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Phytocoenoses of pine forests in the central part of the Záhorská nížina Lowland

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Pine vegetation of eolian sandy substrates in the "Bor" complex (Záhorská nížina Lowland) has been studied in the paper. The authors recommend to clasiffy these forests within the association *Pyrolo-Pinetum* (Libb. 1933) Schmid 1936. It includes former syntaxonomical names *Hylocomio-Pinetum zahoricum* Ružička 1960, *Dicrano-Pinetum zahoricum* Ružička 1960, *Pino-Quercetum zahoricum* Ružička 1960 and *Pino-Quercetum* Krippel 1965 according to the author's opinion. Three subassociations (*typicum, callunetosum, dianthetosum serotini*) have been recognized.

Key words: pine forest vegetation, Záhorská nížina Lowland, syntaxonomy, *Pyrolo-Pinetum.*

Introduction

Pine forests of the Záhorská nížina Lowland, which are distributed on eolian sandy sediments, were the subject for several scientific studies in the last 50 years. Krippel & Ružička (1959) belong among the first ones who began to classify these forests. In addition to proofs about *Pinus sylvestris* inidigenousness in the region, these authors described several sites, which fulfill their idea about the natural character of pine-oak forests in the study area. It was Ružička (1960 a,b) who established the basic syntaxonomical frame of these coenoses. He proposed several associations (*Cladonio-Pinetum zahoricum, Dicrano-Pinetum zahoricum, Pino-Quercetum zahoricum, Molinio-Pinetum zahoricum*) on the relatively small area lying on the northern boundary of the lowland (Polesie Bory locality). As syntaxonomical names show, the author defined syntaxones by the designation "*zahoricum*" as a specific geographical variant. Krippel (1965) described same plant communities within the only association *Pino-Quercetum.*

The authors of this paper extended the basic phytocoenological research to the whole subdistrict "Bor" (Mazúr & Lukniš, 1980) of the Záhorská nížina Lowland. After processing the wide syntaxonomical material, we reached the conclusion that these phytocoenoses could be classified into widely understood association *Pyrolo umbellatae-Pinetum* (Libb. 1933) Schmid 1936 established much earlier.

On the base of original relevés, the contribution is aimed to extend and complete phytocoenological data on pine forests of central part of the Záhorská nížina lowland and to check their contemporary classification.

Study area

Phytocoenoses we are dealing with occur in the central part of the Záhorská nížina Lowland known as "Bor" (this name is probably derived from the frequent pine forest occurrence). Its forest area covers about 22 thousand hectares. The western boundary is formed by line Stupava – Šaštín-Stráže Villages, the northern one is created by the Myjava river alluvium. Podmalokarpatsk depresia Depression borders the study area from Malé Karpaty Mountains on the east. The soil substrate is especially built up by eolian sands silted up on the former terraces of the Morava River, or on the tertiary clays eventually. The modulation of siliceous sands into the system of sandy dunes began in the Pleistocene or earlier and continued after glacial period. The depth of these sandy dunes reaches 30 m in some places (Krippel, 1965). Continuous complex of eolian sands named "Bor" is typical by its wavy relief with numerous inter-dune depressions where the topsoil contacts the groundwater level. Specific hydro-hygrophilous vegetation, which is completely different from the pine forest communities developed on the coarse sandy sediments, grows in these relief depressions. This kind of vegetation is not included in the paper because of it was syntaxonomically studied by Šmarda (1951), Klika (1958), Krippel (1959, 1965), Šomšák (1959), Šomšák & Kubíček (2000) etc. earlier.

An altitude of the study area varies between 170 – 297 m a.s.l. The annual rainfall reaches 635 mm in average, 457 mm during the vegetation period. July is the month with the highest rainfall. The average annual temperature is 9.4 ℃, 14 ℃ during the vegetation period. The snow cover remains only a few days during the year. Podzols as well as Dystric Arenosols, in lower rate however, built up by mineral poor siliceous sands represent the most frequent soil types in the study area.

The above-mentioned extreme site conditions evoked the development of specific oak vegetation with high admixture of Scotch pine (*Pinus sylvestris*). The map of reconstructed natural vegetation (Michalko, 1986) shows (scale 1 : 100 000) oak forests of the alliance *Potentillo albae-Quercion* in the study area as well as acidophilous pine forests of the alliance *Dicrano-Pinion* – in the larger area however. The segments of oak forests on the eolian sandy sediments in the Záhorská nížina Lowland are nowadays proved by Šomšák & Kubíček (1994, 1995, 2000).

Scotch pine (*Pinus sylvestris*) is considered to be an indigenous tree species here. Krippel (1965) documents its continual occurrence since older Dryas. It grew together with the species of *Betula* genus and *Pinus mugo* at the beginning of the mentioned period and together with oak trees afterwards. Approximately 1400 years ago, Scotch pine began to prevail absolutely under effect of human attacks. Forestry management planted it on the whole scale of the sites with eolian sands. Individual oaks (*Quercus robur*, but mainly *Quercus petraea* agg.) with a sparse occurrence all over the Bor complex, which are over 300 – 400 years old, prove a continual presence of the natural pine-oak forests up to these days. This idea is supported by presence of several species of a herb layer as *Convallaria majalis, Polygonatum odoratum, Teucrium chamaedrys, Trifolium alpestre* etc. Voluntary planting of *Pinus sylvestris* on no-forested soils of the alliance *Corynephorion* in the last 300 – 400 years helped to its domination in the Bor complex as well as in the whole Záhorská nížina Lowland.

Methods

The study area was intentionally chosen to prove the existence of stands of the association *Pyrolo-Pinetum* (Libb. 1933) Schmidt 1936. The research includes only the sites of eolian sandy relief without a groundwater contact. It means that stands, where Scotch pine has been planted on the wet sites of former stands of the alliance *Alnion glutinosae* or relatively drier *Potentillo albae-Quercion* in the past, were intentionally omitted. Extremely dry sites belonging to non-forest vegetation of the alliance *Corynephorion* in the past were omitted as well. The lichens dominate in such secondary pine forests (*Cladonio-Pinetum zahoricum* Ružička 1960).

Sixty phytocoenological relevés were made in two years (2000, 2001) in the field and 56 of them are added into the phytocoenological table. These relevés were sampled wholly within 70 – 100 year old stands with the tree layer cover above 60%. The field analysis strictly followed the principles of the Zürich-Montpellier school. Species abundances were estimated by the combine Braun-Blanquet scale for abundance and dominance accompanied by the 5-degree scale for sociability. Manual table sorting was used to design the table.

