ISSN 2336-3193
DOI: 10.2478/cszma-2021-0014

Acta Mus. Siles. Sci. Natur., 70: 225-242, 2021
Published: online 25th January 2022, print January 2022

Biodiversity of the Quarry in Stará Ves near Bílovec with focus on butterflies

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Biodiversity of the Quarry in Stará Ves near Bílovec with focus on butterflies. – Acta Mus. Siles. Sci. Natur. 70: 225-242, 2021.

Abstract: The quarry in Stará Ves near Bílovec is considered a significant geotouric attraction. The dominant feature is the front northern wall representing one of the best outcrops of the fold-thrust tectonics of the Jeseník culm. Until 1983, shale and Moravian offal were mined in the quarry, then the quarry was restored, abandoned, and left to natural succession. Inventory of vertebrates from 2009–2011 revealed 46 specially protected species. Arachnological research from 2013–2015 revealed the occurrence of 69 species of spiders, including seven taxonomically important xerothermophilic species. Botanical research was carried out at the site twenty years ago, systematic entomological research has not been carried yet. We performed an inventory of invertebrates focused primarily on butterflies, using sweeping and netting, supplemented by individual sampling and observation of other species. We also performed a botanical inventory, supplemented by an estimate of tree and bush cover to evaluate host offer and form of habitats present in the quarry. We revealed 144 species of higher plants, of which six belong to the Czech red list, and 121 species of animals, of which 102 species of insects, and 52 species of butterflies. Nineteen species of animals fell into the categories of endangerment according to the Czech red list, legal categories, or are part of some of the European directive annexes. Most of these species depend on the conservation of early succession xerothermic habitats. Their ecology is discussed in relation to possible management.
Keywords: butterflies, care plan, *Coenonympha arcania*, coverage estimate, netting, sweeping, xerothermic habitats, *Zygaena purpuralis*

Introduction

In the sloping terrain of the southeastern foothills of the Low Jeseník called Vítkovská vrchovina and geomorphologically belonging to the Oderské vrchy area, there is an abandoned quarry in the cadastre of the village of Bílovec in the local part named Stará Ves. The locality is situated 3.3 km northwest of the city center, approximately at coordinates 49° 46.265', 17° 58.959', on plot no. 3061 with an area of approximately seven hectares, length of 400 meters, and width of 300 meters, of which the excavated pit is about 200 meters long and 150 meters wide. The altitude of the area ranges from 310–350 m a.s.l. (Mikunda 2021, Pilátová 2021).

From the geological point of view, it is a type locality of the Kyjovice layers of the Hradec-Kyjovice formation. In sediments originating from the culm (lower and middle carbon), bench-shaped fine-grained offal alternates with siltstones and shales. The offals are dark gray, often thinly parallelly layered. They contain 50% of quartz, 20% of plagioclase, 10% of acid volcanic fragments, and 20% fragments of phyllites, gneisses, and shales (Dvořák 1999). Siltstones and shales are gray-black, parallelly laminated, and with the presence of pyrite. They are interspersed by small veins of quartz, crystal, calcite, and ankerite, sometimes with gray-green aggregates of chlorite or exceptionally with barite. In addition to pyrite, sulfides are represented by chalcopyrite and sphalerite (Zimák *et al*. 2002). Of the secondary products, limonite is abundant, and malachite is rare. Fragments of prehistoric plant fossils like *Lepidophloios*, *Archaeocalamites*, *Calamites*, and unidentified gymnosperms, have been identified in sediments. Thus, the quarry is considered a study profile of regional-geological significance and is recommended for protection as a potential geotouric attraction. The dominant feature

of the locality is the front northern wall (Fig. 1) representing one of the best outcrops of fold-thrust tectonics in the Jeseník culm (Grygar 1997, ČGS 2012).

Fig 1: The northern wall of the quarry representing one of the best outcrops of fold-thrust tectonics in the Jeseník culm (photo by Adam Mikunda).

The locality belongs to the typical Silesian shale quarries, which arose mainly in the second half of the 19th century in the landscape of the Low Jeseník, in the Moravice and Odra river basins, especially in the Budišov and Vítkov regions. Shale and Moravian offal were mined in these quarries, the second used primarily in the construction industry, especially for roads and sidewalks (Moučka & Chroust 2012). Around 1900, the quarry in Stará Ves was owned by Benedikt Lazecký from nearby Tísek. In 1921, it was taken over by the road administration of the District Governor's Office of the Bílovec. The stone was mined using explosives. The material was then loaded onto hand carts, later by crawler excavators on trucks, transported from the quarry wall into a crushing machine. The individual fractions were then separated in a sorting device. Between 1960–1980, 30000–50000 m³ stones were mined per year. On average, 15–25 workers worked in the quarry. The activities in the quarry ceased in 1983 due to the deterioration of the quality of the mined stone. In the years 1984–1989, the quarry was restored. The equipment was dismantled, taken away, and found further use in other quarries, such as in Bohučovice. Subsequently, demolition of buildings in the locality was conducted, followed by terrain leveling, and planting of grass, clover and tree species, e.g. *Betula pendula* Roth (Mikunda 2021, Pilátová 2021).

In the last thirty years, the quarry has been left to natural succession (Fig. 2). Disturbed rock walls, rock debris, and unshaded sunny places with a xerothermic microclimate form

a specific habitat ideal for the occurrence of steppe species of plants and animals. During the geobotanical survey of vegetation in 2002, no endangered species have been identified. However, there was potential for possible interesting future development of beginning oak-hornbeam forests, wetland vegetation at the entrance to the quarry, and moving rock debris with *Epilobium dodonaei* Vill. (Štursová 2002). A vertebrate inventory from 2009–2011 revealed 46 endangered or protected animal species. Five species of amphibians have occurred here: *Bombina bombina* (Linnaeus, 1761), *Bufo bufo* (Linnaeus, 1758), *Bufotes viridis* (Laurenti, 1768), *Hyla arborea* (Linnaeus, 1758), and *Rana dalmatina* (Fitzinger, 1839). From reptiles, *Lacerta agilis* (Linnaeus, 1758), in the shaded parts *Anguis fragilis* (Linnaeus, 1758) and *Natrix natrix* (Linnaeus, 1758), and in 2011 also *Coronella austriaca* (Laurenti, 1768) were noted here (Molitor 2011). The *Vipera berus* (Linnaeus, 1758) has also been observed in quarry repeatedly (Štursová 2002). The occurrence of 27 species of birds has been documented, of which 12 species nested in the locality. The most important nesting species were *Bubo bubo* (Linnaeus, 1758) and *Lanius collurio* (Linnaeus, 1758) (Molitor 2011).

Fig 2: View from the north side to the bottom of the quarry – an advanced phase of succession is evident, yet there are still steppe habitats at the site (photo by Adam Mikunda).

