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DIVERSITY OF CARABIDAE IN LIMESTONE QUARRIES OF SOUTH MORAVIA

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Abstract

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This paper presents the results of a study of Carabid beetles in two limestone quarries in South Moravia. The first one was a limestone quarry pit called Lesní lom which is located approximately 1 km away from the northern edge of the city district of Brno-Líšeň. The second locality was a limestone quarry of Malá dohoda which is located in a protected landscape area in the northern part of Moravian Karst. Using formaldehyde pitfall traps, 1682 specimens belonging to 66 species were caught in 2012, out of which 847 specimens (49 species) were from the active quarry of Malá dohoda and 835 specimens (40 species) came from Lesní lom quarry which had already been closed for 15 years at the time of research. The most abundant species included *Anchomenus dorsalis*, *Carabus ullrichii ullrichii*, *C. cancellatus*, and *Aptinus bombarda*. Relict species collected were *Aptinus bombarda*, *Leistus rufomarginatus*, and *Carabus irregularis irregularis* which is together with *C. cancellatus*, and *Cylindera germanica* included in the Red List of the Czech Republic. Xerothermophilic species of Carabid beetles found refuge mainly in the quarry marginal sites. In the case of Malá dohoda quarry, the influence of the surrounding PLA Moravian Karst was evident in the distribution of Carabid beetles.

Carabid beetles, limestone quarries, South Moravia

The importance of post-industrial habitats, such as sand pits, quarries, coal mines, and ash repositories, have lately been of increasing importance. If the aforementioned habitats are left to spontaneous succession, they can become rich in species diversity (Doležalová *et al*., 2012; Holec & Frouz, 2005) and be used as refugia for rare animal species. The first references to the rich biodiversity of these degraded locations date back to the 70s of the 20th century, when e.g. Davis & Jones (1978), Davis (1979), and Jefferson (1984) published papers on the importance of limestone quarries in terms of their high potential as refugia for xerothermophilic species of plants and invertebrates. Other interesting works that highlight the importance of post-industrial habitats for thermophilic invertebrates in the Czech Republic include Beneš *et al*. (2003), Tropek (2007), Tropek *et al*. (2008, 2010). All these works point out the positive impact of spontaneous succession in the development of plant and animal communities. After extraction, these abandoned sites are strongly degraded, there is a lack of soil profile, vegetation, and moisture. Such habitats are rugged, vegetation grows very slowly here and various successional stages can occur. Dry steppe grasslands, areas with exposed loose substrate, or lakes appear here. The diversity of conditions along with rugged topography and bedrock enables creation and existence of communities rich in species (Konvička, 2012).

This work is focused on selected limestone quarries in the Czech Republic. It describes and compares Carabid beetles communities from two quarries in various stages of management – an active quarry and a quarry already closed for 15 years.

We were interested in the following basic questions: Is it possible for an active quarry with a high degree and repetitive disturbance to provide conditions suitable for invertebrates to live in? How does the composition of Carabid beetles communities change in a quarry, which has been closed for 15 years? Is the composition of Carabid beetles influenced by the adjacent protected landscape area PLA Moravian Karst?

Carabid beetles were selected as the key model group for the research. It is a very important ecological group mostly predators that significantly contribute to the cycle of substances. And thanks to their sensitive and rapid response to changes in the surrounding environment, they are an appropriate biological indicator of environmental changes.

MATERIAL AND METHODS

The survey was conducted in two quarries of around the same age (early mining in the 30s of the 20th century). The first one was a limestone quarry Lesní lom which is located approximately 1 km away from the northern edge of the city district of Brno-Líšeň (49°13'24.662"N, 16°41'41.494"E), faunistic square 6766 (Pruner & Míka, 1996). The location is situated at an altitude of 360 m.a.s.l. At the time of research, the quarry had been closed and no mining or reclamation activities had taken place here for 15 years. The second field of study was a limestone quarry of Malá dohoda which 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 (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. At the time of the research, the quarry was active and mining was going on here.

In order to capture Carabid beetles, formaldehyde pitfall traps with a detergent as a wetting agent were used. In each 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 (Plot 4), one at the edge of the quarry (Plot 5) and one in the vicinity of the quarry (Plot 6) – and three sites in habitats with advanced succession – one line again directly in the quarry (Plot 1), one at the edge of the quarry (Plot 2) and one in the vicinity of the quarry (Plot 3).