Phytocoenological table (Tab. 2) respects the characteristic species combination (characteristic species and species with the constancy IV or V). Three subassociations as well as one variant are recognised on the base of differential species. The nomenclature of plant taxa is according to Marhold & Hindák (1998), soil types and subtypes are classified according to Kolektív (2000) in WRB terminology and their chemical properties are adopted from Kubešová (1998); Revalová (1998) and Trizuliaková (1999).

We used the numerical classification to compare and discuss the results of table synthesis of the Zürich-Montpellier school. Detrended Correspondence Analysis (DCA) by no-transformed matrix of phytocoenological relevés (excluding the tree and shrub layer) and symmetric scaling was used within the environment of the Canoco for Windows 4.0 program to analyze the primary inner variability within the table of relevés (ter Braak, 1988). The quadratic trend between axes was eliminated by way of the second polynomial detrending method. Such a method creates the assumption for numerical classification of vegetation known as ordination methods (Fig. 2). On the Fig. 3, species are plotted in their ecological optimum (weighted average) whereas they both (Figs 2 and 3) represent identical section of the ordination space. The affinity of phytocoenological relevés to light, temperature, soil acidity as well as to continentality of the environment was estimated for individual relevés by method of weighted average (BALKOVIČ, 2001) based on the ELLENBERG's ecological indicator values (ELLENBERG, 1992). Statistical significance of ecological factors was tested by the Monte Carlo permutation test at a significance level $\alpha = 0.05$ by 1999 iterations. Dendrogram similarity analysis is based on the Ward agglomeration method using Euclidian distance. Device GPS 13 XL was used to gain position data.

Syntaxonomical remarks

As mentioned above, the pine forests of the Záhorská nížina Lowland, especially the central part named "Bor", was classified by RUŽIČKA (1960a,b) as a specific geographical variant "*zahoricum*" for associations as *Cladonio-Pinetum, Dicrano-Pinetum, Pino-Quercetum* and *Molinio-Pinetum*. Soil-ecological conditions were considered to be the principal differential features by this author. The former sites of non-forest vegetation of the alliance *Corynephorion* gradually planted by Scotch pine (*Cladonio-Pinetum*) were also included among mentioned communities. On the other hand, also the authors agree with an opinion, that soils typical for the association *Molinio-Pinetum* indicate the former communities of the alliance *Alnion glutinosae* or suboceanic oak forests (*Querco-Betuletum*). Other two associations *Dicrano-Pinetum* and *Pino-Quercetum* should classify natural pine-oak forests and the forests exchanged by Scotch pine plantation. However, the author (RUŽIČKA, 1960a,b) missed their mutual floristic differentiation. Later, these forests were classified within the only association *Pino-Quercetum* with the subassociations*cladonietosum, festucetosum* and *hylocomietosum* by KRIPPEL (1965). Although this classification presents the author's proofs to the Scotch pine authenticity in this region, it does not respect older rules for the name validity of phytocoenological units (DAHL & HADAČ, 1941). It is necessary to mention, that the similar pine forests were described before from the other parts of Europe and they were originally named *Pyrolo-Pinetum* (LIBB. 1933) SCHMID 1936 in Germany or *Dicrano-Pinetum* in Poland and Hungary (KOBENDZA, 1930; PÓCS, 1958). The pine forest phytocoenoses of the Záhorská nížina Lowland may be included into these coenoses or they can by eventually floristically differed. Moreover, differential species of the geographical variant "*zahoricum*", which are mentioned by RUŽIČKA (1960b page 66), as *Pyrola rotundifolia, P. chlorantha, Chimaphila umbellata, Moneses uniflora* etc. represent a part of the pine forests of southern Germany for example – it concretely deals with the association *Pyrolo umbellatae-Pinetum* (LIBB. 1933) SCHMID 1936 (OBERDORFER et al. 1992. page 38 tab. 254). In term of priority, the name *Pyrolo umbellatae-Pinetum* (LIBB. 1933) SCHMID 1936 is the valid name in this case.

The secondary pine forests in the southern and southwestern part of the Záhorská nížina Lowland were described as *Pleurozio schreberi-Pinetum* (ŠOMŠÁKOVÁ, 1982). Based on the current state of knowledge, this association cannot be considered to be analogous to pine forests of the central part of this lowland (Bor complex) because of it is markedly surviving at the sites of oak-hornbeam forests (*Carpinion*). The name *Pleurozio schreberi-Pinetum* ass. cult. can be recommended for this association.

Pine forests on the sandy substrate described as *Peucedano-Pinetum* by MATUSZKIEWICZ (1962) from Poland have also some common signs with the initially described association *Pyrolo-Pinetum* (LIBB. 1933) SCHMID 1936. This is probably also the case, when geographically evoked aberrations gave the reason to create a new name. But there is necessary detailed comparison.

The floristic composition of pine forest communities of the study area (Bor in the Záhorská nížina Lowland) hint at their transitional position between subcontinental-continental conditions of Hungary and Ukraine (POCS, 1958; SOÓ, 1971) and suboceanic-oceanic conditions in Germany. The occurrence of such species as *Scorzonera purpurea, Festuca dominii* (= *Festuca vaginata* subsp. *dominii*), *Dianthus serotinus* proves this idea and there are *Lembotropis nigricans, Melampyrum subalpinum, Genista pilosa* etc. on the other hand. This opinion is supported also by the average ELLENBERG's econumber calculated for the continentality factor, which ranges between 4.84 and 4.96 for selected subassociations in this paper (Tab. 1). These values respond to the transition between suboceanic and subcontinental conditions of the environment (evaluation according ELLENBERG, 1979).

The differences after comparison with the syntaxonomical results of OBERDORFER (1992) seem to be such negligible, that we are allowed to classify the pine forests of dry siliceous sands in the Bor complex (Záhorská nížina Lowland) within the association *Pyrolo umbellatae-Pinetum* (LIBB. 1933) SCHMID 1936.

