is no diversity in current agrarian landscape. Heterogeneity is represented only by small pieces of wood in the middle of fields and, in some places, also by catch crop incurred within the EU subsidies. Unfortunately, we do not know how big the landscape heterogeneity should be in order to grow the diversity back.

In Moravský krás PLA there is a huge range of natural biotopes, however, most of them are located in the southernmost part (Hády, Ochoz, Lysá hora) or in the karst valleys. Agrarian landscape is relatively homogeneous, it is located mainly in the karst plateaus. In past years, in particular in 70s–80s, these plateaus (Ostrovská plošina a Harbechy) were converted made into arable land. Sinkholes are one of the few elements of this landscape, which increase the heterogeneity of the environment. They are mostly without management (or were without management for a long time). Some of the sinkholes were systematically destroyed – filled by soil or in some cases by waste. Nowadays, the entire plateau is protected and, thanks to the agro-environmental subsidies from Ministry of Agriculture of the Czech Republic, most of the Ostrovská plošina surface is covered by grass. Interest in sinkholes has also increased currently. Previously, they represented neglected areas, but recently they have become important places for wintering bats (usually open entrances to caves). We therefore wondered whether there are some interesting species in these places and how big are their populations. Fauna of sinkholes in the Czech Republic was studied only by Horáková (2005) and Horáková et al. (2005), no more works exist.
MATERIALS AND METHODS

Spiders were collected at selected locations according to the methodology proposed by Řezáč (2009): formaldehyde pitfall traps with roofs. The pitfall traps were installed on 24 March 2010. Nine traps were placed over the entire sinkhole. Two traps (the first one and the last one) were placed outside the sinkhole in surrounding vegetation, four traps were placed on the sides of the sinkhole (in the upper part and in the slope) and one was placed at the bottom of the sinkhole (if possible because sinkhole). In this design (Fig. 1), traps were placed in all the monitored areas (7 sinkholes, Fig. 2), thus a total number of 63 traps were placed. Traps lines were always placed in the north-south orientation. Traps were collected at regular monthly intervals from April to September 2010 (22 April, 19 May, 28 June, 22 July, 26 August, and 22 September). A 4% formaldehyde with a detergent addition as a wetting agent was used as fixative fluid. After collection, the obtained material was preserved in 70% alcohol.

The collected material was evaluated by using the approach of species relictness according to Buchar (1983) who classified spider species into groups according to their relationship to originality
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16°44'E; flooding during torrential rains. GPS: 49°22'N, 16°44'E; a large number of nitrophilous species and heavy degradation of the center of sinkhole was strongly degraded due to burning. GPS: 49°23'N, 16°44'E; well; its surrounding corresponded to cultural meadow without special mowing. GPS: 49°22'N, 16°44'E; in comparison with those of the rest of monitored sinkholes. GPS: 49°23'N, 16°44'E; in the center. GPS: 49°24'N, 16°44'E; cereal), ruderal and strongly nitrophilous vegetation species, especially by nettles. During the year, two mowing destroyed some pitfall traps or their roofs. GPS: 49°24'N, 16°46'E; Sinkhole 6: Located in field crops (2010 cereal), ruderal and strongly nitrophilous vegetation in the center. GPS: 49°24'N, 16°44'E; Sinkhole 3: Located in permanent grasslands. The entire sinkhole was heavily overgrown by nitrophilous species, especially by sorrel (Rumex spp.). GPS: 49°23'N, 16°44'E; Sinkhole 4: Located in permanent grasslands. The very species-rich vegetation composition of surrounding permanent grasslands was very close to potential natural grassland habitats in the area. There were indeed nitrophilous species present in the sinkhole. However, their amount was the lowest in comparison with those of the rest of monitored sinkholes. GPS: 49°23'N, 16°44'E; Sinkhole 5: With fewer nitrophilous species as well; its surrounding corresponded to cultural meadow without special mowing. GPS: 49°22'N, 16°44'E; Sinkhole 6: Located in field crops (2010 cereal), the center of sinkhole was strongly degraded due to a large number of nitrophilous species and heavy flooding during torrential rains. GPS: 49°22'N, 16°44'E; Sinkhole 7: In 2010, it was surrounded by field crops (opium poppy), but the sinkhole was in very bad condition due to torrential rains. The sinkhole was covered by cultural meadow vegetation with great representation of dicotyledonous species and relatively small representation of ruderal nitrophilous species. GPS: 49°21'N, 16°43'E.

