

CARABIDAE OF AN ACTIVE LIMESTONE QUARRY

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Abstract

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In 2012, a research was conducted on Carabid beetles in the active limestone quarry of Mokrý-Horákov. Collections were carried out on quarry terraces and quarry edges using pitfall traps. A total of 37 species with a total number of 197 specimens were captured. The most abundant species was *Cicindela sylvicola* (34 specimens) which is protected under Decree No. 395/1992 Coll. as amended by Decree No. 175/2006 Coll., other detected species protected by this Decree included *C. campestris* (28 specimens) and *Cylindera germanica* (26 specimens) which also belongs to the category of vulnerable under the Red List of Threatened Species of the Czech Republic. The quarry is mostly settled by eurytopic species preferring open habitats. Species that require unshaded habitats and species indifferent to shading occurred especially on the quarry terraces and on its outskirts. Species of shaded habitats were not reported.

Keywords: Carabid beetles, limestone quarries, Mokrý-Horákov (Czech Republic)

INTRODUCTION

The most important area of Moravia with limestone deposits of different sizes is Moravian Devonian. The main ingredient in most localities is Vilémovice limestone (VV, 96–97% CaCO₃). Vilémovice limestone is very fine-grained, thickly tabular to massive, of light gray color. From the chemical point of view, it is a very pure limestone, representing the best rock for the formation of karst phenomena. The largest and best developed complex of these high-percentage organogenesis carbonates is found in the territory of Protected Landscape Area (PLA) Moravský Kras (AOPK, 2013).

Demand for high quality limestone is still growing and this leads to the expansion and opening of new mining areas. Fortunately, awareness of potential benefits of surface mining, in particular benefits arising from leaving the closed quarry alone – for spontaneous succession – has been currently increasing (e.g. Bradshaw, 1997, 2000; Prach & Pyšek, 2001; Šálek, 2012; Tropek *et al.*, 2013; Wheeler & Cullen, 1997; Gremlica *et al.*, 2011). Mining is indeed a very drastic intervention into the environment in the broadest sense, but in the long-term perspective,

the abandoned quarries can revive otherwise monotonous cultural landscape and become major islands of higher biodiversity to various extent.

Deposits of limestone and cement raw materials are mined on the surface in the Czech Republic. The same is true for the large quarry of Mokrý-Horákov which lies between the villages of Mokrý-Horákov and Hostěnice adjacent to PLA Moravský Kras with a surface mining area of 2 659 881 m² (Donocik, Českomoravský cement, a.s., pers. comm.). The aim of this study was to discover whether there could not be any life in an active quarry which covers an area of 370 football pitches, in some places almost without vegetation, with extreme microclimatic conditions. Due to the limestone bedrock and the vicinity to PLA Moravský Kras, there is a presumption that at least in its peripheral parts it could be a site of major faunistic importance (Nováková & Šťastná, 2013; Košulič *et al.*, 2013).

MATERIAL AND METHODS

The survey was conducted in the active quarry of Mokrý-Horákov where mining operations have been ongoing since 1968. The quarry is located in

the village Mokrý-Horákov, district Brno-venkov (Czech Republic, 49°14'42.424"N, 16°45'50.116"E, faunistic square 6766 (Pruner & Míka, 1996). The location is situated at an altitude of 410m. The area of Mokrý deposit is formed by a strong ridge elongated in the direction east-west, PLA Moravský Kras is adjacent to the north-western and partially to the northern part of it. The area is divided into three separate quarries, the research was conducted in the so called Prostřední Quarry (Fig. 1) where mining began in the first half of the 70s of the 20th century. The basic mining methods for breaking rock are major blasting operations. Due to its location and exposure, the area can be assigned to the warmest areas of Moravský Kras. The area is characterized by the average air temperature in July 16 to 18 °C and in winter months between -2 to -5 °C and an average amount of atmospheric precipitation within the range of 550–750 mm (Mackovčín & Sedláček, 2008).

In order to capture Carabid beetles, formaldehyde pitfall traps with a detergent as a wetting agent were used. In the quarry, the pitfall traps were placed in lines of three to four locations, two lines of traps within the quarry (plots 1 and 2) and two lines on the quarry edge (plots 3 and 4). Samples were collected at monthly intervals during the growing season of 2012. Pitfall traps were installed on 21 March 2012, collections were then made on (dd/mm/yyyy) 23/4/2012, 24/5/2012, 20/6/2012, 26/7/2012, 21/8/2012, 27/9/2012, 29/10/2012. 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).

