

Bryophytes of the Special Areas of Conservation - Humenský Sokol and Brekovský hradný vrch (the Eastern Carpathians, Slovakia)

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Abstract: Despite the fact, that both Humenský Sokol and Brekovský hradný vrch are included in the Special Areas of Conservation, the bryophytes remain largely unknown. We examined the preference of bryophytes to forest floor, rocky substrate or tree bark in a forest ecosystem and to the secondary habitats of castle ruins. On Brekovský hradný vrch we recorded 47 species of bryophytes. From the bryological point of view, Humenský Sokol was more interesting, with 85 species of bryophytes recorded. Particular attention was paid to the red-listed species. We compare phytogeographical relations in both sites and analyzed the preference of areatypes to habitats. Presence of species of European importance has not been recorded.

Keywords: Bryophytes, Special Areas of Conservation, Eastern Carpathians, Slovakia.

Introduction

Brekovský hradný vrch and Humenský Sokol were included into a Special Areas of Conservation (SAC), defined in the European Union's Habitats Directive (92/43/EEC). The first bryofloristical records from the Eastern Carpathians came from CHYZER (1905), a physician and naturalist, born in Bardejov (1836-1909). He published 51 species of bryophytes from the vicinity of Snina, whereas there

were no records from Humenský Sokol and Brekovský hradný vrch. In the first half of the last century, the bryophytes of the Western Carpathians were studied by the amateur bryologist BAUER (1941). He was born in 1860 in the town of Písek and served as Secretary of the Prosecutor's Office in Prague before dying in 1942. Bauer collected bryophytes mainly in the Czech Republic, but also in Slovakia around Snina and Stakčín, though he did not work in our area of investigation. Specimens from Slovakia collected by Bauer are stored in the Herbarium of the Department of Botany, Charles University in Prague (PRC).

In the past, Brekovský hradný vrch and Humenský Sokol were only rarely visited by bryologists. PEČIAR (1970) only recorded three species from both the Humenský Sokol and Brekovský hradný vrch. DUDA & VÁŇA (1979) published the liverwort *Porella platyphylla* from the Humenský Sokol. So far, the most thorough inventory of identified species of the Humenský Sokol was by PUJMANOVÁ et al. (1990), totalling 19 species. In terms of ecology and vegetation, Humenský Sokol and Brekovský hradný vrch represent different habitats. The Brekovský hradný vrch forest canopy is dominated by hornbeam (*Carpinus betulus*), with a smaller population of oak (*Quercus petraea*), beech (*Fagus sylvatica*), scotch pine (*Pinus sylvestris*) and other trees. The eastern slopes are richly covered by shrubs like blackthorn (*Prunus spinosa*), wild privet (*Ligustrum vulgare*), dog rose (*Rosa canina*), common juniper (*Juniperus communis*), dogwoods (*Swida australis* and *Cornus mas*), european barberry (*Berberis vulgaris*), european spindle tree (*Euonymus europaeus*), buckthorns (*Rhamnus catharticus*) amongst others. Humenský Sokol is a rocky ridge, 405 m a.s.l. and the majority of the territory is represented by the communities of oak-beech forests dominated by beech (*Fagus sylvatica*), with hornbeam (*Carpinus betulus*) and scotch pine (*Pinus sylvestris*) commonly occurring, whereas oak (*Quercus pubescens*) is local in distribution.

Methods

Field work was carried out in July 14-15, 2014 and in September 3-4, 2014. The nomenclature of bryophytes follows KUČERA et al. (2012), or if not included there, HILL et al. (2006) was used; threat categories follow KUBINSKÁ et al. (2001). Phytogeographical analysis is based on the papers of DÜLL (1994a, 1994b) and DÜLL & MEINUNGER (1989). Geographical coordinates and altitude were recorded using the WGS 84 system, GPS GARMIN DACOTA 20. PCA was used to analyze areatypes in relation to principal habitats. Herbaria specimens are deposited in the Administration of Protected Landscape Area in Medzilaborce.

Results and discussion

Bryofloristical inventory

a) Brekovský hradný vrch (Appendix 1)

Forest ecosystems

Soil in the forest ecosystems, support the bryophytes *Metzgeria furcata*, *Atrichum undulatum*, *Barbula unguiculata*, *Eurhynchium angustirete*,

Oxyrrhynchium schleicheri, *Rhytidiadelphus squarrosus*, *Sciuro-hypnum reflexum*, *Sciuro-hypnum starkei*, *Oxyrrhynchium hians*, *Oxyrrhynchium speciosum*, *Plagiomnium cuspidatum*, *P. rostratum* and *P. undulatum*. Wet soil in the forest ecosystem support *Aulacomnium palustre*, *Bryum pseudotriquetrum* and *Kindbergia praelonga*. Rotting wood on the forest floor is occupied by *Amblystegium serpens*, *Brachytheciastrum velutinum*, *Plagiomnium rostratum*, *Pylaisia polyantha*, *Sciuro-hypnum reflexum* and on cut surfaces of stumps *Brachythecium salebrosum* frequently occurs.

