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WALL VEGETATION IN OLD ROYAL MINING TOWNS IN CENTRAL SLOVAKIA

Jiří KOLBEK[1], Milan VALACHOVIČ[2] & Katarína MIŠÍKOVÁ[3]

Abstract
During May, 2013, the vegetation on city walls has been studied in five old royal mining towns of Central Slovakia (Banská Belá, Banská Štiavnica, Kremnica, Nová Baňa, and Pukanec). In the four last-named towns, phytocoenological material was recorded according to the Braun-Blanquet method, providing 41 relevés. Analysis of data (TWINSPAN, DCA) grouped the relevés into four clusters: ass. *Cymbalarietum muralis, Corydalidetum luteae, Asplenietum rutae-murarie-trichomanis*, and the most hemerobic community dominated by *Chelidonium majus*. All communities are generally rather heterogeneous, with a large range of number of species and with frequent participation of accessory plants. In the observed localities, 22 epilithic mosses and 2 liverworts were recorded: the most common species appears *Encalypta streptocarpa*, *Homalothecium sericeum*, *Tortula muralis*, *Hypnum cupressiforme*, *Schistidium apocarpum* agg., and *Bryum caespiticium*.
Keywords: anthropophytes, *Asplenietea trichomanis*, hemeroby, phytocoenology, *Tortulo-Cymbalarietalia*, vegetation classification.

Izvleček
Maja 2013 smo vzorčili vegetacijo mestnih zidov v petih starih kraljevih rudarskih mestih v srednji Slovaški (Banská Belá, Banská Štiavnica, Kremnica, Nová Baňa in Pukanec). V zadnjih štirh mestih smo naredili 41 vegetacijskih popisov po Braun-Blanquetovi metodi. Z analizo podatkov (TWINSPAN, DCA) smo dobili štiri klastre: *Cymbalarietum muralis, Corydalidetum luteae, Asplenietum rutae-murarie-trichomanis* in združbo z največjo hemerobijo v kateri dominira vrsta *Chelidonium majus*. Vse združbe so splošno zelo raznolike z velikim spektrom vrst v katerih so zelo pogoste slučajne vrste. Na proučevanih lokacijah smo zabeležili 22 epilitskih mahov and 2 jeternjaka. Najbolj pogoste vrste so: *Encalypta streptocarpa*, *Homalothecium sericeum*, *Tortula muralis*, *Hypnum cupressiforme*, *Schistidium apocarpum* agg. in *Bryum caespiticium*.
Ključne besede: antropofiti, *Asplenietea trichomanis*, hemerobija, fitocenologija, *Tortulo-Cymbalarietalia*, klasifikacija vegetacije.

1. INTRODUCTION

The mining of gold, silver and some other metals in the Austro-Hungarian Kingdom has a long history. The first mining town on the territory of Slovakia was established in Banská Štiavnica (before year 1250), followed by 6 other towns in the years 1255–1450. Rich town treasures were an attraction for conquerors, e.g. Turks; therefore typical features of those towns were high stone walls and defensive towers. Also, the majority of city buildings was constructed from stone. Now these walls represent notable habitats for vegetation and wall plants specialists (bryophytes and vascular plants). Ecological conditions of walls are similar to those on natural rocks, nevertheless

[1] Pod Stadiony 2719/19, 150 00 Praha 5, Czech Republic; e-mail: jiri.kolbek@gmail.com
[2] Institute of Botany, Slovak Academy of Sciences, Dúbravská cesta 9, 845 23 Bratislava, Slovakia; e-mail: milan.valachovic@savba.sk
[3] Comenius University Bratislava, Department of Botany, Révová 39, 811 02 Bratislava, Slovakia; e-mail: katarina.misikova@fns.uniba.sk

specific combinations of substrates and heavy anthropogenic influence such as air pollution in towns make the walls an interesting object for the study of succession processes and coexistence of vascular plants, bryophytes and lichens.

City walls have been studied in various European towns and regions during recent decades, mostly in Italy (Hruška 1985, 1987, Poldini & Vidali 1994, Brullo & Guarino 1998, Świerkosz 2012) and Germany (e.g. Kaiser 1926, Tüxen 1937, Oberdorfer 1957, 1967, 1969, 1977, Görs 1966, Hübschmann 1967, Hilbig & Reichhoff 1977, Runge 1980, Brandes 1982, 1987, 1989, 1992a, b, Gödde 1987, Werner et al. 1989, Brandes & Griese 1991, Schubert et al. 1995, Brandes et al. 1998, Brandes & Brandes 2010). Among neighboring countries there are some similar works from the Czech Republic (Kolbek & Kurková 1979, Kolbek 1983a, b, 1995, 1997, 2001, Klimeš 1986, Jehlík 1989, 2013, Kolbek & Sádlo 1994, Duchoslav 1994, 2002, Sádlo & Kolbek 2001, Procházková & Duchoslav 2004, Simonová 2008, Chytrý 2009), Poland (Świerkosz 1993, 1994, 2004, Szczęśniak & Świerkosz 2003), Austria (Karrer 1985, Brandes 1989, Mucina 1993) and some communities are mentioned in vegetation survey of Hungary (Borhidi et al. 2012). Šilc & Čarni (2012) describe thermophytic vegetation of walls for the territory of Slovenia.

A total synthesis of phytocoenological data from wall communities in the territory of Slovakia has not been completed, although there exist some works from towns, e.g. Piešťany (Mucina 1987) and from some castle and ruin walls (Eliáš 1985, 1988, 1989) which were used for description of syntaxa of the class *Asplenietea trichomanis* (cf. Valachovič 1995). Also bryocoenoses on walls were not explicitly studied; only epilithic bryophytes on anthropogenic habitats have been inventoried in several papers. Uhereková-Šmelková & Mišíková (2010) recorded from walls of ruins in Glanzenberg above Banská Štiavnica and Old Castle right in the city a total of 14 taxa of bryophytes. The authors have analyzed 20 ruins and castles in the whole of Slovakia and found a total of 41 bryophytes, the most frequent species generally being *Tortula muralis*, *Anomodon viticulosus*, *Hypnum cupressiforme*, or *Homalothecium sericeum*. Later Uhereková-Šmelková et al. (2011) recorded 46 taxa from ruin walls in the Malé Karpaty Mts, where the same bryophytes were the most frequent – *Tortula muralis*, *Homalothecium sericeum*, *Hypnum cupressiforme*, *Bryum capillare*, and *Encalypta vulgaris*.