RESULTS

During the arachnological research of sinkholes area from 24 March 2010 to 22 September 2010, a total number of 5742 adult spiders were collected. Out of this number, 59 species belonging to 14 families were determined. In addition, 687 juvenile specimens were found. Three expansive species of the family Lycosidae (Pardosa amentata, P. pullatris, and P. pullatula) were the most numerous representatives. The first two above-mentioned species comprised nearly half of all of the collected material. The highest occurrence of spiders was recorded in the period of 24 March–19 May 2010 when other representatives, such as Alopecosa cuneata, A. pulverulenta, Pachygnatha cuneata, and Trochosa terricola, reached high abundances as well. Two rare species listed in the Red List of endangered animals (Růžička, 2005) were found – critically endangered Porrohroma errans and endangered Walkenenia monocus. Among other relicts, two typical thermophilic species (Alopecosa trabalis [RII] and Zelotes longipes [RI]) were observed relatively frequently. Mecopistes silus [RI], which lives typically in preserved peat bogs, spruce, and waterlogged beechwood (Buchar & Růžička, 2002), appears to be an interesting finding as well.

According to the thermopreference assessment, the highest number of species belongs to mesophilic (55%) and thermophilic (30%) class. Species living mainly in colder areas of oreophytic class (psychrophilic class) are represented by the remaining 15%. In the Moravský kras PLA, thermophilous species were found mainly in the southern part towards the massif of Hády. The biotope gradually changes into mesophytic to the north of the studied sinkholes. That was evident as more than half of representations consisted of mesophilic species. Solely thermophilic species were represented by Porrohroma errans and Walkenenia monocus which are among the most important findings in the surveyed area.

According to the bioindicative evaluation (Buchar & Růžička, 2002; Růžička & Buchar, 2008; Režáč, 2009), 44% species preferred original habitats and 37% preferred semi-natural habitats. The remaining 19% species also settled in habitats with high level of disturbance. It should be noted that members of the latter class dominated numerically in the material collected from the studied sinkholes. On the other hand, there were very few (often only one adult specimen) species preferring natural undisturbed habitats. Therefore, it is better to use assessment according to species relictness (Buchar, 1983) instead of classifying C, SN, D and A. In this assessment, only four RI species (7%) and 24 RI species (40%) were found. These species inhabited natural and semi-natural habitats represented here by forest habitats. Most of the RII specimens were
discovered in the fourth and fifth sinkholes. These sinkholes were located nearby a forest habitat where these species could come from. The remaining part of the material (31 species, 53%) belonged to expansive species that inhabit disturbed ruderal habitats and survived here successfully. This group is represented by the dominant species of the material that occurred in high numbers in most of the investigated sinkholes.

**Annotated list of species found**

Distribution and ecology of species follow Buchar & Růžička (2002), Růžička & Buchar (2008), and other literature cited under particular species. The categories of threat follow Růžička (2005): CR (critically endangered), EN (endangered). All dates are in the central European format of dd.m.yyyy.

**Mimetidae**

*Enu furata* (Villers, 1789)
The most abundant representative of the pirate spiders having a continuous occurrence throughout the Czech Republic. Very abundant in various open as well as in forest habitats.

*Data: 1♀, 24.3.–22.4. 2010, sinkhole 2.*

**Linyphiidae**

*Bathyphantes nigrinus* (Westring, 1851)
Very abundant species of wet biotopes such as waterlogged meadows, floodplain forests, waterlogged alder and waterways banks.

*Data: 1♂, 24.3.–22.4. 2010, sinkhole 7.*

*Centromerita bicolor* (Blackwall, 1833)
Very abundant species in natural as well as in ruderal, human disturbed habitats like fields, dumps, heap dumps, and cultural meadows.

*Data: 2♀, 24.3.–22.4. 2010, sinkhole 2; 1♂, 24.3.–22.4. 2010, sinkhole 6.*

*Centromerus sylvicola* (Blackwall, 1841)
Common species on different types of open and forest habitats.