Epiphytes

The bark of older trees in the forest ecosystem provides a habitat for *Metzgeria furcata*, *Alleniella complanata*, *Anomodon viticulosus*, *Brachythecium salebrosum*, *Bryum moravicum*, *Hypnum cupressiforme*, *Leskea polycarpa*, *Leucodon sciuroides*, *Pseudoamblystegium subtile*, *Pylaisia polyantha*, *Sanionia uncinata*, *Syntrichia ruralis* and *Syntrichia virescens*.

The limestone cliffs and rocky steppe

The Mesozoic rocks of the inner Carpathians provides a suitable substrate for calciphilous bryophytes.

On sunlit stones we have recorded *Abietinella abietina*, *Encalypta streptocarpa*, *Encalypta vulgaris*, *Grimmia orbicularis*, *G. pulvinata*, *Homalothecium philippeanum*, *H. sericeum*, *Leucodon sciuroides*, *Schistidium apocarpum*, *Syntrichia montana*, *Tortella inclinata* and *T. tortuosa*. On limestone detritus *Mannia fragrans* grows and on shaded limestone rocks grows *Alleniella complanata*, *Amblystegium serpens*, *Brachytheciastrum velutinum*, *Homomallium incurvatum*, *Hypnum cupressiforme*, *Plagiomnium rostratum*, *Sanionia uncinata* and *Thuidium recognitum* can be found.

Castle ruins

The dominating feature above the village of Brekov are the castle ruins, at the highest point in the territory at 280 m a.s.l. and habitat for species such as *Anomodon viticulosus*, *Bryum argenteum* and *Encalypta streptocarpa*.

Secondary habitats

On trampled or degraded sites *Bryum caespiticium*, *Ceratodon purpureus*, *Syntrichia ruralis* occur.

Grasslands complex

The access paths to the castle ruin are accompanied by grasslands dominated by fingered sedge (*Carex digitata*), sheep's fescue (*Festuca ovina*) and tor-grass (*Brachypodium pinnatum*). This habitat harbours species such as *Rhytidiadelphus squarrosus*, *Abietinella abietina* and *Sanionia uncinata*.

b) Humenský Sokol (Appendix 2)

Forest ecosystems

The soil in the forest provides a habitat for bryophytes such as *Atrichum undulatum*, *Brachythecium rutabulum*, *B. salebrosum*, *Dicranella heteromalla*, *Dicranum scoparium*, *Eurhynchium angustirete*, *Hylocomium splendens*, *Mnium stellare*, *Plagiomnium rostratum*, *Plagiothecium denticulatum*, *Pohlia nutans*,

Polytrichum formosum, *Rhytidiadelphus squarrosus*, *R. triquetrus*, *Sciuro-hypnum starkii* and *Taxiphyllum wissgrillii*. Where the ground is more moist *Marchantia polymorpha*, *Plagiochila porelloides*, *Aulacomnium palustre*, *Bryum pseudotriquetrum*, *Cratoneuron filicinum*, *Fissidens exilis*, *Kindbergia praelonga*, *Oxyrrhynchium hians*, *O. speciosum*, *Plagiomnium cuspidatum*, *P. undulatum*, *Plagiothecium nemorale*, *Polytrichum commune*, *Rhizomnium punctatum* and *Sciuro-hypnum plumosum* occur. On buttress roots *Dicranum montanum*, *Eurhynchium angustirete*, *Oxyrrhynchium hians*, *Sciuro-hypnum starkii* and *Taxiphyllum wissgrillii* can be found. Decaying wood in the forest ecosystem support *Blepharostoma trichophyllum*, *Chiloscyphus profundus*, *Amblystegium serpens*, *Climacium dendroides*, *Herzogiella seligeri*, *Plagiomnium rostratum*, *Plagiothecium denticulatum*, *Pohlia nutans*, *Tetraphis pellucida* and on stump surfaces *Blepharostoma trichophyllum*.



Fig. 1. The bark of older forest trees is a substrate for *Porella platyphylla*

Epiphytes

The bark of older forest trees is a substrate for species such as *Frullania dilatata*, *Chiloscyphus profundus*, *Metzgeria conjugata*, *M. furcata*, *Porella platyphylla* (Fig. 1), *Ptilidium pulcherrimum*, *Alleniella besseri*, *A. complanata*, *Anomodon attenuatus*, *A. viticulosus*, *Brachytheciastrum velutinum*, *Bryum capillare*, *Herzogiella seligeri*, *Homalia trichomanoides*, *Homalothecium*

sericeum, *Hypnum cupressiforme*, *Leskea polycarpa*, *Leucodon sciuroides*, *Orthotrichum pallens*, *Pseudoamblystegium subtile*, *Pterigynandrum filiforme*, *Pylaisia polyantha*, *Sanionia uncinata* and *Sciuro-hypnum populeum*.

