



# Hrabůvka quarry

A potential refuge of rare species

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# **Project overview**

Title:	Hrabůvka quarry: a potential refuge of rare species
Contest: (Research/Community)	Research
Quarry name:	Hrabůvka







# Hrabůvka quarry: a potential refuge of rare species

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#### **Abstract**

The main aim of this project was to conduct a biological survey in Hrabůvka quarry with an emphasis to south part of the quarry premises called Bobroviště. Specifically, this area is composed of various habitats, including forests, open soils, ruderal habitats and a sewage water body. Based on our findings, we suggest appropriate interventions or changes in management to support and enhance local biodiversity. Our results showed that species composition of plants and animals in the quarry premises is characterized mostly by common species (with only few plant taxa exception) without any specific habitat requirements. We found that the most botanically valuable habitats in Bobroviště are the forest fragment and the spring with its immediate vicinity. Since wetland habitats became valuable in the respect of climate changes in the last few years, we suggest creating new ponds and a littoral zone in the sewage water body to enhance biodiversity of this area and consequently increase water retention in the landscape.

#### Introduction

Mining areas are often perceived by the public as a scar on the landscape. However, in many cases a mosaic of various habitats in different successional stages is often created during mining. Such habitats may act as secondary refuges for many rare and/or threatened species that almost disappeared from urbanized and simplified agricultural landscape (Beneš *et al.* 2003, Ottonetii *et al.* 2006, Topp *et al.* 2010, Heneberg *et al.* 2012, Harabiš and Dolný 2015, Trnka and Rada 2015). Hrabůvka quarry and its immediate surroundings could be composed of biologically valuable habitats with a potential occurrence of threatened species. This quarry could be an important source of biodiversity that could spread from it. The aim of this project is therefore (i) to carry out a zoological and botanical survey and, on its basis, (ii) to suggest environmental management to support and enhance biodiversity within quarry premises with focus on southern abandoned part, called Bobroviště. Furthermore, we want (iii) to design an educational display board that will present the biological values to the public, thus raising awareness of the benefits of mining areas for biodiversity in the landscape.

#### Methods

Hrabůvka quarry is situated approximately 5 km to the north-west from the town of Hranice na Moravě (GPS: 49.577N, 17.697E, Olomouc region, Czech Republic). The mined raw material is a building stone, Culmian



greywacke, and the mining processes have been carried since 1890. The high potential for the quarry's biodiversity is based on its surroundings which consist of a mosaic of forests, ruderal habitats and arable fields. Meadows are represented to a lesser extent. In addition, the quarry is located at the intersection of the Carpathian and Hercynian biogeographical regions (Culek et al. 2013) amidst an important biocorridor. We expect that local biodiversity can be driven by these factors and that it can be enriched with both Carpathian and Hercynian species together.

Based on a previous agreement with the organizers of QLA and the manager of the quarry, our survey was focused especially on the abandoned area called Bobroviště (area of 320 × 150 m, GPS: 49.575N, 17.702E) in the southern part of the quarry premises. It is located between a reclaimed spoil tip on the north and a four-lane highway on the south with an adjacent aqueduct. Bobroviště seems to represent a fragment of the semi-natural forests occurring in the wider surroundings (Fig. 1, all figures and tables are in Appendix of this report) and some parts were probably formed by spontaneous succession after the landscape intervention during the highway building between 2004 and 2008. A sewage water pond was built here; it does not have a littoral zone and is strongly eutrophic, surrounded mostly by the nitrophilous semi-ruderal vegetation. From this pond, a drainage channel runs along the highway. There is also a spring that does not go dry even during the hottest summer days and creates a small shallow pond in its immediate vicinity. The presence of perennial wetland herb species confirms a relatively stable water conditions at this place at least during several last years. Moreover, open and ruderal patches exist in Bobroviště as well due to relatively recent landscaping along the highway. These environmental conditions create a diverse habitat mosaic in a relatively small area. However, for better understanding of the overall biodiversity composition in the focused area, we conducted intensive botanical and zoological surveys in Bobroviště, as well as in the quarry itself (i.e. the stone mining areas) and its close surroundings.

Biological surveys were carried out from March to August 2018 by standard floristic, phytosociological and zoological methods. Botanical survey was performed in the actual mining area and its closest vicinity. Additionally, we performed botanical inventory in the future mining area. The study area was divided into 20 homogenous plots (Fig. 2). For each of the plots, all taxa of the vascular plants were recorded.

For collecting ground-dwelling arthropods, we used pitfall traps (plastic cups) with 4% formaldehyde as a preservation solution. 11 traps were located in Bobroviště in various microhabitats, such as a forest, a meadow, and open sandy soils, to cover all presented habitats. Traps were exposed for 3 months, from May to July, and checked monthly. We especially focused on ground beetles (family Carabidae), one of the most abundant groups of ground-dwelling arthropods, which are often used as bioindicators of habitat quality (Altieri 1999). For other invertebrates we used vegetation sweeping and beating, individual collection, or a direct observation. Birds were recorded by point counting (direct observation or voice recognition) and net trapping. Occurrence of other vertebrates was mainly detected by the direct observation and signs, such as foot prints and excrements.



Nomenclature of the vascular plants was unified according to Danihelka et al. (2012). We have assigned a conservation status to each of the recorded species according to the Czech Red Lists of vascular plants (Grulich 2012), invertebrates (Hejda et al. 2017), vertebrates (Chobot and Němec 2017). Moreover, for animals, a list of specially protected species (regulation 395/1992 Sb., issued by the Ministry of Environment of the Czech Republic) and species listed in The Habitats Directive (adopted by EU in 1992 as Council Directive 92/43/EEC) was additionally considered (no plant species included in the list were found). List of abbreviations of conservation statuses is provided in Table 1.

#### Results

All recorded species of plants and animals are listed in the appendix (Tables 2-4). Here, we provide a commentary on the selected groups and/or species.

#### **Plants**

In total, 322 taxa were recorded in the surveyed area (Table 2). Out of them, 7 were included in the Czech Red list of vascular plants and 16 in the list of invasive taxa. The most abundant Red-listed species was *Filago arvensis* (C3), which was common in the mining area and its closest vicinity. It typically grew in the initial successional stages. The other Red-listed species recorded in the mining area was *Cota tinctoria* subsp. *subtinctoria* (C4b). Some more conservation-valuable taxa occurred mainly in the forest and meadow habitats in the future mining areas on the eastern border of the quarry, and in Bobroviště. These were: *Hieracium levicaule* (C3), *Corydalis solida* subsp. *solida* (C4a), *Neottia nidus-avis* (C4a), *Abies alba* (C4a) and *Pilosella cymosa* (C4a). On the other hand, invasive species reached a high abundance in the mining area as well (e.g. *Arrhenatherum elatius*, *Acer negundo*, *Erigeron annuus*, *Impatiens parviflora*).

In the mining area, vegetation was missing from most of the surface because of the mining activity. In the places with low level of disturbance, species-poor ruderal communities dominated with a frequent occurrence of the invasive taxa. More valuable communities were developed only on wet sites and dumps of small-grained particles. Especially on the dumps we recorded interesting communities with some thermophilous species (e.g. *Turritis glabra*, *Filago arvensis*, *Cota tinctoria*).

