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Forest vegetation of the northern part of the Štiavnické vrchy Mts

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Abstract

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The article presents first results of vegetation research of the forest plant communities in the north part of the Štiavnické vrchy Mts. Research was carried out by traditional Zürich-Montpellier (Braun-Blanquet) approach during the vegetation period 2008. The data set of 21 original phytosociological relevés was sampled and analysed using numerical divisive classification (TWINSPAN) and detrended correspondence analysis (DCA). Five different communities within four alliances were distinguished and characterised – *Carici pilosae-Fagetum*, *Dentario bulbiferae-Fagetum, Mercuriali-Fraxinetum*, *Poo nemoralis-Quercetum petraeae* and *Luzulo albidae-Quercetum petraeae*. Information about their species composition and ecology is presented. The main ecological gradients responsible for the variability of the forest vegetation are light conditions, temperature and moisture with nutrients together.

Key words

classification, forest vegetation, gradient analysis, Štiavnické vrchy Mts

Introduction

In frame of the floristic region *Praecarpaticum*, the vegetation of the Štiavnické vrchy Mts has a special status. The localisation, geological substrate and soils, together with N-S aspect of this mountain unit provide a background for parallel occurrence of thermophilous – Pannonian as well as submountain – Carpathian species.The phytosociological research in forest communities of the Štiavnické vrchy Mts started in the 30s of the last century with publishing works discussing vegetation conditions of the massives Skalka, Anderloch (by Banský Studenec village) and surveys of forest vegetation of the Slovenské stredohorie Mts (Mikyška, 1929, 1930, 1937, 1939). A special care was devoted to the plant communities of the Sitno Mt, especially to its beech phytocoenosis (Mikyška, 1932). Forest communities of the SE promontories and foothills of the Štiavnické vrchy Mts were treated in Neuhäusl and Neuhäuslová-Novotná (1964) and Neuhäuslová-Novotná (1965). These works analysed floristic composition and soil conditions in selected syntaxonomical units in this area. Vegetation description of the Nature Reserve Holík with its forest stands can be found in Mikyška (1933) and David (1999). Several phytosociological relevés obtained on northern slopes of the Štiavnické vrchy Mts have also been published by Kontrišová (1980). The knowledge of ecology of forest stands in the NW part of the Štiavnické vrchy Mts has been contributed by Balkovič (2001) and Ciriaková and Hegedüšová-Kučerová (2003). This paper should contribute to better understanding of the forest communities in N part of the Protected Landscape Area (PLA) Štiavnické vrchy Mts, their species compositions, ecological links and distribution of the relevant syntaxa.

Material and methods

The Štiavnické vrchy Mts are a neovolcanic mountain unit situated in Central Slovakia (Fig 1). They mainly consist of pyroclastic rocks, primarily andesite (in NW part also ryolite) tuff agglomerates, in ridge zones also

Fig 1. Localisation of the Štiavnické vrchy Mts

andesites and ryolites. In surroundings of Sklené Teplice occur also carbonate rocks.

Futák (1984) classifies the Štiavnické vrchy Mts as belonging to the phytogeographical district Slovenské stredohorie Mts – in frame of which they have status of a separate sub-district.

The local forest communities were studied in field research running over the growing season 2008, to the north of the line connecting the villages Voznica, Svätý Anton and Babiná. Phytosociological relevés were recorded by implementing the generally used methods of the Zürich-Monpellier approach (Braun-Blanquet, 1964), with using the extended 9-point Braun-Blanquet scale for species abundance and dominance (Barkman et al., 1964). In Table 2, the degrees 2a and 2b are listed in shortened form (a, b). At first, the relevés were saved in database programme TURBOVEG (Hennekens and Schaminée, 2001), and then they were exported to the programme JUICE 6.5 (Tichý, 2002). The vegetation was classified with using the method for divisive polythetic classification TWINSPAN (Hill, 1979). The final form of this classification takes in consideration also the results of detrended correspondence analysis (DCA) which we used for analysing the principal gradients of variability in the species composition of the studied forest vegetation. The analysis ran in the programme Canoco for Windows (Ter Braak and Šmilauer, 2002). For interpreting the ordination axes in DCA, we provided with selected environmental factors (slope, altitude) and plant indicator values (calculated as weighted arithmetic mean for each relevé) sensu Ellenberg et al. (1992) as supplementary variables. Before the analysis, the data were subjected to logarithmic transformation. The phytosociological table presents the data for separate layers, ranked according to decreasing constancy. For each syntaxonomical unit, we distinguished diagnostic species (Moravec, 1994), constant (permanent in the given vegetation unit by >60%) and dominant species (reaching cover values 3–5 at least in one relevé). The diagnostic species were determined only based on our data set (Table 2).

The nomenclature of flowering plants follows Marhold and Hindák (1998). The names of syntaxa are according to Moravec et al. (2000) and Jarolímek et al. (2008), in case of the first appearance, the author's name and year of description are attached.

For determining altitude and geographical coordinates, we used a GPS appliance (Garmin GPSmap 60 CSx) working with an accuracy less than 15 m. In the following text, we use these abbreviations: ass. – association, c – constant species, dif. – differential species, dom. – dominant species, rel. – relevé. The subspecies (without the species name) are provided with asterisks (*).

Results and discussion

Survey of vegetation units

Five forest communities within four alliances were found out in northern part of the Štiavnické vrchy Mts.