The limestone cliffs and rocky steppe

On sunlit stones we have seen the species *Alleniella besseri*, *Anomodon viticulosus*, *Bryoerythrophyllum recurvirostrum*, *Ctenidium molluscum*, *Ditrichum flexicaule*, *Encalypta streptocarpa*, *Entodon concinnus*, *Grimmia orbicularis*, *G. pulvinata*, *Gymnostomum aeruginosum*, *Homalothecium philippeanum*, *Homalia trichomanoides*, *Homalothecium sericeum*, *Hypnum cupressiforme*, *Leucodon sciuroides*, *Orthotrichum cupulatum*, *Pseudoleskeella catenulata*, *Pterigynandrum filiforme*, *Schistidium apocarpum*, *Syntrichia montana*, *Tortella inclinata* and *T. tortuosa*. Limestone detritus support *Mannia fragrans*. On shaded limestone rocks *Lejeunea cavifolia*, *Metzgeria conjugata*, *Plagiochila porelloides*, *Alleniella complanata*, *Amblystegium serpens*, *Anomodon attenuatus*, *Brachythecium rutabulum*, *B. salebrosum*, *B. tommasinii*, *Brachytheciastrum velutinum*, *Cyrtomnium hymenophylloides*, *Exsertotheca crispa*, *Fissidens dubius*, *Hymenostylium recurvirostrum*, *Hypnum vaucheri*, *Isothecium alopecuroides*, *Mnium stellare*, *Sanionia uncinata*, *Sciuro-hypnum populeum*, *Syntrichia ruralis*, *Thuidium delicatulum* and *Thuidium recognitum* occur.

Secondary habitats

Old fireplaces, trampled or degraded sites have *Ditrichum heteromallum* and *Funaria hygrometrica*.

Species of European importance

A list of species of European interest is found under Annex 4, Directive 24/2003.

The species *Buxbaumia viridis* was recorded in Poloniny Mts, but only at altitudes above 550 m a.s.l. on decaying trunks of conifers (PLÁŠEK 2006; ŠOLTÉS & BURAL 2012); the occurrence in the studied sites was not expected. Potentially, *Dicranum viride* could be present as it has been recorded at three locations in Poloniny Mts as an epiphyte on the trunks of older deciduous trees (maple, birch) (PLÁŠEK 2006; ŠOLTÉS & BURAL 2012), but we have not seen the species in the studied area. Species of European importance do not occur in the studied area.

Redlisted species

a) Brekovský hradný vrch

Kindbergia praelonga (VU)

Syn. *Eurhynchium praelongum* (Hedw.) Schimp.

Shaded habitats, along streams, rare.

Recorded site: Nearby well, 48°54,064'; 21°50,139'; 175 m a.s.l., September 3 , 2014.

Grimmia orbicularis (VU)

On illuminated limestone rocks, scattered.

Recorded site: Below the castle, stones, 48°54,143'; 21°50,020'; 240 m a.s.l., September 3, 2014.

b) Humenský Sokol

Fissidens exilis (LR:nt)

Wet soil, rare.

Recorded site: Buttress roots *Acer campestre*, 48°54,457'; 21°55,820'; 218 m a.s.l., July 15, 2014.

Entodon concinnus (LR:nt)

Limestone rocks, limestone soil, scattered

Recorded sites:

Skalka, land register Chlmec, limestone, 48°53,466'; 21°56,028'; 270 m a.s.l., September 4, 2014.

Skalka, land register Chlmec, limestone, 48°53,477'; 21°56,082'; 260 m a.s.l., September 4, 2014.

Kindbergia praelonga (VU)

Syn. *Eurhynchium praelongum* (Hedw.) Schimp.

Shaded habitats, along streams, wet meadows, rarely.

Recorded site: Soil, 48°54,045'; 21°55,653'; 254 m a.s.l., July 15, 2014.

Grimmia orbicularis (VU)

Sunlit, particularly limestone rocks.

Recorded sites:

Skalka, land register Chlmec, limestone, 48°53,458'; 21°56,014'; 270 m a.s.l., September 4, 2014.

Skalka, land register Chlmec, limestone, 48°53,483'; 21°56,092'; 260 m a.s.l., September 4, 2014.

Cyrtomnium hymenophylloides (VU)

Limestone rocks, humus crevices, rare.

Recorded site: Dúpná jaskyňa cave, shaded rocks, 48°54,061'; 21°55,139'; 360 m a.s.l., September 4, 2014.