Description of particular plots within Lesní lom (Fig. 1)

Plot 1 presented a bottom part of a steep slope above the central quarry terrace where there was a minimum amount of soil with the total vegetation coverage of 3%. Plot 2 was constituted by a reclaimed area where *Tilia cordata* were planted (about 0.5 m high). The total coverage was 70%. *Arrhenatherum elatius* was present in a significant number, *Tilia cordata* and *Calamagrostis epigeios* were present in a lesser extent. Plot 3 was constituted by a mature oak-hornbeam forest, about 50 years old. The total coverage was 95%. There was a greater proportion of *Fraxinus excelsior*, *Pinus sylvestris*, *Cornus sanguinea*,

1: *Lesní lom quarry; scheme of pitfall traps locations, each rectangle indicates a line of three pitfall traps at a mutual distance of 5 m* (source: mapy.cz)

Acer campestre, and *Carex sylvatica*. Plot 4 was situated on a quarry terrace overgrown by vegetation from natural seeding. The total coverage was 35%. *Arrhenatherum elatius*, *Pinus sylvestris*, *Anthyllis vulneraria*, *Lotus corniculatus*, and *Calamagrostis epigeios* were present in greater proportions. Plot 5 represented the transition between a freshly sown foxtail meadow and an uncut overgrown section at the edge of the quarry. The total coverage was 75%. There was significantly represented *Arrhenatherum elatius*, and a lesser extent of *Phleum pratense*, and *Festuca pratensis*. Plot 6 represented uncut grassland. The total coverage was 70%. *Arrhenatherum elatius* was present significantly, *Calamagrostis epigeios*, *Festuca rubra*, and *Acer campestre* in a smaller proportion.

Description of particular plots within Malá dohoda (Fig. 2)

Plot 1 was basically a mudslide and stones, the total coverage was 45%. *Artemisia vulgaris*, *Agrostis capillaris*, and *Arrhenatherum elatius* were rather strongly represented. Plot 2 was situated in continuous ruderal grassland, soil was partially torn down and there was a rocky backfill. The total coverage was 75%. Rather numerous were *Crepis biennis*, *Lotus corniculatus*, and *Poa pratensis*. Plot 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. Plot 4 was represented by the initial stage of ruderal vegetation. The total coverage was 20%. There was a greater proportion only of *Tussilago farfara*. Plot 5 was located at the quarry edge, soil was a 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. Plot 6 was an edge of a meadows and an unpaved road. The total coverage was 95%.

Samples were collected in monthly intervals in 2012 in the growing season. The pitfall traps in Lesní lom were installed in March (16 March 2012) and samples were then collected on (dd.mm.yyyy) 18. 4. 2012, 24. 5. 2012, 20. 6. 2012, 24. 7. 2012, 21. 8. 2012, 27. 9. 2012, 29. 10. 2012. In the other quarry, Malá dohoda, the traps were also installed in March (19 March 2012) and 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 converted into a permanent fixation in 70% alcohol. Determination of species of the Carabidae was performed by the authors hereof using Hůrka's (1996) monograph. The nomenclature is according to Vigna Taglianti (2012).

Pursuant to Hůrka *et al.* (1996), species were classified into three indication groups (R, A, E) according to their ecological valency and dependence on the habitat. Species in the R group are stenotopic species with the narrowest ecological valency, mostly rare and endangered species of native, intact ecosystems. Group A is characterized

2: *Malá dohoda quarry; scheme of pitfall traps locations, each rectangle indicates a line of three pitfall traps at a mutual distance of 5 m* (source: mapy.cz)

by adaptable species occurring in habitats close to natural state. The last bioindication group E includes eurytopic species that have no special demands on the quality of the environment (species of unstable and changing habitats, habitats strongly influenced by human activities).