*Data: 5♀, 3♂, 24.3.–22.4. 2010, sinkhole 2; 1♀, 24.3.–22.4. 2010, sinkhole 7; 2♀, 28.6.–22.7. 2010, sinkhole 2; 1♂, 24.3.–22.4. 2010, sinkhole 5; 2♀, 22.7.–26.8. 2010, sinkhole 6.*

*Diplocephalus cristatus* (Blackwall, 1833)
Very abundant species of open habitats, often in fields and other ruderal habitats.

*Data: 1♀, 24.3.–22.4. 2010, sinkhole 2; 4♀, 22.4.–19.5. 2010, sinkhole 4.*

*Diplocephalus picinus* (Blackwall, 1841)
Very abundant species primarily in wet habitats.

*Data: 2♀, 24.3.–22.4. 2010, sinkhole 3; 8♀, 1♂, 24.3.–22.4. 2010, sinkhole 4; 4♀, 24.3.–22.4. 2010, sinkhole 1; 1♀, 19.5.–28.6. 2010, sinkhole 2; 4♀, 24.3.–22.4. 2010, sinkhole 6; 4♀, 22.4.–19.5. 2010, sinkhole 7.*

*Diplostyla concolor* (Wider, 1834)
Very abundant species occurring in many different habitats. The highest abundances are reached in floodplain forests, smaller number can be found on moist meadows and fields.

*Data: 1♀, 1♂, 24.3.–22.4. 2010, sinkhole 2; 1♀, 24.3.–22.4. 2010, sinkhole 3; 3♀, 1♂, 24.3.–22.4. 2010, sinkhole 4; 2♀, 19.5.–28.6. 2010, sinkhole 6; 2♀, 1♂, 24.3.–22.4. 2010, sinkhole 7.*

*Mecopisthes silus* (O. P.-Cambridge, 1872)
Rare species of undisturbed habitats such as peat bogs, waterlogged spruce and beech forests. Numerous findings are identified from the hill of Stožec in Šumava (Kůrka, 1982) and Rejvíz in Hrubý Jeseník (Miller, 1951). From the area of South Moravia, a finding was reported by prof. F. Miller from Pouzdřany NNR – Kolby in the 60s of the last century (Bryja et al., 2005). To date, occurrence of this species in southern Moravia has not been confirmed. In the nearby surrounding of the surveyed sinkholes, a finding from the slopes of Vilémovická and Macošská stráň has been reported (Niedobová et al., 2011).

*Data: 1♀, 28.6.–22.7. 2010, sinkhole 3; 1♀, 2♀, 24.3.–19.5. 2010, sinkhole 5; 1♀, 24.3.–19.5. 2010, sinkhole 6; 1♀, 24.3.–22.4. 2010, sinkhole 7.*

*Meioneta rurestris* (C. L. Koch, 1836)
Abundant epigeic species, ubiquitous aeronaut in various sites in the forest and outside it, in agrobiocenes and synanthropicly on the walls of houses.

*Data: 1♀, 24.3.–22.4. 2010, 1♀, 24.3.–19.5. 2010, sinkhole 6; 5♀, 1♂, 24.3.–22.4. 2010, 7♀, 28.6.–22.7. 2010, sinkhole 7.*

*Micrargus herbigiadius* (Blackwall, 1854)
Common epigeic species with Palearctic distribution, living in moss and damp leaves of deciduous and mixed forests.

*Data: 1♀, 24.3.–22.4. 2010, sinkhole 7.*

*Neriene clathrata* (Sundevall, 1830)
Very abundant species in different forest habitats, often on wetlands, river banks, agrobiocenes, meadows, and other unshaded habitats.
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♂ species has been detected several times recently especially from the Moravský kras PLA, where this
nearby to Olomouc (Miller 1974), later on rocky
sporadically also on forest edges and sunlit meadow

♀ Oedothorax agrestis (Blackwall, 1853)
Non-forest epigeic species that is dominant
mainly in disturbed habitats of agrocenoses, cultural
meadows, and at locations in the initial stage of
succession. More abundant and more numerous than
the aforementioned related species of Oedothorax agrestis.
Data: 1♂, 5♀, 24. 3.–22. 4. 2010, 1♀, 3♂, 22. 4.–
2010, 2♂, 22. 4.–19. 5. 2010, 2♂, 10♀, 28. 6.–22. 7.
2010, sinkhole 3; 3♂, 5♀, 24. 3.–22. 4. 2010, sinkhole 4;
6♂, 8♀, 24. 3.–22. 4. 2010, 3♂, 22. 4.–19. 5. 2010,
2♂, 28. 6.–22. 7. 2010, sinkhole 5; 1♀, 8♀, 24. 3.–22. 4.
2010, 3♂, 28. 6.–22. 7. 2010, sinkhole 6; 9♂, 34♂,
24. 3.–22. 4. 2010, 1♀, 9♂, 22. 4.–19. 5. 2010, sinkhole 7.