A similar situation seems to be the case abroad – special studies targetting the bryocoenoses on the walls are missing too, and bryophytes are accepted only as part of wall vegetation with lower importance (Brandes 1992b, Brandes et al. 1998, Duchoslav 2002, García-Rowe & Saiz-Jimenez 2002, Presland 2008, Simonová 2008).

The aim of paper is to complete information about vegetation on rocky walls of selected locations, display variability of plant communities including the role of bryophytes in those coenoses, together with notes to their hemeroby.

2. MATERIAL AND METHODS

A total of 41 phytocoenological relevés were surveyed in May-Jun, 2013 in five selected royal mining towns (Banská Belá, Banská Štiavnica, Kremnica, Nová Baňa, and Pukanec) according to the Zürich-Montpellier approach (Braun-Blanquet 1964). Except in the small town of Banská Belá (where vegetation was removed a short time ago during reconstruction of walls), in all others there were many suitable biotopes for wall vegetation (Figure 1). The relevés were entered into a Turboveg database (Hennekens 1995) and classified using TWINSPAN classification (Hill 1979), carried out by using JUICE software (Tichý 2002). Detrended correspondence analysis (DCA) from the CANOCO 4.5 for Windows package (ter Braak & Šmilauer 2002) was applied for the interpretation of the positions and relations between the communities. All observed data are stored in Central Database at the Institute of Botany, Slovak Academy of Sciences (http://ibot.sav.sk/cdf).

The result of the classification was manually relocated in the table according to decreasing rate of hemeroby of communities. The term hemeroby means the degree of anthropogenic impacts on ecosystems in the context of work published by Sukopp (1969). The **levels of anthropophytisation** and the diversity and complexity of the anthropophytes (synanthropic and invasive alien plant species) was calculated according to Kostrowicky index ***Ia = 100%. (Ga.Pa /g.p)***, where ***Ga*** is the number of anthropophytes and ***Pa*** their abundance, ***g*** is the number of all species in relevé, and ***p*** is the total abundance of all species and it is consistent with the work by Jurko (1990). All alien taxa that could indicate a degree of anthropophytisation in the community were chosen

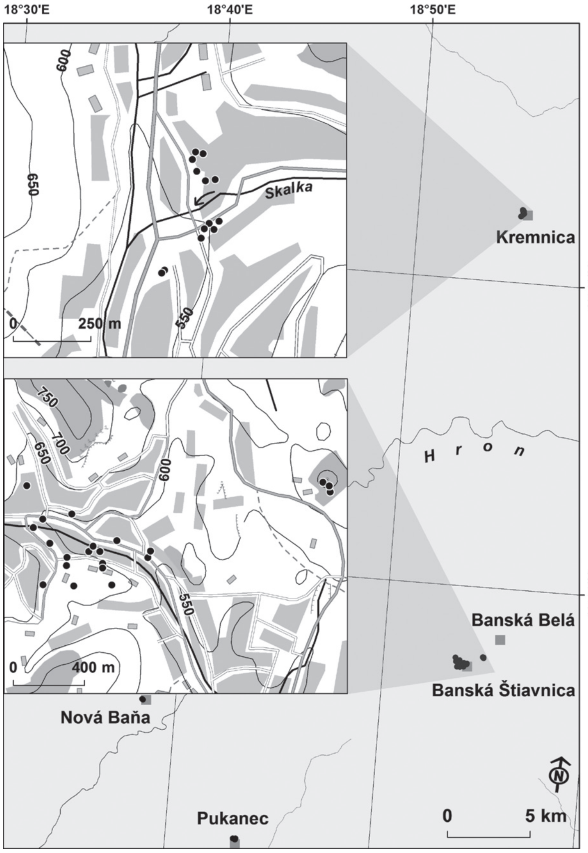

Figure 1: Map of study area; the position of five royal mining towns in Central Slovakia and detailed location of relevés in Kremnica (above), and Banská Štiavnica (below).
Slika 1: Zemljevid preučevanega območja; lokacije petih kraljevih rudarskih mest v srednji Slovaški in natančna lokacija popisov v mestih Kremnica (zgoraj) in Banská Štiavnica (spodaj).

Figure 2: *Cymbalarietum muralis*, Kremnica city, below Town Castle, photo M. Valachovič.
Slika 2: *Cymbalarietum muralis*, Kremnica, pod mestnim gradom, foto M. Valachovič.

according to list of Marhold & Hindák (1998). The same source was used for nomenclature of vascular plant names and bryophytes including infra-specific names (here shorted by an asterisk* before the last name). **Categories of hemeroby of bryophytes (HB)** and **air quality (AP)** are used in accordance of study by Düll (2010).

3. RESULTS

A classification of the dataset using Twinspan grouped the relevés into four clusters (see Table 1). A subsequent ordination of relevés has confirmed this result. The result of classification and ordination can be interpreted according to the following scheme:

Survey of wall communities in the hierarchical system of syntaxa

Asplenietea trichomanis (Br.-Bl. in Meier et Br.-Bl. 1934) Oberd. 1977
- *Tortulo-Cymbalarietalia* Segal 1969
  - *Cymbalario-Asplenion* Segal 1969 emend. Mucina 1993
    - *Cymbalarietum muralis* Görs in Oberdorfer 1967
    - *Corydalidetum luteae* Kaiser 1926
    - *Chelidonium majus* community
    - *Asplenietum rutae-murarie-trichomanis* Kuhn 1937

Cymbalarietum muralis Görs in Oberdorfer 1967

This association comprises a species-poor and highly variable community of neglected and uncultivated stony walls (Figure 2). Such European stands are described in some publications under the name *Cymbalaria muralis* community, stand, form, etc. The number of species fluctuates between 2 and 18, on average 6.9. A shrub layer was recorded in one relevé with a coverage <5% only. The coverage of the herb layer ranges from 5 to 45% (on average 21.7) and in the moss layer from 0 to <5%. *Chelidonium majus*, *Asplenium ruta-muraria* and aggregate species *Taraxacum* sect. *Ruderalia* were species of higher constancy. Other species grow in the stands with random occurrence and their successfully ecession of diaspores is dependent upon the contact communities. The community occurs in various expositions (see Table head in Appendix), but apparently with adequate moisture for the germination of the dominant *Cymbalaria muralis*.