Phytogeographical analysis

Temperate arealtype is predominant within both examined areas. Nevertheless, this arealtype is dominant in the area of Brekovský hradný vrch (Tab. 1). This corresponds with the ecological conditions of the site, where eastern slopes are deforested and covered by warm limestone rocks. (Sub)boreal areal type is widespread in the Humenský Sokol site, where the canopy is created by oak-beech forests dominated by beech (*Fagus sylvatica*).

Tab. 1. Phytogeographical analysis, proportion of areatypes in the treated areas

Arealtype	Brekovský hradný vrch 47 species		Humenský Sokol 85 species	
	Absol. number	Percentage	Absol. number	Percentage
Temperate	25	53.2	37	43.5
(Sub)boreal	12	25.5	30	35.3
Subcontinental	3	6.4	6	7.1
Submediterranean	5	10.7	2	2.3
Suboceanic	1	2.1	7	8.2
Subarctic	1	2.1	2	2.4
Holarctic	0	0	1	1.2

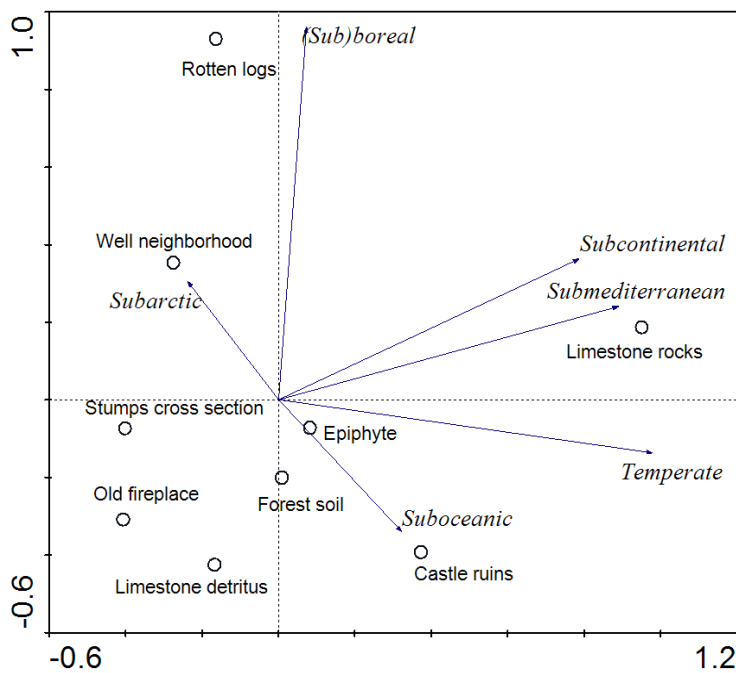


Fig. 2. PCA, preference of areatypes to habitats, Brekovský hradný vrch

Preference of areatypes to habitats is shown on Fig. 2 (Brekovský hradný vrch) and Fig. 3 (Humenský Sokol). Within the habitats of Brekovský hradný vrch, suboceanic species prefers the castle ruins e.g. *Thuidium recognitum*. Habitats of Humenský Sokol harbour wider ecological diversity of suboceanic species e.g. soils (*Entodon concinnus*, *Metzgeria conjugata*), rocks (*Thuidium*

recognitum), shaded rocks (*Lejeunea cavifolia*), along brooks (*Rhizomnium punctatum* and *Sciuro-hypnum plumosum*).

Submediterranean species in Brekovský hradný vrch are confined mainly to limestone rocks (e.g. *Grimmia orbicularis*, *Mannia fragrans*, *Syntrichia montana* and others), but also occur on soil in forest ecosystem (*Oxyrrhynchium schleicheri*), *Encalypta vulgaris* has been recorded in the castle ruins. In line with the dominant habitats, submediterranean species are rarely found in habitats of Humenský Sokol, which are restricted to limestone rocks (*Grimmia orbicularis* and *Mannia fragrans*).

Temperate species occupy the Brekovský hradný vrch in a variety of habitats, epiphytes (*Alleniella complanata*, *Bryum moravicum*), rotten wood (*Amblystegium serpens*, *Brachytheciastrum velutinum*), limestone (*Anomodon viticulosus*), castle ruins (*Bryum argenteum*), old fireplace (*Bryum caespiticium*) and wet soil (*Bryum pseudotriquetrum*) or drier soil (*Barbula unguiculata*, *Atrichum undulatum*, *Plagiomnium undulatum*). Similar habitats allow temperate species to grow on Humenský Sokol; rotten wood (*Amblystegium serpens*, *Brachythecium retabulum*, *Brachytheciastrum velutinum* and *Bryum capillare*), limestones (e.g. *Anomodon viticulosus*, *Ctenidium molluscum*, *Grimmia pulvinata*, *Plagiomnium rostratum* and *Syntrichia ruralis*), shaded cliffs (*Fissidens dubius*, *Exsertotheca crispa*, *Porella platyphylla*), soil (*Atrichum undulatum*, *Dicranella heteromalla*, *Thuidium delicatulum*), along brooks (*Bryum pseudotriquetrum*, *Cratoneuron filicinum*, *Marchantia polymorpha*), buttress roots (*Fissidens exilis*, *Oxyrrhynchium hians*, *Polytrichum formosum*), epiphytes (*Frullania dilatata*, *Homalia trichomanoides*, *Homalothecium sericeum*, *Hypnum cupressiforme*, *Leskea polycarpa*, *Leucodon sciuroides*, *Metzgeria furcata*, *Pterigynandrum filiforme* and *Sciuro-hypnum populeum*) and old fireplace (*Funaria hygrometrica*).