Porocidentemum pumila (Blackwall, 1841)
Abundant species of the forest and its
surrounding, where it lives in the grass, moss, and
debris. It occurs sporadically also in open non-
forest habitats.
Data: 1♀, 26. 8.–22. 9. 2010, sinkhole 5.

Porhomma errans (Blackwall, 1841), CR
Very rare species with unclear environmental
requirements. Firstly identified in the beet fields
nearby to Olomouc (Miller 1974), later on rocky
steppes of the Czech Central Mountains (Kůrka &
Buchar, 2010), and sandy marlite hillsides of eastern
Bohemia (Dolanský, 2003). There are other recent
data from Pála in Moravia (Bryja et al., 2005) and
especially from the Moravský kras PLA, where this
species has been detected several times recently
(Horáková, 2005; Niedobová et al., 2011), even in field
habitats.
Data: 1♀, 24. 3.–22. 4. 2010, sinkhole 3.

Stenonyphantes lineatus (Linné, 1758)
Moderately abundant species occurring in
the grass undergrowth of xerothermic habitats,
sporadically also on forest edges and sunlit meadow
clearings.
Data: 8♂, 4♀, 24. 3.–22. 4., 1♀, 22. 4.–19. 5. 2010, sinkhole 2; 3♂, 22. 4.–19. 5. 2010, sinkhole 3; 3♀,
1♂, 24. 3.–22. 4. 2010, 2♂, 22. 4.–19. 5. 2010, 3♂, 1♀,
19. 5.–28. 6. 2010, sinkhole 4; 1♀, 1♂, 24. 3.–22. 4.
2010, sinkhole 7.

Tapinocyba inseta (L. Koch, 1869)
Common Palaeartic species living in moss,
leaves, and debris of forest and unshaded non-forest
habitats. Except for western and southern Bohemia,
it has a continuous distribution across most of
Czech Republic.
Data: 2♂, 22. 4.–19. 5. 2010, sinkhole 4.

Tetragenatha crista (Menge, 1866)
Very abundant epigeic species, common in forest
habitats.
Data: 1♀, 24. 3.–22. 4. 2010, sinkhole 7.

Walkeaera monoeora (Wider, 1834), EN
Rare thermophilic species known only from a few
localities in Czech thermophyticum (Valešová 1962;
Použákova 1975). It prefers well-preserved rocky
steppes in lowland areas. There have not been any
findings recorded from Moravia yet. A single
adult male specimen was found in the outskirts of
sinkhole No. 6.
Data: 1♀, 24. 3.–22. 4. 2010, sinkhole 6.

Tetragnathidae
Pachygnatha cleri (Sundevall, 1823)
Abundant species living in wet leaves and debris
of wet meadows, alder, and waterlogged forests.
Data: 1♀, 24. 3.–22. 4. 2010, sinkhole 4; 2♂, 24. 3.–
22. 4. 2010, 1♀, 1♂, 22. 4.–19. 5. 2010, sinkhole 7.