Hůrka *et al.* (1996) classified Carabidae into three indication groups (R, A, E) according to their ecological valence and dependence on the habitat. Species in the R group are stenotopic with the narrowest ecological valence, mostly rare and endangered of native, intact ecosystems. Group A is characterized 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 environment (species of unstable and changing habitats, habitats strongly influenced by human activities).

Description of individual locations in the Mokrý quarry (Fig. 2)

Plot 1 was formed by a steep slope above the middle quarry terrace, where a landslide occurred and there are relatively few stones. The total coverage was 25%. *Tussilago farfara* was rather abundant here. Plot 2 was formed by a steep slope above the quarry terrace, where a land and ravelslide occurred. The total coverage was 0%. Plot 3 represented a bare rock with little soil, close to the upper edge of the quarry. The total coverage was 80%. Rather abundant species included *Quercus petraea*, *Brachypodium pinnatum*, *Cornus sanguinea*, *Crataegus* sp., *Euphorbia cyparissias*, *Hieracium pilosella*, *Pinus sylvestris*, and *Rubus fruticosus*. Plot 4 was a grassy community, slightly ruderal, above the upper edge of the quarry. The soil here was partially removed. The total coverage was 70%. There were greater amounts of *Lotus corniculatus* and *Rubus fruticosus*.



1: Quarry of Mokrý-Horákov; localization of the Prostřední quarry



2: Prostřední Quarry; scheme of pitfall trap locations, each ellipse indicates a line of three pitfall traps at a mutual distance of 5 m (source: mapy.cz)

RESULTS AND DISCUSSION

A total of 37 species with a total number of 197 specimens were captured (Tab. I). The most specimens and species were captured at plot 4 (118 specimens, 23 species) and the least at plot 2 (5 specimens, 4 species). Species of group E prevailed (57%) over species of group A (43%), no species of group R were recorded (Fig. 3). The area was dominated by species of open habitats (70%), whereas forest species (16%) and generalists (14%) were less abundant (Fig. 4). Forest species were observed mainly at plot 1, species of open habitats prevailed at plots 2, 3, and 4. One species from among vulnerable (VU – *Cylindera germanica*, cf. Veselý *et al.*, 2005) was recorded which is also a species under special protection of Decree No. 395/1992 Coll. as amended by Decree No. 175/2006 Coll. Other reported species protected under the Decree included *Cicindela campestris* and *C. sylvicola*. Due to the open nature of the quarry habitat it was not surprising that primary species that require unshaded habitats (59%) and species indifferent to shading (38%) occurred on the terraces of the quarry on the outskirts (Fig. 5). Species of shaded habitats were not reported. The ratio of representation of these environmental groups (60:40) was unchanged on the terraces as well as on the outskirts of the quarry.

In 2001, a research was conducted at the quarry of Mokrá-Horákov by Vašátko (2001) who found 1943 specimens of Carabid beetles belonging to 20 species, whereas the surveyed areas were directly in the mining area and its immediate surroundings. On the quarry edge the species of *Abax ater* and *Pterostichus oblongopunctatus* significantly prevailed,

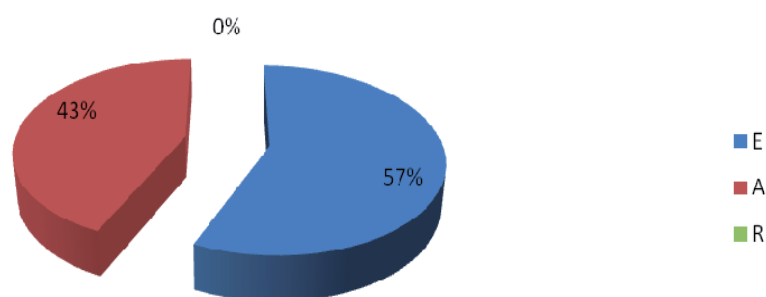
however, we have not recorded any of them in 2012. In our research *Cicindela campestris* and *Harpalus rubripes* prevailed on the quarry edge. Vašátko *et al.* (1991, 1992) indicate the species of *Carabus hortensis* in those years near the quarry edge as dominant, in 1997 (Vašátko, 2001) as a receding species. In our research in 2012 it was not recorded at all. Overall, significantly fewer specimens but more species of Carabid beetles were found in our study. Species preferring rather open habitats predominate on the quarry edges.