In the publications mentioned in the Introduction, this unit is sometimes associated with a related community *Corydalidetum luteae*, but which differs by the presence of other dominant species *Pseudofumaria lutea* and usually also by the absence of *Cymbalaria muralis*. In Central Europe, it is a relatively abundant community on old city walls, around castles and stone terraces. It is typical community under anthropogenic influence, which can repair walls which disappear.

In urban historic towns, around castles and on old walls, it also fulfils an aesthetic function. The optimum occurrence of this community is considered to be in the Mediterranean region and South Europe, where the species *Cymbalaria muralis* is significantly more frequent (Tutin et al. 1972: vol. 3: 236–237). While in the West, suboceanic parts of Europe, the community is quite common in subcontinental areas, which includes Slovakia, it gradually decreases until disappearing completely. *Cymbalaria muralis* was found in a past time only rarely in some localities in Slovakia, e.g. Bratislava, Kremnica, Levoča, Piešťany, Prešov, Revúca, Ružomberok, and Žilina (cf. Mártonfi 1997). In Pukanec city, the taxon was known long ago (Kupčok 1956; we have not found this species here) and from Banská Štiavnica the discovery of the species was published by Hlavaček (1986). In recent times, several new findings have been recorded (cf. Letz et al. 2013), and the taxon shows a trend to further spread.

This community showed the highest value of anthropophytisation with approximate Ia = 38.4%, because the dominant species *Cymbalaria muralis* is itself considered as an anthropophyte in Central Europe. The community was found at altitudes from 560 to 593 m in the two cities.

Corydalidetum luteae Kaiser 1926

This community of stone walls and banks is characterized by the occurrence of the dominant spe-

Figure 3: *Corydalidetum luteae*, Banská Štiavnica city, Katova Street, photo M. Valachovič.
Slika 3: *Corydalidetum luteae*, Banská Štiavnica, Katova ulica, foto M. Valachovič.

cies *Pseudofumaria lutea* (Figure 3). Such stands are also described as *Cymbalaria muralis* stands under the name *Corydalis lutea* community, stand, form, etc. Due to this species the flowering stands are much more noticeable and physiognomically more robust than previous community. Also, due to the dominant, these stands often have higher coverage than the previous community, although they are very species-poor. The number of species fluctuates between 2 and 10, on average 5.5. The cover of the herb layer is 5–60% (in average 33.8); no shrub layer was found. The moss layer has a cover of 0 to <5% (on average <2%). This community is well-known in the oceanic Western Europe and in connection with the cultivation of *Pseudofumaria lutea* as ornamental plants has spread on the walls in Central Europe. Due to good germination of seeds and myrmecochory, the dominant species also often spreads well (Cejp 1948). On neglected walls the community usually persists for a long time. In Slovakia, the species *Pseudofumaria lutea* was found in the cities of Banská Štiavnica, Kremnica and Revúca (Slezák et al. 2011), but also in Zvolen and Ružomberok (Letz et al. 2013). In Southern and Southwestern Europe, rarely also in Central and Western Europe, this taxon is sometimes replaced by the related species *Pseudofumaria ochroleuca*.

The index of anthropophytisation is slightly lower with approximate value Ia = 21.4% (9.3–41.6). The association occurs on stony, sunny, mostly south-facing walls. It was found in two cities at an altitude of 555–601 m.

Chelidonium majus community

This is an extremely nitrophilous and only negatively differentiated community. The floristic composition is heterogeneous, prevailingly of nitrophytes such as *Chelidonium majus*, *Urtica dioica*, *Taraxacum* sect. *Ruderalia*, *Artemisia vulgaris*, *Sonchus arvensis* (Figure 4). Although similar vegetation has been documented from the whole of Central Europe, nobody has proposed that it

Figure 4: *Chelidonium majus* community, Banská Štiavnica city, corner of Katova and Novozámocká Streets, photo M. Valachovič.
Slika 4: Združba z vrsto *Chelidonium majus*, Banská Štiavnica, križišče ulic Katova in Novozámocká, foto M. Valachovič.

should have the status of association. A high occurrence of accessory species does not allow us to propose this community as a serious association. Many of the species are typical anthropophytes, therefore the approximate Ia is 22.2%. The number of species in the community is highly variable: in our relevés it varies between 5 and 18 species (in average 13.5). The coverage of the herb layer ranges from 5 to 65% (in average 30.9%) and the moss layer from 0 to 25% (in average 6.1% only). It was found in three cities at altitudes of 233–650 m.

This community is very abundant in Central Europe, but it is highly variable and in surveys of wall communities is usually overlooked. It represents a community which with successional changes in relation to increasing nitrate content will constitute one of the most common communities of Central Europe. Towards the south of Europe, however, it wanes and is replaced by more thermophilous and xerophilous communities.

Asplenietum rutae-murarie-trichomanis Kuhn 1937

This is a community of rock crevices and walls rich in calcium carbonate. The number of species is moderately abundant with large numbers of accessory species and high variability. The coverage of the stands is usually not high (Figure 5). The primary community is linked to the natural habitat of carbonate rocks and secondary stands on walls are characterized by a high occurrence of nitrophilous species, most of which are missing from the rocks. Homotoneity of the stands depends on the age of the walls or species population. The number of species varies between 2 to 26 per relevé (in average 13.4). The cover of the herb layer varies between 5 to 55%, in average 18.9%. The moss layer is developed with coverage up to 70% (in average 19.5%), or absent. Only rarely was a shrub layer found in the visited localities (coverage 0–5%, in average <1%) but seedlings of trees and shrubs do occur regularly.

This community occurs with varying frequency across Europe on rocky habitats, often as accompanying vegetation on old walls, stone bridges, castles, etc. In Slovakia the association is common both in natural situations and in alternative habitats. Except for alpine locations it is rather frequent, but its optimum is known primarily from warmer areas such as the warmer regions of Slovakia, Bohemia, Moravia, Austria, Germany and other neighbouring countries in Central, Western and Southern Europe. This community was synthesized for the whole territory of Slovakia by Valachovič (1995).