In our opinion, the classification of the association into higher syntaxonomical units, into the alliance especially, still remains as an unsolved problem. OBERDORFER (1992) considers this association to be a part of the alliance *Cytiso ruthenici-Pinion sylvestris* (KRAUCH, 1962) OBERD. 1983. As he presents (page 37), this alliance characterizes boreal-subcontinental conditions. However, the classification within the alliance *Pino-Quercion* MEDWECKA-KORNAŚ in MEDWECKA-KORNAŚ et al. 1959 seems to be more logical for suboceanic-subcontinental conditions in the Záhorská nížina Lowland as it is realized in the list of vegetation units in Slovakia (MUCINA & MAGLOCKÝ eds. et al., 1985) for the pine forests of the Z horie. This alliance is understood as a part of the order *Pino-Quercetalia* SOÓ 1962 and class *Quercetea robori-petraeae* BR.-BL. et TX. 1943 in mentioned list.

According to codification of the independent order and class for the communities of pine forests in the

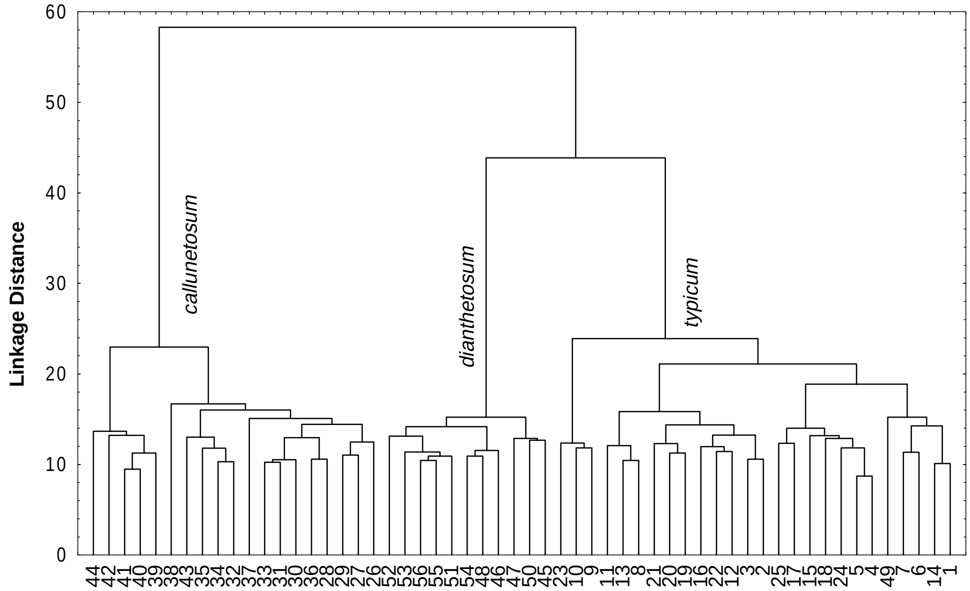

Fig. 1. Dendrogram of studied phytocoenoses(Ward's method, Euclidean distance, refer: Statistica '99).

xerothermous regions, we propose following classification:

association: *Pyrolo umbellatae-Pinetum* (LIBB. 1933) SCHMID 1936
subassociation: *typicum* subass. nova
callunetosum PHILIPPI 1970
dianthetosum serotini subass. nova
alliance: *Pino-Quercion* MEDW.-KORNAŚ in MEDW.-KORNAŚ et al. 1959
order: *Pulsatillo-Pinetalia* Oberd. in TH. MÜLLER 1966
class: *Pulsatillo-Pinetea* (SCHMID 1936, OBERD. 1967) OBERD. 1992

Results

Characteristics of the association *Pyrolo umbellatae-Pinetum* (LIBB. 1933) SCHMID 1936

Syn. *Hylocomio-Pinetum zahoricum* RUŽIČKA 1960, *Dicrano-Pinetum zahoricum* RUŽIČKA 1960, *Pino-Quercetum zahoricum* RUŽIČKA 1960, *Pino-Quercetum* KRIPPEL 1965

Characteristic species combination
Characteristic species: *Chimaphila umbellata, Carex ericetorum, Pulsatilla pratensis* subsp. *bohemica, Pyrola rotundifolia, Scorzonera purpurea*
Constant species: *Festuca ovina* agg. *Calamagrostis epigejos, Peucedanum oreoselinum, Tithymalus cyparissias*

Floristic and phytocoenological composition
Pinus sylvestris dominates in the tree layer of the association stands in the Bor complex. Its nearly absolute prevailing is a consequence of a longtime voluntary planting. Durmast oak (*Quercus petraea* agg.) is admixed somewhere in the form of 300–400 year old tree individuals. These leading trees are accompanied by *Frangula alnus* (abundant also in the herb layer) and *Carpinus betulus* in the shrub layer. *Frangula alnus* comes from more wet phytocoenoses of alder forests or oak forests.

Festuca ovina agg. is present in all the cases in the herb layer. The occurrence of *Calamagrostis epigejos* species is connected with the light conditions within the stands. It dominantly covers the topsoil especially in the phytocoenoses of cutting areas. *Peucedanum oreoselinum*, which is considered to be an association species, indicates higher and drying sandy sediments. *Pulsatilla pratensis subsp. bohemica* together with *Scorzonera purpurea* belong among extremely rare and endangered taxa in the study area. Nowadays way of long-area forest regeneration endangers their future existence. Other characteristic species (*Chimaphila umbellate, Pyrola rotundifolia*) are very sporadic in their occurrence and they dominate only in some unfrequented cases.

Podzols developed from the eolian siliceous sandy sediments represent the most frequent soil type. Dystric Arenosols are developed only sporadically. Following the chemical analyses of soil

Table 1. ELLENBERG's average ecological indicator values and their standard deviations (sd).