Pachygnatha degeeri Sundevall, 1830
The most abundant species of the genus
Pachygnatha living in detritus of various open
habitats. Very abundant at mesophilic meadows,
agrocenoses, clearings, and bright forest edges.
Data: 14♀, 11♂, 24. 3.–22. 4. 2010; 6♀, 5♂, 22. 4.–
19. 5. 2010, 4♀, 13♂, 19. 5.–28. 6. 2010, 12♀, 3♂,
28. 6.–22. 7. 2010, 2♂, 26. 8.–22. 9. 2010, sinkhole 1;
8♂, 5♀, 24. 3.–22. 4. 2010, 5♀, 4♂, 22. 4.–19. 5. 2010,
3♂, 28. 6.–22. 7. 2010, sinkhole 2; 6♂, 1♀, 24. 3.–
2010, 2♂, 28. 6.–22. 7. 2010, 1♀, 1♂, 24. 3.–22. 4.
2010, 1♀, 25♀, 22. 7.–26. 8. 2010, sinkhole 3; 8♂,
10♀, 24. 3.–22. 4. 2010, 7♂, 6♀, 22. 4.–19. 5. 2010,
10♀, 1♂, 19. 5.–28. 6. 2010, 6♀, 28. 6.–22. 7. 2010,
1♂, 22. 7.–26. 8. 2010, sinkhole 4; 24♀, 12♂,
24. 3.–22. 4. 2010, 3♀, 3♂, 22. 4.–19. 5. 2010, 1♀,
4♂, 19. 5.–28. 6. 2010, 2♂, 6♀, 28. 6.–22. 7. 2010,
4♂, 22. 7.–26. 8. 2010, 3♀, 6♂, 26. 8.–22. 9. 2010,
sinkhole 5; 15♀, 5♂, 24. 3.–22. 4. 2010, 10♀, 12♂,
22. 4.–19. 5. 2010, 3♂, 19. 5.–28. 6. 2010, 2♂, 7♂,
28. 6.–22. 7. 2010, 2♂, 22. 7.–26. 8. 2010, 1♂,

Pachygnatha listeri Sundevall, 1830
Scarce epigeic species living in moss and damp
grass of deciduous and coniferous forests.
Data: 2♂, 24. 3.–22. 4. 2010, sinkhole 1; 3♀, 22. 4.–
19. 5. 2010, sinkhole 2; 1♀, 1♂, 19. 5.–28. 6. 2010,
sinkhole 5; 3♀, 24. 3.–22. 4. 2010, 1♀, 1♂, 28. 6.–22. 7.
2010, sinkhole 5; 2♀, 3♂, 24. 3.–22. 4. 2010, sinkhole
6; 3♀, 24. 3.–22. 4. 2010, 1♀, 22. 4.–19. 5. 2010,
sinkhole 7.
Lycosidae

_Alopecosa cuneata_ (Clerck, 1758)

Very common species in dry meadows and warm non-forested slopes, often in anthropogenically disturbed habitats. Data: 2♀, 2♂, 23–24. 4. 2010, 6♂, 22. 4.–19. 5. 2010, 1♀, 3♂, 19. 5.–28. 6. 2010, 1♀, 26. 8.–22. 7. 2010, sinkhole 1; 6♀, 24. 2.–19. 5. 2010, sinkhole 2; 2♀, 24. 3.–22. 4. 2010, 3♀, 22. 4.–19. 5. 2010, 1♀, 19. 5.–28. 6. 2010, sinkhole 3; 8♀, 5♂, 24. 3.–22. 4. 2010, 70♀, 11♂, 22. 4.–19. 5. 2010, sinkhole 6; 9♀, 19. 5.–28. 6. 2010, 1♀, 19. 5.–28. 6. 2010, sinkhole 7. An interesting finding is mutual (less frequent) occurrence of closely related species _Pardosa palustris_, which was, however, much more numerous than _P. agrestis._


_Alopecosa pulverulenta_ (Clerck, 1758)

Euryvalent species inhabiting many different habitats ranging from lowlands to mountains. An interesting finding is mutual (less frequent) occurrence of closely related species _P. palustris_, which was, however, much more numerous than _P. agrestis._


_Alopecosa trilineata_ (Clerck, 1758)

Scare species occurring in xerothermic habitats, in forests with southern exposure, and forest-steppe habitats in the warmer parts of the Czech Republic. It reached higher numbers only in the fourth and fifth sinkholes which were adventitious to forest habitat.


_Aulonia albimana_ (Walckenaer, 1805)

The smallest species of wolf spiders in our country, it lives in various open habitats from wet sites and slopes oriented to the north.

Data: 1♀, 28. 6.–22. 7. 2010, sinkhole 4; 2♀, 24. 3.–22. 4. 2010, 1♀, 28. 6.–22. 7. 2010, sinkhole 7.