Querco-Fagetea Br.-Bl. et Vlieger in Vlieger 1937
Fagetalia Pawlowski in Pawlowski et al. 1928
Tilio-Acerion Klika 1955
    Mercuriali-Fraxinetum (Klika 1942) Husová in Moravec et al. 1982
Fagion sylvaticae Luquet 1926
Eu-Fagenion Oberd. 1957 em. R. Tx. in Oberd. et R. Tx. 1958
    Carici pilosae-Fagetum Oberd. 1957
    Dentario bulbiferae-Fagetum Zlatník 1938

Pulsatillo-Pinetea sylvestris Oberd. 1992

Pulsatillo-Pinetalia Oberd. in Th. Müller 1966
Cytiso ruthenici-Pinion Krausch 1962
Poo nemoralis-Quercetum petraeae J. Michalko 1980

Quercetea robori-petraeae Br.-Bl. et R. Tx. ex Oberd. 1957
Quercetalia roboris R. Tx. 1931
Genisto germanicae-Quercion Neuhäusl et Neuhäuslová-Novotná 1967
Luzulo albidae-Quercetum petraeae Hilitzer 1932

Main environmental gradients

The first DCA ordination axis explains 18.6% of variability in the species data. Along this axis, the species are ordered from left to right, from shade-tolerating mesotrophic to heliophilous, hemioligotrophic ones (Fig 2). The spatial distribution of the relevés in the Štiavnické vrchy Mts in relation to the main environmental gradients is illustrated in Fig 3. The values of correlation between ordination scores of the relevés and of environmental variables (Table 1) show that the first DCA axis expresses the relation between the type of phytocoenosis and light together with temperature. Negative correlation was found for relation to soil moisture and nutrient content. From the cluster of more-hygrophilous beech phytocoenosis (ass. *Carici pilosae-Fagetum*, *Dentario bulbiferae-Fagetum*) and heminitrophilous debris phytocoenosis (ass. *Mercuriali-Fraxinetum*), the first axis separated cluster of more-drought-tolerating mesotrophic oak stands (ass. *Poo nemoralis-Quercetum petraeae*) and acidophilous oak stands (ass. *Luzulo albidae-Quercetum petraeae*).

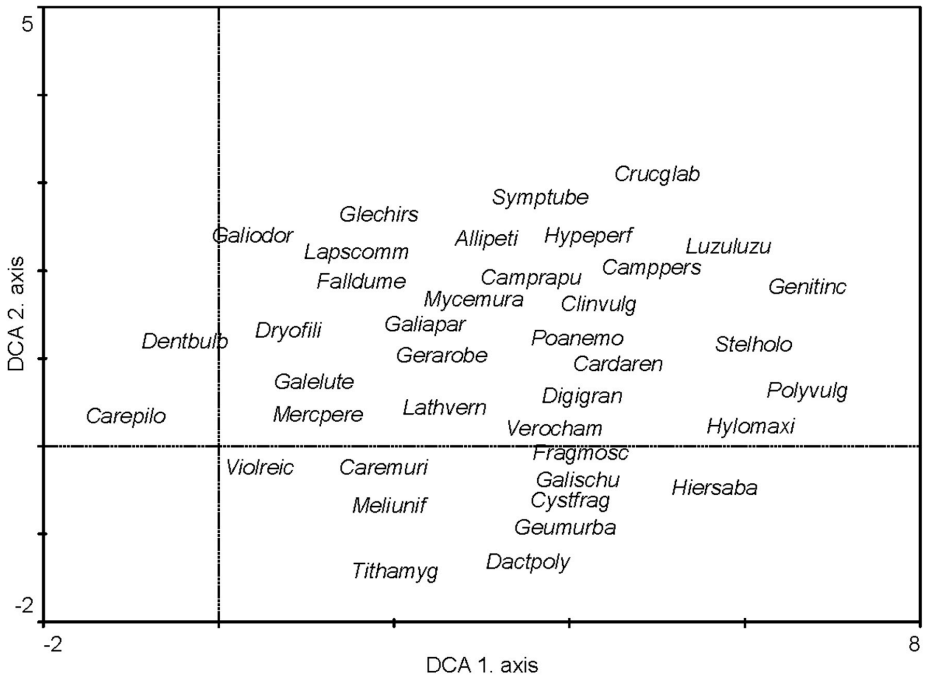

Fig 2. Detrended correspondence analysis (DCA) ordination diagram of the species. Eigenvalues: 1st axis 0.793; 2nd axis 0.240; Lengths of gradient: 1st axis 6.361; 2nd axis 1.978. Total inertia: 4.266
(Ordination scores of the species that occur at least in 4 relevés.)

Allipeti – Alliaria petiolata, *Camppers – Campanula persicifolia*, *Camprapu – Campanula rapunculoides*, *Cardaren – Cardaminopsis arenosa*, *Caremuri – Carex muricata*, *Carepilo – Carex pilosa*, *Clinvulg – Clinopodium vulgare*, *Crucglab – Cruciata glabra*, *Cystfrag – Cystopteris fragilis*, *Dactpoly – Dactylis polygama*, *Dentbulb – Dentaria bulbifera*, *Digigran – Digitalis grandiflora*, *Dryofili – Dryopteris filix-mas*, *Falldume – Fallopia dumetorum*, *Fragmosc – Fragaria moschata*, *Galelute – Galeobdolon luteum*, *Galiapar – Galium aparine*, *Galiodor – Galium odoratum*, *Galischu – Galium schultesii*, *Genitinc – Genista tinctoria*, *Gerarobe – Geranium robertianum*, *Geumurba – Geum urbanum*, *Glechirs – Glechoma hirsuta*, *Hiersaba – Hieracium sabaudum*, *Hylomaxi – Hylotelephium maximum*, *Hypeperf – Hypericum perforatum*, *Lapscomm – Lapsana communis*, *Lathvern – Lathyrus vernus*, *Luzuluzu – Luzula luzuloides*, *Meliunif – Melica uniflora*, *Mercpere – Mercurialis perennis*, *Mycemura – Mycelis muralis*, *Poanemo – Poa nemoralis*, *Polyvulg – Polypodium vulgare*, *Stelholo – Stellaria holostea*, *Symptube – Symphytum tuberosum*, *Tithamyg – Tithymalus amygdaloides*, *Verocham – Veronica chamaedrys*, *Violreic – Viola reichenbachiana*