In 2012, a botanical survey of the forest on the southern and western edges of the quarry was carried out. The vegetation was characterized as polonian oak-hornbeam forest with *Carpinus betulus* L. and *Quercus robur* L. as the dominant species of the tree layer, supplied by *Acer pseudoplatanus* L., *Fraxinus excelsior* L., *Tilia cordata* Mill., and in the bush floor with rare presence of *Crataegus* sp. L. This forest is accompanied by high mesophilic and xerophilic shrubs, dominated by *Prunus spinosa* L. and supplied by *Sambucus nigra* L., and *Rosa canina* L. (Gerža 2012). In the years 2013–2015, an arachnological inventory was conducted in the quarry, which revealed the occurrence of 69 species of spiders. The largest abundance and species diversity were described in the steppe part of the site. Dominant species were *Mangora acalypha* (Walckenaer, 1802), *Alopecosa pulverulenta* (Clerck, 1757), *Trochosa terricola* (Thorell, 1856), *Centromerus sylvaticus* (Blackwall, 1841), and *Agroeca brunnea* (Blackwall, 1833). The important taxa were mainly xerothermophilic species of rocks and steppes such as *Titanoeca quadriguttata* (Hahn, 1833), *Zelotes petrensis* (C. L. Koch, 1839),

Ozyptila atomaria (Panzer, 1801), *Alopecosa trabalis* (Clerck, 1757), *Dipoena melanogaster* (C. L. Koch, 1837), *Heliophanus cupreus* (Walckenaer, 1802), and endangered species *Philodromus rufus* (Walckenaer, 1826) (Žitníková 2014, Černochová 2015, Řezáč *et al*. 2015).

Polyommatus bellargus (Rottemburg, 1775) classified as vulnerable species, is the most important insect species so far recorded in quarry. This butterfly currently penetrates anthropogenically disturbed areas, such as quarries but its occurrence is still very sporadic in northern Moravia and Silesia (Filipová 2013). Thus, the overview shows that in the last 20 years there is a lack of inventory of vegetation directly in the quarry, which could have been saturated meantime by taxa due to succession, and there is also a lack of insect inventory, despite present habitats could be suitable especially for a large number of butterfly species. Our work aimed to perform

(i) a botanical inventory supplied by the estimate of the tree and shrub vegetation cover;
(ii) an inventory of invertebrates with a focus on butterflies.

Material and Methods

Inventarization was conducted from the beginning of May to the end of October 2021. The first visit took place on 21-05-06. Eight subsequent visits were conducted approximately in period of three weeks: 21-05-27, 21-06-22, 21-07-06, 21-07-25, 21-08-16, 21-09-09, 21-10-03, 21-10-28. To monitor the insects, we swept the vegetation by sweeping nets and catched insects by standard nets with a sampling effort of six man-hours per visit (two persons for three hours) during the early afternoon (usually 13:00–16:00). Each visit was also supplemented by a botanical inventory, and on 21-10-03, the coverage of the tree and shrub layer was estimated using the Braun-Blanquet scale. For this inventory, the quarry area was divided into four parts representing the basic type of present habitats: i) steppe – open and dry habitat with a rich herbaceous layer and scattered shrubs and trees in the north-eastern part of the quarry, ii) forest – a shaded habitat covered with woody vegetation with a sporadic herbaceous layer in the western part of the quarry, iii) wetland – a semi-open wetland in the southern part of the quarry; iv) upper floor of the quarry – a ring of woody plants surrounding the quarry, especially along its northwestern edge. Determination keys and atlases relevant to each group were used to determine individual species (Dungel *et al*. 2021, Ellis 2001, Hůrka 2005, Kubát *et al*. 2002, Macek *et al*. 2010, Macek *et al*. 2015, Moravec 2019, Svrček *et al*. 1976). In the period 21-07-06–21-07-10, a capture-mark-recapture method was used to estimate the population size of two nearly threatened butterfly species: *Zygaena purpuralis* (Brünnich, 1763) and *Coenonympha arcania* (Linnaeus, 1761). Both species were assumed to have closed populations. Thus, the estimate of the size of their imago populations was calculated manually using the Lincoln-Petersen method and Schnabel method from the package "fishmethods" (Nelson 2021) in R 4.1.2.

Fig 3: Four basic types of habitats in the quarry in Stará Ves near Bílovec. The steppe part is represented by yellow, the forest part is green, the entrance part of the quarry is red, and the upper part of the quarry is blue. The source of the underlying map is ČÚZK (Czech Office for Surveying, Mapping and Cadastre).

Results

Totally, 144 species of higher plants were detected in the quarry area: 30 species of trees and shrubs (their cover in individual types of habitats is shown in Tab. 1), and 114 species of the herbaceous layer. Among them we find six species of the Czech red list: four species of C3 – endangered, two species of C4a – requiring further attention (Grulich 2017), we comment on the issue of their nativeness in the discussion. There are also six invasive species, one expansive species, and two domesticated species (Tab. 2). We find also 11 taxa of fungal organisms, one of which is a nearly threatened species (Tab. 3).

Tab 1: Species of trees and shrubs in individual types of habitats. **B-B**: Estimation of coverage according to the Braun-Blanquet scale: 3: 25–50% cover, 2b: 15–25% cover 2: 5–15% cover, 1: 1–5% cover, +: 1% cover, r: 1–2 individuals. **C3**: endangered species according to Czech red list of vascular plants (Grulich 2017), **invasive** – non-native spreading species.

Latin name	Czech name	B-B
Steppe habitat		
Salix caprea L.	vrba jíva	2
Betula pendula Roth.	bříza bělokorá	1
Fraxinus excelsior L.	jasan ztepilý	1
Crataegus sp. L.	hloh	1
Prunus spinosa L.	trnka obecná	1
Rosa canina L.	růže šípková	1
Acer pseudoplatanus L.	javor klen	+
Carpinus betulus L.	habr obecný	+
Prunus avium (L.) L.	třešeň ptačí	+
Malus domestica Borkh.	jabloň domácí	r
Quercus robur L.	dub letní	r
Pinus nigra J. F. Arnold	borovice černá	r
Pinus sylvestris L.	borovice lesní	r
Pyrus communis L.	hrušeň obecná	r
Tilia cordata Mill.	lípa srdčitá	r
Cornus sanguinea L.	svída krvavá	r
Corylus avellana L.	líska obecná	r
Ligustrum vulgare L.	ptačí zob obecný	r
Forest habitat		
Acer pseudoplatanus L.	javor klen	3
Carpinus betulus L.	habr obecný	3
Populus tremula L.	topol osika	2b
Tilia cordata Mill.	lípa srdčitá	2b
Betula pendula Roth.	bříza bělokorá	2
Fraxinus excelsior L.	jasan ztepilý	2
Quercus robur L.	dub letní	2
Salix caprea L.	vrba jíva	2
Cornus sanguinea L.	svída krvavá	2
Rosa canina L.	růže šípková	2
Larix decidua Mill.	modřín opadavý	1
Picea abies (L.) H. Karst.	smrk ztepilý	1
Pinus sylvestris L.	borovice lesní	1
Robinia pseudoacacia L.	trnovník akát	1, invasive
Salix alba L.	vrba bílá	1
Alnus glutinosa (L.) Gaertn.	olše lepkavá	+
Juglans regia L.	ořešák královský	+
Prunus avium (L.) L.	třešeň ptačí	+
Corylus avellana L.	líska obecná	+
Crataegus sp. L.	hloh	r
The entrance part of the quarry		
Carpinus betulus L.	habr obecný	3
Acer pseudoplatanus L.	javor klen	2b
Betula pendula Roth.	bříza bělokorá	2b