A similar research was conducted by Nováková & Šťastná (2013) in the active quarry of Malá dohoda in PLA Moravský Kras. Species of open habitats and generalists prevailed on the quarry terraces. Xerothermophilous species and species preferring unshaded places found refuge particularly at ecotonic quarry zones. The authors collected a total of 342 specimens representing 39 species directly on the quarry terraces and quarry edges. The most numerous species was *Carabus cancellatus* (226 specimens) which was not recorded in the quarry of Mokrá-Horákov at all. In the quarry of Malá dohoda, there were higher numbers of specimens both on the terraces and the edges of the quarry. Species from PLA Moravský Kras probably spread more to the active quarry of Malá dohoda, but the results can also be affected by the short-term duration of the research.

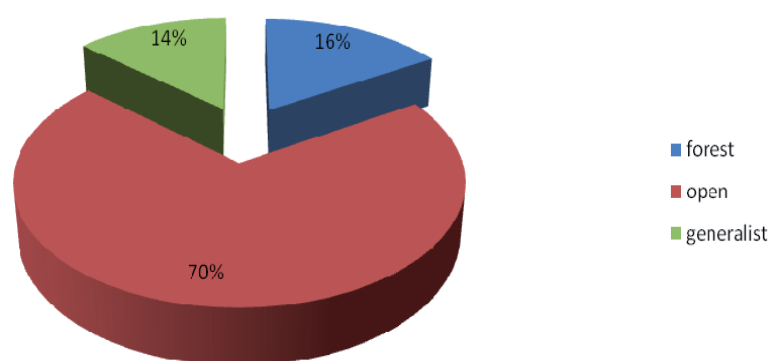
Thus, it can be concluded that the quarries contribute to maintaining and developing biodiversity of invertebrates, provide space for xerothermophilous species, while the surrounding area of surveyed sites has some impact on the taxocenosis composition of Carabid beetles.

I: Overview of species found in the quarry of Mokrý-Horákov. Bioind. G – species bioindication group by Hůrka et al. (1996), E – eurytopic, A – adaptable, R – relict. Light preference by Hůrka et al. (1996), 1 – species requiring habitat free of shading, 2 – species on sites without shade or partial shade, 3 – types indifferent (no preference).