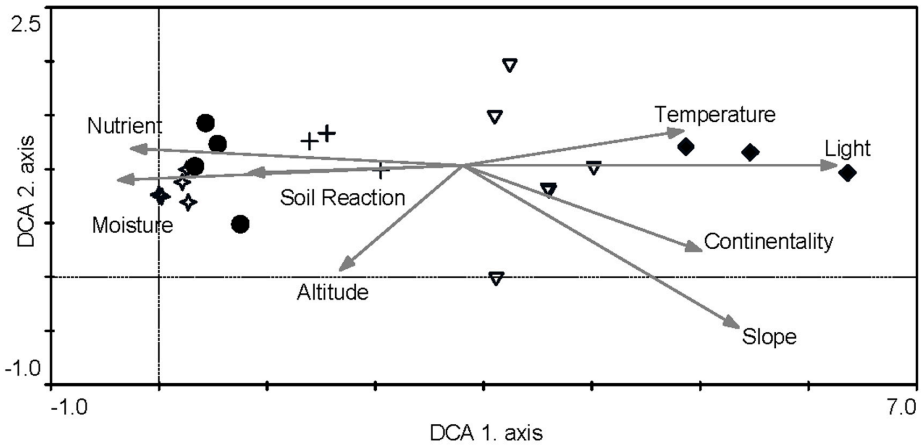

Fig 3. Detrended correspondence analysis (DCA) ordination diagram of 21 relevés of forest vegetation from Štiavnické vrchy Mts with Ellenberg indicator values, altitude and slope as supplementary environmental variables (✧ – *Carici pilosae-Fagetum*; ● – *Dentario bulbiferae-Fagetum*; + – *Mercuriali-Fraxinetum*; ▽ – *Poo nemoralis-Quercetum petraeae*; ◆ – *Luzulo albidae-Quercetum petraeae*)

Table 1. Spearman´s rank correlation matrix between environmental variables and ordination scores of plots for the first two DCA axis. Correlation significant on the level of $p < 0.05$ is in grey

Environmental variables	1st axis	2nd axis
Altitude	–0.3172	–0.2775
Slope	**0.6925**	–0.3517
Light	**0.9551**	0.0835
Temperature	**0.6815**	0.0983
Continentality	0.4857	–0.2519
Moisture	**–0.9087**	–0.0713
Soil Reaction	–0.5366	–0.0478
Nutrients	**–0.8403**	–0.0076

Characteristics of forest communities

Carici pilosae-Fagetum (Table 2, rel. 1–5)
Diagnostic species: *Carex pilosa* (c, dif., dom.), *Dentaria bulbifera* (c), *Fagus sylvatica* (E_3; c, dom., E_2; c), *Galium odoratum* (c).

This association, in general occurring on well developed modal cambisols, belongs to beech communities typical for the submountain vegetation belt. It is characterised by presence of the oceanic species *Fagus sylvatica* (E_3, E_2) as determining edificator species, and by species-poor, to some extent uniform, herbal understorey with dominant *Carex pilosa*. As the result, the overall physiognomy of herb layer looks typical grassy. The shrub layer has been developed in patches only, and it consists only of trees of the tree layer present in different developmental phases and exhibiting low cover. Species composition of the herb layer is supplemented with species occurring with higher frequencies – forest sciophytes *Dentaria bulbifera* and *Galium odoratum*, from the species tolerating strong shadowing, it is *Dryopteris filix-mas* and *Viola reichenbachiana*, from mesotrophic mesophytes, locally occur *Lathyrus vernus* and *Scrophularia nodosa*.

Phytocoenosis of this association have been developed on moderate slopes (5–15°), their foothills or flat ridge areas, situated at 510–770 m asl. In case when exposition is southern, however, these communities can descend down to the area of oak-hornbeam forests.

Dentario bulbiferae-Fagetum (Table 2, rel. 6–9)
Diagnostic species: *Dentaria bulbifera* (c), *Dryopteris filix-mas* (dif.), *Fagus sylvatica* (E_3; c, dom.), *Galium odoratum* (c).

These, floristically least differentiated community in the study area is characterised by a lower species diversity (on average 8 species in herb layer of a relevé), by dominance of *Fagus sylvatica*, and by simple vertical structure. The shrub layer is practically absent. The tree layer with low cover variability (90–95%) mainly consists of *Fagus sylvatica*, with isolated *Acer pseudoplatanus*, *Fraxinus excelsior* and *Picea abies*. In presence of very dense crown canopy, limited light supply and litter accumulation, the cover of herb layer in this community is low (20–30%), too. The herbal understorey shows a strongly dominant presence of heliophilous *Dentaria bulbifera*, primarily in spring. The species composition is supplemented by constant *Dryopteris filix-mas*, *Galium odoratum* and mesotrophic sciophyte *Mercurialis perennis*. The other diagnostic species for the alliance *Fagion sylvaticae* are lacking – with small exceptions.