Tilia cordata Mill.	lípa srdčitá	2b
Salix caprea L.	vrba jíva	2b
Quercus robur L.	dub letní	2
Populus tremula L.	topol osika	2
Corylus avellana L.	líska obecná	2
Rosa canina L.	růže šípková	2
Fraxinus excelsior L.	jasan ztepilý	1
Populus nigra L.	topol černý	1
Cornus sanguinea L.	svída krvavá	1
Juglans regia L.	ořešák královský	+
Larix decidua Mill.	modřín opadavý	+
Picea abies (L.) H. Karst.	smrk ztepilý	+
Pinus nigra J. F. Arnold	borovice černá	+
Prunus avium (L.) L.	třešeň ptačí	+
Prunus spinosa L.	trnka obecná	+
Malus domestica Borkh.	jabloň domácí	r
Sorbus aucuparia L.	jeřáb ptačí	r
Sambucus nigra L.	bez černý	r
The upper floor of the quarry		
Betula pendula Roth.	bříza bělokorá	3
Populus tremula L.	topol osika	2b
Salix caprea L.	vrba jíva	2b
Acer pseudoplatanus L.	javor klen	2
Quercus robur L.	dub letní	2
Carpinus betulus L.	habr obecný	1
Fagus sylvatica L.	buk lesní	1
Pinus sylvestris L.	borovice lesní	1
Prunus avium (L.) L.	třešeň ptačí	1
Rosa canina L.	růže šípková	1
Alnus glutinosa (L.) Gaertn.	olše lepkavá	+
Fraxinus excelsior L.	jasan ztepilý	+
Larix decidua Mill.	modřín opadavý	+
Picea abies (L.) H. Karst.	smrk ztepilý	+
Populus nigra L.	topol černý	+
Ligustrum vulgare L.	ptačí zob obecný	+
Taxus baccata L.	tis obecný	r, C3

Tab 2: Plant species of the herbaceous layer recorded in the quarry during May–October 2021. **Habitat**: type of habitat, where individual species were most represented (steppe, forest, wetland, upper. p – the upper part of the quarry); **Notes**: **C3** – endangered species according to Czech red list (Grulich 2017), **C4a** – species requiring further attention, **invasive** – non-native spreading species, **expansive** – native species behaving as invasive, **domesticated** – non-native species probably from nearby gardens.

Latin name	Czech name	Habitat	Notes
Dryopteridaceae	**Kapraďovité**		
Dryopteris filix-mas (L.) Schott	kapraď samec	forest	
Equisetaceae	**Přesličkovité**		
Equisetum arvense L.	přeslička rolní	forest	
Amaryllidaceae	**Amarylkovité**		
Allium schoenoprasum L.	pažitka pobřežní	wetland	C3
Cyperaceae	**Šáchorovité**		
Carex brizoides L.	ostřice třeslicovitá	wetland	
Carex echinata Murray	ostřice ježatá	wetland	
Juncaceae	**Sítinovité**		
Juncus conglomeratus L.	sítina klubkatá	wetland	
Juncus tenuis Willd.	sítina tenká	steppe	
Poaceae	**Lipnicovité**		
Calamagrostis epigejos (L.) Roth	třtina křovištní	steppe	expansive
Poa nemoralis L.	lipnice hajní	forest	
Setaria pumila (Poir.) Roem. & Schult.	bér sivý	steppe	

Typhaceae	**Orobincovité**		
Typha latifolia L.	orobinec širolistý	wetland	
Apiaceae	**Miříkovité**		
Anthriscus sylvestris (L.) Hoffm.	kerblík lesní	forest	
Daucus carota L.	mrkev obecná	steppe	
Pimpinella saxifraga L.	bedrník obecný	steppe	
Asteraceae	**Hvězdnicovité**		
Achillea millefolium L.	řebříček obecný	steppe	
Carduus acanthoides L.	bodlák obecný	steppe	
Carlina vulgaris L.	pupava obecná	steppe	
Centaurea jacea L.	chrpa luční	upper p.	
Cichorium intybus L.	čekanka obecná	wetland	
Cirsium vulgare (Savi) Ten.	pcháč obecný	steppe	
Erigeron annuus (L.) Pers.	turan roční	steppe	invasive
Eupatorium cannabinum L.	sadec konopáč	forest	
Hieracium murorum L.	jestřábník zední	steppe	
Hypochaeris radicata L.	prasetník kořenatý	upper p.	
Leucanthemum vulgare Lam.	kopretina bílá	steppe	
Pilosella aurantiaca (L.) F.W. Sch. & Sch. Bip.	chlupáček oranžový	upper p.	C3
Senecio jacobaea L.	starček přímětník	steppe	
Solidago canadensis L.	zlatobýl kanadský	steppe	invasive
Solidago virgaurea L.	zlatobýl obecný	steppe	
Symphyotrichum novi-belgii (L.) Nesom	hvězdnice novobelgická	steppe	
Tanacetum vulgare L.	vratič obecný	steppe	
Taraxacum sect. *Ruderalia*	sekce pampelišky smetánky	steppe	
Tragopogon pratensis L.	kozí brada luční	steppe	
Tussilago farfara L.	podběl lékařský	wetland	
Boraginaceae	**Brutnákovité**		
Myosotis palustris (L.) L.	pomněnka bahenní	wetland	
Myosotis sylvatica Hoffm.	pomněnka lesní	wetland	
Symphytum officinale L.	kostival lékařský	forest	
Brassicaceae	**Brukvovité**		
Alliaria petiolata (M. Bieb.) Cavara & Grande	česnáček lékařský	forest	
Barbarea vulgaris W. T. Aiton	barborka obecná	steppe	
Lepidium campestre (L.) R. Br.	řeřicha chlumní	forest	
Turritis glabra L.	huseník lysý	steppe	
Campanulaceae	**Zvonkovité**		
Campanula patula L.	zvonek rozkladitý	steppe	
Campanula trachelium L.	zvonek kopřivolistý	forest	
Caryophyllaceae	**Hvozdíkovité**		
Dianthus armeria L.	hvozdík svazčitý	steppe	C4a
Dianthus carthusianorum L.	hvozdík kartouzek	steppe	
Dianthus deltoides L.	hvozdík kropenatý	steppe	
Lychnis flos-cuculi L.	kohoutek luční	steppe	
Lychnis viscaria L.	smolnička obecná	steppe	
Silene latifolia subsp. *alba* (Mill.) Gr. & Burdet	silenka širolistá bílá	steppe	
Silene nutans L.	silenka nicí	steppe	
Convolvulaceae	**Svlačcovité**		
Convolvulus arvensis L.	svlačec rolní	steppe	
Crassulaceae	**Tlusticovité**		
Hylotelephium maximum (L.) Holub	rozchodníkovec velký	upper p.	
Sedum acre L.	rozchodník prudký	steppe	
Sedum spurium M. Bieb.	rozchodník pochybný	steppe	domesticated
Dipsacaceae	**Štětkovité**		
Dipsacus fullonum L.	štětka planá	steppe	
Knautia arvensis (L.) J. M. Coult.	chrastavec rolní	steppe	
Euphorbiaceae	**Pryšcovité**		
Euphorbia cyparissias L.	pryšec chvojka	steppe	
Fabaceae	**Bobovité**		
Astragalus glycyphyllos L.	kozinec sladkolistý	steppe	