On the other hand, valuable habitats were present in the future mining area, mainly a semi-natural beech forest in the northeast part and an oak forest in the northwest part. In the area of our interest, Bobroviště, a secondary mixed forest represented the main vegetation type, probably influenced by the tree planting. Mainly nitrophilous semi-ruderal plant species occurred in the herb layer; nevertheless, some interesting grove and forest species were also found there (i.g. *Polygonatum multiflorum*), including a mycotrophic bird's nest orchid (*Neottia nidus-avis*). A water spring with an adjacent shallow pond was also located to this plot, where a fragmentary wetland community developed (with dominant *Typha latifolia*). Although only the common wetland herb species grew there (*Typha latifolia*, *Ranunculus sceleratus*, *Rorippa palustris*), they seriously contributed to the total



biodiversity of the surveyed area. Bobroviště has a strong potential to be enriched with more species by the nearby aqueduct with similar (better developed) vegetation, which may serve as a diaspore source. In addition, wetland habitats have become valuable in the landscape in the last years, with respect to the climatic change and extremely dry weather in the Czech Republic.

#### **Animals**

During our survey in Bobroviště, we recorded 496 individuals of ground beetles in 41 species (Table 3). The community composition was characterized mostly by common species of forests and open habitats. Only two species belonged to Czech Red-list of invertebrates: *Chlaenis tristis* (NT) and *Cylindera germanica* (NT). In total, six species were protected by Czech legislation, namely *Brachinus crepitans*, *B. explodens*, *Carabus scheidleri*, *C. ullrichii*, *Cicindela campestris* and *C. germanica*. This mixture of common and relatively abundant open, forest and generalist species showed that the habitat quality of Bobroviště is not higher than the surrounding agricultural and forest landscape. *C. germanica* is the species of fallow lands and meadows (Hůrka 1996) and it was recorded at the border of the reclaimed area and in open soils near the highway. On the other hand, *C. tristis* is a ground beetle of wet habitats and we found this species near the sewage water pond.

During the spring, we found *Gammarus fossarum*, a bio-indicating species of clean waters, and in the adjacent shallow pond several species of water heteropterans (*Gerris lacustris, Hydrometra stagnorum* and *Nepa cinerea*). The occurrence of dragonfly *Aeshna mixta* larvae showed that this water body likely does not dry during summer. On the other hand, we found only highly tolerant larvae of Culicidae, Chironomidae and Stratiomyidae (Diptera) in the sewage pond. Of the other invertebrates with affinity to the aquatic environment, 11 species of dragonflies and damselflies were recorded in the study area. The drainage channel along the highway provided opportunities for only a few common species. On the contrary, a freshly emerged adult of red-listed *Orthetrum coerulescens* (NT) was observed on the meadow before the quarry entrance. This species is very rare in the region and we assume that its larval development occurred in the channel (with appropriately created coastal vegetation) on the adjacent aqueduct. Thus, this species likely did not make its larval development in Bobroviště. We also observed adults of three species (*Anax imperator*, *A. parthenope* and *Libellula depressa*) and exuviae of *Sympetrum sanguineum* and *Lestes sponsa* in a small pond in the middle of the mining area. Some of these species are relatively good fliers, thus their occurrence in such pond were not particularly surprising, as they came from the wider surroundings. The finding of exuviae suggests that this pond existed for a year at least. However, it can be presumed that the pond will disappear with continued mining operations.

We recorded 35 species of birds (Table 4) with most of them found during the majority of the visits, indicating their breeding affinity to the area. Species with documented breeding in the Bobroviště area were: Sitta europaea, Phylloscopus collybita, Erithacus rubecula, Turdus pilaris, T. merula, Falco tinnunculus, Garrulus glandarius, Dendrocopos major, Emberiza citrinella, Poecile palustris, and Sturnus vulgaris. One pair of mallards (Anas platyrhynchos) successfully nested on the eutrophic sewage water body in Bobroviště. Some species were detected only once during the spring migration, such as Streptopelia turtur and Motacilla cinerea. The mining area



itself was not inhabited by any bird species with the exception of tree patches inside the quarry and around its edges. There, we recorded e.g. *Phylloscopus trochilus*, *Cyanistes caeruleus*, and *Buteo buteo*. Many other species not found in these localities inhabited the close village, but did not protrude into the quarry or Bobroviště (e.g. *Serinus serinus*, *Passer domesticus*, *Carduelis chloris*). On the other side of the highway also nested a pair of kestrels (*Falco tinnunculus*) in the installed nest box. Interestingly, on one occasion we recorded an inter-specific feeding of woodpecker nestlings (*Dendrocopos major*) by nuthatches (*Sitta europaea*). Out of all the observed bird species, four are Red-listed: *Ardea cinerea* (NT), *Circus aeruginosus* (VU), *Ficedula albicollis* (NT) amd *Hirundo rustica* (NT) and two species are protected by the Czech law (*C. aeruginosus*, *H. rustica*).

From 11 recorded species of other vertebrates (amphibians, reptiles and mammals), six were directly observed in the area (*Rana dalmatina*, *Lacerta agilis*, *Vulpes vulpes*, *Capreolus capreolus*, *Lepus europaeus* and *Sciurus vulgaris*), while for the rest we found only signs of late (e.g. foot prints in the mud for boars *Sus scrofa*, excrements for martens *Martes martes*) or former activity (e.g. a burrows of badger *Meles meles* and trees cut by beavers *Castor fiber*, which were, however, probably no longer in active use). From this list, four species are Redlisted (*R. dalmatina*, *L. agilis*, *S. vulgaris*, *L. europaeus*) and four protected by Czech legislation (*R. dalmatina*, *L. agilis*, *S. vulgaris*, *C. fiber*).

#### **Discussion**

Hrabůvka quarry is located on the transition between two different biogeographical regions and within the mosaic of semi-natural forests and arable fields. However, contrary to the findings in other quarries, sand and gravel pits (e.g. Popelka et al. 2017), our results showed that plant and animal species composition in the mining area (quarry itself and Bobroviště as well) is characterized mostly by common species without any specific habitat requirements. These species also often occur in wider surroundings. There are only few exceptions in the plant taxa, e.g. *Neottia nidus-avis* (C4a), *Euphorbia dulcis* and *Polygonatum multiflorum*, all found exclusively in Bobroviště within the surveyed area. Only few red-listed species and by Czech legislation protected species were recorded there (e.g. *C. germanica, R. dalmatina, L. agilis*). Thus, from the zoological point of view, the current habitat quality of Bobroviště and Hrabůvka quarry is not as high as we anticipated. According to the plant community composition, a part of Bobroviště represents a relatively valuable forest fragment.

In this current state of Bobroviště, we see the potential for the enhancement of the local biodiversity in the water sources, i.e. the sewage water pond and the spring with the adjacent shallow pond. Most of the streams and rivers in the Czech Republic are regulated, thus their natural processes of water circulation are restricted or completely disappeared. Water is drained as quickly as possible out of the landscape. Moreover, summers in the last years are getting warmer and drier without enough precipitation. These conditions lead to overall drought in the country. For longer retention of water in the landscape we therefore suggest to build several small ponds in Bobroviště. Damming the spring stream into two parts (in approx. 10 and 15 m distance from the spring) by soil, stones or concrete blocks would create a system of ponds (Fig. 3). Our survey revealed that the water in the spring



is clean with the occurrence of bio-indicating *Gammarus fossarum*. Thus, new ponds could be occupied by various species of sensitive water invertebrates and amphibians. However, it is important to keep the surface of the new ponds and their immediate surrounding in the sunlight; otherwise they will not be utilized by the target species. Likely, it will be necessary to cut down several trees nearby. With consideration that only three pairs of hollow nesting species of birds (*Sitta europaea*, *Poecile palustris*, *Dendrocopos major*) were recorder in Bobroviště in the close vicinity of the spring (and thus the expected clearing), taking down the surrounding trees should not heavily affect their population. However, it would be still advisable to keep there trees with apparent hollows. Chopped trees should be utilized into variously long logs and used for building a loggery. Loggeries are important for enhancing biodiversity of xylophagous beetles and other insects for which they represent a suitable habitat for development of larvaes.