The stands of this association meet their ecological distribution optimum on moderate (10–35°), mostly N-oriented slopes with colder and more humid microclimate. They have been developed on deep soils with high retention capacity, at altitudes 610–810 m.

Over the studied area, beech stands are relatively abundant primarily in case of north-oriented sites (Ciriaková and Hegedüšová-Kučerová, 2003). In submountain parts of volcanic mountains, presence of analogical communities (ass. *Carici pilosae-Fagetum* and *Dentario bulbiferae-Fagetum*) with similar structure and species composition is not a rarity. Their occurrence documented with phytosociological relevés has been reported from the Javorie Mts (Mikyška, 1939), S-E part of the Kremnické vrchy Mts (Kukla et al., 1998) and from the Cerová vrchovina Mts (Ujházy et al., 2004).

Mercuriali-Fraxinetum (Table 2, rel. 10–12)
Diagnostic species: *Acer platanoides* (E_3; c), *A. pseudoplatanus* (E_3; c), *Alliaria petiolata* (c, dif.), *Carpinus betulus* (E_3; c), *Cerasus avium* (E_3; c), *Dentaria bulbifera* (c), *Fagus sylvatica* (E_3; c, dom.), *Fallopia dumetorum* (c), *Fraxinus excelsior* (E_3; c, dom.), *Galeobdolon luteum* (c, dif.), *Galium aparine* (dif.), *G. odoratum* (c, dom.), *Geranium robertianum* (c, dif.), *Lilium martagon* (c), *Melica uniflora* (c), *Mercurialis perennis* (c, dif., dom.), *Mycelis muralis* (c), *Symphytum tuberosum* (c), *Viola reichenbachiana* (c).

This association represents edaphically and topographically conditioned heminitrophilous community, in most cases present in small-sized fragments in the beech forest belt. For the tree layer is characteristic a considerable species diversity. The edificator species is *Fraxinus excelsior*, in case of rel. 11 also with subdominant *Fagus sylvatica*; presence of *Acer platanoides* and *A. pseudoplatanus* is in general lower. *Cerasus avium*, *Quercus polycarpa* and *Ulmus glabra* occur with varying frequency and cover. Shrub layer is totally absent.

In the herb layer, *Mercurialis perennis*, associated with thin forests on skeletal and debris soils, is dominant with a high cover. Apart from subdominant species of the order *Fagetalia* and alliance *Fagion sylvaticae* (*Dentaria bulbifera* and *Galium odoratum*), there are also present *Campanula rapunculoides*, *Galium aparine* and *Geranium robertianum*. Typical feature of the herb layer is presence of heminitrophilous and nitrophilous species with wide temperature amplitude, indicating favourable humification (*Alliaria petiolata*, *Galeobdolon luteum* and *Glechoma hirsuta*). The moss layer is concentrated on rocks in the surface debris.

The community is associated with rough-rocky or bouldery slopes covered with debris, more rarely with ridge or sub-ridge bouldery localities on neutral, in-minerals-richer rocks. It has been developed on mineral-rich moderately humid soils, at altitudes from 530–870 m. Their relation to site exposition is indifferent.

As for floristic composition, the stands of the studied association are to some extent similar to phytocoenosis of the Biele Karpaty Mts (Fajmonová, 1984). The occurrence of debris phytocoenosis of the alliance *Tilio-Acerion* in the Štiavnické vrchy Mts has not been mentioned either by Balkovič (2001), or Ciriaková and Hegedüšová-Kučerová (2003).

Poo nemoralis-Quercetum petraeae
(Table 2, rel. 13–18)
Diagnostic species: *Campanula persicifolia* (c), *C. rapunculoides* (c, dif.), *Clinopodium vulgare* (c, dif.), *Carpinus betulus* (E_3; c), *Cruciata glabra* (c), *Dactylis polygama* (c, dif.), *Dentaria bulbifera* (c), *Digitalis grandiflora* (c), *Fragaria moschata* (c), *Galium schultesii* (c, dif.), *Geum urbanum* (c), *Hieracium sabaudum* (c), *Hypericum perforatum* (c, dif.), *Lathyrus vernus* (c), *Melica uniflora* (c), *Poa nemoralis* (c, dif., dom.), *Quercus polycarpa* (E_3; c, dom.), *Veronica chamaedrys* (c).

This community is the richest in species (22 to 41 species in the herb layer of a relevé), and in general it is characterised by *Quercus polycarpa* dominance in the tree and mesophilous *Poa nemoralis* dominance in the herb layer. In stands with lower cover variability (70–80%), apart from oak, *Carpinus betulus* occurs regularly, but with a low cover. In the sporadically developed shrub layer grow isolated trees of the natural regeneration or bushes of *Rosa* sp. (rel. 15 and 16). Species composition of the herb layer mainly consists of differential species (*Campanula rapunculoides*, *Clinopodium vulgare*, *Dactylis polygama*, *Galium schultesii*, *Hypericum perforatum*, *Poa nemoralis*), species belonging to the alliance *Carpinion betuli* (*Campanula persicifolia*, *Lathyrus vernus*, *Melica uniflora*) and contact communities of penetrating mesotrophic species of the order *Fagetalia* (*Dentaria bulbifera*, *Galium odoratum*).

Phytocoenosis of this association have colonised climax, moderately undulated parts of ridges at 380–775 m asl. They are associated with warmer and drier localities situated on shallower soils on moderate, mostly S-oriented slopes.