	Pyrolo-Pinetum					
Factor	*Typicum*		*callunetosum*		*dianthetosum*	
	average	Sd	average	sd	average	sd
Light	6.24	0.13	6.30	0.23	6.34	0.17
Temperature	3.79	0.23	3.70	0.2	3.72	0.37
Moisture	4.03	0.12	4.28	0.15	4.02	0.16
Soil reaction	3.84	0.42	3.45	0.46	4.04	0.31
Nitrogen	2.31	0.96	2.23	0.64	2.42	1.06

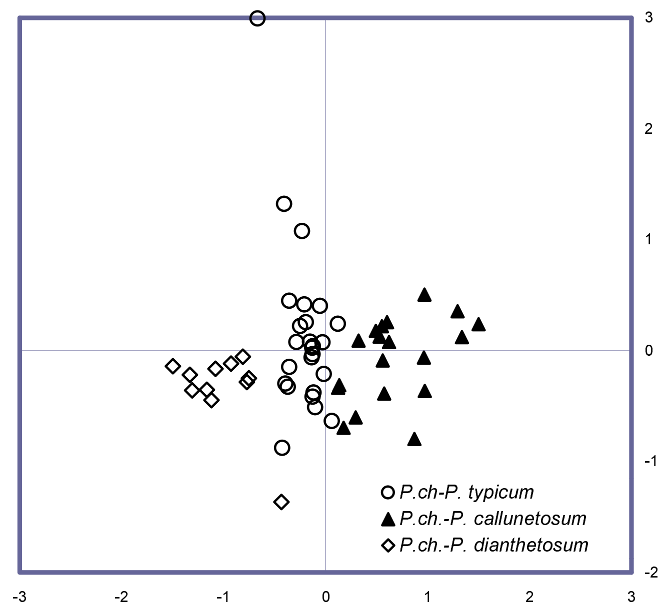

Fig. 2. DCA-analyses (relevés).

profiles in the study area (KUBEŠOVÁ, 1998; REVALOVÁ, 1998; TRIZULIAKOVÁ, 1999), we can say that these soils are very acid in soil reaction with pH values in the upper horizons ranging between 4.2 and 4.7 in H_2O and between 3.3–3.8 in KCl. Base saturation is very low. Nitrogen content is at about 0.09–0.10 %.

Differences in nanorelief of sandy dunes evoked some differences in the phytocoenological composition. We can classify several following subassociations in the study area therefore: *Pyrolo-Pinetum typicum* subass. nova, *Pyrolo-Pinetum callunetosum* PHILIPPI 1970, *Pyrolo-Pinetum dianthetosum serotini* subass. nova. These subassociations are validly differed by phytocoenological table (Tab. 2). In addition, Fig. 1 as well as Fig. 2 and 4 manifests that the used numerical classification method and ordination method fit the table results very well.

As for the requirements for the site conditions (expressed by ELLENBERG's ecological indicator values), this association can be marked as sciophilous-semisciophilous, suboceanic-subcontinental, acidophilous, slightly termophilous-psychrophilous, xerophilous-mesophilous and very poor to poor in soil nitrogen (notice Tab. 1).

Subassociation *Pyrolo-Pinetum typicum*

Neotype: relevé No. 4, Table 2.

It is a typical representant of the association. It spreads on the plane peaks of sandy dunes or on the plane relief of wider depres-

Table 2. Association *Pyrolo umbellatae-Pinetum sylvestris*

subassociation		*typicum*																								
variant																										
Relevé No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
E3 %		70	70	65	80	80	80	65	70	70	70	70	75	70	60	80	70	80	70	65	65	65	65	70	70	70
E2 %		1	1	15	10	1	1	5	1	15	30	20	20	–	–	1	–	20	20	1	1	–	–	35	25	15
E1 %		70	70	70	65	65	65	75	65	65	65	70	75	70	75	65	75	65	65	75	65	80	70	65	70	60
E_0%		80	65	75	75	75	75	80	85	90	75	90	95	90	90	–	70	65	95	95	90	90	85	70	70	85
Trees:																										
Pinus sylvestris	E3	5	5	4	5	5	5	3	4	4	4	4	5	4	3	5	4	5	4	3	3	3	3	4	4	4
	E2	.	.	.	.	.	+	12	.	.	.	.	.	.	+	.	.	21	.	.	.	.	.	.	.	r
	E1	.	r	+	+	.	.	r	.	.	.	.	12	r	+	+	.	+	.	.	+	.	.	+	.	11
Quercus petraea agg.	E3	.	.	.	.	.	.	r	.	.	.	.	.	.	+	.	.	.	r	.	.	.	.	.	.	.
	E2	.	.	.	.	.	.	+2	.	.	.	11	r	.	.	.	.	.	.	.	.	.	.	.	r	.
Frangula alnus	E2	.	.	+	r	.	+	+	.	.	.	.	.	.	.	r	.	+	21	.	.	.	.	.	.	r
	E1	.	.	11	+	+	.	.	.	.	+	.	.	.	.	+	r	11	r	.	.	.	.	.	r	+
Sorbus aucuparia	E2	.	.	.	.	.	.	.	.	21	21	.	.	.	.	.	.	.	11	.	.	.	.	32	11	.
	E1	.	+2	12	11	.	.	.	r	11	12	12	+2	.	.	+	.	r	.	r	.	.	.	21	11	11
Crataegus monogyna	E2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	E1	+2	.	.	.	.	.	.	.	.	.	r	.	.	r	.	r	.	.	r	r	.	r	.	.	+
Betula pendula	E1	.	.	r	.	.	.	.	r	r	+	r	.	r	.	.	.	.	r	.	.	.	.	+	.	.
Carpinus betulus	E1	.	r	.	.	.	.	.	.	r	r	.	.	.	.	r	.	.	r	r	.	.	.	.	r	+2
Characteristic species combination (species with constancy V, IV + characteristic species of																										
Festuca ovina agg.		22	32	32	22	22	12	22	22	22	32	32	22	32	32	22	32	32	32	22	22	22	32	22	32	12
Calamagrostis epigejos		32	12	+2	12	13	22	33	12	+	+	11	12	+	11	12	22	r	12	12	13	12	22	+2	11	12
Peucedanum oreoselinum		+2	21	21	r	+	.	.	.	.	.	.	+	.	.	r	11	.	.	11	11	21	.	.	r	.
Tithymalus cyparissias		+	r	+	+2	+	+	.	r	r	.	.	.	.	+	.	r	+	.	+	.	11	.	+	r	.
**Chimaphila umbellata*		.	.	.	12	.	+2	+2	.	r	.	.	.	.	.	21	.	+2	.	.	.	.	.	11	+2	.
**Carex ericetorum*		.	.	+	r	.	.	.	12	+2	.	r	.	.	.	.	.	r	.	+2	r	+2	.	.	.	12
**Pulsatilla * bohemica*		11	.	.	.	+2	.	.	.	.	.	.	r	r	r	.	r	.	r	r	.	.	.	.	.	.
**Pyrola rotundifolia*		.	.	.	.	r	+2	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
**Scorzonera purpurea*		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11	21	r	.	.	.
Differential species of the subassociations																										
Calluna vulgaris		.	.	+2	.	.	.	.	.	.	.	+2	+2	+2	.	.	.	.	.	r	r	.	+2	.	.	.
Lembotropis nigricans		+2	.	.	.	.	.	.	.	r	r	r	r	+2	.	.	.	.	+	+2	+2	.	.	.	.	.
Danthonia decumbens		.	12	12	+2	.	.	.	.	+2	+2	.	12	r	.	.	.	12	.	+2	+2	12	.	r	.	12
Polygonatum odoratum		r	.	.	.	.	.	.	.	.	.	r	12	.	.	.	.	.	.	.	.	.	.	.	.	.
Differential species of the variant with Daphne cneorum																										
Daphne cneorum		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Dianthus serotinus		.	.	.	+2	+2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Festuca dominii		+2	12	.	+2	.	+	.	.	.	.	.	.	.	+2	+2	.	.	.	+2	+2	+2	.	.	.	.
Thymus angustifolium		.	.	.	.	.	.	r	+2	12	.	.	.	.	+2	+2	.	12	+	r	+2	+2	.	+2	+2	.
Pilosella officinarum		.	.	.	.	.	.	.	.	r	.	.	.	.	.	12	.	.	.	.	.	.	.	+2	.	+2
Spergula morisonii		.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Silene nutans		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+2	+2	.	r	.	r	.	.	.	.
Other species:																										
Rubus fruticosus agg.		+2	r	12	.	.	.	.	r	r	+2	21	12	.	.	r	+2	+2	.	.	+2	.	12	11	.	+2
Hieracium murorum		.	r	.	+	.	.	.	+	r	+	.	.	.	r	.	11	12	11	r	.	.	r	+	12	+
Solidago virgaurea		.	.	.	+	r	.	.	.	r	.	r	.	.	.	+	.	r	+	+	+	.	.	.	r	r
Anthoxanthum odoratum		r	.	.	.	.	22	+	.	.	.	.	.	.	12	+	r	.	+	.	r	.	.	+2	+2	+
Fragaria vesca		+	.	.	.	.	12	.	+	+	+	.	.	r	+2	+2	r	+2	.	r	r	12	.	+	12	+
Acetosella vulgaris		+	r	r	.	.	+	.	.	r	r	.	.	12	12	.	.	.	.	+	.	r	r	.	.	+
Cerastium arvense		.	.	r	.	.	.	.	r	r	.	+	.	r	.	.	r	.	.	.	.	+	.	.	.	.