Figure 5: *Asplenietum rutae-murariae-trichomanis*, Kremnica city, Štefanikovo Square, photo M. Valachovič.
Slika 5: *Asplenietum rutae-murariae-trichomanis*, Kremnica, Trg Štefanikovo, foto M. Valachovič.

In accordance of expectation the index of anthropophytisation is low, only 2.6% (0–6.7). The association was found in the area in altitudes 344–725 m in three cities.

4. DISCUSSION

Plant communities specific to wall biotopes are typically monocoenotic, usually with one dominant taxon. Especially in anthropogenic stands, e.g. walls in towns, there is also typically a high abundance of nitrophytes, including vascular plants but also bryophytes. All our localities are situated in a neovolcanic region (Štiavnické vrchy Mts, Pohronský Inovec Mts), where andesitic rocks are the general building material for walls. The reaction of the substratum where lime mortar is present in crevices is slightly higher, optimal for majority of recorded plants. There are no explicit acidophytes.

On the DCA graph (Figure 6) the relevés are concentrated in the central part. Only the data from the association *Cymbalarietum muralis* are optimally clustered, with the other communities more or less mixed. This fact is explained by the small differences in species content in a very uniform habitat, similar petrology, altitude, and generally similar environmental conditions operating throughout. Some outliers are caused by a small species pool, or by random dominance of one taxon, e.g. *Sedum spurium* in relevé 34. The structure and composition of the stands are dependent on the age of wall, the development of the dominant species *Cymbalaria muralis* and penetration of accessory species. With age, this simple vegetation is usually homogenized as is apparent from observation of structure and composition throughout Europe, even though the number of species may increase and species composition become stabilized. This finding is usually valid for other communities of walls as observation by the first author in the Czech Republic, Germany and Austria confirms.

From central European, authors, especially German investigators, have studied the vegetation walls though in recent decades, interest in wall vegetation has grown rapidly in other Central European countries. The following text provides most important views on the classification of vegetation in neighbouring countries.

Probably the first eight relevés of the association *Cymbalarietum muralis* from Pieštany, western Slovakia were provided by Mucina (1987) with the first contributions to the wall vegetation (*Cymbalarietum muralis*) from Bohemia originating from Kolbek & Kurková (1979). Homola (1990) published relevés from the city of Olomouc under the name *Cymbalarietum muralis* with the dominant species *Cymbalaria muralis*, *Corydalis lutea* and with the presence of *Antirrhinum majus*. Szczęśniak & Świerkosz (2003) published from Lower Silesia the association *Cymbalarietum muralis* divided into four new subassociations: *typicum*, *lycopetosum*, *poetosum nemoralis*, and *poetosum compressae*, reflecting a large area of study. Our small material does not allow such more detailed classification.

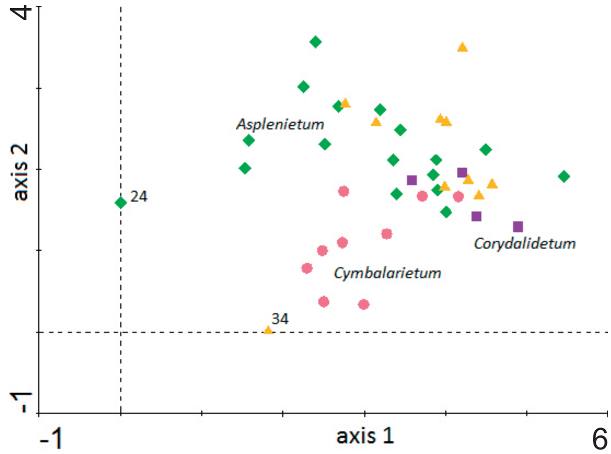

Figure 6: Relevé ordination (DCA) of the communites; *Cymbalarietum muralis* (circles), *Corydalidetum luteae* (squares), *Asplenietum rutae-murariae-trichomanis* (diamonds), and *Chelidonium majus* community (triangles).
Slika 6: Ordinacija (DCA) popisov združb: *Cymbalarietum muralis* (krožci), *Corydalidetum luteae* (kvadrati), *Asplenietum rutae-murariae-trichomanis* (diamanti) in združba z vrsto *Chelidonium majus* (trikotniki).

The association *Asplenietum rutae-murariae-trichomanis* has colonized in countries of Central Europe, primarily in crevices of lime or mineral-rich substrates, secondarily walls. From western Slovakia (village Smolenice) Eliáš (1985) describes this unit from the limestone walls near the castle and the church and classified five relevés in the subassociation *typicum*. Eliáš (1988) also provides one relevé of this association from the ruins of the Oponice Castle and Eliáš (1989) mentioned two relevés from the walls of Devín Castle near Bratislava. In the Czech Republic, this community is found more often on walls, because the calcium bearing rocks are relatively rare (Bohemian Karst, South Bohemian limestones, Moravian Karst). In comparison, this community is quite common in Slovakia, thanks to more frequent occurrence of basic substrates. Jehlík (1989) published the *Asplenietum trichomano-rutae-murariae* from Northern Bohemia, and one relevé is described as a transition stand to *Cymbalarietum muralis*. In the second article, Jehlík (2013) has described the *Asplenietum trichomano-rutae-murariae cymbalarietosum*.

The *Corydalidetum luteae* has been considered as an independent unit by a number of authors (Brandes 1987, Mucina 1993, Kolbek 2001). Some stands with both species *Cymbalaria muralis* and *Corydalis lutea* are classified in the *Cymbalarietum muralis* (Hilbig & Reichhoff 1977, Kolbek

& Kurková 1979, Homola 1990, Valachovič 1995), rarely in *Corydalidetum luteae*.