Floristic composition, including presence of acidophilous species (*Calmagrostis arundinacea*, *Luzula luzuloides*) and mesophilous taxons of the alliance *Carpinion betuli,* of these phytocoenosis in the Štiavnické vrchy Mts corresponds to an ass. *Poo nemoralis-Quercetum petraeae* in the Popradská basin described based of one relevé, by Michalko (1980). Analogous communities were also recorded in the Spišská basin Šmarda (1961) and in the Tríbeč Mts, Eliáš (1986). Stands with similar species composition are known under the name of *Querco petraeae-Carpinetum poetosum nemoralis* from surroundings of the town of Zvolen by Mikyška (1939), from the Vihorlat Mts by Michalko (1957), and from the territory of

the Štiavnické vrchy Mts by Balkovič (2001) and Ciriaková and Hegedüšová-Kučerová (2003). Relative communities: ass. *Poo nemoralis-Quercetum dalechampii* Šomšák et Háberová 1979 described in the Silická plateau show certain differences – for the last one is characteristic higher presence of oligotrophic (*Genista tinctoria*, *Veronica officinalis*) and thermophilous species (*Astragalus glycyphyllos*, *Galium verum*, *Lactuca quercina*, *Trifolium sarosiense*) (Šomšák and Háberová, 1979).

Luzulo albidae-Quercetum petraeae

(Table 2, rel. 19–21)

Diagnostic species: *Asplenium trichomanes* (c), *Avenella flexuosa* (c, dif.), *Calamagrostis arundinacea* (c, dif.), *Campanula persicifolia* (c), *Cardaminopsis arenosa* (c), *Dianthus carthusianorum* (c), *Fagus sylvatica* (E_3; c, E_2; c), *Galium odoratum* (c), *G. schultesii* (c), *Genista tinctoria* (c, dif.), *Hieracium sabaudum* (c), *H.* sp. (c), *Hylotelephium maximum* (c), *Hypericum perforatum* (c), *Lembotropis nigricans* (c, dif.), *Luzula luzuloides* (c, dom.), *Poa nemoralis* (c), *Polypodium vulgare* (c, dif.), *Quercus polycarpa* (E_3; c, dom., E_2; c), *Steris viscaria* (c, dif.), *Vaccinium myrtillus* (dif., dom.), *Veronica chamaedrys* (c).

This community, in which are present acidophilous species, has a simple vertical structure, and it is floristically poorer. In the tree layer is dominant *Quercus polycarpa*, in general with a low admixture of *Fagus sylvatica*. Phytocoenosis on steeper slopes have lower stocking, thinner crown canopy and smaller overall growth. Higher amounts of light penetrating through the stand have been reflected on higher cover values in the herb layer. Qualitatively poorer shrub layer lacks a conspicuous dominant species. Floristically composition of this association in the study area is relatively homogeneous. The main constituent of the herb layer is a group of acidophilous species *Luzula luzuloides*, *Hieracium sabaudum* and *Calamagrostis arundinacea*. Consequently, the overall physiognomy of this layer looks grassy. The species composition is completed with the alliance species *Avenella flexuosa*, *Genista tinctoria*, thermophilous *Lembotropis nigricans*, *Steris viscaria*, mesotrophic *Cardaminopsis arenosa* and *Galium schultesii*, tolerating more oligotrophic character of the site.

The area with this association is not large. The stands represent only small patches, primarily in ridge parts and in convex spots. The associations have been developed on shallow soils with minimum water retention capacity.

The community recorded in the N part of the Štiavnické vrchy Mts is floristically more similar to the ones recorded in East Slovakia by Jurko (1975). Comparing the species composition between them, we can see only a lower presence of *Vaccinium myrtillus* and absence of xerophilous *Festuca ovina*. In contrast to the relevés obtained in the Malé Karpaty Mts (Neuhäuslová-Novotná, 1970), higher floristic diversity as well as higher dominance of species belonging to the alliance *Carpinion betuli* in the herb layer is evident. The above mentioned deviations evidently result from the nature of site conditions of the community and from the size of the analysed data set (Slezák and Kukla, 2009).

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Table 2. Phytosociological table of forest communities in the north part of the Štiavnické vrchy Mts (*Cp-F – Carici pilosae-Fagetum*, *Db-F – Dentario bulbiferae-Fagetum*, *L-Q – Luzulo albidae-Quercetum petraeae*, *M-F – Mercuriali-Fraxinetum*, *Pn-Q – Poo nemoralis-Quercetum petraeae*)

Number of relevé:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Species in herb layer:	12	3	8	8	10	9	1	8	12	19	18	24	39	22	41	24	29	39	25	25	17
Community	*Cp-F*					*Db-F*				*M-F*			*Pn-Q*						*L-Q*		
Tree layer (E3)																					
Fagus sylvatica	4	5	5	5	5	5	5	5	5	.	3	b	+	.	.	.	r	.	+	1	.
Quercus polycarpa	.	a	.	r	.	.	.	.	.	.	.	a	4	4	4	4	4	4	4	4	4
Carpinus betulus	.	r	.	.	.	.	.	.	.	.	r	r	+	r	.	r	+	a	.	.	.
Fraxinus excelsior	.	.	.	.	.	.	.	.	1	4	3	4	.	.	.	.	.	.	.	.	.
Acer pseudoplatanus	.	.	.	.	.	.	.	.	1	1	.	+	.	.	.	.	.	.	.	.	.
Acer platanoides	.	.	.	.	.	.	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.