In both the special areas of conservation Brekovský hradný vrch and Humenský Sokol, subboreal species preferentially occupy rotten wood. In Brekovský hradný vrch, this habitat is occupied by *Plagiomnium cuspidatum*, whereas other habitats occupied by subboreal species are limestone (*Abietinella abietina*), epiphytes (*Pylaisia polyantha*), castle ruins (*Encalypta streptocarpa*, *Homomallium incurvatum*), soil (*Brachythecium salebrosum*, *Rhytidiadelphus squarrosus*). In the Humenský Sokol site subboreal species occur on rotten wood; *Blepharostoma trichophyllum*, *Chiloscyphus profundus*, *Climacium dendroides*, *Herzogiella seligeri* and *Plagiomnium cuspidatum*. Other habitats with recorded occurrence of subboreal species are sunlit limestone (*Encalypta streptocarpa*), shaded limestone (*Ditrichum flexicaule*, *Plagiochila porelloides*), soil (*Dicranum scoparium*, *Hylocomium splendens*, *Polytrichum commune*), epiphyte (*Pylaisia polyantha*), buttress roots (*Brachythecium salebrosum*, *Dicranum montanum*, *Plagiothecium denticulatum*, *Pohlia nutans*, *Rhytidiadelphus squarrosus*, *Rh. triquetrus*).

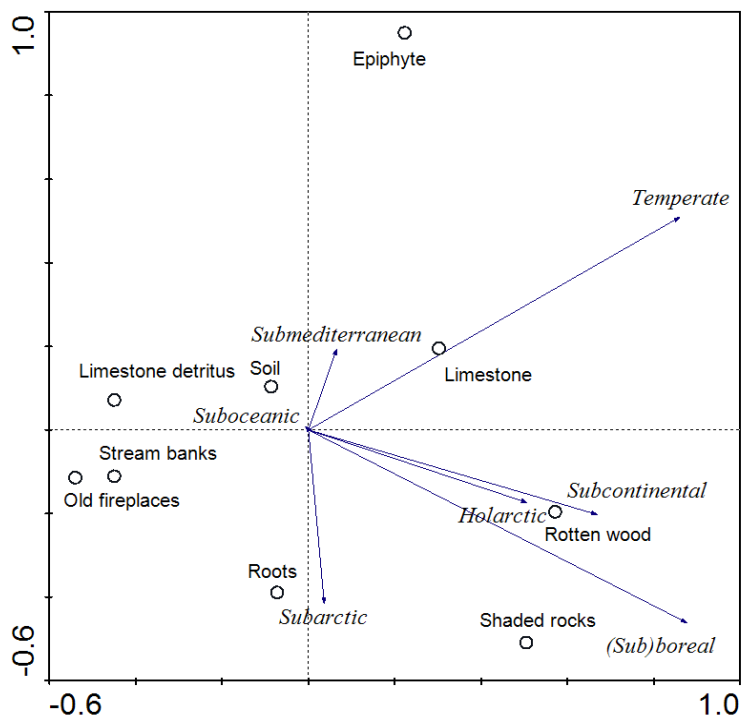


Fig. 3. PCA, preference of areatypes to habitats, Humenský Sokol

Different habitats allow subcontinental species on Brekovský hradný vrch such as; *Homalothecium philippeanum* (limestone) and, *Eurhynchium angustirete* (rotten wood). On Humenský Sokol, *Anomodon attenuatus* occurs on limestone *Eurhynchium angustirete* on rotten wood and *Alleniella bessereri* on shaded limestone rocks.

Subarctic areatype is represented only by *Cyrtomnium hymenophylloides* and *Kindbergia praelonga*. The species *Kindbergia praelonga* occurs in both Brekovský hradný vrch and Humenský Sokol. In Brekovský hradný vrch the species has been recorded in the humid forest ecosystem in the vicinity of a well at the altitude of 175 m a.s.l. (N 48°54.064'; E 21°50.139'). In Humenský Sokol, the species was recorded on wet soil at the altitude of 254 m a.s.l. The species *Cyrtomnium hymenophylloides* was found on shaded rocks in Dúpna jaskyňa cave in Humenský Sokol at the altitude of 360 m a.s.l.