Genista tinctoria L.	kručinka barvířská	steppe	
Lotus corniculatus L.	štírovník růžkatý	steppe	
Melilotus albus Medik.	komonice bílá	steppe	
Securigera varia (L.) Lassen	čičorka pestrá	steppe	
Trifolium arvense L.	jetel rolní	steppe	
Trifolium campestre Schreber	jetel ladní	upper p.	
Trifolium pratense L.	jetel luční	steppe	
Trifolium repens L.	jetel plazivý	steppe	
Vicia angustifolia L.	vikev úzkolistá	steppe	
Vicia villosa Roth	vikev huňatá	steppe	
Geraniaceae	**Kakostovité**		
Geranium columbinum L.	kakost holubičí	wetland	
Geranium robertianum L.	kakost smrdutý	steppe	
Hypericaceae	**Třezalkovité**		
Hypericum perforatum L.	třezalka tečkovaná	forest	
Lamiaceae	**Hluchavkovité**		
Ajuga genevensis L.	zběhovec lesní	forest	
Ajuga reptans L.	zběhovec plazivý	steppe	
Betonica officinalis L.	bukvice lékařská	steppe	
Clinopodium vulgare L.	klinopád obecný	steppe	
Galeobdolon luteum Huds.	pitulník žlutý	steppe	
Galeopsis bifida Boenn.	konopice dvouklanná	steppe	
Glechoma hederacea L.	popenec obecný	forest	
Lamium album L.	hluchavka bílá	steppe	
Origanum vulgare L.	dobromysl obecná	steppe	
Salvia pratensis L.	šalvěj luční	steppe	
Thymus pulegioides L.	mateřídouška vejčitá	steppe	
Malvaceae	**Slézovité**		
Malva alcea L.	sléz velkokvětý	upper p.	C4a
Onagraceae	**Pupalkovité**		
Epilobium dodonaei Vill.	vrbovka rozmarýnolistá	steppe	
Epilobium montanum L.	vrbovka horská	forest	
Oenothera biennis agg. L.	pupalka dvouletá	steppe	invasive
Orobanchaceae	**Zárazovité**		
Melampyrum nemorosum L.	černýš hajní	wetland	
Papaveraceae	**Makovité**		
Chelidonium majus L.	vlaštovičník větší	forest	
Papaver confine Jord.	mák časný	upper p.	C3
Plantaginaceae	**Jitrocelovité**		
Plantago lanceolata L.	jitrocel kopinatý	steppe	
Veronica chamaedrys L.	rozrazil rezekvítek	steppe	
Veronica officinalis L.	rozrazil lékařský	steppe	
Polygonaceae	**Rdesnovité**		
Rumex acetosa L.	šťovík kyselý	forest	
Rumex acetosella L.	šťovík menší	forest	
Primulaceae	**Prvosenkovité**		
Lysimachia nummularia L.	vrbina penízková	forest	
Primula elatior (L.) Hill	prvosenka vyšší	forest	
Primula veris L.	prvosenka jarní	forest	
Primula vulgaris Huds.	prvosenka bezlodyžná	forest	domesticated
Ranunculaceae	**Pryskyřníkovité**		
Anemone nemorosa L.	sasanka hajní	forest	
Ranunculus acris L.	pryskyřník prudký	steppe	
Ranunculus repens L.	pryskyřník plazivý	steppe	
Rosaceae	**Růžovité**		
Alchemilla vulgaris L.	kontryhel ostrolaločný	steppe	
Fragaria vesca L.	jahodník obecný	steppe	
Geum rivale L.	kuklík potoční	forest	
Geum urbanum L.	kuklík městský	wetland	
Potentilla argentea L.	mochna stříbrná	steppe	

Potentilla recta L.	mochna přímá	steppe	
Potentilla reptans L.	mochna plazivá	steppe	
Sanguisorba officinalis L.	krvavec toten	wetland	
Rubiaceae	**Mořenovité**		
Galium pumilum Murray	svízel nízký	steppe	
Galium verum L.	svízel syřišťový	steppe	
Scrophulariaceae	**Krtičníkovité**		
Verbascum thapsus L.	divizna malokvětá	steppe	
Violaceae	**Violkovité**		
Viola arvensis Murray	violka rolní	steppe	
Vitaceae	**Révovité**		
Parthenocissus quinquefolia (L.) Planch.	loubinec pětilistý	steppe	invasive

Tab 3: Species of fungal organisms recorded in the quarry in May–October 2021. **NT** – nearly threatened according to Czech red list of lichens (Liška & Palice 2010).

Latin name	Czech name	Notes
Lichenes	**Lišejníky**	
Cladonia pyxidata (L.) Hoffm.	dutohlávka pohárkatá	
Hypogymnia physodes (L.) Nyl.	terčovka bublinatá	
Parmelia sulcata Taylor	terčovka brázditá	
Pseudevernia furfuracea (L.) Zopf	terčovka otrubčitá	NT
Xanthoria parietina (L.) Th. Fr.	terčovník zední	
Myxomycetes	**Hlenky**	
Lycogala epidendrum (J.C. Buxb. ex L.) Fr. 1829	vlčí mléko červené	
Fungi	**Houby**	
Clathrus archeri (Berk.) Dring	květnatec Archerův	
Laetiporus sulphureus (Bull.) Murrill	sírovec žlutooranžový	
Leccinum scabrum (Bull.) Gray	kozák březový	
Piptoporus betulinus (Bull.) P. Karst.	březovník obecný	
Schizophyllum commune Fr.	klanolístka obecná	

Totally, 121 species of animals were recorded in the quarry during the mapping, of which 102 species of insects. Butterflies with 52 species were the most important and the focal group. Thirteen species of insects (eight species of butterflies) fell into one of the categories of Czech red lists (Hejda *et al*. 2017, Chobot & Němec 2017), legal categories, or are part of the annexes to some of the European directives (Tab. 5). Estimation of population size of *Zygaena purpuralis* based on 55 individuals reached 129 individuals (LCI = 81, UCI = 258) for Schnabel and 124 individuals (LCI = 73, UCI = 176) for Lincoln-Petersen method. We captured and marked 33 individuals of *Coenonympha arcania*. Estimation of population size reached 355 individuals (LCI = 118, UCI = Inf) for Schnabel method, and 83 individuals (LCI = 0, UCI = 182) between first and second recapture, and 62 individuals (LCI = 4, UCI = 120) between second and third recapture for Lincoln-Petersen method (Tab. 4).