Mucina (1993) classified the wall communities of Austria in the *Asplenietea trichomanis* and the *Cymbalario-Asplenion* Segal 1969 em. Mucina 1993. Extensive work from the city of Wroclaw, Poland (Świerkosz 1993), treated the wall communities and provides a number of relevés of *Cymbalarietum muralis*, *Asplenietum trichomano-rutae-murariae* and the newly described unit *Tortulo-Cystopteridetum*. However, this last community missed the nomenclatural type relevé. Świerkosz (1994) also describes the last two associations from the Krkonoše (Giant Mountains) National Park. From the Protected Landscape Area Křivoklátsko (Central Bohemia), Kolbek (2001), among others, provides relevés of the new association *Asplenietum rutae-murariae-Gymnocarpietum robertiani* and a community with *Cystopteris fragilis*. Duchoslav (2002) classified 114 relevés of the vertical wall vegetation of Eastern Bohemia in nine communities and one association (*Asplenietum trichomano-rutae-murariae*). From 223 relevés in Central Moravia Procházková & Duchoslav (2004) distinguish 12 communities accompanied by a synthetic table. From South and West Moravia published Simonová (2008) a numerical processing of the 302 relevés from the walls. The results are divided into 10 groups, which are referred to as communities, though the numerical method ignored the sociological weight of any species. The compendium "Vegetation of the Czech Republic" (Chytrý 2009) publishes probably the most well-known synthesis from this area, but without phytocoenological relevés. In the survey of the plant communities of Hungary, Borhidi et al. (2012) give only two associations (without phytocoenological relevés or tables), namely, the *Asplenietum trichomanis-rutae-murariae* and *Cymbalarietum muralis,* but this is not the case in neighbouring countries. From Slovenia, Šilc & Čarni (2012) included four associations of walls in the order *Parietarietalia* and alliances *Cymbalario-Asplenion quadrivalentis* and *Parietario judaicae-Centranthion rubri*.

The role of bryophytes in wall plant communities

The problem of classification of the wall communities is not only their species-poor composition, but also the frequent absence of the moss layer in the published relevés. From the literature, it is not always clear whether they also contained mosses that were unrecorded, or whether the mosses were actually absent. The study of wall communities shows that the taxa of moss layer for the synthesis are not sufficient to use.

On our localities we collect 24 bryophytes, all common species without natural conservation importance. They were mostly mosses (22 taxa from *Bryophyta*), but we also found two foliose liverworts (*Marchantiophyta*), which mostly prefer moist habitats with permanently wet soil. From the mosses, there are 14 acrocarpic and 8 plerocarpic taxa – according to Duchoslav (2002), the first group is typical of vertical and steep walls, the second morphological type prefers horizontal and sloping ledges, where acrocarpic mosses are not competitive enough compared to vascular plants. Moreover, acrocarpic mosses form dense cushions on sunny surfaces, because they are more resistant to drying than vascular plants (Niemelä et al. 2011).

Rocky substrates, but also brick and concrete walls typify stands where the diversity of bryophytes is one of the highest, especially on slanting, slightly wet, and moderately shaded walls (Fudali 2000). That author indicates that the approximate number of bryophytes in Central European towns was around 30–40 species. Schaeppe (1986) found in Berlin a total of 92 taxa, and Brandes et al. (1998) recorded 41 taxa from the town of Braunschweig. This variety of species numbers was probably strongly influenced by the different ways of data collection. In this respect, only 17 species from Bratislava (Janovicová et al. 2003) is not significantly different. Also here nitrophilous, moderately basiphilous mosses with high hemeroby value predominate – *Barbula convoluta*, *Bryum caespiticium*, *Ceratodon purpureus*, *Hypnum cupressiforme*, *Schistidium apocarpum*, *Tortula muralis*, species more or less the same as we recorded in selected mining towns of Slovakia.

Generally, the most common species in Central Europe are *Encalypta streptocarpa*, *Homalothecium sericeum*, *Hypnum cupressiforme*, *Schistidium apocarpum* agg., *Tortula muralis*, and *Bryum caespiticium*. In our study *Encalypta streptocarpa*, *Bryum caespiticium* and 6 other species are present too. According to Brandes (1992) all these species are very common in plant communities of the class *Asplenietea trichomanis.* In particular, *Tortula muralis* should be the most frequent moss in the association *Cymbalarietum muralis* (cf. Duchoslav 2002). Its relation to nitrogen is also reflected in its common occurrence in the *Chelidonium majus-Sambucus nigra* community (cf. Simonová 2008). In our relevés *Tortula muralis* is very common in all recognized communities without clear preference to one association.

Rank of hemeroby of plant communites

The wall vegetation of Central Europe is characterized by a considerable degree of anthropic influence, like other synanthropic communities. If the habitats are old and the community on them exists without significant disturbance, the vegetation is fairly homogeneous. For very old undisturbed habitats without continuing human influence, the vegetation may be substantially homogeneous. In terms of adaptation, the prevalent species are short rather than tall, compact or tuberous. Significant numbers of small seeds permit successful colonization in these environmentally extreme habitats. Geophytes are almost absent. Tall species are rather rare or reaching up to the time of flowering and seed set (*Verbascum* sp. div.). Taller plants height inhabiting habitats allows heavier seeds larger dispersion and thus gets away from the parent plant. Species with leaf rosettes help protect against the loss of soil moisture in the immediate vicinity of the plant. Leaf area can be small or strongly concentrated, and in climatically unfavourable periods leaves may die or atrophy. The root system of persistent or perennial species is thick and penetrates the substrate deeply. Annual species are found especially in the spring when the substrate is generally more humid and insolation often reduced. Most wall substrates are poor in nutrients, though calcium carbonate content can be high. Some habitats of walls function as nitrophilous substrates and can be colonized by relevant species (*Geranium robertianum*, *Chelidonium majus*, *Urtica dioica*). This is the case of frequent central European communities dominated by *Chelidonium majus* described above.

With regard to the nature and value of habitat types, polyhemerobic species dominate, i.e. species inhabiting habitats created by human activity. Some species with broad ecological amplitude have adapted to life on the secondary habitat of walls, and colonized them as a replacement habitat (*Asplenium* sp. div.). These were originally ahemerobic types that have not been exposed to human influence. This is especially the case with species of rock crevices adapted to considerable differences in ecological conditions within a short time: the lack of soil substrate and nutrients, often dry in winter, the direct effect of frost without snow cover. The habitats of these communities are therefore substantially drier with good drainage and with variable, but rather low, nutrient content (Kolbek 1997). They show relations with plant communities of ruderal xeric habitats. In terms of urbanity there is a wide range of species from urbanoneutral over moderately urbanophilic to urbanophilic species (see e.g. Klotz & Kühn 2002). In evaluating species it is necessary to take into account the natural range of the species; outside of their natural range, many species chang their site requirements. A typical example is a fern *Ceterach officinarum* agg., which in its natural habitats in southern Europe and northern Africa occurs abundantly on dry rocks, oriented to the south with considerable desiccation. In its isolated locations in Central Europe, mostly poor populations, the bedrock avoids the southerly orientation and is often shaded.