									callunetosum																*dianthetosum serotini*						constancy			
														with *Daphne cneorum*																				
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56				
75	75	65	65	65	60	70	70	60	60	70	75	70	70	70	70	70	75	70	65	70	70	65	70	75	75	60	70	70	65	70				
20	10	10	1	1	1	1	5	1	20	1	5	5	–	–	–	–	–	–	–	1	5	–	1	–	–	–	1	–	–	–	a	b	c	to-
75	75	85	65	65	75	80	65	85	70	65	80	5	70	75	80	80	85	75	60	85	80	65	85	75	80	80	75	65	60	60				tal
70	80	65	65	90	100	100	95	90	100	95	75	95	90	95	85	75	90	80	60	50	45	45	40	40	55	40	45	40	55	55				
5	5	4	4	4	3	4	4	3	3	4	4	4	4	4	4	4	5	4	3	4	4	3	4	4	4	2	4	4	3	4	V	V	V	V
.	.	.	.	.	.	.	.	+	21	.	.	r	.	.	.	.	11	.	.	.	.	.	.	.	.	.	.	.	.	r	I	II	I	I
.	+	11	11	.	r	r	.	+	.	11	11	22	.	.	.	.	11	r	+	+	+	.	.	+	.	.	.	.	+	+	III	III	III	III
.	r	.	.	.	.	r	.	1	r	r	r	r	.	.	.	.	.	r	.	.	.	.	.	.	+	.	r	.	.	.	I	III	I	II
.	.	.	.	.	.	.	12	.	.	.	12	.	.	.	.	.	.	.	.	.	12	.	.	.	.	.	.	.	.	.	I	I	I	I
22	+	11	.	r	.	.	12	.	.	.	.	12	.	.	.	.	.	.	.	.	12	.	+	.	.	.	.	.	.	.	II	II	II	II
11	11	.	+	+	r	.	.	.	.	.	r	.	r	.	.	+2	.	.	r	.	.	.	.	+	.	.	.	.	.	.	II	III	I	II
.	.	11	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	I	I	I	I
11	.	11	.	+	.	r	+	.	.	r	.	.	.	.	.	.	.	.	r	r	r	.	.	.	.	.	+	+	r	+	III	II	III	III
.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	.	I
r	.	.	.	.	.	r	.	+	.	.	.	.	.	.	r	r	.	.	.	.	.	.	.	.	.	.	.	.	.	r	II	II	I	II
r	.	.	r	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	II	I	.	I
.	.	r	.	r	r	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	II	II	I	II
the association)																																		
12	23	12	12	12	12	12	+2	12	11	12	12	22	12	22	22	12	12	+2	+2	23	22	23	12	32	32	22	22	22	12	22	V	V	V	V
11	11	12	11	11	11	21	12	11	12	12	12	23	21	11	11	11	12	21	12	13	12	.	34	12	12	.	12	12	.	12	V	V	IV	V
+	.	r	.	r	r	.	11	11	.	+	.	.	+	11	11	+	r	.	+	+	11	11	11	.	11	22	11	11	+	21	III	IV	V	IV
r	r	r	.	r	r	r	.	11	+	+	.	11	.	r	.	.	r	.	+2	.	11	+	+	.	+	r	+	+	+	r	III	IV	IV	IV
.	11	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	II	I	I	I
.	.	12	.	+2	22	+2	+2	12	.	r	.	.	.	+2	.	+2	r	.	+2	+2	12	12	+2	.	.	.	.	+2	r	+2	II	III	IV	III
.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11	.	.	.	r	.	II	I	I	I
12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	I	I	.	I
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	r	.	.	.	.	.	.	I	.	II	I
22	22	32	22	22	22	32	23	43	32	23	33	12	+2	12	12	12	22	12	.	+2	.	.	.	.	+2	.	.	.	+2	+2	II	V	II	III
12	+2	.	+2	12	r	r	12	12	.	.	12	22	.	.	.	12	.	+2	.	12	.	.	.	.	+	.	.	.	.	+2	II	IV	II	II
+2	.	+2	12	.	+2	12	12	12	.	r	22	22	.	+2	12	+	32	.	.	12	.	+2	.	.	.	.	.	.	.	.	III	IV	I	III
.	.	.	+2	r	.	.	.	.	r	.	.	+	.	.	.	.	+2	22	.	.	r	.	.	.	.	.	.	.	.	+2	I	II	I	I
.	.	.	.	.	.	.	.	.	.	.	.	12	22	12	12	11	12	11	.	.	.	.	.	.	.	.	.	.	.	.	.	II	.	I
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12	12	+2	12	12	22	22	11	12	22	22	12	I	.	V	II
.	+2	.	.	.	.	+2	.	.	+2	+2	12	+2	.	.	.	.	.	.	+2	+2	+2	+	+2	+2	+	32	.	.	12	+2	II	II	V	III
.	.	.	+2	.	.	+2	.	+2	+2	.	.	+2	.	.	.	.	+2	.	.	12	12	12	.	12	+	+	+2	+2	+2	+2	III	II	V	III
.	.	+2	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	+2	+2	+	+2	.	r	.	.	r	+2	+2	+	I	II	IV	II
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	11	11	+	.	.	r	.	.	+	.	r	.	I	.	III	I
.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+2	12	+	+2	12	+	.	.	+2	.	+2	I	I	IV	II
+	.	r	11	+2	r	.	.	.	.	.	+2	12	.	+2	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	11	III	III	I	III
+	+	.	11	r	r	+2	12	12	+	.	r	r	+	.	.	.	r	11	+	.	r	11	.	.	.	.	r	.	+	.	III	IV	III	III
r	12	.	+	.	+	+	+	.	r	r	r	r	.	.	.	+2	r	+	.	.	r	.	r	+	.	.	.	.	r	.	III	IV	II	III
.	.	+	r	.	+	+2	11	11	+	.	+	r	12	.	+2	11	+	.	.	11	.	r	22	.	.	.	.	r	.	.	III	IV	II	III
.	.	.	.	r	r	r	r	.	+	.	.	12	.	+	+	.	12	.	.	11	.	r	22	.	.	.	.	12	.	.	IV	III	I	III
+	.	+2	r	.	r	+	r	.	+	.	.	.	.	.	.	.	r	.	+	11	+	.	.	.	.	.	.	.	.	.	III	III	II	III
.	.	r	r	.	.	.	.	r	.	r	.	r	+2	.	r	.	.	.	.	+2	.	+	.	.	+2	.	12	r	.	.	II	II	III	II