RESULTS AND DISCUSSION

In Lesní lom quarry, a total of 40 species with a total number of 835 specimens were captured. Review of all entrapped species is presented in Tab. I. The most abundant species was *Anchomenus dorsalis* (467 specimens), the most specimens of it were captured at Plot 5. The majority were eurytopic species (57%), adaptable species were represented by 35% and relict species by 8%. The relict species occurring in the quarry were *Aptinus bombarda*, *Carabus irregularis irregularis*, and *Leistus rufomarginatus*. All relict species were caught at Plot 3, and one *Aptinus bombarda* specimen was captured at Plot 1. According to Veselý *et al*. (2005), vulnerable species was detected (VU – *Cylindera germanica* – which is also a protected species under Decree 395/1992 Coll. as amended by Decree 175/2006 Coll.). Further, one near threatened species was identified (NT – *Carabus irregularis irregularis* also protected species under Decree 395/1992 Coll. as amended by Decree 175/2006 Coll.). Out of other species protected by Decree 395/1992 Coll. as amended by Decree 175/2006 Coll., *Brachinus crepitans, B. explodens* and *Carabus ullrichii ullrichii* were detected.

In Malá dohoda quarry, a total of 49 species with a total number of 847 specimens were captured. Review of all entrapped species is presented in Tab. II. The most numerous species was *Carabus cancellatus* (226 specimens), the most specimens of it were captured at Plot 6. The majority were eurytopic species (55%), adaptable species were represented by 43% and relict species by 2%. Only *Aptinus bombarda* represented relict species and it was collected in the largest number at Plot 3 (130 specimens) and in individual specimens at Plots 1 and 2. According to Veselý *et al*. (2005), one vulnerable species was detected (VU – *Cylindera germanica*) which is also a protected species under Decree 395/1992 Coll. as amended by Decree 175/2006 Coll. Further, one near threatened species was identified (NT – *Carabus cancellatus*). Out of other species protected by Decree 395/1992 Coll. as amended by Decree 175/2006 Coll., *Brachinus crepitans, B. explodens*, *Carabus ullrichii ullrichii* and *Cicindela campestris* were detected.

Research of Carabid beetles was conducted in Lesní lom quarry in 2007 and 2008 (Hula & Šťastná, 2010). Overall, 2918 specimens of Carabid beetles (1981 specimens in 2007, 638 specimens in 2008) belonging to 60 species were collected in Lesní lom. The most numerous species in both years was *Brachinus crepitans*. Among more significant species, the authors detected *Aptinus bombarda*, *Licinus casideus*, and *Harpalus modestus*. Further research in Lesní lom quarry was carried out during 2009 and 2010 (Novotná & Šťastná, 2012). A total number of 462 specimens of Carabidae were captured belonging to 43 species in both years. In 2009 it was 281 pieces belonging to 34 species and in 2010 it was 181 pieces belonging to 30 species. The most abundant species in both years was *Pseudoophonus rufipes* which was the third most abundant in our research. Significant species were found at the edge of the quarry, including *Brachinus crepitans*, *B. explodens*, and *Ophonus sabulicola*. Out of the more significant species, *Cylindera germanica* and *Cicindela sylvicola* were found at quarry terraces. Except for *Cylindera germanica* and *Cicindela sylvicola*, the above mentioned significant species were recorded in our research as well.

The authors' results showed that Carabid beetles are almost completely absent from quarry terraces, which was also confirmed by our results. On the quarry terraces of Lesní lom quarry, only 17 specimens (8 species) of Carabidae were recorded. In our research, the most abundant was *Anchomenus dorsalis* which was the second most abundant species in 2009–2010. Identically, in our work eurytopic species prevailed over adaptable ones. From the bioindicative perspective, this site is strongly anthropogenically influenced.

Forest species predominated at Plot 3. Mainly species of surrounding habitats occurred on the periphery of the quarry. Species of xerothermal open habitats and generalists occurred on the quarry terraces. Quarry terraces thus increased biodiversity of xerothermophilic species preferring open habitats.