In our relevés 7 mosses represent the hemeroby category of HB4 (transition between polyhemerobe and euhemerobe level, according to Düll 2010), where belong mosses growing on walls in the smaller towns, near less frequent communications. Next are seven species characteristic of category HB6 (transition between euhemerobe and mesohemerobe level), which is typical for old ruins, bridges and walls under lower anthropogenic influence.

When it comes to bryophyte sensitivity to the content of sulfur dioxide in the air the majority of mosses (19 taxa) can be classified in category of AP1–AP4 (Air purity/Air pollution classes, cf. Düll 2010), that means moderate sensitivity with maximum capacity 0.16 mg/m^3 SO_2. Only *Tortula muralis* or *Barbula convoluta* can grow under heavier air pollution. On the other hand, species, such as *Leucodon sciuroides, Porella platyphylla* and *Tortula virescens* are sensitive (category AP5–AP7, content of sulfur dioxide lower as 0.085 mg/m^3 SO_2).

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7. APPENDIX

Table head: Relevé number, Town abbreviation (B = Banská Štiavnica, K = Kremnica, N = Nová Baňa, and P = Pukanec), Locality, Latitude/Longitude, Aspect, Slope (degrees), Relevé area (m²), Altitude (m), Cover: shrub layer (%), Cover: herb layer (%), Cover: moss layer (%), Date.

1. B, Farská street, no. 3, 48°27'28,7"/18°53'52,5", SW, 90, 2, 580, 0, 10, <1, 28. 5. 2013;
2. B, Kamerhoffska str., opposite post office, 48°27'26,1"/18°54'01,3", SSW, 85, 12, 563, 0, 15, 0, 28. 5. 2013;
3. B, Záhradná str., wall of house, 48°27'27,3"/18°54'01,9", SE, 85, 4, 564, 0, 10, 0, 29. 5. 2013;
4. K, below city's castle, 48°42'29,3"/18°55'03,5", W, 85, 10, 576, 0, 40, 0, 31. 5. 2013;
5. K, below city's castle, disturbed wall, recently new, 48°42'20,5"/18°55'02,7", S, 80, 15, 579, 0, 35, <1, 31. 5. 2013;

6. K, below city's castle, 48°42'21,2"/18°55'04,3", SE, 85, 10, 584, 0, 5, 0, 31. 5. 2013;
7. K, city's castle, between castle walls, 48°42'21,3"/18°55'03,1", S, 90, 4, 592, 0, 45, 0, 31. 5. 2013;
8. K, Ján Kollár str., Famous noses courtyard, 48°42'18,4"/18°55'05,0", NE, 90, 4, 593, 0, 15, 2, 31. 5. 2013;
9. K, Štefánikovo nám. square, wall of house, 48°42'14,0"/18°55'06,1", S, 85, 16, 560, <5, 20, <5, 31. 5. 2013;
10. B, Dolná Ružová str., 48°27'32,9"/18°53'39,7", SE, 90, 6, 584, 0, 5, <1, 28. 5. 2013;
11. B, Katova str., 48°27'24,4"/18°53'49,1", NE, 90, 7, 601, 0, 60, 1, 29. 5. 2013;
12. B, Katova str., 48°27'24,5"/18°53'49,3", N, 90, 9, 601, 0, 50, <5, 29. 5. 2013;
13. K, Červená veža tower, outer wall, 48°42'14,3" /18°55'07,6", SE, 85, 6, 555, 0, 20, 0, 31. 5. 2013;
35. B, above Catholic cemetery, direction to Klinger, 48°27'19,7"/18°53'33,3", SE, 90, 12, 650, <5, 60, 20, 29. 5. 2013;
31. B, Starozámocká str., court, 48°27'37,4"/18°53'26,8", E, 95, 4, 297, 0, 55, 1, 28. 5. 2013;
32. B, stairs from Klopačka to pension Resl, 48°27'27,3"/18°53'34,3", E, 80, 14, 644, 0, 5, 1, 29. 5. 2013;
33. B, Novozámocká str., 48°27'25,0"/18°53'39,3", E, 80, 3, 649, 0, 40, 25, 29. 5. 2013;
36. B, A. Sládkovič str., 48°27'29,9"/18°53'29,5", NNE, 80, 21, 630, 0, 20, 5, 29. 5. 2013;
37. B, corner of Katova and Novozámocká streets, 48°27'23,5"/18°53'39,3", NE, 80, 10, 616, 0, 35, <5, 29. 5. 2013;
38. P, fortification under the church, 48°21'09,1"/18°43'22,8", E, 85, 24, 349, 0, 5, 1, 1. 6. 2013;
39. P, fortification under the church, 48°21'09,7"/18°43'22,4", S, 85, 16, 347, 0, 25, 5, 1. 6. 2013;
40. N, below Námestie slobody square, 48°25'28,1"/18°38'17,0", S, 90, 12, 240, 10, 15, <5, 1. 6. 2013;
41. N, below Námestie slobody square, 48°25'26,9"/18°38'19,6", S, 85, 20, 233, 0, 15, 1, 1. 6. 2013;
34. B, wall below New Castle, 48°27'19,9"/18°53'41,7", ESE, 85, 9, 637, 0, 65, 0, 29. 5. 2013.
15. B, Radničné square, below Immaculate statue, 48°27'31,6"/18°53'31,9", ESE, 90, 2, 636, 0, 10, 1, 29. 5. 2013;
17. B, Strieborná str., near the stairs, 48°27'27,2"/18°53'45,9", W, 90, 3, 582, 0, 15, 0, 29. 5. 2013;
18. B, Strieborná str., above pizzeria Kachelmann, 48°27'26,5"/18°53'48,1", N, 85, 15, 571, 0, 40, 10, 29. 5. 2013;
19. B, Kalvária, retaining wall path, 48°27'40,8"/18°54'49,5", SW, 80, 8, 691, 0, 15, 50, 30. 5. 2013;
20. B, Kalvária, retaining wall path, 48°27'41,8"/18°54'48,7", SW, 80, 3, 709, 0, 10, 70, 30. 5. 2013;
21. B, Kalvária, retaining wall of church, 48°27'41,6"/18°54'49,3", N, 80, 20, 725, 0, 5, 0, 30. 5. 2013;
22. K, P. Križku str., wall above stream, 48°42'08,5"/18°54'59,3", NW, 85, 15, 540, 0, 45, 40, 31. 5. 2013;
23. K, P. Križku str., wall above stream, 48°42'08,4"/18°54'59,3", NW, 85, 10, 540, 0, 55, 70, 31. 5. 2013;
24. K, opposite Jan Nepomucký statue, 48°42'18,6"/18°55'06,5", W, 90, 7, 545, 0, 10, <1, 31. 5. 2013;
25. K, Štefánikovo square, wall of house, 48°42'13,4"/18°55'06,9", S, 85, 24, 560, 0, 25, <5, 31. 5. 2013;
26. K, wall of regulated stream, 48°42'13,4"/18°55'05,4", ESE, 90, 6, 560, 0, 25, 5, 31. 5. 2013;
27. K, wall of regulated stream, 48°42'12,4"/18°55'05,0", W, 85, 3, 551, 0, 20, <5, 31. 5. 2013;
29. P, fortification under the church, 48°21'10,6"/18°43'23,0", NNE, 80, 24, 346, 0, 15, 25, 1. 6. 2013;
30. P, fortification under the church, 48°21'10,1"/18°43'15,4", NE, 85, 24, 344, 5, 20, 45, 1. 6. 2013;
14. B, wall of Jewish cemetery, 48°27'20,6"/18°53'52,1", NE, 90, 12, 632, 0, 5, 1, 29. 5. 2013;
16. B, Strieborná str., near retirement home, 48°27'27,0"/18°53'45,6", NNE, 90, 6, 571, 0, <5, 1, 29. 5. 2013;
28. P, wall of the Lutheran church, 48°21'10,1"/18°43'15,4", NNE, 85, 5, 357, 0, 3, <5, 1. 6. 2013;