Summary

On Brekovský hradný vrch, we recorded 47 species of bryophytes, of which only 2 species are liverworts and 45 moss species. Red-listed are *Eurhynchium praelongum* (VU) and *Grimmia orbicularis* (VU). A much richer assemblage of bryophytes is seen in Humenský Sokol. We noted here 85 species of bryophytes,

of which 11 species are liverworts and 74 moss species. Redlisted are *Fissidens exilis* (LR:nt), *Entodon concinnus* (LR:nt), *Kindbergia praelonga* (VU), *Grimmia orbicularis* (VU) and *Cyrtomnium hymenophylloides* (VU). Species of European importance have not been recorded. From the phytogeographical viewpoint we suppose that the temperate species prefer limestone substratum.

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Appendix 1. List of bryophytes recorded in the Special Area of Conservation Brekovský hradný vrch

Taxon	Frequency	Habitat	Source
<i>Abietinella abietina</i>	Scattered	Limestone bellow castle	Own collection
<i>Alleniella complanata</i>	Rarely	Epiphyte, <i>Crataegus</i>	Own collection
<i>Amblystegium serpens</i>	Scattered	Rotting wood	Own collection
<i>Anomodon viticulosus</i>	Common	Limestone, castle ruins	Own collection
<i>Atrichum undulatum</i>	Common	Forest floor	Own collection
<i>Aulacomnium palustre</i>	Rarely	Wet soil	Own collection
<i>Barbula unguiculata</i>	Scattered	Forest floor	Own collection
<i>Brachytheciastrum velutinum</i>	Common	Rotten logs	Own collection
<i>Brachythecium salebrosum</i>	Abundant	Stumps cut surfaces, forest floor, epiphyte	Own collection
<i>Bryum argenteum</i>	Scattered	Castle ruins	Own collection
<i>Bryum caespiticium</i>	Scattered	Old fireplace	Own collection
<i>Bryum moravicum</i>	Scattered	Epiphyte, <i>Crataegus</i>	Own collection
<i>Bryum pseudotriquetrum</i>	Scattered	Wet forest floor	Own collection
<i>Ceratodon purpureus</i>	Scattered	Castle ruins	Own collection
<i>Encalypta streptocarpa</i>	Scattered	Castle ruins	Own collection
<i>Encalypta vulgaris</i>	Scattered	Castle ruins	Own collection
<i>Eurhynchium angustirete</i>	Scattered	Rotten logs	Own collection
<i>Grimmia orbicularis</i>	Rarely	Limestone bellow castle	Own collection
<i>Grimmia pulvinata</i>	Rarely	Limestone detritus bellow castle	Own collection, Peciar (1970)
<i>Homalothecium philippeanum</i>	Abundant	Limestone, castle ruins	Own collection
<i>Homalothecium sericeum</i>	Scattered	Castle ruins	Own collection
<i>Homomallium incurvatum</i>	Scattered	Castle ruins	Own collection
<i>Hypnum cupressiforme</i>	Abundant	Stumps cut surfaces, limestones, epiphyte	Own collection
<i>Kindbergia praelonga</i>	Rarely	Wet soil	Own collection
<i>Leskea polycarpa</i>	Common	Epiphyte, <i>Crataegus</i> , <i>Acer campestre</i>	Own collection
<i>Leucodon sciuroides</i>	Common	Limestone bellow castle	Own collection
<i>Mannia fragrans</i>	Rarely	Limestone detritus bellow castle	Peciar (1970)
<i>Metzgeria furcata</i>	Rarely	Limestone detritus bellow castle	Own collection
<i>Oxyrrhynchium hians</i>	Scattered	Forest floor	Own collection
<i>Oxyrrhynchium schleicheri</i>	Scattered	Forest floor	Own collection
<i>Oxyrrhynchium speciosum</i>	Scattered	Forest floor	Own collection
<i>Plagiomnium cuspidatum</i>	Scattered	Rotten wood	Own collection
<i>Plagiomnium rostratum</i>	Scattered	Castle ruins, wet soil	Own collection
<i>Plagiomnium undulatum</i>	Scattered	Forest floor	Own collection
<i>Pseudoamblystegium subtile</i>	Rarely	Rotten wood	Own collection
<i>Pylaisia polyantha</i>	Common	Epiphyte, rotting wood	Own collection
<i>Rhytidiadelphus squarrosus</i>	Common	Wet soil	Own collection
<i>Sanionia uncinata</i>	Common	Rotten logs	Own collection
<i>Sciuro-hypnum reflexum</i>	Scattered	Rotten wood, forest floor	Own collection
<i>Sciuro-hypnum starkii</i>	Common	Rotten wood	Own collection
<i>Schistidium apocarpum</i>	Common	Limestone bellow castle	Own collection

Appendix 1. – cont.