Šťastná and Bezděk (2001) conducted a research in Moravian Karst on Carabidae in 1999 and 2000. The research was conducted at five locations (a natural pool edge, an unpaved road edge, a deciduous forest edge, meadow in the vicinity of a pond, and bank communities of natural pools). The authors discovered the following relict species: *Aptinus bombarda* and *Pterostichus gracilis*. The discovery of *Aptinus bombarda* in relatively high numbers (133 individuals) in the quarry of Malá dohoda is also remarkable. This species does not occur in Bohemia and it is rare in Moravia. It prefers deciduous forests, it is often found in the debris, especially on limestone. It occurs from the lowlands to the mountains, mostly in the hills. It has been reported as abundant only from the area of Moravian Karst (Uhlíková, 2009). Kocmánková (2005) conducted a research on Carabid beetles in Moravian Karst in 2002–2004 at three locations (uncut meadow, hedgerow between a field and a meadow, meadow vegetation at the edge of the forest). Most frequently represented species at all the locations was *Aptinus bombarda*. In Malá dohoda, it was the most numerous species at Plot 3. Kraus (1985) conducted a research in PLA Moravian Karst in several areas (forest area, field, and sinkholes) in 1983–1984. He collected in total 23 species in the total number of 3795 specimens. The most numerous species was *Carabus cancellatus*. This species occurred in Malá

I: *Overview of species found in the quarry of Lesní lom; Bioind. G – species bioindication group by Hůrka et al. (1996), E – eurytopic, A – adaptable, R – relict*

SPECIES	Bioind.G	1	2	3	4	5	6
Abax parallelepipedus (Piller & Mitterpacher, 1783)	A			2		3	1
Amara aulica (Panzer, 1796)	E		1				
Amara convexior Stephens, 1828	E					1	
Amara similata (Gyllenhal, 1810)	E		1				
Anchomenus dorsalis (Pontoppidan, 1763)	E		3	1	1	461	1
Aptinus bombarda (Illiger, 1800)	R	1		8			
Badister sodalis (Duftschmid, 1812)	A						1
Brachinus crepitans (Linnaeus, 1758)	E		4			2	1
Brachinus explodens Duftschmid, 1812	E					2	
Calathus fuscipes (Goeze, 1777)	E		7			10	18
Callistus lunatus (Fabricius, 1775)	A		1				
Carabus granulatus Linnaeus, 1758	E					1	
Carabus intricatus Linnaeus, 1761	A			8			
Carabus irregularis irregularis Fabricius, 1792	R			1			
Carabus nemoralis O. F. Müller, 1764	A			2			
Carabus ullrichii ullrichii Germar, 1824	A		2	4		24	59
Carabus violaceus violaceus Linnaeus, 1758	A		1				
Cylindera germanica (Linnaeus, 1758)	A		11		1	1	1
Harpalus caspius roubali Schauberger, 1928	A		9		3	11	2
Harpalus distinguendus (Duftschmid, 1812)	E						1
Harpalus honestus (Duftschmid, 1812)	A		1				
Harpalus pumilus Sturm, 1818	A					1	
Harpalus rubripes (Duftschmid, 1812)	E	1	4		6	5	1
Leistus ferrugineus (Linnaeus, 1758)	E		26	2	1	15	2
Leistus rufomarginatus (Duftschmid, 1812)	R			1			1
Metallina lampros (Herbst, 1784)	E					1	
Metallina properans (Stephens, 1828)	E					1	
Microlestes maurus (Sturm, 1827)	E		2			12	
Molops elatus (Fabricius, 1801)	A			1			
Nebria brevicollis (Fabricius, 1792)	E			1			
Ocydromus stephensii (Crotch, 1866)	E	1					
Ophonus azureus (Fabricius, 1775)	E		1				
Ophonus laticollis Mannerheim, 1825	A					1	
Ophonus puncticeps Stephens, 1828	E		2				
Panagaeus bipustulatus (Fabricius, 1775)	A		2				
Poecilus cupreus (Linnaeus, 1758)	E		2			3	
Pseudoophonus griseus (Panzer, 1797)	E					3	
Pseudoophonus rufipes (De Geer, 1774)	E		2	2	2	33	13
Pterostichus melanarius (Illiger, 1798)	E					1	1
Zabrus tenebrioides (Goeze, 1777)	E					4	4
In total		**3**	**82**	**33**	**14**	**596**	**107**