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Table 1: Plant communities on walls in four mining towns. Synanthropic plants and invasive taxa are shown in bold. An asterisk indicates a taxon determinated on sub-species level.
Tabela 1: Rastlinske združbe na zidovih štirih rudarskih mest. Sinantropne in invazivne vrste so označene krepko. Zvezdica označuje podvrsto.

Relevé no.	1	2	3	4	5	6	7	8	9	10	11	12	13	35	31	32	33	36	37	38	39	40	41	34	15	17	18	19	20	21	22	23	24	25	26	27	29	30	14	16	28
Number of all taxa	8	4	5	3	9	4	2	9	18	10	5	5	2	18	12	10	18	14	17	10	14	17	14	5	7	2	20	21	16	7	25	16	4	17	23	7	18	6	26	6	7
Approximate value of Ia (%)	38.4									21.4				22.2											2.6																
<u>*Cymbalarietum muralis*</u>																																									
Cymbalaria muralis	2	2	2	3	3	2	3	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<u>*Corydalidetum luteae*</u>																																									
Pseudofumaria lutea	.	.	.	.	.	.	.	.	.	1	3	3	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<u>Community dominated by *Chelidonium majus*</u>																																									
Sonchus arvensis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	r	.	.	r	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r
Artemisia vulgaris	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	+	+	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	r	.	.	.
<u>*Asplenietum rutae-murariae-trichomanis*</u>																																									
Asplenium ruta-muraria	.	.	.	.	r	+	+	2	2	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	2	2	1	r	+	2	1	.	2	2	2	2	2	2	2	1	.
Cystopteris fragilis	.	.	.	.	.	.	.	r	1	r	.	.	.	.	3	2	.	.	.	.	.	.	.	.	r	.	+	2	1	.	+	.	.	1	+	.	.	.	r	.	.
Encalypta streptocarpa E0	.	.	.	.	.	.	.	+	+	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	2	.	1	.	2	2	.	1	1	.	.	.	+	.	2
Asplenium trichomanes	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	2	.	.	+	.	.	.	.	+	+	.	.	1
*Poa *nemoralis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	+	.	.	+	.	.	1	1	.	.	.
Homalothecium sericeum E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	2	.	3	4	.	.	1	.	2	3	.	.	.
Dryopteris filix-mas	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	r	.	.	.	.	.	.	1	.	r	2	.	.	.	.	.	.
Hypnum cupressiforme E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	1	.	.	.	.	1	.	.	.	.	.
Schistidium apocarpum E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	1	.	.	.	+	.	+	+	.	.	.
<u>Other taxa</u>																																									
Chelidonium majus	1	r	1	.	1	r	.	1	r	.	1	.	.	+	2	+	2	1	2	1	1	1	2	1	.	.	+	.	.	.	+	2	+	r	.	1	+	+	+	+	.
Tortula muralis E0	+	.	.	.	+	.	.	+	1	+	+	1	.	.	1	+	2	+	+	.	1	.	+	.	+	.	1	.	1	.	+	1	.	+	+	+	+	+	+	+	+
Taraxacum sect. *Ruderalia*	r	.	.	r	r	.	.	.	+	.	.	r	.	+	r	r	.	1	1	.	.	r	r	.	.	.	+	.	.	.	1	1	r	.	+	r	1	+	.	r	r
Arrhenatherum elatius	.	.	.	.	.	.	.	.	r	.	.	.	.	+	1	.	.	.	1	r	r	.	r	+	.	.	2	.	.	.	2	1	.	.	1	.	+	+	.	.	.
Urtica dioica	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	+	+	+	+	.	r	+	.	.	.	+	.	.	.	2	2	.	r	+	.	.	.	.	.	.
Poa compressa	.	.	.	.	.	.	.	.	+	.	.	r	.	.	.	+	r	1	1	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1	+	+	.	.	.	.
Campanula rapunculoides	.	1	.	.	.	.	.	.	r	r	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	1	.	.	.	2	.	.	.
Lamium purpureum	.	.	.	.	+	r	.	.	.	r	.	.	.	.	.	.	.	.	.	+	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	.	.
Bryum caespiticium E0	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	+	.	2	1	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Stellaria media	1	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1	.	.	.	.	.	.	r	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+
Epilobium montanum	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	r	.	.	+	.	.	.	.	.	.	.	r	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Galium aparine	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	r	.	.	.	.	.	.	.	.	r	.	.	r	.	.	.	.	.	.	.	.	.	.
*Cerastium *vulgare*	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Crepis biennis	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Sedum spurium	.	.	.	+	.	.	.	.	.	.	r	.	.	.	.	.	.	.	r	.	.	.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alliaria petiolata	.	.	.	.	.	.	.	.	r	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.
Dactylis glomerata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	.	.	.	.	r	.	r	.	.	.	.	.	.	.	.	.	.	.	.
Amblystegium serpens E0	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1	.	.	.	.	.	.	.
Geranium robertianum	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	r	.	.	r	.	.	.
Viola odorata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	+	.	.	.
Sagina procumbens	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.
Poa annua	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.
Rubus fruticosus agg.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
*Poa *rigidula*	.	.	.	.	.	.	.	.	1	.	.	.	.	1	.	.	.	2	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Achillea millefolium	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.