_Pardosa agrestis_ (Westring, 1861)

Very abundant non-forest species in disturbed ruderal biotopes – ploughed areas, early stages of successional heaps, meadows, flooded meadows, etc. An interesting finding is mutual (less frequent) occurrence of closely related species _Pardosa palustris_, which was, however, much more numerous than _P. agrestis._

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Pardosa pullata (Clerck, 1758)

Very abundant species of a smallish wolf spiders living in both moist and dry habitats, forest edges from where they expand to agroecosos too. Dominant occurrence mainly in flooded sinkholes with ruderal (nitrophilous) vegetation.


Pardosa riparia (C. L. Koch, 1833)

Scarcse species on rocky steppes, forest clearings and edges of fields. It prefers preserved manundisturbed biotopes (Thaler & Bucher, 1996). Detected only in sinkholes with a smaller proportion of nitrophilous vegetation.


Trocchosa ruvicola (De Geer, 1778)

Common and very abundant species living in grassy vegetation of wet meadows and fields. It prefers unshaded biotopes.

Trocchosa terricola Thorell, 1856

A very abundant species occurring in both dry and wet forests and their edges throughout the Czech Republic. It was numerous and dominant in all studied sinkholes.


Pisauridae

Pisaura mirabilis (Clerck, 1758)

One of our most common spiders that inhabits open and moderately shaded habitats – forest edges, meadows, hillsides, light woods, rubble (mainly in netles).

Data: 1♀, 2♂, 24.3.–22.4. 2010, 3♀, 19♀, 5.5.–28.6. 2010, 1♀, 1♂, 2♀, 26.8.–22.7. 2010, sinkhole 1; 1♀, 2♂, 24.3.–22.4. 2010, 1♀, 2♂, 24.3.–22.4. 2010, sinkhole 2; 1♀, 2♂, 24.3.–22.4. 2010, sinkhole 3; 2♂, 2♀, 24.3.–22.4. 2010, sinkhole 4; 5♂, 2♀, 24.3.–22.4. 2010, 2♂, 2♀, 26.8.–22.7. 2010, sinkhole 5.

Agelenidae

Coelotes terrestris (Wider, 1834)

Very abundant species occurring in all types of forest habitats, especially in shaded locations.

Data: 1♂, 2♂, 24.3.–22.4. 2010, 1♂, 2♀, 22.7.–26.8. 2010, sinkhole 4; 2♂, 26.8.–22.7. 2010, sinkhole 5.
\textit{Malthonica campestris} (C. L. Koch, 1834)

Scare species living in shaded places in deciduous and coniferous forests. Only one specimen found in the sinkhole on meadow habitat adjacent to a deciduous forest.

Data: 1♂, 24. 3.–22. 4. 2010, sinkhole 5; 1♀, 22. 4.–19. 5. 2010, sinkhole 7.

\textbf{Dictynidae}

\textit{Cicarina cier} (Fabricius, 1793)

Abundant species living in grass and moss of shady deciduous and coniferous forests. Species characterized by its autumn activity, the adults mature in winter (Tretzel, 1954).


\textbf{Amaurobiidae}

\textit{Callibius clausarius} (Hahn, 1833)

Moderately abundant species living under stones and barks of trees in preserved forest habitats. Three specimens only were detected in a sinkhole near forest.


\textbf{Liocranidae}

\textit{Agroeca brunnea} (Blackwall, 1833)

Very abundant species equally distributed throughout the Czech Republic. It is abundant especially in deciduous and coniferous forests, waterlogged meadows, and peat bogs.

Data: 1♀, 1♂, 24. 3.–22. 4. 2010, sinkhole 4; 7♀, 3♂, 24. 3.–22. 4. 2010, sinkhole 5; 1♀, 24. 3.–22. 4. 2010, sinkhole 6; 2♀, 24. 3.–22. 4. 2010, sinkhole 7.

\textbf{Gnaphosidae}

\textit{Drassodes lapidosus} (Walckenaer, 1802)

The most abundant representative of the Gnaphosidae family that occurs in most xerothermal habitats. One adult female specimen only detected in the peripheral part of the first sinkhole.

Data: 1♂, 28. 6.–22. 7. 2010, sinkhole 1.

\textit{Drassyllus praeficus} (L. Koch, 1866)

Abundant species of open habitats, very common in grassland habitats, forest clearings and edges.

Data: 1♀, 22. 7.–26. 8. 2010, sinkhole 5.

\textit{Drassyllus pusillus} (C. L. Koch, 1833)

Abundant euryvalent species occurring in both xerothermal and waterlogged habitats, forest edges, dumps, agrocones, and other ruderal sites.