dohoda relatively abundantly at all locations, but it was the most abundant at Plot 6. Klašková (2005) conducted a research on Carabid beetles in the northern part of PLA Moravian Karst in 2002–2003 in the grasslands and forest habitats on the plateaus of Ostrovská and Habešská plošina. From 2005 to 2007 a research on Carabid beetles was conducted by Hamet *et al*. (2009) in PLA Moravian Karst. Among near threatened species (NT) *Carabus irregularis irregularis* was captured, and among interesting species *Aptinus bombarda, Carabus ullrichii ullrichii* and *Cychrus attenuatus* were detected. Species of *Carabus irregularis irregularis* and *Cychrus attenuatus* did not appear in our traps, *Carabus ullrichii ullrichii* was present at all locations, the greatest abundance was at Plot 6. Šťastná & Hula (2012) conducted a research in sinkholes in the northern part of PLA Moravian Karst in 2010 and 2011. The first sinkhole

II: *Overview of species found in the quarry of Malá dohoda; Bioind. G – species bioindication group by Hůrka et al. (1996), E – eurytopic, A – adaptable, R – relict*

SPECIES	Bioind.G	1	2	3	4	5	6
Abax ovalis (Duftschmid, 1812)	A		1	1			
Abax parallelepipedus (Piller & Mitterpacher, 1783)	A	7	1	8		1	2
Abax parallelus (Duftschmid, 1812)	A	1					
Acupalpus meridianus (Linnaeus, 1761)	E		1				
Amara aenea (De Geer, 1774)	E		1				9
Amara aulica (Panzer, 1796)	E			1			
Amara bifrons (Gyllenhal, 1810)	E		1				1
Amara equestris (Duftschmid, 1812)	A		1		1	4	9
Amara familiaris (Duftschmid, 1812)	E						2
Amara lunicollis Schiödte, 1837	A						4
Amara nitida Sturm, 1825	A						1
Amara ovata (Fabricius, 1792)	E		1				1
Amara praetermissa (C. R. Sahlberg, 1827)	A		2				
Amara sabulosa (Audinet-Serville, 1821)	E	2	5	1		3	
Amara similata (Gyllenhal, 1810)	E		1				6
Anchomenus dorsalis (Pontoppidan, 1763)	E		1			3	2
Aptinus bombarda (Illiger, 1800)	R	2	1	130			
Badister bullatus (Schrank, 1798)	A			1			1
Brachinus crepitans (Linnaeus, 1758)	E		1		1	9	
Brachinus explodens Duftschmid, 1812	E					1	
Calathus fuscipes (Goeze, 1777)	E	3	8	1	1	5	
Callistus lunatus (Fabricius, 1775)	A	1	1				1
Carabus cancellatus Illiger, 1798	A	24	26	14	31	32	99
Carabus granulatus Linnaeus, 1758	E	1	2	2			1
Carabus hortensis Linnaeus, 1758	A			1			
Carabus intricatus Linnaeus, 1761	A			1	1		
Carabus ullrichii ullrichii Germar, 1824	A	3	3	35	36	12	84
Cicindela campestris Linnaeus, 1758	A		1				
Cylindera germanica (Linnaeus, 1758)	A	33	11			2	24
Harpalus affinis (Schrank, 1781)	E	1	3				12
Harpalus atratus Latreille, 1804	A					1	
Harpalus distinguendus (Duftschmid, 1812)	E					1	
Harpalus honestus (Duftschmid, 1812)	A		1			2	1
Harpalus latus (Linnaeus, 1758)	A			1			1
Harpalus rubripes (Duftschmid, 1812)	E	1	4		3	3	
Lebia cruxminor (Linnaeus, 1758)	A	1				1	
Leistus ferrugineus (Linnaeus, 1758)	E		9		1	1	2
Metallina lampros (Herbst, 1784)	E					1	
Microlestes maurus (Sturm, 1827)	E	2	2				
Molops elatus (Fabricius, 1801)	A			2			
Ophonus azureus (Fabricius, 1775)	E	2					4
Ophonus melletii (Heer, 1837)	E						1
Ophonus puncticeps Stephens, 1828	E		1				
Ophonus rupicola (Sturm, 1818)	E		1			1	
Poecilus cupreus (Linnaeus, 1758)	E		1	1	1	2	6
Poecilus versicolor (Sturm, 1824)	E						6
Pseudoophonus rufipes (De Geer, 1774)	E		2	15			7
Pterostichus melanarius (Illiger, 1798)	E	1		1			3
Stomis pumicatus (Panzer, 1796)	A	1					
In total		**86**	**95**	**216**	**76**	**85**	**291**