Tab 4: Estimates of population size by Schnabel and Lincoln-Petersen (between individual capture occassions) methods with its 95% confidence interval (N - estimated abundance, LCI - Lower bound confidence interval, UCI - Upper bound confidence interval)

	Zygaena purpuralis			*Coenonympha arcania*		
Method	N	LCI	UCI	N	LCI	UCI
Schnabel	129	81	258	355	118	Inf
Lincoln-Petersen (1–2)	124	73	176	83	0	182
Lincoln-Petersen (2–3)	NA	NA	NA	62	4	120

Tab 5: Animal species recorded in the quarry during the period May–October 2021. **Method**: **sweeping** – using sweeping nets on vegetation, **netting** – using standard net for butterflies, **larva** – the presence of larvae or galls with larvae, **observation** – direct observation of the animal, **voice** – voice recording. **Notes**: Threat categories according to Czech red list of invertebrates (Hejda *et al*. 2017) or vertebrates (Chobot & Němec 2017): **VU** – vulnerable, **NT** – nearly threatened, **EN** – endangered; Categories according to legal protection: **O** – endangered, **SO** – strongly endangered, **KO** – critically endangered; **ES I** – Birds Directive Annex I, **ES II** – Habitats Directive Annex II, **ES IV** – Habitats Directive Annex IV.

Latin name	Czech name	Method	Notes
Aranea	**Pavouci**		
Argiope bruennichi (Scopoli, 1772)	křižák pruhovaný	sweeping	
Insecta	**Hmyz**		
Odonata	**Vážky**		
Sympecma fusca (Vander Linden, 1820)	šídlatka hnědá	netting	
Dermaptera	**Škvoři**		
Forficula auricularia (Linnaeus, 1758)	škvor obecný	sweeping	
Mantodea	**Kudlanky**		
Mantis religiosa (Linnaeus, 1758)	kudlanka nábožná	sweeping	VU/KO
Orthoptera	**Rovnokřídlí**		
Oedipoda caerulescens (Linnaeus, 1758)	saranče modrokřídlá	sweeping	
Tetrix bipunctata (Linnaeus, 1758)	marše suchobytná	sweeping	
Tettigonia viridissima (Linnaeus, 1758)	kobylka zelená	sweeping	
Hemiptera	**Polokřídlí**		
Cercopis sanguinolenta (Scopoli, 1763)	pěnodějka nížinná	sweeping	
Palomena prasina (Linnaeus, 1761)	kněžice trávozelená	sweeping	
Pyrrhocoris apterus (Linnaeus, 1758)	ruměnice pospolná	sweeping	
Raphidioptera	**Dlouhošíjky**		
Phaeostigma notata (Fabricius, 1781)	dlouhošíjka znamenaná	sweeping	
Hymenoptera	**Blanokřídlí**		
Andrena hattorfiana (Fabricius, 1775)	pískorypka chrastavcová	netting	EN
Bombus sylvarum (Linnaeus, 1761)	čmelák lesní	netting	-/O
Diplolepis rosae (Linnaeus, 1758)	žlabatka růžová	larva	
Camponotus ligniperdus (Latreille, 1802)	mravenec dřevokaz	sweeping	
Macrophya montana (Scopoli, 1763)	pilatka	sweeping	
Diptera	**Dvoukřídlí**		
Asphondylia melanopus (Kieffer, 1890)	bejlomorka	larva	
Kiefferia pericarpiicola (Bremi, 1847)	bejlomorka	larva	
Lasioptera rubi (Schrank, 1803)	bejlomorka	larva	
Eristalis arbustorum (Linnaeus, 1758)	pestřenka	sweeping	
Urophora cardui (Linnaeus, 1758)	vrtule bodláková	larva	
Coleoptera	**Brouci**		
Carabidae	**Střevlíkovití**		
Abax parallelepipedus (Piller & Mitt., 1783)	čtvercoštítník černý	observation	
Anchomenus dorsalis (Pontoppidan, 1763)	střevlíček ošlejchový	observation	
Brachinus explodens (Duftschmid, 1812)	prskavec menší	observation	-/O
Poecilus cupreus (Linnaeus, 1758)	střevlíček měděný	observation	
Carabus coriaceus (Linnaeus, 1758)	střevlík kožitý	observation	
Carabus granulatus (Linnaeus, 1758)	střevlík zrnitý	observation	
Carabus intricatus (Linnaeus, 1761)	střevlík vrásčitý	observation	
Carabus ulrichii (Germar, 1824)	střevlík Ulrichův	observation	-/O
Buprestidae	**Krascovití**		
Anthaxia nitidula (Linnaeus, 1758)	krasec lesknavý	sweeping	
Cantharidae	**Páteříčkovití**		
Cantharis fusca (Linnaeus, 1758)	páteříček sněhový	sweeping	
Rhagonycha fulva (Scopoli, 1763)	páteříček žlutý	sweeping	
Cerambycidae	**Tesaříkovití**		
Leptura maculata (Poda, 1761)	tesařík skvrnitý	sweeping	
Stenostola ferrea (Schrank, 1776)	tesařík	sweeping	
Stenurella bifasciata (O. F. Müller, 1776)	tesařík dvojpásý	sweeping	
Stenurella melanura (Linnaeus, 1758)	tesařík černošpičký	sweeping	