Table 2. Continued

Number of relevé:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Abies alba	.	.	1	.	.	r	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.
Quercus cerris	.	.	.	.	.	.	.	.	.	.	.	.	.	b	a	.	.	r	.	.	.
Ulmus glabra	.	.	.	.	.	.	.	.	r	1	.	.	.	.	.	.	.	.	.	.	.
Cerasus avium	.	.	.	.	.	.	.	.	.	r	.	r	.	.	.	.	.	.	.	.	.
Acer campestre	.	.	.	.	.	.	.	.	.	r	.	.	.	.	r	.	.	.	.	.	.
Tilia cordata	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	r	.
Shrub layer (E2)																					
Fagus sylvatica	1	.	1	1	r	.	.	.	a	.	.	.	r	.	.	.	.	.	r	1	.
Carpinus betulus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	1	.	.	.	.
Rosa sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.
Quercus polycarpa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	1
Herb layer (E1)																					
Diagnostic species																					
Carex pilosa	4	a	b	4	4	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.
Dryopteris filix-mas	.	.	r	.	+	r	.	+	+	+	.	.	r	r	.	.	.	.	.	.	r
Mercurialis perennis	.	.	.	.	+	.	.	r	1	b	b	3	r	.	+	.	.	.	.	.	.
Alliaria petiolata	.	.	.	.	.	.	.	.	.	a	1	+	r	.	+	r	+	1	.	.	.
Galium aparine	.	.	.	.	.	.	.	.	.	a	+	1	.	.	r	.	.	+	.	.	r
Geranium robertianum	r	.	.	.	.	.	.	.	.	+	.	r	.	.	.	.	+	r	.	.	.
Glechoma hirsuta	.	.	.	.	.	.	.	.	.	+	1	a	.	a	.	.	.	.	.	.	.
Galeobdolon luteum	.	.	.	.	.	.	.	.	.	r	a	+	+	.	.	.	.	.	.	.	.
Poa nemoralis	r	.	.	r	r	.	.	.	.	1	.	.	3	4	4	4	4	4	b	1	.
Hypericum perforatum	r	.	.	.	.	.	.	.	.	.	.	.	+	.	r	r	r	+	r	.	r
Campanula rapunculoides	.	.	.	.	.	.	.	.	.	.	a	.	+	1	1	+	+	1	.	.	.
Galium schultesii	.	.	.	.	.	.	.	.	.	.	.	.	1	1	b	1	1	1	+	1	.
Dactylis polygama	.	.	.	.	.	.	.	.	.	.	.	.	+	r	1	r	1	.	r	.	.
Clinopodium vulgare	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	.	.
Polypodium vulgare	.	.	.	.	.	.	.	.	.	r	.	.	+	.	.	.	.	.	+	a	1
Genista tinctoria	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	a	1
Steris viscaria	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	1	.
Lembotropis nigricans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	a	+
Calamagrostis arundinacea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	1	1	.
Avenella flexuosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	b
Vaccinium myrtillus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4
Genisto germanicae-Quercion, Quercetalia roboris																					
Luzula luzuloides	r	.	r	r	.	.	.	.	.	.	.	.	.	+	.	.	r	a	3	4	+
Hieracium sabaudum	.	.	.	.	.	.	.	.	.	.	.	.	r	r	+	+	.	.	1	+	.
Melampyrum pratense	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Carpinion betuli																					
Lathyrus vernus	.	.	.	+	.	.	.	r	.	.	r	.	r	.	+	+	+	+	.	r	.
Melica uniflora	.	.	.	.	r	.	.	.	.	a	.	1	1	+	1	+	+	r	.	.	.
Campanula persicifolia	.	.	.	.	.	.	.	.	.	.	.	.	1	+	r	+	.	+	+	r	r
Fallopia dumetorum	.	.	.	.	.	.	.	.	.	+	r	.	+	.	r	.	.	+	.	.	.
Stellaria holostea	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	1	+	r	.	.	1
Symphytum tuberosum	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	+	+	.	.	.
Melittis melissophyllum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	+	r	.	.	.
Fagion sylvaticae, Fagetalia																					
Dentaria bulbifera	1	b	a	+	a	b	b	b	a	a	a	a	+	+	1	.	.	1	.	.	.
Galium odoratum	1	r	+	1	b	1	.	1	+	.	3	3	.	1	r	.	.	1	+	r	.