Table 2. (continued)

subassociation														typicum											
variant																									
Relevé No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Veronica officinalis	r	+2	.	.	.	.	.	r	r	12	.	.	.	r	r	.	r	.	.	.	.	.	+	.	.
Teucryum chamaedrys	11	r	12	.	.	.	.	.	.	.	.	r	.	12	.	.	.	.	12	r	+	r	.	.	.
Viola canina	+	.	+	.	.	.	.	.	r	r	.	.	.	.	+2	r	.	.	+2	.	.	+	+	.	.
Chamerion angustifolium	.	.	.	.	.	+	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Carex hirta	.	+	.	.	.	.	+2	r	.	r	.	.	r	.	.	.	r	.	.	+	r	.	r	.	.
Hypericum perforatum	.	r	.	.	.	.	.	.	.	+	.	.	r	.	+2	.	r	+	+	+	.	r	.	.	+
Viola rupestris	.	r	.	.	.	.	.	r	.	r	r	.	12	.	r	.	.	.	+	.	.	+	.	.	.
Campanula rotundifolia	.	r	+	+2	r	.	.	.	.	.	.	.	.	.	r	+	r	r	.	.	r	r	.	.	.
Melampyrum subalpinum	.	+	+	12	.	.	.	.	.	.	.	11	.	.	12	.	.	11	11	r	.	+	.	+2	.
Dryopteris carthusiana	+2	+2	+2	.	.	.	.	.	r	r	12	.	.	.	r	.	.	r	.	.	.	r	.	.	.
Mycelis muralis	.	.	.	.	.	11	+2	.	r	+	.	.	.	.	r	.	.	.	.	.	.	.	r	.	.
Nardus stricta	.	12	.	.	.	.	.	r	+2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+2
Lichens and mosses (E_0) in %																									
Pleurozium schreberi	10	35	10	15	10	15	40	40	45	10	15	60	10	10	45	45	30	30	35	60	55	50	30	10	15
Pseudoscleropodium purum	60	25	45	40	60	35	35	30	65	60	70	25	75	75	25	20	15	65	55	15	15	15	25	45	55
Dicranum polysetum	5	3	15	20	5	15	5	5	5	10	5	5	5	3	15	.	20	.	1	5	15	5	5	5	5
Hylocomium splendens	1	1	1	1	3	3	1	.	.	.	1	.	.	2	1	1	3	1	1	5	1	5	10	1	5
Hypnum cupressiforme	1	2	1	1	1	1	2	5	1	2	3	1	1	.	.	1	.	.	2	2	3	5	1	.	1
Leucobryum glaucum	2	2	1	2	1	3	5	1	2	.	.	.	.	.	2	2	1	2	1	3	1	1	.	.	1
Dicranum scoparium	.	.	3	.	1	.	.	1	1	1	.	.	.	.	1	.	.	1	.	.	1	.	.	2	1
Brachythecium starkei	5	1	.	1	.	.	.	.	5	1	.	5	1	1	.	1	.	.	.	.	.	5	.	.	.
Brachythecium velutinum	.	1	1	.	1	.	.	1	.	.	1	.	.	.	1	1	.	.	.	1	.	.	.	.	.
Ceratodon purpureus	.	.	.	1	1	.	.	1	.	1	.	.	.	.	.	1	.	.	1	1	.	.	.	.	.