Stictoleptura rubra (Linnaeus, 1758)	tesařík obecný	sweeping	
Coccinellidae	**Sluněčkovití**		
Coccinula quatuordecimpustulata (Linn., 1758)	sluněčko čtrnáctislunné	sweeping	
Exochomus quadripustulatus (Linn., 1758)	planetka čtyřskvrnná	sweeping	
Curculionidae	**Nosatcovití**		
Liparus glabrirostris (Küster, 1849)	klikoroh devětsilový	sweeping	
Chrysomelidae	**Mandelinkovití**		
Cassida rubiginosa (O. F. Müller, 1776)	štítonoš	sweeping	
Cassida stigmatica (Suffrian, 1844)	štítonoš	sweeping	
Clytra laeviuscula (Ratzeburg, 1837)	vrbař uhlazený	sweeping	
Chrysomela populi (Linnaeus, 1758)	mandelinka topolová	sweeping	
Oulema melanopus (Linnaeus, 1758)	kohoutek černohlavý	sweeping	
Oedemeridae	**Stehenáčovití**		
Oedemera sp. (Olivier, 1789)	stehenáč	sweeping	
Oedemera virescens (Linnaeus, 1767)	stehenáč zelenavý	sweeping	
Scarabaeidae	**Vrubounovití**		
Cetonia aurata (Linnaeus, 1758)	zlatohlávek zlatý	sweeping	
Protaetia cuprea (Fabricius, 1775)	zlatohlávek hladký	sweeping	
Onthophagus ovatus (Linnaeus, 1767)	vrubounek malý	sweeping	
Silphidae	**Mrchožroutovití**		
Oiceoptoma thoracicum (Linnaeus, 1758)	mrchožrout znamenaný	sweeping	
Lepidoptera	**Motýli**		
Erebidae			
Diacrisia sannio (Linnaeus, 1758)	přástevník chrastavcový	sweeping	
Euplagia quadripunctaria (Poda, 1761)	přástevník kostivalový	sweeping	-/-/ES II
Orgyia antiqua (Linnaeus, 1758)	štětconoš trnkový	sweeping	
Geometridae	**Píďalkovití**		
Ematurga atomaria (Linnaeus, 1758)	tmavoskvrnáč vřesový	sweeping	
Idaea rufaria (Hübner, 1799)	žlutokřídlec hnědočárný	sweeping	
Noctuidae	**Můrovití**		
Autographa gamma (Linnaeus, 1758)	kovolesklec gama	sweeping	
Lasiocampidae	**Bourovcovití**		
Euthrix potatoria (Linnaeus, 1758)	bourovec trávový	sweeping	
Macrothylacia rubi (Linnaeus, 1758)	bourovec ostružiníkový	sweeping	
Pterophoridae	**Pernatuškovití**		
Sesiidae	**Nesytkovití**		
Chamaesphecia empiformis (Esper, 1783)	nesytka pryščová	sweeping	
Sphingidae	**Lišajovití**		
Hyles euphorbiae (Linnaeus, 1758)	lišaj pryščový	netting	EN/O
Macroglossum stellatarum (Linnaeus, 1758)	dlouhozobka svízelová	netting	
Zygaenidae	**Vřetenuškovití**		
Zygaena ephialtes (Linnaeus, 1767)	vřetenuška čičorková	netting	NT
Zygaena filipendulae (Linnaeus, 1758)	vřetenuška obecná	netting	
Zygaena loti (Denis & Schiffermüller, 1775)	vřetenuška kozincová	netting	
Zygaena purpuralis (Brünnich, 1763)	vřetenuška mateřídoušková	netting	NT
Hesperiidae	**Soumračníkovití**		
Carterocephalus palaemon (Pallas, 1771)	soumračník jitrocelový	sweeping	
Erynnis tages (Linnaeus, 1758)	soumračník máčkový	sweeping	
Ochlodes sylvanus (Esper, 1777)	soumračník rezavý	sweeping	
Thymelicus lineola (Ochsenheimer, 1808)	soumračník čárečkovaný	sweeping	
Thymelicus sylvestris (Poda, 1761)	soumračník metlicový	sweeping	
Lycaenidae	**Modráskovití**		
Aricia agestis (Denis & Schiffermüller, 1775)	modrásek tmavohnědý	netting	
Celastrina argiolus (Linnaeus, 1758)	modrásek krušinový	netting	
Cupido argiades (Pallas, 1771)	modrásek štírovníkový	netting	
Polyommatus bellargus (Rottemburg, 1775)	modrásek jetelový	netting	VU
Polyommatus icarus (Rottemburg, 1775)	modrásek jehlicový	netting	
Lycaena dispar (Haworth, 1802)	ohniváček černočárný	netting	-/SO/ES II & IV
Lycaena phlaeas (Linnaeus, 1761)	ohniváček černokřídlý	netting	

Nymphalidae	**Babočkovití**		
Aglais urticae (Linnaeus, 1758)	babočka kopřivová	netting	
Araschnia levana (Linnaeus, 1758)	babočka síťkovaná	netting	
Inachis io (Linnaeus, 1758)	babočka paví oko	netting	
Nymphalis antiopa (Linnaeus, 1758)	babočka osiková	netting	
Nymphalis polychloros (Linnaeus, 1758)	babočka jilmová	netting	
Polygonia c-album (Linnaeus, 1758)	babočka bílé C	netting	
Aphantopus hyperanthus (Linnaeus, 1758)	okáč prosíčkový	netting	
Brintesia circe (Fabricius, 1775)	okáč voňavkový	netting	
Coenonympha arcania (Linnaeus, 1761)	okáč strdivkový	netting	NT
Coenonympha pamphilus (Linnaeus, 1758)	okáč poháňkový	netting	
Lasiommata megera (Linnaeus, 1767)	okáč zední	netting	
Maniola jurtina (Linnaeus, 1758)	okáč luční	netting	
Melanargia galathea (Linnaeus, 1758)	okáč bojínkový	netting	
Pararge aegeria (Linnaeus, 1758)	okáč pýrový	netting	
Argynnis paphia (Linnaeus, 1758)	perleťovec stříbropásek	netting	
Issoria lathonia (Linnaeus, 1758)	perleťovec malý	netting	
Speyeria aglaja (Linnaeus, 1758)	perleťovec velký	netting	
Papilionidae	**Otakárkovití**		
Papilio machaon (Linnaeus, 1758)	otakárek fenyklový	netting	-/O
Pieridae	**Běláskovití**		
Colias crocea (Fourcroy, 1785)	žluťásek čilimníkový	netting	
Colias hyale (Linnaeus, 1758)	žluťásek čičorečkový	netting	
Gonepteryx rhamni (Linnaeus, 1758)	žluťásek řešetlákový	netting	
Pieris brassicae (Linnaeus, 1758)	bělásek zelný	netting	
Pieris napi (Linnaeus, 1758)	bělásek řepkový	netting	
Pontia edusa (Fabricius, 1777)	bělásek rezedkový	netting	
Squamata	**Šupinatí**		
Anguidae	**Slepýšovití**		
Anguis colchica (Nordmann, 1840)	slepýš východní	observation	NT
Lacertidae	**Ještěrkovití**		
Lacerta agilis (Linnaeus, 1758)	ještěrka obecná	observation	VU/SO/ES IV
Aves	**Ptáci**		
Strigiformes	**Sovy**		
Bubo bubo (Linnaeus, 1758)	výr velký	observation	EN/O/ES I
Accipitriformes	**Dravci**		
Buteo buteo (Linnaeus, 1758)	káně lesní	voice	
Falconiformes	**Sokoli**		
Falco tinnunculus (Linnaeus, 1758)	poštolka obecná	observation	
Passeriformes	**Pěvci**		
Emberiza citrinella (Linnaeus, 1758)	strnad obecný	voice	
Fringilla coelebs (Linnaeus, 1758)	pěnkava obecná	voice	
Erithacus rubecula (Linnaeus, 1758)	červenka obecná	observation	
Phoenicurus phoenicurus (Linnaeus, 1758)	rehek zahradní	observation	
Phylloscopus collybita (Vieillot, 1817)	budníček menší	voice	
Sitta europaea (Linnaeus, 1758)	brhlík lesní	observation	
Sylvia atricapilla (Linnaeus, 1758)	pěnice černohlavá	observation	
Curruca communis (Latham, 1787)	pěnice hnědokřídlá	observation	
Turdus merula (Linnaeus, 1758)	kos černý	observation	
Piciformes	**Šplhavci**		
Picus canus (J. F. Gmelin, 1788)	žluna šedá	observation	VU/ES I
Bucerotiformes	**Zoborožci**		
Upupa epops (Linnaeus, 1758)	dudek chocholatý	observation	EN/SO
Mammalia	**Savci**		
Capreolus capreolus (Linnaeus, 1758)	srnec obecný	observation	
Lepus europaeus Pallas, 1778	zajíc polní	observation	NT

Discussion

The quarry, the property of Kamenolomy ČR, is currently managed by the Mikuláš Koperník Grammar School in Bílovec. The data obtained during the inventory will be used by this institution to prepare a nature trail and also as a basis for site management, which will be conducted as volunteer and community work. The aim is to build an ecological center focused on teaching biology, geology, and especially the environmental activities of students (ČTK 2021, Orlíková 2021). To fulfill these ideas, it will be appropriate to define a care plan of the site, considering the requirements of the present species of plants, vertebrates, and invertebrates, especially butterflies.