Water in the sewage pond is strongly eutrophic and occupied only by highly tolerant species such as larvae of Culicidae, Chironomidae and Stratiomyidae. Littoral zone is completely absent and banks are covered by nitrophilous semi-ruderal vegetation. The water body itself attracts also other species of water invertebrates such as Dytiscus marginalis, but these larvae cannot finish their development in the pond due to the adverse environmental conditions. Larvae migrate (we recorded them in pitfall traps located nearby) to find another potential pond. However, the non-existence of other suitable ponds is fatal for the larvae. The most appropriate solution for the sewage water treatment and thus the improvement of the environmental conditions is to build a root zone wastewater treatment system. We are deeply aware that the space requirements for building such treatment are large (the size of the filter tank should be at least 5 m<sup>2</sup> per capita; Vymazal 2004) and building costs are not in the competence of the quarry nor the entire company, but should be in the interest of the adjacent municipality that damps there its sewers (Hrabůvka village, approx. 320 inhabitants). Therefore, we propose an alternative option in the form of modeling of banks of the sewage pond to create a shallow littoral zone. This could support the occurrence of littoral plant species, such as Phragmites australis and Typha latifolia, which are also used in the root zone wastewater treatment system, and other associated plant and animal communities. These landscaping practices should be done during winter months (December - February) to avoid unwanted interference in the development of target species.

Our detailed data of the occurrences of plants and animals in the quarry premises and its surroundings obtained by this project can be used, for example, as a basis for EIA process (eventual expansion of mining) or future conservation projects. Moreover, our suggestions for interventions and management practices may help to enhance the biodiversity in Hrabůvka quarry and will lead to the improved environmental conditions in the focused area. Therefore, the quarry could become a refuge of rare and threatened species in the future. Additional educational board highlighting the benefits of mining areas for the biodiversity should be introduced to the public after interventions leading to the creation of ponds and loggery. We are open for further cooperation with HeidelbergCement group to help with coordination of landscaping practices and to create this education board for public audience.



#### **Final conclusions**

We presumed that Hrabůvka quarry could serve as a refuge for rare species, but (i) our survey conducted in Bobroviště revealed that this area is occupied mainly by common plant and animal species. Most of the species are abundant also in the wider surroundings of the quarry. Nevertheless in Bobroviště, we see the biological value of this area in the forest fragment together with the spring and its immediate vicinity. Moreover, (ii) we suggest creating new ponds and to make littoral zone in the sewage water body to enhance biodiversity of this area and to increase the water retention in the landscape. Finally, (iii) our intended education board which will highlight the potential of quarry premises for biodiversity should be introduced to the public audience after the execution of our proposed interventions.

## **Acknowledgements**

We would like to thank Bohumil Trávníček and Jiří Kocián for their help with plant determination. We are also grateful to Českomoravský štěrk (HeidelbergCement Group, Czech Republic) for financial support of this research within the Quarry Life Award 2018, and for providing access to the Hrabůvka quarry premises.

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Project focus:  Beyond quarry borders Biodiversity management Cooperation programmes Connecting with local communities Education and Raising awareness Invasive species Landscape management Pollination Rehabilitation & habitat research Scientific research Soil management Species research Student class project Urban ecology Water management	Habitat:  Artificial / cultivated land Cave Coastal Grassland Human settlement Open areas of rocky grounds Recreational areas Sandy and rocky habitat Screes Shrub & groves Soil Wander biotopes Water bodies (flowing, standing) Wetland Woodland
☐Trees & shrubs ☐Ferns ☐Flowering plants ☐Fungi ☐Mosses and liverworts  Fauna: ☐Amphibians ☐Birds ☐Insects ☐Fish ☐Mammals ☐Reptiles ☐Other invertebrates ☐Other species	Stakeholders:  □ Authorities □ Local community □ NGOs □ Schools ☑ Universities



# **Appendix**

Figure 1: The habitat mosaic in Bobroviště.

Figure 2: Map of the Hrabůvka quarry.

Figure 3: Proposed interventions in Bobroviště.

**Table 1:** List of abbreviations of conservation statuses.

Table 2: List of recorded plants in the Hrabůvka quarry.

Table 3: List of recorded invertebrates in the Hrabůvka quarry.

Table 4: List of recorded vertebrates in the Hrabůvka quarry.



**Figure 1:** The habitat mosaic in Bobroviště: the forest fragment (top left, top right), the sewage water body (middle left), the meadow with solitary willows (middle right), ruderal habitats created by landscaping during the building of the adjacent highway (bottom left, bottom right).



**Figure 2:** Map of the Hrabůvka quarry divided into plots used for the botanical survey (HA1-HG4). Bobroviště is highlighted by green color.



**Figure 3:** Proposed interventions in Bobroviště. The sewage water body with littoral vegetation, new ponds with the position of loggery and clear cut area is displayed.

Table 1: List of abbreviations of conservation statuses used in Table 2-4.

Source	Abbreviation	Explanation
Grulich 2012	C1	Critically threatened species
(Red list of vascular plants)	C2	Endangered species
	C3	Vulnerable species
	C4	Lower risk
Decree no. 395/1992 Sb.	КО	Critically threatened
(Conservation status by Czech legislation)	SO	Strongly threatened
, , ,	0	Threatened
	0.0	
Hejda et al. 2017, Chobot & Němec 2017	CR	Critically endangered
(Red list of invertebrates and vertebrates)	EN	Endangered
	VU	Vulnerable
	NT	Near threatened
	LC	Least concern
	RE	Extinct in CZ
	DD	Data deficient
	NE	Not evaluated

**Table 2:** List of recorded plants in the Hrabůvka quarry. Nomenclature by Danihelka et al. 2012, RL CZ = category of threatened species by Grulich 2012, status = status by Pyšek et al. 2012.

Taxa	CZ Red list	status	HA1	HA2	里	HC1	HC2	НСЗ	HD1	HD2	HD3	뿦	HF1	HF2	HF3	HG1	HG2	ндз	HG4
Abies alba	C4a								*	*	*			*	*				
Acer campestre				*				*											
Acer negundo		inv neo					*												*
Acer platanoides									*		*				*				*
Acer pseudoplatanus									*	*	*		*						*
Actaea spicata				*															
Aegopodium podagraria			*	*											*				
Aesculus hippocastanum		nat neo													*				
Agrostis sp.			*								*								*
Agrostis stolonifera																		*	
Achillea millefolium agg.			*	*			*	*					*	*	*		*	*	*
Ajuga genevensis					*			*											*
Ajuga reptans			*	*			*												
Alchemilla sp.							*												
Alisma plantago-aquatica																			*
Alliaria petiolata					*						*			*	*	*			
Allium oleraceum				*															
Allium sp.										*									
Alnus glutinosa			*																
Alopecurus aequalis				*															
Alopecurus pratensis					*														
Anagallis arvensis		nat ar			*	*									*				*
Anemone nemorosa			*						*										
Anthoxanthum odoratum							*									*			