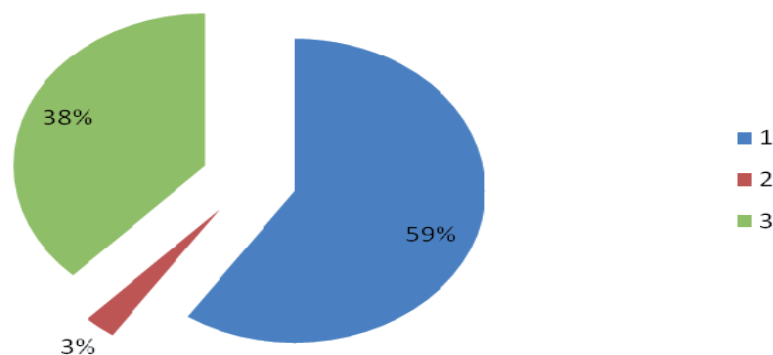
SPECIES	plot				bioindication group	light preference
	1	2	3	4		
<i>Abax parallelepipedus</i> (Piller & Mitterpacher, 1783)	1		4	1	A	3
<i>Abax parallelus</i> (Duftschmid, 1812)	1				A	3
<i>Acupalpus meridianus</i> (Linnaeus, 1761)	1	2			E	3
<i>Amara aenea</i> (De Geer, 1774)			1		E	1
<i>Amara convexior</i> Stephens, 1828			2	8	E	3
<i>Amara eurynota</i> (Panzer, 1797)			1		E	1
<i>Amara ovata</i> (Fabricius, 1792)			1		E	3
<i>Amara similata</i> (Gyllenhal, 1810)				2	E	1
<i>Badister bullatus</i> (Schränk, 1798)			1	1	A	3
<i>Bembidion lampros</i> (Herbst, 1784)				6	E	1
<i>Bembidion obtusum</i> (Audinet-Serville, 1821)				2	E	1
<i>Bembidion quadrimaculatum</i> (Linnaeus, 1761)				1	E	1
<i>Callistus lunatus</i> (Fabricius, 1775)				1	A	1
<i>Carabus violaceus violaceus</i> Linnaeus, 1758				1	A	3
<i>Cicindela campestris</i> Linnaeus, 1758			6	22	A	1
<i>Cicindela sylvicola</i> Dejean in Latreille & Dejean, 1822	33	1			A	3
<i>Cylindera germanica</i> (Linnaeus, 1758)	1		4	21	A	1
<i>Demetrias monostigma</i> Samouelle, 1819		1			A	1
<i>Harpalus atratus</i> Latreille, 1804			1		A	1
<i>Harpalus distinguendus</i> (Duftschmid, 1812)				1	E	1
<i>Harpalus honestus</i> (Duftschmid, 1812)			1		A	1
<i>Harpalus latus</i> (Linnaeus, 1758)			2		A	3
<i>Harpalus rubripes</i> (Duftschmid, 1812)				23	E	1
<i>Harpalus signaticornis</i> (Duftschmid, 1812)			1	1	E	1
<i>Leistus ferrugineus</i> (Linnaeus, 1758)	1		4	5	E	3
<i>Microlestes maurus</i> (Sturm, 1827)				1	E	3
<i>Ophonus azureus</i> (Fabricius, 1775)				2	E	1
<i>Ophonus puncticeps</i> Stephens, 1828				8	E	2
<i>Ophonus rupicola</i> (Sturm, 1818)	1			1	E	1
<i>Poecilus cupreus</i> (Linnaeus, 1758)		1		1	E	1
<i>Poecilus versicolor</i> (Sturm, 1824)			1		E	1
<i>Pseudoophonus griseus</i> (Panzer, 1797)	1				E	1
<i>Pseudoophonus rufipes</i> (De Geer, 1774)	1		1	7	E	1
<i>Pterostichus burmeisteri</i> Heer, 1838			1		A	3
<i>Pterostichus longicollis</i> (Duftschmid, 1812)				1	A	1
<i>Pterostichus niger</i> (Schaller, 1783)			1		A	3
<i>Pterostichus vernalis</i> (Panzer, 1796)				1	A	3
In total	41	5	33	118		



3: Percentage of bioindicating groups (E – eurytopic species, A – adaptable species, R – stenotopic species)



4: Percentage of recorded species by habitat preferences



5: Light preference of recorded species (1 – species requiring habitat free of shading, 2 – species on sites without shade or partial shade, 3 – types indifferent (no preference))

SUMMARY

A faunistic survey of Carabid beetles (Carabidae) took place during the growing season in 2012. The species were captured in formaldehyde pitfall traps directly on the terraces and edges of the quarry. A total of 37 species with a total number of 197 specimens were captured in the Mokrá-Horákov quarry. The most specimens and species were captured at plot 4 (118 specimens, 23 species) and the least species were collected at plot 2 (5 specimens, 4 species). One species from among vulnerable (VU – *Cylindera germanica*, cf. Veselý *et al.*, 2005) was recorded which is also a species under special protection of Decree No. 395/1992 Coll. as amended by Decree No. 175/2006 Coll. Other reported species protected under the Decree included *Cicindela campestris* and *C. sylvicola*. Overall, widespread species (eurytopic, 57%) prevailed in the quarry over adaptable species with narrow ecological amplitude (43%), relict species were not recorded. In terms of habitat, species of open habitats substantially prevailed over wild species and generalists. Xerothermophilous species and species preferring unshaded places found refuge particularly on quarry terraces.