During the survey, the occurrence of several species of plants listed in the Czech red list was detected. *Papaver confine* was found in a few individuals on the sunlit edge of the upper floor of the quarry. It is a species growing scattered in thermophytic, rarely in lower mesophytic sites, on dry grassy slopes, in abandoned quarries, or on the edges of rocky outcrops, always on basic substrates (Mrázek 2012). *Allium schoenoprasum* occurs in several large clumps in the wetland part of the quarry. The species originally growing on the banks of rivers now often occurs in secondary habitats, such as dumps, and is also grown in gardens (Hoskovec 2016). *Pilosella aurantiaca* occurs on the sunlit spots of the upper floor of the quarry. It is originally species of mountain meadows and pastures, but due to its unpretentiousness and color, it is grown often in gardens, so it can be found in several secondary habitats (Hoskovec 2007). *Taxus baccata* occurs in one juvenile in the forested upper floor of the quarry. Originally, this rare species grows mainly on steep thermophilic rocky habitats. At present, it is also widely planted in parks (Eliáš 2007). *Malva alcea* occurs mainly on the edge of the forested upper floor of the quarry. Typical habitats of this species are sunny slopes and edges of forests. It is also a species widely grown in gardens since the Middle Ages (Eliáš 2007). *Dianthus armeria* occurs relatively abundantly in the steppe part of the quarry. This species grows scattered at forest edges but also along roads and embankments, sometimes is grown in gardens (Krása 2007). As follows from the above mentioned, the botanical significance of these species found in the quarry is problematic, as they are mainly grown in gardens, from where they could escape into the quarry area, perhaps except *Papaver confine*. This is supported by the presence of two other non-native garden species: *Primula vulgaris*, growing at the edge of the forested and steppe part of the quarry, and *Sedum spurium*, occurring at the eastern rock wall of the quarry.

Thus, the locality appears to be more significant for the occurrence of animals, especially insects. *Mantis religiosa* is still a critically endangered species by law, although in the last 15–20 years it has undertaken a massive expansion from the warmest areas of South Moravia to the north and today inhabits a relatively wide range of open xerothermic habitats, including ruderal ones (Vitáček & Janšta 2016). Unshaded warm habitats, such as pastures, dry meadows, and quarries, are preferred also by *Brachinus explodens*, *Carabus ullrichii*, and despite its name by *Bombus sylvarum* (Saska & Honek 2004, Zahradník 2008, Ptáček 2013). *Andrena hattorfiana* uses meadows with sparse vegetation for nesting. Both adults and larvae feed on *Knautia arvensis*. The species is dependent on the continuous flowering of the host plant and is thus sensitive to the large-scale mowing of meadows but also to their overgrowth with woody plants. Appropriate management is extensive grazing, local turf removal with heavy equipment, or occasional motor vehicle traffic (Macek *et al*. 2010).

Butterflies were the focal monitored group. *Polyommatus bellargus* needs arid short-stemmed steppes with sparse vegetation, which can be recently found in limestone quarries. From its host plants, *Securigera*, *Centaurea*, *Senecio*, *Carduus*, *Cirsium*, and *Origanum* spp. occur in the locality. For *P. bellargus* protection, it is necessary to maintain short-stemmed disturbed areas by grazing or support activities such as camping (Beneš & Konvička 2002). *Coenonympha arcania* requires a diverse mosaic structure of vegetation – very sparse deciduous forests and bushy forest-steppes, especially smaller meadows surrounded by shrubs

(Fig. 4a). The host plants are grasses, mainly *Brachypodium pinnatum* and *Holcus lanatus* (Beneš & Konvička 2002). *Zygaena purpuralis* prefers steppe localities on a lime-stone base (Fig. 4b). The larvae develop on *Thymus*, sometimes on *Veronica* spp. (Bourn 1995). Since we found these host plants of *Zygaena purpuralis* abundantly in the quarry, we assume that our species determination is correct. However, to make sure that it is not mistaken for the similar *Zygaena minos*, molecular analyses and searching for caterpillars on host plants will be carried out next year. *Zygaena ephialtes* requires xerothermic localities such as steppes, dry meadows, or bushy slopes. The host is *Coronilla varia* (Horák 2013). *Brintesia circe* disappeared in the past from all Silesian and North Moravian localities. However, with climate change, its populations are expanding and it has been excluded from the categories of the current Czech red list. This species is habitat-linked to steppes and secondary habitats in quarries and sandpits. The hosts are various types of steppe grasses (Beneš & Konvička 2002). *Callimorpha quadripunctaria* inhabits warm rocky forest-steppe areas (Fig. 4c). The larvae are polyphagous, but adults sit on nectar-bearing plants, especially *Eupathorium* and *Carduus* spp. In past years, the species has disappeared from many localities due to insufficient management, as it requires extensive mosaic management supplied with the tree removal (Trnka 2012). *Lycaena dispar* inhabits moist meadows, amelioration canals, or quarry bottoms (Fig. 4d). The hosts are broadleaf species of *Rumex* spp. L. At present, species is not endangered, significantly expanding to ruderal habitats. However, in the Czech Republic as well as in the EU, the species is legally protected, similarly to the following species (Beneš & Konvička 2002). *Papilio machaon* inhabits meadows, gardens, steppes, or early succession habitats. The host species belong to the family Apiaceae, e.g. *Daucus carota* or *Pimpinella* spp. At present, the species is not endangered, the existence of early succession enclaves in the landscape contributes to its expansion (Beneš & Konvička 2002). *Hyles euphorbiae* looks for dry slopes, field edges, or rocky slopes (Fig. 4e). The species is threatened by the loss of suitable habitats with host plants i.e. various species of Euphorbiaceae, especially *Euphorbia cyparissias* L. (Pokorný 2014). In contrast to our results, Molitor (2011) during the vertebrate inventory also recorded critically endangered *Zygaena osterodensis* Reiss, 1921, and nearly threatened *Aricia eumedon* (Esper, 1780). We have failed to find these species. We suggest that in the first case it is a mis-identification with the species *Zygaena purpuralis/minos*, and in the second case with *Aricia agestis* because these species are quite similar, less rare, and present in quarry. On the other hand, these species could indeed occur here and disappear until these days.