Anthriscus sylvestris		*				*	*										
Anthyllis vulneraria																*	
Arabidopsis thaliana				*													
Arctium lappa	nat ar	*														*	
Arctium sp.						*											
Arenaria serpyllifolia																	*
Armoracia rusticana	nat ar																*
Arrhenatherum elatius subsp. elatius	inv ar			*		*	*				*	*	*				*
Artemisia vulgaris		*	*	*						*			*			*	*
Asarum europaeum		*	*														
Astragalus glycyphyllos			*			*										*	*
Athyrium filix-femina									*		*						
Atriplex sagittata	inv ar												*				
Ballota nigra subsp. nigra	nat ar	*															
Barbarea vulgaris subsp. vulgaris				*	*												*
Berteroa incana subsp. incana	nat ar															*	*
Betonica officinalis							*										
Betula pendula			*						*		*	*	*			*	*
Bidens frondosus	inv neo																*
Brachypodium sylvaticum			*														
Bromus hordeaceus subsp. hordeaceus	nat ar					*										*	
Bromus sterilis	nat ar												*				
Calamagrostis epigejos		*		*						*	*	*	*	*	*	*	*
Campanula patula						*											
Campanula persicifolia		*							*								
Capsella bursa-pastoris	nat ar				*								*				*
Carduus acanthoides	nat ar														*	*	*
Carduus crispus																*	*
Carex digitata		*	*														
Carex hirta				*	*	*	*									*	*
Carex muricata									*	*		*				*	

Carex spicata				*														
Carex sylvatica								*										
Carlina vulgaris															*			*
Carpinus betulus							*	*	*	*		*	*	*			*	*
Carpinus betulus Carum carvi														*				
														*			*	*
Centaurea jacea agg.																	*	
Centaurea scabiosa						*												
Centaurea sp.																	•	
Centaurea stoebe					4												•	
Cerastium glutinosum																		
Cerastium holosteoides subsp. vulgare					*	*								*				
Cichorium intybus	nat ar																	*
Cirsium arvense	inv ar	*		*	*	*	*				*						*	*
Clinopodium vulgare subsp. vulgare																		*
Convolvulus arvensis	nat ar					*					*						*	*
Conyza canadensis	inv neo																*	*
Cornus sanguinea		*	*				*							*			*	*
Corydalis solida subsp. solida	C4a									*								
Corylus avellana		*	*					*	*	*		*	*	*		*		*
Cota tinctoria subsp. subtinctoria	C4b														*	*		
Crataegus sp.		*	*				*	*					*	*				*
Dactylis glomerata		*	*	*	*	*	*							*				
Daphne mezereum			*															
Daucus carota subsp. carota														*			*	*
Dianthus carthusianorum subsp. carthusianorum																*	*	
Dianthus deltoides															*			
Digitalis purpurea	nat neo												*					
Dipsacus fullonum																	*	
Dryopteris filix-mas			*					*	*	*		*	*	*				
Echinochloa crus-galli	inv ar													*				*
Echium vulgare													*	*	*		*	*
•																		

Epilobium angustifolium Epilobium collinum Epilobium collinum Epilobium dodonaei Epilobium ministutum Epilobium montanum Epilobium montanum Epilobium sys. Equisetum arvense subsp. arvense Ergeron annuus Engismum cheiranthoides Engismum cheiranthoides Engismum cheiranthoides Engismum cheiranthoides Euonymus europaeus Eupatorium cannabinum subsp. cannabinum Euphorbia cyparissias Euphorbia dulcis Euphorbia pellus Euphorbia pellus Euphorbia pelpus	Elymus repens subsp. repens																	*	*
Epilobium dodonaei Epilobium dodonaei Epilobium hirsutum Epilobium montanum Epilobium sp. Equisetum arvense subsp. arvense Erigeron annuus Enigeron annuus Enigeron annuus Eunynmus europaeus Eupatorium cannabinum subsp. cannabinum Eupatorium cannabinum subsp. cannabinum Euphorbia cyparissias Euphorbia dulcis Euphorbia dulcis Euphorbia pelplus																*	*		*
Epilobium dodonaei Epilobium Inisutum Epilobium montanum Epilobium arvense subsp. arvense Erigeron annuus Erigeron annuus Erigeron annuus Europanus europaeus Eupontria cannabinum subsp. cannabinum Eupontria cyparissias Euphorbia cyparissias Euphorbia helioscopia Euphorbia peplus Eup	,																		*
Epilobium minisutum Epilobium montanum Epilobium montanum Epilobium sp. Equisetum arvense subsp. arvense Erigeron annuus Erigeron annuus Enysimum cheiranthoides Erigeron annuus Euphoria europaeus Eupatorium cannabinum subsp. cannabinum Euphorbia oyparissias Euphorbia dulcis Euphorbia helioscopia Inat ar Euphorbia pellus Euphorb																*			
Epilobium montanum Epilobium sp. Equisetum arvense subsp. arvense Erigeron annuus Erigeron annuus Enysimum cheiranthoides Inat ar Euonymus europaeus Eupatorium cannabinum subsp. cannabinum Euphorbia cyparissias Euphorbia dulcis Euphorbia helioscopia Euphorbia platyphyllos subsp. platyphyllos Fagus sylvatica Fallopia convolvulus Fastuca arundinacea Festuca gigantea Festuca gigantea Festuca gigantea Festuca rubra Festuca rubra Festuca rubra Fersuca yubra Festuca pratensis Festuca rubra Fersuca yubra Festuca pratensis Festuca prate	•																		*
Equisetum arvense subsp. arvense Erigeron annuus Erigeron annuus Iinv neo Erigeron annuus Euphorium cheiranthoides Euonymus europaeus Eupatorium cannabinum subsp. cannabinum Euphorbia cyparissias Euphorbia dulcis Euphorbia helioscopia Euphorbia peltus subsp. platyphyllos Fagus sylvatica Fagus sylvatica Festuca gigantea Festuca pratensis Festuca rundinacea Festuca rundinac	•			*							*	*	*						
Equisetum arvense subsp. arvense Erigeron annuus Erigeron annuus Inv neo Inv n															*				
Erigeron annuus Erysimum cheiranthoides Eunonymus europaeus Eunotrium cannabinum subsp. cannabinum Euphorbia cyparissias Euphorbia dulcis Euphorbia helioscopia Euphorbia peplus Euphorbia peplus Euphorbia palytyphyllos subsp. platyphyllos Fagus sylvatica Fallopia convolvulus Fastuca arundinacea Festuca grantensis Festuca rubra Festuca rubra Festuca rubra Festuca rubra Festuca sp. Ficaria verna subsp. verna Filago arvensis Fragaria woschata Fragaria vesca Frangula alnus Fraxinus excelsior	·		*	*	*	*	*					*			*				*
Eupatorium cenapaeus Eupatorium cannabinum subsp. cannabinum Euphorbia cyparissian Euphorbia dulcis Euphorbia helioscopia Euphorbia pelplus Euphorbia pelplus Euphorbia pelplus Euphorbia platyphyllos subsp. platyphyllos Fagus sylvatica Fallopia convolvulus Fastuca arundinacea Festuca gigantea Festuca pratensis Festuca runbra Festuca sp. Ficaria verna subsp. verna Filago arvensis Fragaria moschata Fragaria vesca Fragraige alanus Fraxinus excelsior		inv neo	*	*	*		*					*			*		*	*	*
Eupatorium cannabinum subsp. cannabinum Euphorbia cyparissias Euphorbia dulcis Euphorbia helioscopia nat ar Euphorbia peplus nat ar Euphorbia platyphyllos subsp. platyphyllos Fagus sylvatica Fallopia convolvulus nat ar Festuca arundinacea Festuca gigantea Festuca pratensis Festuca pratensis Festuca rubra Festuca sp. Ficaria verna subsp. verna Filago arvensis C3 Fragaria moschata Fragaria vesca Frangula alnus Fraxinus excelsior	_														*				*
Euphorbia cyparissias Euphorbia dulcis Euphorbia helioscopia Euphorbia helioscopia Euphorbia pelpus Euphorbia pelpus Euphorbia platyphyllos subsp. platyphyllos Fagus sylvatica Fallopia convolvulus Festuca arundinacea Festuca gigantea Festuca pratensis Festuca rubra Festuca sp. Ficaria verna subsp. verna Filago arvensis Fragaria vesca Fragaria vesca Frangula alnus Fraxinus excelsior			*	*				*											
Euphorbia cyparissias Euphorbia dulcis Euphorbia helioscopia Euphorbia helioscopia Euphorbia pelplus Euphorbia pelplus Euphorbia pelplus Euphorbia platyphyllos subsp. platyphyllos Fagus sylvatica Fallopia convolvulus Fallopia convolvulus Festuca arundinacea Festuca gigantea Festuca gratensis Festuca gratensis Festuca yratensis Festuca rubra Festuca sp. Ficaria verna subsp. verna Filago arvensis Fragaria moschata Fragaria vesca Frangula alnus Fraxinus excelsior			*	*	*							*	*		*	*		*	*
Euphorbia dulcis Euphorbia helioscopia nat ar Euphorbia peplus nat ar Euphorbia peplus nat ar Euphorbia platyphyllos subsp. platyphyllos Fagus sylvatica Fallopia convolvulus Fallopia convolvulus Festuca arundinacea Festuca granteansis Festuca pratensis Festuca rubra Fiscaria verna subsp. verna Filago arvensis Fragaria moschata Fragaria vesca Frangula alnus Fraxinus excelsior					*	*					*			*	*			*	*
Euphorbia helioscopia         nat ar         * </td <td></td> <td></td> <td></td> <td>*</td> <td></td>				*															
Euphorbia peplus Euphorbia platyphyllos subsp. platyphyllos Fagus sylvatica Fallopia convolvulus Fastuca arundinacea Festuca gigantea Festuca pratensis Festuca rubra Festuca sp. Ficaria verna subsp. verna Filago arvensis Fragaria moschata Fragaria vesca Frangula alnus Fraxinus excelsior	•	nat ar				*									*				
Euphorbia platyphyllos subsp. platyphyllos Fagus sylvatica Fallopia convolvulus Fastuca arundinacea Festuca gigantea Festuca pratensis Festuca rubra Festuca sp. Ficaria verna subsp. verna Filago arvensis Fragaria moschata Fragaria wesca Frangula alnus Fraxinus excelsior	Euphorbia peplus	nat ar																	*
Fagus sylvatica         *																			*
Festuca gigantea Festuca pratensis Festuca pratensis Festuca rubra Festuca sp. Ficaria verna subsp. verna Filago arvensis Fragaria moschata Fragaria vesca Frangula alnus Fraxinus excelsior  * * * * * * * * * * * * * * * * * * *									*		*		*						
Festuca gigantea Festuca pratensis Festuca rubra Festuca sp. Ficaria verna subsp. verna Filago arvensis Fragaria moschata Fragaria vesca Frangula alnus Fraxinus excelsior  * * * * * * * * * * * * * * * * * * *	Fallopia convolvulus	nat ar													*				*
Festuca pratensis Festuca rubra Festuca sp. Ficaria verna subsp. verna Filago arvensis Fragaria moschata Fragaria vesca Frangula alnus Fraxinus excelsior  * * * * * * * * * * * * * * * * * * *	Festuca arundinacea				*		*												
Festuca rubra       *       <	Festuca gigantea			*															
Festuca sp.       * * * *         Ficaria verna subsp. verna       * * * * *         Filago arvensis       C3       * * * * * * * * *         Fragaria moschata       * * * * * * * * * * * * * * * * * * *	Festuca pratensis				*		*												
Ficaria verna subsp. verna       * * * * *         Filago arvensis       C3       * * * * * * * * * *         Fragaria moschata       * * * * * * * * * * * * * * * * * * *	Festuca rubra				*														
Filago arvensis       C3       *	Festuca sp.														*		*	*	
Fragaria moschata  * * * *  Fragaria vesca  Frangula alnus  Fraxinus excelsior  * * * * * * * * * *  * * *  * * * * *	Ficaria verna subsp. verna			*				*	*										
Fragaria vesca         * * * * * * * * * * * * * * * * * * *	Filago arvensis	C3		*										*	*	*	*	*	*
Frangula alnus  * *  Fraxinus excelsior  * * * * * * * * * * * * * * * * * * *	Fragaria moschata		*								*	*							
Fraxinus excelsior * * * * * * * * * * * * * * * * * * *	Fragaria vesca			*	*		*						*		*			*	*
	Frangula alnus										*		*						
Fumaria officinalis subsp. officinalis *	Fraxinus excelsior		*	*					*	*	*		*	*	*				*
	Fumaria officinalis subsp. officinalis														*				