Table 2. Continued

Number of relevé:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Viola reichenbachiana	+	.	+	.	.	.	.	r	+	r	.	r	.	.	.	.	.	r	.	.	.
Tithymalus amygdaloides	.	.	.	.	.	.	.	.	+	.	.	r	.	+	1	.	.	.	.	.	.
Pulmonaria obscura	r	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	r	.	.	.	.
Scrophularia nodosa	.	.	.	+	.	r	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Prenanthes purpurea	.	.	.	.	.	.	.	r	+	.	.	.	.	.	.	.	.	.	.	.	.
Lilium martagon	.	.	.	.	.	.	.	.	.	r	.	r	.	.	.	.	.	.	.	.	.
Campanula trachelium	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	r	.	.	.	.
Polygonatum multiflorum	.	.	.	.	.	.	.	.	.	.	.	+	r	.	.	.	.	.	.	.	.
Quercion confertae-cerris, Quercetalia pubescenti-petraeae																					
Hylotelephium maximum	.	.	.	.	.	.	.	.	.	r	.	.	+	.	.	.	.	.	+	r	+
Fragaria moschata	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	r	+	.	.	.	.
Astragalus glycyphyllos	.	.	.	.	.	.	.	.	.	.	.	.	r	+	r	.	.	.	.	.	.
Lathyrus niger	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	r	+	.	.	.
Pyrethrum corymbosum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	+	+	.	.
Securigera varia	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.
*Verbascum *austriacum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	r	.	.
Querco-Fagetea																					
Cruciata glabra	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	1	.	+	.
Mycelis muralis	.	.	.	.	.	.	.	.	.	.	r	r	.	.	.	.	r	r	.	.	.
Convallaria majalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	r	.
Bromus benekenii	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	.	.	.	.	.	.
Hedera helix	.	.	.	.	+	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.
Other species																					
Veronica chamaedrys	.	.	.	.	.	.	.	.	.	.	.	.	+	r	+	+	+	+	+	r	.
Lapsana communis	.	.	.	r	r	.	.	.	.	.	.	.	r	.	.	.	r	r	.	.	.
Digitalis grandiflora	.	.	.	.	.	.	.	.	.	.	.	r	a	+	+	.	+	+	.	.	r
Cardaminopsis arenosa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	r
Carex muricata	.	.	.	.	.	r	.	.	.	.	.	r	+	.	r	.	.	.	.	.	.
Cystopteris fragilis	.	.	.	.	.	.	.	.	.	r	.	.	r	.	r	.	+	.	.	.	.
Geum urbanum	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	r	r	.	.	.
Rubus hirtus	+	.	.	.	.	.	.	.	r	.	.	.	.	.	1	.	.	.	.	.	.
Dianthus carthusianorum	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	+	r	.
Asplenium trichomanes	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	+	r	.
Hieracium murorum	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	.	.	r	.	.
Veronica officinalis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	.	r	.
Epipactis helleborine	r	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.
Athyrium filix-femina	.	.	r	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Epilobium montanum	.	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Carex sylvatica	.	.	.	.	.	r	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.
Sanicula europaea	.	.	.	.	.	.	.	.	r	.	.	r	.	.	.	.	.	.	.	.	.
Heracleum sphondylium	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	r	.	.	.	.
Genista pilosa	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	+	.	.	.	.	.
Dalanum ladanum	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	.	.	.	.	.
Viola tricolor	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	r
Cephalanthera longifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	r	1	.	.	.	.	.	.
Vicia sepium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	.	.	.
Vicia hirsuta	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	r	.	.	.
Hieracium sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	r

Species present in one relevé only:
E_3: *Betula pendula* 6 (relevé): r; *Picea abie*s 6: 1; *Quercus dalechampii* 6: r; *Sorbus aucuparia* 20: r; *S. torminalis* 15: r; *Tilia platyphyllos* 10: 2.
E_2: *Abies alba* 21: +; *Acer platanoides* 1: r; *Cornus mas* 14: +; *Corylus avellana* 15: 1; *Crataegus laevigata* 15: 1; *C.* sp. 13: +; *Fraxinus excelsior* 19: r; *Picea abies* 20: 1; *Sorbus aucuparia* 21: +.
E_1: *Anthericum ramosum* 18: r; *Anthriscus cerefolium* 15: +; *Arctium sp.* 12: r; *Brachypodium pinnatum* 15: 1; *Cardamine impatiens* 16: r; *Carex montana* 18: +; *Cephalanthera damasonium* 6: r; *C. rubra* 11: r; *Chelidonium majus* 11: r; *Cirsium* sp. 13: r; *Clematis vitalba* 11: r; *Daphne mezereum* 1: r; *Dryopteris dilatata* 8: r; *Festuca heterophylla* 18: +; *F. pallens* 21: +; *Fragaria vesca* 18: +; *Galeopsis tetrahit* 20: r; *Galium glaucum* 19: r; *Impatiens noli-tangere* 10: r*; I. parviflora* 11: 1; *Isopyrum thalictroides* 12: +; *Linaria vulgaris* 13: r; *Melica nutans* 3: r; *Moehringia trinervia* 18: 1; *Myosotis arvensis* 15: r; *Origanum vulgare* 19: r; *Paris quadrifolia* 12: +; *Pimpinella saxifraga* 20: r; *Platanthera bifolia* 18: +; *Polygonatum odoratum* 10: +; *Primula veris* 13: r; *Pulmonaria officinalis* 13: r; *Senecio germanicus* 18: r; *Silene nutans* 20: r; *S. vulgaris* 18: r; *Stachys alpina* 12: r; *Tithymalus cyparissias* 19: 1; *T. epithymoides* 15: r; *Urtica dioica* 12: +; *Vincetoxicum hirundinaria* 15: r; *Viola collina* 14: +; *V. mirabilis* 15: 1.