Taxon	Frequency	Habitat	Source
<i>Syntrichia montana</i>	Scattered	Limestone bellow castle	Own collection
<i>Syntrichia ruralis</i>	Common	Limestone bellow castle	Own collection
<i>Syntrichia virescens</i>	Rarely	Castle ruins	Own collection
<i>Thuidium recognitum</i>	Scattered	Castle ruins	Own collection
<i>Tortella inclinata</i>	Scattered	Limestone detritus bellow castle	Peciar (1970)
<i>Tortella tortuosa</i>	Common	Limestone bellow castle	Own collection

Appendix 2. List of bryophytes recorded in the Special Area of Conservation Humenský Sokol

Taxon	Frequency	Habitat	Source
<i>Alleniella besseri</i>	Scattered	Shaded rocks	Pujmanová et al. (1990), own collection
<i>Alleniella complanata</i>	Rarely	Shaded rocks	Pujmanová et al. (1990)
<i>Amblystegium serpens</i>	Scattered	Rotting wood	own collection
<i>Anomodon attenuatus</i>	Common	Fallen logs, tree roots, tree stems, shaded rocks	Pujmanová et al. (1990), own collection
<i>Anomodon viticulosus</i>	Rarely	Shaded rocks	Pujmanová et al. (1990), own collection
<i>Atrichum undulatum</i>	Scattered	Forest floor	Own collection
<i>Aulacomnium palustre</i>	Scattered	Stream banks, wet soil	Own collection
<i>Blepharostoma trichophyllum</i>	Scattered	Rotting wood, limestone	Own collection
<i>Brachytheciastrum velutinum</i>	Scattered	Rotting wood, limestone	Pujmanová et al. (1990), own collection
<i>Brachythecium rutabulum</i>	Common	Forest floor, rotting wood	Own collection
<i>Brachythecium salebrosum</i>	Abundant	Forest floor, rotting wood, tree roots, tree stems, rocks	Own collection
<i>Brachythecium tommasinii</i>	Rarely	Shaded rocks	Own collection
<i>Bryoerythrophyllum recurvirostrum</i>	Rarely	Shaded rocks	Pujmanová et al. (1990)
<i>Bryum capillare</i>	Scattered	Rotting wood, tree stems	Own collection
<i>Bryum pseudotriquetrum</i>	Scattered	Stream bank, fallen logs	Own collection
<i>Climacium dendroides</i>	Scattered	Forest floor, rotting logs	Own collection
<i>Cratoneuron filicinum</i>	Scattered	Wet soil, stream banks	Own collection
<i>Ctenidium molluscum</i>	Common	Shaded rocks	Own collection
<i>Cyrtomnium hymenophylloides</i>	Rarely	Shaded rocks	Own collection
<i>Dicranella heteromalla</i>	Common	Forest floor	Own collection
<i>Dicranum montanum</i>	Common	Tree roots, base of trees, stems	Own collection
<i>Dicranum scoparium</i>	Abundant	Forest floor, rotting wood, tree roots, tree stems, rocks	Own collection
<i>Ditrichum flexicaule</i>	Common	Shaded rocks	Pujmanová et al. (1990), own collection
<i>Ditrichum heteromallum</i>	Common	Footpath edge, forest floor, tree roots	Own collection
<i>Encalypta streptocarpa</i>	Scattered	Limestone	Own collection
<i>Entodon concinnus</i>	Rarely	Limestone, calcareous soil	Own collection

Appendix 2. – cont.