Relevé no.	1	2	3	4	5	6	7	8	9	10	11	12	13	35	31	32	33	36	37	38	39	40	41	34	15	17	18	19	20	21	22	23	24	25	26	27	29	30	14	16	28
Bryum capillare E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	+	.	.	.	.	.	.	.
Hylotelephium maximum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	r	.	.	.	.	.	.	.	.	.	.	.	.
Eupatorium cannabinum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	2	.	.	r	.	.	.	.	.	.
Hieracium murorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.
Anthriscus sylvestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	+	.	.	r	.	.	.
Barbula convoluta E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	2	+	.	.	.
Barbula unguiculata E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.
Orthotrichum anomalum E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Veronica hederifolia	.	.	.	.	.	.	.	.	.	r	.	.	.	+	.	.	.	.	.	1	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Elymus repens	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Lactuca serriola	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.
Brachythecium rutabulum E0	.	.	.	.	.	.	.	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Helianthus annuus	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.
Rumex scutatus	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glechoma hederacea	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Brachythecium populeum E0	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Festuca rubra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Leucodon sciuroides E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Grimmia pulvinata E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Arenaria serpyllifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Geranium pyrenaicum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Capsella bursa-pastoris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Ballota nigra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Setaria viridis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
*Leontodon *hispidus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	2	.	.	.
Porella platyphylla E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	3	.	.	.	.	.	.	.	.	.	.	.	.
Carpinus betulus juv.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.
Viola tricolor	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.
Hypericum perforatum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	r	.	.	.
Veronica chamaedrys	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.
Hieracium sabaudum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	+	.	.	.
Salix aurita juv.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	r	.	.	.	.	.	.
Marchantia polymorpha E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	1	.	.	.	.	.	.	.	.	.
Athyrium filix-femina	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	2	.	.	.	.	.	.	.	.	.
Sambucus nigra juv.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Betula pendula juv.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	+	.	.	.	.	.	.
Mycelis muralis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	+	.	.	.	.	.	.
Oxalis stricta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.
Bryoerythrophyllum recurvirostre E0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.
Galium album	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	1	.	.	.

Taxa in one relevé only: ***Convolvulus arvensis*** 5: +; *Aquilegia* sp. (hort.) 5: r; ***Veronica polita*** 5: r; *Rosa canina* agg. E_2 9: 1; ***Tanacetum vulgare*** 9: +; *Epilobium* sp. 9: r; ***Impatiens parviflora*** 35: 1; *Rosa canina* agg. E_2 35: 1; ***Allium scorodoprasum*** 35: +; *Brachythecium velutinum* E_0 35: +; *Ribes *grossularia* juv. 35: r; *Moehringia trinervia* 35: r; *Sedum sexangulare* 31: +; *Poa angustifolia* 31: +; *Brachythecium salebrosum* E_0 31: +; *Ribes aureum* juv. 31: r; *Viola reichenbachiana* 31: r; *Tortula ruralis* E_0 33: 1; *Chenopodium* sp. 33: +; *Cotoneaster horizontalis* juv. 33: r; *Epilobium obscurum* 36: +; ***Bromus sterilis*** 38: +; *Tortula virescens* E_0 38: +; ***Verbena officinalis*** 39: 2; ***Veronica persica*** 39: +; *Taxus baccata* juv. 39: +; *Medicago lupulina* 39: r; ***Silene noctiflora*** 39: r; *Betula pendula* E_2 40: 2; *Verbascum nigrum* 40: 1; ***Pyrethrum parthenium*** 40: +; ***Anagallis arvensis*** 40: r; *Calystegia sepium* 41: 1; ***Chenopodium album* agg.** 41: r; ***Conyza canadensis*** 41: r; *Triticum aestivum* 41: r; *Festuca* sp. 18: +; *Asplenium septentrionale* 19: +; ***Silene *alba*** 19: +; *Acer platanoides* juv. 19: r; *Allium vineale* 19: r; ***Cardaminopsis arenosa*** 19: r; *Galeopsis* sp. 19: r; *Allium schoenoprasum* 20: r; *Securigera varia* 20: r; *Festuca rupicola* 21: +; *Populus tremula* 21: +; *Arabis hirsuta* 21: r; *Corylus avellana* juv. 21: r; *Grimmia ovalis* E_0 22: +; ***Syringa vulgaris*** juv. 22: +; *Chrysosplenium alternifolium* 22: r; *Silene *vulgaris* 22: r; *Cerastium biebersteinii* 25: +; *Carduus personata* 26: r; *Salix caprea* juv. 26: r; *Senecio germanicus* 26: r; *Hedera helix* 29: +; *Didymodon rigidulus* E_0 29: +; *Cerastium *brachypetalum* 29: r; *Sambucus nigra* E_2 30: 2; *Rubus idaeus* 30: r; *Thuja orientalis* juv. 14: r.