Galeobdolon montanum			*				*	*	*		*						
Galeopsis pubescens													*				*
Galinsoga quadriradiata	inv neo																*
Galium aparine		*	*	*			*	*	*		*	*	*				
Galium mollugo agg.				*	*	*										*	*
Galium odoratum			*				*	*	*		*						
Galium verum					*								*				
Geranium columbinum	nat ar					*											
Geranium robertianum		*	*				*	*	*	*	*		*				*
Geum urbanum		*	*	*		*			*		*		*				
Glechoma hederacea		*		*			*						*				
Gymnocarpium dryopteris											*						
Hedera helix		*	*				*										
Helianthus tuberosus	inv neo	*														*	*
Heracleum sphondylium		*			*				*				*				
Hieracium cf. levicaule	C3												*				
Hieracium cf. murorum											*						
Hieracium laevigatum																	*
Hieracium lachenalii												*	*				
Hieracium murorum		*	*						*				*				
Hieracium sabaudum													*				
Hieracium sp.																	*
Holcus lanatus					*	*											*
Humulus lupulus									*								*
Hylotelephium maximum		*	*			*						*	*				
Hypericum maculatum			*												*		
Hypericum perforatum		*	*	*	*				*			*		*		*	*
Chaerophyllum aromaticum													*				
Chaerophyllum sp.		*															
Chaerophyllum temulum									*								
Chelidonium majus	nat ar		*				*	*	*				*				
-																	

Chenopodium album agg.														*				
Chenopodium cf. suecicum																		*
Chenopodium glaucum																		*
Chenopodium polyspermum														*				*
Impatiens noli-tangere								*	*	*								
Impatiens parviflora	inv neo		*						*	*				*				*
Inula conyzae	1117 1100		*															*
Juglans regia	nat ar		*											*				*
Juncus articulatus	nat ai																	*
Juncus bufonius																		*
Knautia sp.														*				
Lactuca serriola	nat ar													*				*
Lamium album	nat ar	*																
Lamium maculatum							*	*	*									
Lamium purpureum	nat ar		*		*													
Lapsana communis subsp. communis	nat ar													*				
Larix decidua subsp. decidua								*	*	*								*
Lathyrus pratensis		*		*		*												
Lathyrus sylvestris															*	*	*	*
Lemna minor		*	*															
Leucanthemum vulgare agg.		*		*	*	*								*				*
Ligustrum vulgare		*																
Linaria vulgaris	nat ar			*							*					*	*	*
Linum austriacum (sown plants)																	*	
Lolium perenne		*			*										*	*	*	*
Lotus corniculatus						*								*	*		*	*
Luzula campestris agg.						*												
Luzula luzuloides			*					*		*		*	*	*				
Luzula pilosa		*													*			
Lycopus europaeus subsp. europaeus			*															
Lychnis flos-cuculi subsp. flos-cuculi					*	*												