Taxon	Frequency	Habitat	Source
<i>Eurhynchium angustirete</i>	Scattered	Forest floor, tree roots	Own collection
<i>Kindbergia praelonga</i>	Rarely	Forest floor	Own collection
<i>Exsertotheca crispa</i>	Scattered	Shaded rocks	Pujmanová et al. (1990), own collection
<i>Fissidens dubius</i>	Scattered	Shaded rocks	Pujmanová et al. (1990), own collection
<i>Fissidens exilis</i>	Rarely	Tree roots <i>Acer campestre</i>	Own collection
<i>Frullania dilatata</i>	Scattered	Epiphyte <i>Fagus sylvatica</i>	Own collection
<i>Funaria hygrometrica</i>	Rarely	Old fire places	Own collection
<i>Grimmia orbicularis</i>	Rarely	Limestone	Own collection
<i>Grimmia pulvinata</i> (Hedw.) Sm.	Rarely	Rocks	Pujmanová et al. (1990)
<i>Gymnostomum aeruginosum</i>	Rarely	Shaded rocks	Pujmanová et al. (1990), own collection
<i>Homalia trichomanoides</i>	Scattered	Epiphyte <i>Fagus sylvatica</i>	Own collection
<i>Homalothecium philippeanum</i>	Common	Limestone	Pujmanová et al. (1990), Own collection
<i>Homalothecium sericeum</i>	Scattered	Epiphyte <i>Cotoneaster</i>	Pujmanová et al. (1990), Own collection
<i>Hylocomium splendens</i>	Abundant	Forest floor	Own collection
<i>Hymenostylium recurvirostrum</i>	Scattered	Shaded rocks	Own collection
<i>Hypnum cupressiforme</i>	Abundant	Forest floor, limestones, rotting logs	Own collection
<i>Hypnum vaucheri</i>	Rarely	Shaded rocks	Own collection
<i>Chiloscyphus profundus</i>	Rarely	Rotten wood	Own collection
<i>Isothecium alopecuroides</i>	Scattered	Shaded rocks	Own collection
<i>Lejeunea cavifolia</i>	Rarely	Shaded rocks, epiphyte <i>Fagus sylvatica</i>	Own collection
<i>Leucodon sciuroides</i>	Scattered	Epiphyte <i>Fagus sylvatica</i>	Pujmanová et al. (1990), Own collection
<i>Mannia fragrans</i>	Rarely	Limestone detritus	Peciar (1970)
<i>Marchantia polymorpha</i>	Scattered	Stream bank, wet soil	Own collection
<i>Metzgeria conjugata</i>	Scattered	Soil	Own collection
<i>Metzgeria furcata</i>	Scattered	Epiphyte <i>Fagus sylvatica</i>	Own collection
<i>Mnium stellare</i>	Rarely	Shaded rocks	Own collection
<i>Orthotrichum cupulatum</i>	Scattered	Limestone	Pujmanová et al. (1990)
<i>Orthotrichum pallens</i>	Scattered	Tree bark	Pujmanová et al. (1990)
<i>Oxyrrhynchium hians</i>	Scattered	Tree roots <i>Acer campestre</i>	Own collection
<i>Oxyrrhynchium speciosum</i>	Scattered	Rotting wood	Own collection
<i>Plagiochila porelloides</i>	Scattered	Shaded rocks	Pujmanová et al. (1990), own collection
<i>Plagiomnium cuspidatum</i>	Scattered	rotting wood	Own collection
<i>Plagiomnium rostratum</i>	Scattered	Limestone, tree roots	Own collection
<i>Plagiomnium undulatum</i>	Common	Forest floor	Own collection
<i>Plagiothecium denticulatum</i>	Scattered	Tree roots	Own collection
<i>Plagiothecium nemorale</i>	Scattered	Forest floor	Own collection
<i>Pohlia nutans</i>	Common	Forest floor, tree roots	Own collection

Appendix 2. – cont.

Taxon	Frequency	Habitat	Source
<i>Polytrichum commune</i>	Common	Forest floor	Own collection
<i>Polytrichum formosum</i>	Common	Forest floor, tree roots	Own collection
<i>Porella platyphylla</i>	Abundant	Tree bases, limestone	Duda et Váňa (1979), Peciar (1970), Pujmanová et al. (1990), own collection
<i>Pseudoamblystegium subtile</i>	Rarely	Epiphyte <i>Fagus sylvatica</i>	Own collection
<i>Pseudoleskeella catenulata</i>	Scattered	Limestone	Own collection
<i>Pterigynandrum filiforme</i>	Scattered	Epiphyte <i>Fagus sylvatica</i>	Own collection
<i>Ptilidium pulcherrimum</i>	Scattered	Rotting wood	Own collection
<i>Pylaisia polyantha</i>	Scattered	Dry wood, epiphyte	Own collection
<i>Rhizomnium punctatum</i>	Scattered	Stream bank, wet soil	Own collection
<i>Rhytidiadelphus squarrosus</i>	Common	Forest floor, tree roots	Own collection
<i>Rhytidiadelphus triquetrus</i>	Common	Forest floor	Own collection
<i>Sanionia uncinata</i>	Common	Rotting wood, rocks	Own collection
<i>Sciuro-hypnum plumosum</i>	Rarely	Stream	Own collection
<i>Sciuro-hypnum populeum</i>	Rarely	Epiphyte <i>Fagus sylvatica</i>	Own collection
<i>Sciuro-hypnum starkii</i>	Scattered	Forest floor, fallen logs	Own collection
<i>Schistidium apocarpum</i>	Common	Limestone	Own collection
<i>Syntrichia ruralis</i>	Scattered	Limestone	Peciar (1970)
<i>Taxiphyllum wissgrillii</i>	Scattered	Shaded rocks	Pujmanová et al. (1990)
<i>Tetraphis pellucida</i>	Common	Rotting wood	Own collection
<i>Thuidium delicatulum</i>	Scattered	Soil	Own collection
<i>Thuidium recognitum</i>	Scattered	Soil	Own collection
<i>Tortella tortuosa</i>	Common	Limestone	Own collection

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