was located near the quarry of Malá dohoda. In both years *Carabus ullrichii ullrichii* prevailed significantly in this sinkhole. In the first year, 22 species were captured, and in the second year, 30 species of Carabid beetles were collected. There was, however, no representation of relict species, which corresponds to our Plot 6 in Malá dohoda quarry, which is the closest to the aforementioned sinkhole. Niedobová *et al.* (2011) conducted a research on Carabid beetles at the slopes of Vilémovická and Macošská stráň in PLA Moravian Karst in 2008 and 2009. In total at Macošská stráň, 20 species of Carabid beetles with the total number of 227 specimens were found in 2008 and 18 species of the total number of 116 specimens were caught in 2009. At Vilémovická stráň, 22 species of Carabid beetles with the total number of 1977 specimens were found in 2008 and 21 species of the total number of 623 specimens were caught in 2009. Within the studied area, there was registered an occurrence of four endangered species protected by Decree 395/1992 Coll. as amended by Decree 175/2006 Coll.: *Calosoma auropunctatum* (critically endangered), *Brachinus crepitans, Carabus ullrichii ullrichii*, and *Cicindela campestris* (endangered). Next, two species of Carabidae included in the Red List of the Czech Republic were detected. One of the species found belongs to a vulnerable group (*Calosoma auropunctatum*) and one species to a near threatened group (*Carabus cancellatus*). Another significant species detected at the monitored sites was *Aptinus bombarda*. Except for *Calosoma auropunctatum*, all species were detected in Malá dohoda quarry as well. As for Malá dohoda, there is an assumption that species come to the quarry from the adjacent territory of PLA Moravian Karst, which would explain the discovery that on the active quarry terraces of Malá dohoda we have detected a greater number of specimens and species than on the terraces of Lesní lom quarry with no more mining activity. This can also explain the abundant occurrence of *Carabus cancellatus* species in Malá dohoda, though it did not occur in Lesní lom at all. Similarly, *Carabus ullrichii ullrichii* was captured at all locations of Malá dohoda. Both species were widely found in previous research in PLA Moravian Karst. The positive influence of the surrounding PLA is also indicated by high numbers of collected *Aptinus bombarda*.

SUMMARY

The research was conducted in two limestone quarries in the growing season in 2012. Carabid beetles were captured using pitfall traps with a monthly interval of collection, traps were placed in the quarries themselves and in their surroundings.

In both quarries a total of 1682 specimens belonging to 66 species were collected – Malá dohoda: 847 specimens (49 species); Lesní lom: 835 specimens (40 species). The most abundant species in Lesní lom was *Anchomenus dorsalis* (467 specimens), in Malá dohoda *Carabus cancellatus* (226 specimens). The important species found include species contained in the Red List of the Czech Republic: *Carabus cancellatus*, *Carabus irregularis irregularis*, and *Cylindera germanica,* as well as species protected under Decree No. 395/1992 Coll. as amended by Decree No. 175/2006 Coll.: *Brachinus crepitans*, *B. explodens*, *Cicindela campestris, Carabus irregularis irregularis*, *C. ullrichii ullrichii*, *Cylindera germanica*, and relict species (Hůrka *et al.*, 1996): *Aptinus bombarda*, *Leistus rufomarginatus*, *Carabus irregularis irregularis*.

In terms of habitat preferences, in both quarries similar composition of communities were found. Forest species preferred typically forest Plot 3. At Plots 2, 5, and 6, species favoring open countryside occurred. Species of open habitats and generalists prevailed on quarry terraces. Xerothermophilic species and species preferring unshaded places found refuge particularly at ecotonic quarry zones (Plots 2 and 5).

Thus, it can be concluded that the quarries contribute to maintaining and developing the biodiversity of invertebrates, provide space for xerothermophilic species, while the surrounding area of surveyed sites has some impact on the community composition of Carabid beetles. As for the quarry of Malá dohoda, it was PLA Moravian Karst. It is assumed that the species spread to the said quarry from this PLA, which might explain the higher presence of Carabid beetles on the quarry terraces of the active quarry than on the terraces of the closed quarry.

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