Lysimachia nummularia		*	*								*						
Maianthemum bifolium									*								
Malus domestica	nat ar					*											*
Matricaria discoidea	nat neo				*								*				
Medicago lupulina		*			*								*			*	*
Melampyrum nemorosum						*											*
Melica nutans			*				*		*	*	*	*					
Melica uniflora			*				*	*	*			*					
Melilotus officinalis	nat ar															*	*
Melilotus sp.		*															
Mentha arvensis				*	*												
Mercurialis perennis							*				*	*					
Microrrhinum minus	nat ar									*				*			*
Moehringia trinervia										*							
Mycelis muralis			*				*	*	*		*		*		*		
Myosotis arvensis	nat ar													*	*		
Myosotis ramosissima				*	*	*											
Myosotis sylvatica		*	*														
Neottia nidus-avis	C4a		*														
Oenothera biennis	nat neo																*
Onobrychis viciifolia	nat neo															*	
Origanum vulgare																*	
Oxalis acetosella								*	*		*						
Oxalis stricta	nat neo												*			*	*
Papaver rhoeas	nat ar												*				
Parthenocissus inserta	inv neo												*				*
Parthenocissus quinquefolia	nat neo	*															
Persicaria lapathifolia																	*
Persicaria mitis																	*
Phalaris arundinacea																	*
Picea abies			*								*		*				*

Picris hieracioides * * * * * *  Pilosella cf. bauhini  Pilosella cymosa * C4a *	*
Pilosella piloselloides *	
Pilosella sp. *	
Pimpinella saxifraga *	
Pinus sylvestris * * * * * *	*
Plantago lanceolata * * * * * * * * * * * * * * * * * *	*
Plantago major * * *	*
Plantago media *	
Plantago uliginosa	*
Poa angustifolia *	
Poa compressa * * * * * *	*
Poa nemoralis * * * * * * * * * * * * * * * * * * *	*
Poa palustris	*
Poa pratensis * * * * * * *	
Poa pratensis agg.	*
Poa sp. *	
Polygonatum multiflorum * * * * * *	
Polygonum aviculare agg.	*
Polypodium vulgare *	
Populus tremula * * * * * * * *	*
Populus x canadensis inv neo * *	
Populus x canescens	*
Potentilla anserina *	
Potentilla argentea * * * * * * *	
Potentilla reptans * *	*
Prunella vulgaris *	
Prunus avium * * * * * * * * * * *	
Prunus sp. *	
Prunus spinosa * * * *	

Querous potarea Querous potarea Querous robur Ranunculus acris Ranunculus auricomus agg. Ranunculus repens Ranunculus sceleratus Reseda lutea Reseda lutea Reseda lutea Responutria japonica Ribes uva-crispa Robinia pseudacacia Rorippa palustris Rosa canina agg. Rosa sp. Rubus caesius Rubus fruicosus agg. Rubus fruicosus agg. Rubus rorispa Rumex acetosella Rumex acetosella Rumex acetosella Rumex ocirispus Rumex orispus Rumex orispus Rumex obtusifolius Rumex sp. Salix caprea Salix cf. aurita Salix cf. aurita Salix sp. Sambucus nigra	Pulmonaria obscura		*	*					*		*								
Quercus robur Ranunculus acris Ranunculus auricomus agg. Ranunculus repens Ranunculus sceleratus Reseda lutea Reseda lutea Reynoutria japonica Ribes uva-crispa Robinia pseudacacia Roripap aplustris Rosa canina agg. Rosa sp. Rubus ruticosus agg. Rubus fruticosus agg. Rubus ruticosus agg. Rumex acetosella Rumex acetosella Rumex acetosella Rumex crispus Rumex crispus Rumex obtusifolius Rumex sp. Salix caprea Salix cf. alba Salix cf. aurita Salix cf. caprea Salix cf. caprea Salix cf. caprea									*		*		*						
Ranunculus acris Ranunculus auricomus agg. Ranunculus repens Ranunculus sceleratus Reseda lutea nat ar Reynoutria japonica Ribes uva-crispa Robinia pseudacacia inv neo Rorippa palustris Rosa canina agg. Rosa sp. Rubus caesius Rubus fruticosus agg. Rubus fruticosus			*	*				*	*	*	*		*	*	*		*		*
Ranunculus auricomus agg. Ranunculus repens Ranunculus sceleratus Reseda lutea Reseda lutea Resproutria japonica Ribes uva-crispa Robinia pseudacacia Rorippa palustris Rosa canina agg. Rosa sp. Rubus caesius Rubus fruticosus agg. Rubus idaeus Rubus sp. Rumex acetosella Rumex acetosella Rumex cf. crispus Rumex cf. crispus Rumex obtusifolius Rumex sp. Salix cf. alaba Salix cf. aurita Salix cf. caprea							*												
Ranunculus repens Ranunculus sceleratus Reseda lutea Reseda lutea Reseda lutea Reynoutria japonica Ribes uva-crispa Robinia pseudacacia Rorippa palustris Rosa canina agg. Rosa sp. Rubus caesitus Rubus fruticosus agg. Rubus fruticosus agg. Rubus sp. Rumex acetosa Rumex acetosa Rumex acetosalla Rumex crispus Rumex crispus Rumex crispus Rumex sp. Salix cf. aurita Salix cf. aurita Salix cf. aurita Salix cf. caprea Salix sp. Sambucus ebulus  nat ar				*				*											
Ranunculus sceleratus Reseda lutea Reynoutria japonica Ribes uva-crispa Robinia pseudacacia Rorippa palustris Rosa canina agg. Rosa sp. Rubus caesius Rubus fruticosus agg. Rubus idaeus Rumex acetosala Rumex acetosala Rumex cri. crispus Rumex crispus Rumex ostusifolius Rumex sp. Salix cq. aurita Salix cf. aurita Salix cf. aurita Salix sp. Sambucus ebulus  nat ar  inv neo  inv neo			*		*	*						*	*		*				*
Reseda lutea         nat ar           Reynoutria japonica         inv neo           Ribes uva-crispa         ***           Robinia pseudacacia         inv neo           Rorippa palustris         ***           Rosa canina agg.         ***           Rosa sp.         ***           Rubus caesius         ***           Rubus caesius         ***           Rubus idaeus         ***           Rubus idaeus         ***           Rubus sp.         ***           Rumex acetosal         ***           Rumex certosella         ***           Rumex crispus         ***           Rumex obusifolius         ***           Rumex sp.         ***           Salix cf. alba         ***           Salix cf. alba         ***           Salix cf. caprea         ***           Salix sp.         ***           Sambucus ebulus         ***				*															
Reynoutria japonica Ribes uva-crispa Robinia pseudacacia Rorippa palustris Rosa canina agg. Rosa sp. Rubus caesius Rubus fruticosus agg. Rubus fruticosus agg. Rumex acetosa Rumex acetosalla Rumex crispus Rumex crispus Rumex obtusifolius Rumex sp. Salix caprea Salix cf. alba Salix cf. aurita Salix cf. carpea Salix sp. Sambucus ebulus  inv neo		nat ar										*				*	*	*	*
Ribes uva-crispa Robinia pseudacacia Rorippa palustris Rosa canina agg. Rosa sp. Rubus caesius Rubus fruticosus agg. Rubus idaeus Rubus sp. Rumex acetosa Rumex acetosa Rumex acetosala Rumex cf. crispus Rumex oft. crispus R																		*	
Robinia pseudacacia Rorippa palustris Rosa canina agg. Rosa sp. Rubus caesius Rubus caesius Rubus ifuticosus agg. Rubus sp. Rumex acetosa Rumex acetosalla Rumex cf. crispus Rumex crispus Rumex crispus Rumex crispus Rumex sp. Salix caprea Salix cf. aubia Salix cf. caprea Salix sp. Sambucus ebulus  nat ar		1117 1100									*								
Rorippa palustris Rosa canina agg. Rosa sp. Rubus caesius Rubus fruticosus agg. Rubus idaeus Rubus sp. Rubus sp. Rumex acetosa Rumex acetosa Rumex cf. crispus Rumex cf. crisp		inv neo	*	*											*			*	*
Rosa canina agg. Rosa sp. Rubus caesius Rubus fruticosus agg. Rubus idaeus Rubus sp. Rumex acetosa Rumex acetosa Rumex acetosella Rumex cf. crispus Rumex crispus Rumex crispus Rumex sp. Salix caprea Salix cf. aurita Salix sp. Sambucus ebulus  nat ar				*															
Rosa sp. Rubus caesius Rubus fruticosus agg. Rubus idaeus Rubus sp. Rumex acetosa Rumex acetosella Rumex cf. crispus Rumex cf. crispus Rumex sp. Salix caprea Salix cf. aurita Salix sp. Sambucus ebulus  * * * * * * * * * * * * * * * * * * *								*						*	*				*
Rubus caesius Rubus fruticosus agg. Rubus idaeus Rubus sp. Rumex acetosa Rumex acetosalla Rumex cf. crispus Rumex cf. crispus Rumex sp. Salix caprea Salix cf. aurita Salix sp. Sambucus ebulus  nat ar  *  *  *  *  *  *  *  *  *  *  *  *  *			*		*		*						*						
Rubus fruticosus agg.       *	•																		*
Rubus idaeus         * * * * * * * * * * * * * * * * * * *																			*
Rubus sp.       * * * * * * * * * * * * * * * * * * *			*													*		*	*
Rumex acetosal       * * *         Rumex acetosella       * * *         Rumex cf. crispus       * * *         Rumex crispus       * * * * * * * * * * * * * * * * * * *			*		*			*		*	*		*	*			*	*	
Rumex acetosella Rumex cf. crispus Rumex crispus Rumex obtusifolius Rumex sp. Salix caprea Salix cf. aurita Salix sp. Sambucus ebulus  * * *  * *  * *  * *  * *  * *  * *					*		*												
Rumex crispus Rumex obtusifolius  * * * * * * * * *  Rumex sp.  Salix caprea  Salix cf. alba  Salix cf. aurita  Salix cf. caprea  * *  Salix cf. caprea  * *  Salix sp.  * *  Sambucus ebulus  * * * * * *  * *  * *  * *  * *  * *														*		*			
Rumex crispus Rumex obtusifolius  * * * * * * * * *  Rumex sp.  Salix caprea  Salix cf. alba  Salix cf. aurita  Salix cf. caprea  * *  Salix cf. caprea  * *  Salix sp.  * *  Sambucus ebulus  * * * * * *  * *  * *  * *  * *  * *	Rumex cf. crispus											*							
Rumex obtusifolius  Rumex sp.  Salix caprea  Salix cf. alba  Salix cf. aurita  Salix cf. caprea  Salix sp.  Sambucus ebulus  * * * * * *  * *  * *  * *  * *  * *	•																		*
Salix caprea  Salix cf. alba  * Salix cf. aurita  Salix cf. caprea  * Salix sp.  Sambucus ebulus  *  *  *  *  *  *  *  *  *  *  *  *  *							*					*						*	
Salix cf. alba  Salix cf. aurita  Salix cf. caprea  * Salix sp.  * * * * * * * * * * * * * * * * * *	Rumex sp.		*																
Salix cf. alba  Salix cf. aurita  Salix cf. caprea  * Salix sp.  * * * * * * * * * * * * * * * * * *	Salix caprea																		*
Salix cf. caprea			*																*
Salix sp. * * * * Sambucus ebulus * nat ar *	Salix cf. aurita																		*
Sambucus ebulus nat ar *	Salix cf. caprea		*																
	Salix sp.			*									*				*		
Sambucus nigra * * * * * * * *	Sambucus ebulus	nat ar						*											
	Sambucus nigra		*					*	*				*		*			*	