Data: 1♂, 28. 6.–22. 7. 2010, sinkhole 7.

\textit{Haplodrassus signifer} (C. L. Koch, 1839)

Very abundant epigeic species common in various open as well as forest habitats.

Data: 2♀, 28. 6.–22. 7. 2010, sinkhole 1; 3♀, 2♂, 22. 4.–19. 5. 2010, sinkhole 5; 1♀, 24. 3.–22. 4. 2010, sinkhole 6; 1♀, 24. 3.–22. 4. 2010, sinkhole 7.

\textbf{Zelotes latreillei} (Simon, 1878)

Abundant epigeic species preferring open habitats.


\textbf{Zelotes longipes} (L. Koch, 1866)

Rare relict species recorded in preserved xerothermic sites of the Czech and Moravian thermotypic. Typically autumn species (Norflatcher 1988).

Data: 1♀, 24. 3.–22. 4. 2010, sinkhole 2; 2♀, 22. 4.–19. 5. 2010, sinkhole 4.

\textbf{Zoridae}

\textit{Zora spinimana} (Sundevall, 1833)

Abundant species living in debris and leaves of damp shady woods, in open habitats occurs in wet meadows, marshes and peat bogs.


\textbf{Philodromidae}

\textit{Philodromus collinus} C. L. Koch, 1835

Very abundant species living in vegetation in forests (most numerous in spruce forests) as well as in various open habitats.

Data: 1♂, 28. 6.–22. 7. 2010, sinkhole 5.

\textit{Thanatus formicinus} (Clerck, 1758)

Abundant species characteristic for ground level of rock steppes, heathland, and forest steppes.

Data: 1♀, 24. 3.–22. 4. 2010, sinkhole 3; 3♀, 24. 3.–22. 4. 2010, sinkhole 4; 1♀, 24. 3.–22. 4. 2010, sinkhole 5; 3♀, 1♂, 28. 6.–22. 7. 2010, sinkhole 6.

\textbf{Thomisidae}

\textit{Ozyptila atomaria} (Panzer, 1801)

Rare species living among detritus on rock steppes and other xerothermic habitats.

Data: 1♀, 24. 3.–22. 4. 2010, sinkhole 4; 2♀, 24. 3.–22. 4. 2010, sinkhole 5.

\textit{Ozyptila trux} (Blackwall, 1846)

Very abundant species living among detritus and litter on marshy pond margins and in wet meadows.


\textit{Xysticus audax} (Schrank, 1803)

Very abundant and common species living in low vegetation in various open and forest habitats.


\textit{Xysticus bifasciatus} C. L. Koch, 1837

Very abundant and very common species living in grass in meadows and other open habitats. Bryja
et al. (2005) reported this species as rare in the area of southern Moravia.


*Xysticus cristatus* (Clerck, 1758)

Very abundant and common species living in grass in meadows and other open habitats as well as in fields and in orchards.


*Xysticus kochi* Thorell, 1872

Abundant, in grass and on vegetation on rock steppes, meadows, in urban grasslands, in orchards and gardens.

Data: 1♀, 24.3.–22.4. 2010, 6♀, 22.4.–19.5. 2010, sinkhole 2; 5♀, 1♂, 22.4.–19.5. 2010, sinkhole 3; 2♀, 24.3.–22.4. 2010, 1♀, 22.4.–19.5. 2010, sinkhole 4; 4♀, 22.4.–19.5. 2010, sinkhole 5; 1♀, 19, 5.–28.6. 2010, sinkhole 6.

**Salticidae**

*Enarcha arenata* (Clerck, 1758)

Very abundant species living in herb vegetation in both wet and xerothermic meadows and in other open habitats.

Data: 1♂, 26.8.–22.9. 2010, sinkhole 5.

*Phlegra fasciata* (Hahn, 1826)

Abundant and sometimes common species living in grass on rock steppes and xerothermic slopes, in forest steppes and forest edges, also on spoil heaps and road verges.