Tree species with lower presence
E2 :*Quercus robur* 38 (r), *Crataegus laevigata* 9 (r), 11 (+), *Corylus avellana* 24 (+2),
E1 : *Padus avium* 9 (r), 39 (r), *Crataegus laevigata* 9 (r), 10 (r), 29 (r),*Malus sylvestris* 11 (r), 53 (r),*Prunus spinosa* 18(r), *Acer campestre* 24 (r), *Pyrus communis* 24 (r), 53 (r),*Sarothamnus scoparius* 42 (r), *Rosa canina* 13 (r), 35 (r), 38 (+2), 40 (+2), 54 (r), *Populus tremula* 7, 17, *Euonymus europaea* 41, 54, *Rhamnus catharticus* 1
Species with lower presence
E1: *Achillea millefolium* agg. 6, 24, 28, 37, 44, 46, *Anthericum ramosum* 9, 10, 20, 23, 26, 38, 45, 46, *Armeria maritima subsp. elongata* 20, *Asparagus officinalis* 1, 2, 40, *Brachypodium pinnatum* 1, 38, *Bromus benekenii* 21, *B. erectus* 20, 47, 48, *B. mollis* 16, 45, 49, *Carex brizoides* 1, 37, *C. fritschii* 8, 21, 31, 55, *C. pallescens* 7, *C. pilulifera* 2, 26, 28, *C. supina* 48, *Chelidonium majus* 49, *Chondrilla juncea* 6, 50, *Convallaria majalis* 11, 29, 30, 39, *Descurainia sophia* 45, *Dianthus carthusianorum* agg. 9, 13, 19, 21, 22, 42, 47, 56, *Fallopia convolvulus* 45, *Galeopsis pubescens* 49, 53, *Galium mollugo* 21, 22, 39, 54, *Genista pilosa* 7, 9, 28, 39, 40, 44, *Glechoma hirsuta* 37, 53, *Geranium robertianum* 6, 7, 49, 52, *Hedera helix* 23, *Hieracium bifidum* 25, *H. sabaudum* 17, 45, 51, *Hierochloe repens* 45, 47, 50, *Holcus lanatus* 10, 23, 48, *Hypochaeris radicata* 6, 9, 10, 17, 23, 49, 50,

sions. This subassociation has the highest constancy of characteristic species (*Carex ericetorum, Chimaphila umbellata, Pulsatilla pratensis subsp. bohemica*) from the floristic point of view. *Festuca ovina* agg. creates the physiognomy of the undergrowth. As for the mosses, *Pleurozium schreberi* and *Pseudoscleropodium purum*, which are present in whole the association however, reach the highest abundances. Fig. 2 shows this subassociation as a syntaxonomical core of the association.

Subassociation *Pyrolo-Pinetum callunetosum*

Neotype: relevé No. 29, Table 2.

Higher constancy of *Calluna vulgaris* species (constancy V) often accompanied by its high abundance and dominance floristically differs this subassociation. Dense covers of *Calluna vulgaris* retain rainfall water for a long time and that is reason why relatively hydrophilous species show

callunetosum																				*dianthetosum serotini*											constancy			
with *Daphne cneorum*																																		
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56				
r	.	.	.	.	.	.	.	+2	+2	.	.	.	.	r	12	.	+2	r	r	+2	.	+2	.	.	.	.	.	.	.	.	II	II	II	II
.	.	.	+	.	r	.	.	.	.	+2	.	+2	.	+2	.	.	r	.	.	.	.	r	.	.	.	.	+2	.	.	+2	II	II	II	II
r	.	.	+	r	+	.	r	+	.	.	r	+2	.	+	.	.	+	.	.	.	.	+2	.	.	.	.	.	.	.	.	II	III	I	II
.	.	r	r	.	.	.	.	.	.	.	.	.	+	r	.	+	+	.	r	.	r	.	.	.	.	.	.	r	.	.	I	II	I	II
.	+	.	.	.	r	r	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	II	II	I	II
+	+	.	.	.	.	+	.	.	.	.	r	.	.	.	+	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	II	II	I	II
.	r	.	r	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	r	+	.	+	.	.	.	.	.	.	.	.	II	I	II	II
+	+	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	II	II	I	II
+	.	.	.	.	.	.	.	+	.	.	21	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	II	I	I	II
12	+2	.	+2	12	.	r	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	r	.	.	.	.	.	II	II	I	II
r	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	r	.	.	.	.	.	.	r	.	.	II	I	II	I
.	.	+2	.	.	+2	r	.	.	.	.	.	.	+2	.	r	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	I	II	I	I
10	15	15	10	10	30	45	40	60	10	5	5	15	35	30	35	45	40	30	20	5	10	5	5	10	15	5	10	5	10	10	V	V	V	V
45	40	40	35	65	60	35	35	25	70	70	35	40	25	20	20	.	15	10	15	10	15	15	15	10	20	15	20	5	15	5	V	V	V	V
3	2	2	2	3	3	3	10	.	4	15	20	15	20	30	20	15	5	5	1	1	3	3	1	3	5	5	3	10	5	3	V	V	V	V
2	10	.	5	1	.	2	1	2	.	.	.	1	5	1	.	1	5	.	5	1	.	.	1	1	.	2	5	5	5	1	IV	IV	IV	IV
1	.	.	2	1	1	2	.	1	.	1	1	2	1	1	2	3	1	.	2	3	1	1	2	2	.	1	2	1	1	1	IV	IV	V	IV
15	10	5	5	5	5	10	5	5	10	5	4	15	5	10	10	5	15	20	1	.	1	1	.	.	.	1	.	1	1	1	IV	V	III	IV
3	2	3	2	1	3	2	2	2	5	2	10	.	1	1	1	10	10	15	.	.	1	.	1	1	2	1	1	.	.	.	II	V	III	
1	.	.	1	1	.	.	1	1	.	1	.	.	1	.	.	2	1	.	3	5	5	3	2	3	3	2	3	7	10	15	II	IV	V	III
.	1	2	.	.	1	1	.	.	1	.	1	1	.	.	1	1	.	.	5	3	5	3	5	3	3	3	10	5	3	10	II	III	V	III
1	.	.	.	1	1	.	.	.	1	.	.	.	1	.	1	.	.	.	2	3	2	3	.	3	3	4	1	3	3	5	II	II	V	II