Sambucus racemosa								*									
Sanguisorba minor																	*
Saponaria officinalis	nat ar															*	
Saxifraga granulata						*											
Scrophularia nodosa				*						*				*		*	*
Securigera varia										*						*	
Senecio ovatus			*						*				*				
Senecio viscosus													*				*
Senecio vulgaris subsp. vulgaris	nat ar											*	*				*
Setaria viridis subsp. viridis	nat ar												*				
Silene latifolia subsp. alba	nat ar						*			*							
Silene nutans												*	*				
Silene vulgaris																*	
Sinapis alba	cas neo			*													
Sisymbrium officinale	nat ar												*				
Solanum nigrum	nat ar												*				*
Solidago canadensis	inv neo															*	
Sonchus asper	nat ar																*
Sonchus oleraceus	nat ar												*				*
Sorbus aucuparia			*						*		*	*	*				*
Stachys palustris																	*
Stachys recta subsp. recta																*	
Stachys sylvatica			*														
Stellaria graminea						*				*							
Stellaria holostea		*					*										
Stellaria media											*		*				*
Symphytum officinale		*	*	*		*							*				*
Syringa vulgaris	nat neo												*				
Tanacetum vulgare	nat ar	*		*		*	*				*			*		*	*
Taraxacum sect. ruderalia		*	*		*										*	*	*
Thlaspi arvense	nat ar		*		*												*

Tilia cordata								*	*	*		*		*				
Tilia plathyphyllos										*		*						
Torilis japonica														*				
Trifolium arvense																	*	*
Trifolium campestre						*							*		*		*	*
Trifolium hybridum subsp. hybridum	nat neo				*	*												
Trifolium pratense		*				*								*			*	*
Trifolium repens		*				*											*	*
Tripleurospermum inodorum	nat ar													*	*	*	*	*
Trisetum flavescens						*								*				*
Turritis glabra							*				*		*					*
Tussilago farfara		*	*	*							*				*	*	*	*
Typha latifolia			*															*
Ulmus glabra			*						*					*				
Urtica dioica		*	*	*	*	*	*			*		*		*			*	*
Valeriana officinalis		*	*	*														
Verbascum nigrum																	*	*
Verbascum sp.													*					
Verbascum thapsus subsp. tahapsus																		*
Veronica arvensis	nat ar					*	*							*				
Veronica beccabunga			*															
Veronica chamaedrys agg.		*	*	*		*	*			*			*	*				
Veronica officinalis		*				*				*	*		*		*		*	*
Veronica persica	nat neo				*									*				
Veronica serpyllifolia subsp. serpyllifolia		*				*	*											
Veronica sublobata		*	*															
Viburnum opulus		*	*															
Vicia angustifolia	nat ar														*			
Vicia cracca		*	*			*											*	*
Vicia hirsuta												*						
Vicia sativa	nat ar	*																

Total taxa records per plot:	85	86	45	24	65	41	36	29	56	29	48	42	109	33	27	79	143
Viscum album subsp. album	*																
Viola sp.																	*
Viola riviniana						*											
Viola reichenbachiana	*	*						*	*								
Viola cf. reichenbachiana							*										
Viola arvensis				*						*		*		*			
Vinca minor													*				
Vicia tetrasperma	*		*		*												
Vicia sepium					*												

**Table 3:** List of recorded invertebrates in the Hrabůvka quarry. CZ § = regulation 395/1992 Sb (issued by the Ministry of Environment of the Czech Republic), RL CZ = category of threatened species by Hejda et al. 2017, EU § = The Habitats Directive (adopted by EU in 1992 as Council Directive 92/43/EEC).