**DISCUSSION**

The study found no significant number of species but, generally, species of cultural landscapes. Several findings are interesting, e.g. the discovery of *Porrorhomba crana*. This species is very rare in the Czech Republic (Buchar & Růžička, 2002), but it has also been reported previously in the monitored area (Horáková 2005; Niedobová et al., 2011). In the Czech Republic, this species was first recorded by Miller (1974) from beet fields, and other published findings of this species come from fields as well (Roberts 1987, 1995; Rezák et al., 2006; Öberg et al., 2008; British Arachnological Society, 2011). We believe that it is unreasonable to include this species in the Red List of invertebrates of the Czech Republic (Růžička, 2005) at all, it is very rare species although common habitats like arable fields and it is impossible to manage or protect habitats according to its presence.

*Walckenaeria monoceros* is another species important from the faunistic perspective. This species is more commonly observed in xerothermic habitats (Buchar & Růžička, 2002), as well as rocky steppes, but only from the so called Czech thermophyticum (sensu Slavík, 1984). This is the first finding of *W. monoceros* in the area of Moravia. To date, all findings of this thermophilous species have been recorded from the western part of Czech thermophyticum. *Zelotes longipes* is among the other species important from the faunistic perspective. From the Moravský kras PLA, it was reported only from Hádecká planinka (Kůrka, 1994). Recently, it has also been reported from the hillside of Macošská stráň at Vilémovice (Niedobová et al., 2011). The same situation is in case of record of *Mecopistes silus*. However, Linyphiidae family representatives very often migrate aeronautically by wind, which can result in spreading and settling in the nearby as well as more distant areas.

The other species are very abundant and most of them are typical for agrarian landscape. However, typically steppe and forest-steppe species (e.g. *Allopecosa trivialis* or *Pardosa riparia*) and forest species (*Coelotes terratris*, *Pardosa lugubris*, *Agroeca brunnea*, and *Callobius claustrarius*) were also recorded. All these species were found near the forest (100 m from the edge). Their presence indicates that in the case of appropriately adjusted conditions and management in sinkholes, these can be populated by both forest and steppe species. On the other hand, a typical meadow species *Pseudognatha degerti* does occur in sinkholes in a limited number, but it is much more abundant mainly in and around their edges. At the same time, very abundant wolf spiders *Allopecosa cuneata*, *A. pulcherrulenta*, and *Pardosa amentata* occur mainly in sinkholes without any significant nitrophilous vegetation cover, such as *Rumex* spp. or the *Urtica dioica* nettle.

We can conclude that there is a relatively valuable fauna in the sinkholes and that there are suitable conditions for rare species which cannot survive in an open farmland. On the other hand, sinkholes don't increase total number of species in open agricultural areas of Moravský kras PLA.
Summary of species recorded – Relictness (Buchar 1983): RI (relict species of type 1), RII (relict species of type 2), E (euryvalent species);
Habitat preferences (Buchar & Růžička, 2002): C (climax), SN (seminatural), D (disturbed); Thermopreferences (Buchar & Růžička, 2002):

<table>
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<th>Species</th>
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<th>Relictness</th>
<th>Habitat preferences</th>
<th>Thermopreferences</th>
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Spiders (Araneae) of selected sinkholes of Moravský kras Protected Landscape Area (Czech Republic)

SUMMARY

During the arachnological research of sinkhole area from 24 March 2010 to 22 September 2010, a total number of 5,742 adult spiders were collected. Out of this number, 59 species belonging to 14 families were determined. In addition, 687 juvenile specimens were also found. The crucial records are as follows:

- **Porrhomma errans** – very rare species known from different habitats (beet fields, steppe habitats in České středohoří PLA, Moravský kras PLA, and Pálava PLA, and meadows in Moravský kras PLA);
- **Walckenaeria monoceros** – from the Czech Republic, species known mainly from Bohemia, where prefers xerothermic habitats in Bohemian termophyticum.

According to thermopreference assessment, the highest number of species is mesophilic (55%) and thermophilic (30%), the remaining (15%) species are psychophilic. In the area of Moravský kras PLA, thermophilous species can be found mainly in the southern part, towards the massif of Hády. To the north of the studied sinkholes, the biotope gradually changes into mesophyticum, which is evident in more than half representation of mesophilic species. Solely thermophilic species are represented by **Porrhomma errans** and **Walckenaeria monoceros** which are among the most important findings in the surveyed area. There are suitable conditions in the sinkholes, enabling a survive of relatively valuable fauna. On the other hand, sinkholes cannot increase the biodiversity in an agrarian landscape because of their relatively small size.

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