Based on the above-listed species, the priority of the management in the quarry should be the protection of non-forest subxerothermic and xerothermic habitats. The expansive plant, which potentially endangers especially steppe habitats, is *Calamagrostis epigejos*. The most abundant invasive species is *Erigeron annuus*, followed by less frequent *Aster novi-belgii*, and strongly invasive *Solidago canadensis*. *Parthenocissus quinquefolia* occurs in two large spots, *Oenothera biennis* occurs sporadically. For similar xerothermic quarries, mowing is recommended to be done once every two years in places with unconnected vegetation, once a year on places of xerothermic grasslands with rich species composition, and twice per year on places after tree felling or on degraded spots with the occurrence of ruderal and expanding vegetation (Czernik 2019). To eliminate *C. epigejos*, it is important to limit its seed bank by early mowing before blooming (June–August). Thus, the first mowing should be ideally done in April–May, the second mowing in June–August (during the period of maximum biomass). From the point of view of diurnal butterflies and bees, it is important to leave 30% of the area unmown, especially their host plants. Properly timed mosaic mowing could even lead to increased abundances of host plants. The omitted areas would be mowed during the second mowing or the following year. The mowing must be supplemented by disturbances of the vegetation cover as a simulation of grazing. The use of forage tedder (or metal rakes), which disturbs the soil surface during raking hay, has proven to be effective (Czernik 2019).

Fig 4: Valuable species of butterflies in the quarry: a) *Coenonympha arcania*, b) *Zygaena purpuralis*, c) *Callimorpha quadripunctaria*, d) *Lycaena dispar*, e) *Hyles euphorbiae* (photo by Adam Mikunda).

Grazing is a more suitable option than mowing. Grazing selectively and continuously removes biomass, disrupts turf, and thus creates new spots for the germination of plant species of interest and for the nests of solitary bees. Grazing should take place in September–November once every 3–5 years, exclusively by sheep and goats. A number of animals should correspond to extensive grazing, i.e. 0.3–1.0 Dj*ha^{-1} (1 Dj = 500 kg live weight of animals). Mowing of rests is not necessary unless they belong to invasive or expansive plant species, because they are utilized by insects (Czernik 2019). Due to the nature of the locality, the originally considered fallow deer breeding cannot be recommended (Kočí 2009). Manual removal of individual clumps of invasive species carried out repeatedly before their flowering is a demanding but very effective alternative of mowing, especially suitable for *Solidago canadensis*. A new alternative biotechnological method of *C. epigejos* reduction, which can survive even decades of proper mowing, is the sowing of semi-parasitic *Rhinanthus* spp. L. carried out in July–October (Chaudron *et al*. 2021). In addition, flowering *Rhinanthus* provides a diet to large numbers of insects.

It is also important to carry out a continuous reduction of shrubs and trees, which applies especially to the currently forested part of the quarry. There should be a selective reduction, especially of aspens, ashes, maples, birches, willows, or pines. On the contrary, it is appropriate to leave autochthonous shrubs: hawthorns, dogwoods, blackthorns, and wild privets, always a group of shrubs rather than individual solitaires. During the reduction, it is necessary to remove the biomass, for example, by depositing it on a built-up composting site. The cutting of some trunks onto a 6–8 m high sunlit torso, which will serve as a habitat for saproxylophagous insects, solitary bees, as a nesting place for birds, and shelters for bats, may be an interesting

supplement. To support reptiles, it is appropriate to reduce woody plants from the slopes of the quarry and rocky outcrops. An important task is also the elimination of *Robinia pseudoacacia*. As *R. pseudacacia* is a very dangerous invasive species that changes the chemistry of the soil and strongly ruderalizes the shrub and herbaceous layer, its liquidation in the area should be the priority. Management needs to be adapted to the fact that this species has high production of coppices stimulated by damage. Cutting to a low stump is not recommended (Czernik 2019). An attempt to do this in past years has been already done, but since it has not been carried out properly, rejuvenating coppices appeared. Felling on a high stump or partial ringing followed by herbicide application at the end of the growing season is ideal. Ringing consists of removing a few centimeters wide strip of bark around the entire log and leaving only a few centimeters wide strip of bark, which will allow a partial flow of nutrients. The tree gradually becomes exhausted. In the second year, the ring is closed and in the third, the tree is cut down. With regard to the nesting of birds, it is necessary to not perform tree felling in April–July. At the nesting site of the eagle-owl, it is advisable to carry out only the liquidation of the *R. pseudoacacia*, leaving sufficient wood cover. This should be done not earlier than in July. It is advisable to leave the forested upper floor of the quarry adjacent to the fields or cultural meadows also without reduction of trees so that agrochemicals or expansive species cannot penetrate the quarry (Czernik 2019).

It is necessary to place composting site, where mown biomass interspersed with branches and trunks of felled shrubs and woody plants will be stored, outside the botanically valuable parts, but in an at least partially sunlit place. Properly located composting sites can support the occurrence of reptiles, which will use it as a hatchery or wintering ground, but also bumblebees, which can build nests here (Czernik 2019). Wetland at the entrance to the quarry appears to be suitable for the construction of a pond, which would serve as a breeding ground for invertebrates and amphibians. Its bottom could be formed by a pond foil overlaid with stones.

Except for insects, we recorded also valuable species of vertebrates in the quarry. *Lacerta agilis* inhabits mainly drier sunny places with little vegetation cover on the edge of forests and bushy stands, but also railway embankments or quarries. A large set of the localities is currently degraded by succession due to overgrowth by trees. The remaining isolated populations are highly endangered by the construction of buildings, repairs of roads, or predation pressure from hens, pheasants, and free-range cats (Háková & Losík 2018). From this point of view, the possible breeding of pheasants in the quarry area seems to be problematic. In addition to the previously recorded *Anguis fragilis*, we also found *Anguis colchica* because the contact hybrid zone of both species runs through the area (Moravec & Gvoždík 2019). *Bubo bubo* is adapted to secondarily created localities, e.g. quarries or castle ruins. The basic condition for its occurrence is the possibility of hiding in the rocks surrounded by tree vegetation. *Picus canus* nests in forests, gardens, and parks in tree cavities. *Upupa epops* was also seen in the quarry. Species occurs in the open landscape of pastures and meadows with trees, and with low agricultural intensity. *U. epops* often seeks food in the form of insects in the feces of grazing animals (Šťastný *et al*. 2006).

Conclusion

The quarry in Stará Ves near Bílovec is a geological study profile of regional-geological significance and is recommended for protection as a potential geotouric attraction. Based on the inventory of its biodiversity, we can conclude that it is an important site also from a biological point of view, providing a habitat for many endangered and protected species of birds, reptiles, beetles, bees, and especially butterflies. However, it is important to prevent the ongoing successional development and to maintain and expand the steppe part of the site. The wetland part has the potential for building a pond that could serve as a breeding habitat for amphibians. Concerning the occurrence of the valuable species of ground beetles, it would be appropriate to

supplement our study by sampling epigeic insects using pitfall traps, which will be done next year. With proper management, the locality deserves the status of a natural monument, or with regard to a higher number of interesting species of animals, even a nature reserve.

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