Species	CZ §	CZ Red list	EU §
Oligochaeta	02 g	CZ Red list	E0 8
Lumbricus terrestris			
Gastropoda			
Helix pomatia			
Succinea putris			
Fruticicola fruticum			
Cepaea nemorali			
Cepaea hortensis			
Diplopoda			
Ommatoiulus sabulosus			
Polydesmus complanatus			
Megaphyllum unilineatum			
Glomeris sp.			
Unciger foetidus			
Chilopoda			
Lithobius forficatus			
Geophilus flavus			
Arachnida			
Misumena vatia			
Xysticus cristatus			
Ixodes ricinus			
Araneus diadematus			
Nuctenea umbratica			
Argiope bruennichi			
Araneus angulatus			
Araniella cucurbitina			
Phalangium opilio			
Pardosa lugubris			
Pardosa amentata			
Crustacea			
Gammarus fossarum			
Oniscus asellus			
Armadillidium vulgare			
Odonata			
Calopteryx splendens			
Platycnemis pennipes			
Coenagrion puella			
Pyrrhosoma nymphula			
Ischnura elegans			
Lestes sponsa			
Anax imperator			
Anax parthenope			
Aeshna mixta			
Libellula depressa			
Orthetrum coerulescens		NT	
Sympetrum sanguineum			
Orthoptera			
Pholidoptera griseoaptera			
Tettigonia viridissima			
Tettigonia cantans			
Tetrix subulata			
Chorthippus parallelus			
Omocestus viridulus			
Euthystira brachyptera			

#### Dermaptera

Forficula auricularia Chelidura acanthopygia

#### Hemiptera

Gerris lacustris

Miris striatus

Capsodes gothicus

Elasmucha grisea

Aelia acuminata

Carpocoris

purpureipennis

Graphosoma lineatum

Palomena viridissima

Aphis fabae

Aphrophora alni

Lygaeus equestris

Spilostethus saxatilis

Pyrrhocoris apterus

Nepa cinerea

Eurygaster maura

Hydrometra stagnorum

Coreus marginatus

Rhynocoris iracundus

## Coleoptera (ex.

#### Carabidae)

Galeruca tanaceti

Meligethes aeneus

Malachius bipustulatus

Paederus littoralis

Ocypus sp.

Phyllotreta undulata

Altica oleracea

Nicrophorus vespillo

*Mordelidae* 

Amphimallon solstitiale

Phyllobius sp.

Labidostomis longimana

Chrysolina fastuosa

Chrysomela populi

Silpha obscura

Oiceoptoma thoracicum

Cantharis rustica

Cantharis fusca

Rhagonycha fulva

Dorcus parallelipipedus

Dytiscus marginalis

Adalia bipunctata

Propylea

quatuordecimpunctata

. Coccinella

septempunctata

Calvia

quatuordecimguttata

Harmonia axyridis

Oedemera femorata

Oedemera podagrariae

Oedemera virescens

Leptura quadrifasciata

Leptura maculata

Calamobius filum

Agapanthia			
villosoviridescens			
Carabidae			
Abax ovalis			
Abax parallelepipedus			
Amara aenea			
Amara plebeja			
Anchomenus dorsalis Badister lacertosus			
Bembidion lampros			
Bembidion properans			
Brachinus crepitans	0		
Brachinus explodens	Ö		
Calathus erratus	Ü		
Calathus fuscipes			
Carabus coriaceus			
Carabus hortensis			
Carabus intricatus			
Carabus scheidleri	0		
Carabus ullrichii	0		
Carabus violaceus			
Cicindela campestris	0		
Cylindera germanica	0	NT	
Drypta dentata			
Elaphrus cupreus			
Harpalus affinis			
Harpalus distinguendus			
Harpalus tardus			
Chlaenius nitidulus		NIT	
Chlaenius tristis		NT	
Microlestes minutus			
Nebria brevicollis			
Notiophilus palustris Ophonus azureus			
Panagaeus cruxmajor			
Platinus assimilis			
Poecilus cupreus			
Pseudoophonus griseus			
Pseudoophonus rufipes			
Pterostichus melanarius			
Pterostichus nigrita			
Stomis pumicatus			
Syntomus truncatellus			
Trechus quadristriatus			
Neuroptera			
Chrysoperla carnea			
Hymenoptera	0		
Bombus terrestris	0		
Bombus lapidarius Sphex funerarius	U		
Lasius fuliginosus			
Lasius niger			
Formica sp.	0		
Myrmica rubra	Ü		
Vespa crabro			
Vespula vulgaris			
Polistes dominula			
Apis mellifera			
Diptera			
Clitellaria ephippium			

Calliphora vicina Lucilia caesar Lipoptena cervi Ectophasia crassipennis Culex pipiens Sarcophaga carnaria Musca domestica Simulium sp. Chironomus plumosus Syrphidae Rhagoletis cerasi Tipula oleracea Mecoptera Panorpa communis Trichoptera Limnephilidae Lepidoptera Vanessa atalanta Aglais io Araschnia levana Pieris rapae Pieris napi Anthocharis cardamines Pieris brassicae Euclidia glyphica Autographa gamma Chiasmia clathrata Cucullia verbasci Polyommatus icarus Celastrina argiolus Maniola jurtina Coenonympha pamphilus Argynnis paphia Camptogramma bilineata Euplagia quadripunctaria VU Tyria jacobaeae Yponomeuta cagnagella Pyrgus malvae Erynnis tages Thymelicus sylvestris Ochlodes sylvanus Orgyia antiqua Ematurga atomaria Chrysoteuchia culmella Crambus lathoniellus Gonepteryx rhamni

**Table 4:** List of recorded vertebrates in the Hrabůvka quarry. CZ § = regulation 395/1992 Sb (issued by the Ministry of Environment of the Czech Republic), RL CZ = category of threatened species by Chobot & Němec 2017, EU § = The Habitats Directive (adopted by EU in 1992 as Council Directive 92/43/EEC).

Species	CZ §	CZ Red list	EU §
Amphibia			
Rana dalmatina	SO	NT	annex IV
Reptilia			
Lacerta agilis	SO	VU	annex IV
Aves			
Sitta europaea			
Phylloscopus collybita			
Phylloscopus trochilus			
Erithacus rubecula			
Turdus pilaris			
Turdus philomelos			
Columba palumbus			
Streptopelia turtur			
Anas platyrhynchos			
Buteo buteo			
Motacilla alba			
Motacilla cinerea			
Turdus merula			
Ficedula albicollis		NT	annex I
Circus aeruginosus	0	VU	annex I
Sylvia atricapilla			
Sylvia curruca			
Fringilla coelebs			
Falco tinnunculus			
Phoenicurus ochruros			
Garrulus glandarius			
Carduelis carduelis			
Pica pica			
Dendrocopos major			
Emberiza citrinella			
Poecile palustris			
Parus major			
Cyanistes caeruleus			
Sturnus vulgaris	_		
Hirundo rustica	0	NT	
Ardea cinerea		NT	
Passer domesticus			
Passer montanus			
Carduelis chloris			
Serinus serinus			
Mammalia	00		
Castor fiber	SO		annex II, IV
Microtus arvalis			
Meles meles			
Talpa europaea			ann \ /
Martes martes			annex V
Vulpes vulpes			
Myodes glareolus			
Sus scrofa			
Capreolus capreolus	0	חח	
Sciurus vulgaris	U	DD NT	
Lepus europaeus		IN I	