The header data of relevés:
Relevé number, village (locality); altitude (m); aspect; slope (°); relevé area (m^2); cover of tree layer (E_3); cover of shrub layer (E_2); cover of herb layer (E_1); cover of mosses and lichens (E_0); longitude; latitude; date (day/month/year); author of the relevé (Ms – M. Slezák, Jk – J. Kukla).
1. Močiar (Štálová); 770 m; NW; 10°; 400; E_3 80%; E_2 5%; E1 80%; E0 0%; 18°56'51.1"; 48°31'36.2"; 29. 7. 2008; Ms.
2. Kozelník; 510 m; E-SE; 5°; 400; E_3 95%; E_2 0%; E_1 30%; E_0 0%; 18°59'88.6"; 48°31'51.9"; 6. 6. 2008; Ms, Jk.
3. Vyhne; 620 m; SE; 15°; 400; E_3 90%; E_2 5%; E_1 30%; E_0 0%; 18°50'27.5"; 48°29'92.5"; 3. 6. 2008; Ms, Jk.
4. Banská Belá (Veľký vrch); 660 m; NE; 10°; 400; E_3 85%; E_2 3%; E1 80%; E_0 0%; 18°57'98.4"; 48°27'86.5"; 8. 7. 2008. Ms.
5. Šášovské Podhradie (Suť); 695 m; NW; 15°; 400; E_3 90%; E_2 1%; E_1 90%; E_0 0%; 18°55'49.5"; 48°34'27.5"; 25. 6. 2008; Ms, Jk.
6. Kozelník; 625 m; N-NE; 15°; 400; E_3 95%; E_2 0%; E1 30%; E_0 0%; 18°58'68.3"; 48°31'29.2"; 6. 6. 2008; Ms, Jk.
7. Babiná (Holý vrch); 695 m; NW; 10°; 400; E_3 90%; E_2 0%; E_1 20%; E_0 0%; 19°01'90.9"; 48°26'84.9"; 11. 6. 2008; Ms, Jk.
8. Kozelník (Strela); 810 m; NW; 25°; 400; E_3 95%; E_2 0%; E_1 25%; E_0 0%; 18°59'72.0"; 48°29'02.9"; 9. 6. 2008; Ms, Jk.
9. Repište; 610 m; NW; 35°; 400; E_3 95%; E_2 10%; E_1 30%; E_0 0%; 18°51'92.0"; 48°30'32.1"; 5. 6. 2008; Ms, Jk.
10. Banský Studenec (Skalka); 870 m; E-NE; 25°; 400; E_3 85%; E_2 0%; E_1 75%; E_0 0%; 18°59'73.1"; 48°27'42.5"; 13. 6. 2008; Ms, Jk.
11. Repište; 530 m; SSW; 25°; 400; E_3 80%; E_2 0%; E_1 90%; E_0 0%; 18°51'98.2"; 48°30'83.7"; 5. 6. 2008; Ms, Jk.
12. Kozelník (Strela); 835 m; W; 10°; 400; E_3 90%; E_2 0%; E1 90%; E_0 0%; 18°59'72.7"; 48°28'90.8"; 9. 6. 2008; Ms, Jk.
13. Banská Belá (Vtáčnik); 775 m; S; 30°; 400; E_3 70%; E_2 3%; E_1 70%; E_0 0%; 18°57'95.2"; 48°28'99.2"; 10. 7. 2008; Ms.
14. Voznica; 380 m; SW; 25°; 400; E_3 80%; E_2 5%; E_1 80%; E_0 0%; 18°43'20.8"; 48°27'39.0"; 16. 6. 2008; Ms, Jk.
15. Kozelník; 695 m; SW; 30°; 400; E_3 70%; E_2 10%; E1 95%; E_0 0%; 18°58'47.6"; 48°31'08.6"; 6. 6. 2008; Ms, Jk.
16. Hronská Breznica (Kamenné); 470 m; S; 20°; 400; E_3 75%; E_2 3%; E_1 70%; E_0 0%; 18°59'30.1"; 48°33'31.2"; 22. 8. 2008; Ms.
17. Hronská Breznica; 610 m; W; 25°; 400; E_3 70%; E_2 3%; E_1 70%; E_0 0%; 19°01'02.3"; 48°33'11.0"; 6. 8. 2008; Ms.
18. Babiná (Holý vrch); 630 m; SW; 10°; 400; E_3 80%; E_2 0%; E_1 80%; E_0 0%; 19°01'65.6"; 48°27'20.5"; 11. 6. 2008; Ms, Jk.
19. Hronská Breznica (Kamenné); 440 m; SW; 25°; 400; E_3 70%; E_2 5%; E_1 70%; E_0 0%; 18°59'45.9"; 48°33'34.7"; 22. 8. 2008; Ms.
20. Kozelník; 490 m; NW; 40°; 400; E_3 70%; E_2 10%; E_1 85%; E_0 20%; 19°00'07.8"; 48°30'00.9"; 9. 6. 2008; Ms, Jk.
21. Vyhne (Jelenia Skala); 750 m; NW; 45°; 400; E_3 60%; E_2 5%; E_1 95%; E_0 50%; 18°49'49.0″; 48°29'46.7"; 10. 6. 2008; Ms, Jk.

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Lesná vegetácia severnej časti Štiavnických vrchov

Súhrn

Predkladaný príspevok sa venuje syntaxonómii lesných spoločenstiev severnej časti Štiavnických vrchov, dopĺňa údaje o rozšírení a druhovom zložení príslušných vegetačných jednotiek. Fytocenologický výskum realizovaný tradičnými metódami zürišsko-montpellierskej školy sa uskutočnil počas vegetačného obdobia roku 2008. Na vyhodnotenie snímkového materiálu sme využili metódu divíznej polytetickej klasifikácie TWINSPAN. Finálna podoba klasifikácie zohľadňuje aj výsledok nepriamej gradientovej analýzy (DCA). Pomocou Ellenbergových indikačných hodnôt boli zisťované hlavné faktory prostredia zodpovedné za variabilitu vo fytocenologických dátach.

Zaznamenali sme prítomnosť piatich lesných spoločenstiev – *Carici pilosae-Fagetum*, *Dentario bulbiferae-Fagetum*, *Mercuriali-Fraxinetum*, *Poo nemoralis-Quercetum petraeae* a *Luzulo albidae-Quercetum petraeae*. Hlavným gradientom prostredia sa ukázali byť svetelné a teplotné podmienky v kombinácii s vlhkosťou a obsahom živín.

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