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REFERENCES

- AOPK, 2013: *Moravský kras – charakteristika oblasti*. Available online at: <http://moravskykras.ochranaprirody.cz/> [cited on 10th Sep 2013].
- BRADSHAW, A., 1997: Restoration of mined lands—using natural processes. *Ecological Engineering*, 8: 255–269. ISSN 0925-8574.
- BRADSHAW, A., 2000: The use of natural processes in reclamation: advantages and difficulties. *Landscape and Urban Planning*, 51: 89–100. ISSN 0169-2046.
- GREMLICA, T. *et al.*, 2011: Projekt VaV SP/2d1/141/07 “Rekultivace a management nepřírodních biotopů v České republice”. Závěrečná zpráva. [cited on 3th Feb 2014]. Available online at: http://ekopolitika.cz/images/stories/obnova%20krajiny/Zaverecna_zprava_2007-2011%28prosinec%202011%29.pdf.
- HŮRKA, K., 1996: *Carabidae of the Czech and Slovak Republics*. Zlín: Kabourek, 565 pp. ISBN 80-901466-2-7.
- HŮRKA, K., VESELÝ, P., FARKAČ, J., 1996: Využití střevlíkovitých (Coleoptera: Carabidae) k indikaci kvality prostředí. *Klapalekiana*, 32: 15–26. ISSN 1210-6100.
- KOŠULIČ, O., NOVÁKOVÁ, L., ŠTÁTNÁ, P., 2013: Epigeic spiders (Araneae) from the Malá Dohoda Quarry (Moravský Kras Protected Landscape Area, Czech Republic). *Acta Univ. Agric. Silvic. Mendelianae. Brun.*, 61, 3: 651–662. ISSN 1211-8516.
- MACKOVČIN, P., SEDLÁČEK, M. (eds), 2008: *Chráněná území ČR. Svazek IX – Brněnsko*. Praha: Agentura ochrany přírody a krajiny, 932 pp. ISBN 978-80-86064-66-6.
- NOVÁKOVÁ, L., ŠTÁTNÁ, P., 2013: Diversity of Carabidae in limestone quarries of South Moravia. *Acta Univ. Agric. Silvic. Mendelianae. Brun.*, 61, 3: 757–764. ISSN 1211-8516.
- PRACH, K., PYŠEK, P., 2001: Using spontaneous succession for restoration of human-disturbed habitats: Experience from Central Europe. *Ecological Engineering*, 17: 55–62. ISSN 0925-8574.
- PRUNER, L., MÍKA, P., 1996: Seznam obcí a jejich částí v České republice s čísly mapových polí pro síťové mapování fauny. *Klapalekiana*, 32: 1–175. ISSN 1210-6100.
- ŠÁLEK, M., 2012: Spontaneous succession on opencast mining sites: implications for bird biodiversity. *J. Appl. Ecol.*, 49: 1417–1425. ISSN 0021-8901.
- TROPEK, R., HEJDA, M., KADLEC, T., SPITZER, L., 2013: Local and landscape factors affecting communities of plants and diurnal Lepidoptera in black coal spoil heaps: Implications for restoration management. *Ecological Engineering*, 57: 252–260. ISSN 0925-8574.
- VASÁTKO, J., 2001: *Výsledky průzkumu modelových skupin živočišné složky geobiocenóz (měkkýši, střevlíci, drabčici a pavouci) dobývacího prostoru lomu Mokrá v roce 2001*. Brno. Výzkumná zpráva, 12 pp.
- VASÁTKO, J., VANĚČKOVÁ, L., DĚDEČKOVÁ, M., 1991: *Biota Moravského krasu a její změny vlivem lidské činnosti na příkladu rostlin a modelových skupin živočichů (severní část Moravského krasu)*. GGÚ ŠAV v Brně. Výzkumná zpráva. Archiv CHKO Moravský kras, 49 pp.
- VASÁTKO, J., VANĚČKOVÁ, L., DĚDEČKOVÁ, M., 1992: *Biota v jižní části Moravského krasu a její změny vlivem lidské činnosti na příkladu rostlin a modelových skupin živočichů*. GGÚ ŠAV v Brně. Výzkumná zpráva. Archiv CHKO Moravský kras, 19 pp.
- VESELÝ, P., MORAVEC, P., STANOVSKÝ, J., 2005: Carabidae (střevlíkovití), pp. 406–411. In: FARKAČ, J., KRÁL, D., ŠKORPÍK, M., 2005: *Červený seznam ohrožených druhů České republiky – Bezobratlí*. Praha: Agentura ochrany přírody a krajiny České republiky, 760 pp. ISBN 80-86064-96-4.
- VIGNA TAGLIANTI, A., 2012: Fauna Europaea: Carabidae. In: AUDISIO, P., *Fauna Europaea: Coleoptera, Adephaga. Fauna Europaea version 2.5*. [online]. [cited on 10th Sep 2012]. Available online at: <http://www.faunaeur.org/>.
- WHEATER, C. P., CULLEN, W. R., 1997: The flora and invertebrate fauna of abandoned limestone quarries in Derbyshire, United Kingdom. *Restor. Ecol.*, 5, 1: 77–84. ISSN 1526-100X.

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