Impatiens parviflora 49, *Inula conyzae* 50, *Jasione montana* 6, 7, 45, 5, *Koeleria macrantha* 45, 47, 50, *Lamium purpureum* 21, *Linaria genistifolia* 45, *Lithospermum officinale* 51, *Luzula luzuloides* 52, *L. pilosa* 9, 23, 25, 40, *Lycopodium clavatum* 42, *Lysimachia vulgaris* 26, 52, *Maianthemum bifolium* 32, *Melica nutans* 24, *Moehringia trinervia* 16, 17, 31, *Molinia arundinacea* 10, 11, 26, 30, 37, *Orthilia secunda* 4, *Oxalis acetosella* 24, *Pilosella bauhinii* 8, 13, 32, 33, 34, *Pimpinella saxifraga* 9, 16, 42, *Poa angustifolia* 6, 11, 21, 24, 30, 39, 44, *P. compressa* 43, 49, *P.nemoralis* 45, 47, 48, 54, *Potentilla arenaria* 9, 20, 21, 32, 35, 38, 40, 49, *P. erecta* 26, *Polypodium vulgare* 9, 23, 53, *Rubus hirtus* 50, *R. idaeus* 9, 13, 15, 20, 25, 28, 38, 40, 41, 42, 43, *Scabiosa canescens* 38, *Sedum sexangulare* 45, 46, 47, *Senecio vulgaris* 6, 22, 45, 50, *Seseli pallasii* 20, *Silene otites* 16, *S. vulgaris* 12, 16, *Stellaria media* 7, *Steris viscaria* 48, *Thesium linophyllum* 15, *Tithymalus seguierianus* 21, *Trifolium alpestre* 12, 16, 31, 38, 43, *Arabis glabra* 45, *Vaccinium myrtilus* 10, 38, *Verbascum phoeniceum* 52, *Veronica chamaedrys* 9, 18, 53, *Vicia dumetorum* 24, *Viola * sabulosa* Gayer 15, 37, 47, 49,

Eo: *Cladonia pyxidata* 46, 52, 56, *C. rangiferina* 45, 50, 51, *C. rangiformis* 45, 50, 53, 55, *C. uncialis* 47, *Dicranum scoparium* 30, 34, 41, *D. spurium* 6, 9, 20, 33, 47, *Eurhynchium striatum* 11, 19, 25, *E. angustirete* 6, 45, *Plagiomnium affine* 26, 31, 43, *P. rostratum* 9, 17, 28, *Pohlia nutans* 30, 38, 44

higher weighted abundance in the subassociation *callunetosum* (Fig. 3). Species as *Lembotropis nigricans, Danthonia decumbens* and less strongly also *Polygonatum odoratum* seem to be indicative too. The last mentioned *Polygonatum odoratum* indicates the bonds with older oak individuals (*Quercus petraea* agg.), which are in *callunetosum* of the highest constancy among compared subassociations (Tab. 2). Moss taxa *Leucobryum glaucum* and *Dicranum scoparium* are accounted as differential. As for the site differences, we can denote bigger row humus layer (mor) to be significant in comparison with other subassociations. This layer is probably the reason for relatively hydrophilous species occurrence. Other characteristics of Podzols are similar to those in typical subassociation.

A variant with *Daphne cneorum* was distinguished within frame of this subassociation. However, stands of this variant are concentrated only in the small part of the study area laying southeastward from the Rudava River. The authors are

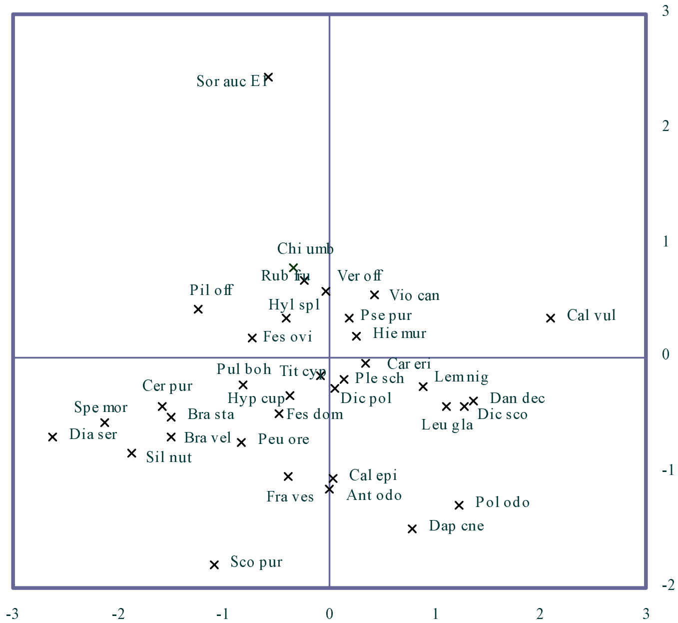

Fig. 3. DCA-analysis (species).
Abbreviations: Ant odo – *Anthoxanthum odoratum*, Bra vel – *Brachythecium velutinum*, Bra sta – *Brachythecium starkei*, Cal epi – *Calamagrostis epigeios*, Cal vul – *Calluna vulgaris*, Car eri – *Carex ericetorum*, Cer pur – *Ceratodon purpuraeus, Dan dec – Danthonia decumbens*, Dap cne – *Daphne cneorum*, Dia ser – *Diantus serotinus*, Dic pol – *Dicranum polysetum,* Dic sco – *Dicranum scoparium*, Fes dom – *Festuca dominii*, Fes ovi – *Festuca ovina*, Fra ves – *Fragaria vesca*, Hie mur – *Hieracium murorum*, Hyl spl – *Hylocomium splendens*, Chi umb – *Chimaphila umbellata*, Lem nig – *Lembotropis nigricans*, Leu gla – *Leucobryum glaucum*, Peu ore – *Peucedanum oreoselinum*, Pil off – *Pilosella officinalis*, Ple sch – *Pleurozium schreberi*, Pul boh – *Pulsatilla bohemica,* Pol odo – *Polygonatum odoratum,* Pse pur – *Pseudoscleropodium purum*, Rub fru – *Rubus fruticosus*, Sco pur – *Scorzonera purpurea,* Sil nut – *Silene nutans*, Spe mor – *Spergularia morisonii*, Tit cyp – *Tithymalus cyparissias*, Ver off – *Veronica officinalis*, Vio can – *Viola canina*.

not able to explain the reasons for such a limited distribution. It probably relates with the florogenesis of the whole region. Although *Daphne cneorum* is not determined in the Male Karpaty Mts. nowadays, its occurrence in the study area should relate with *Daphne* migration in the postglacial period.

Subassociation *Pyrolo-Pinetum dianthetosum serotini*

Neotype: relevé No. 46, Table 2.

Stands of subassociation *dianthetosum serotini* have relatively high number of differential species, such as *Dianthus serotinus, Festuca dominii* (= *F. vaginata* subsp. *dominii*), *Thymus angustifolius, Pilosella officinarum, Spergula morisonii* and *Silene nutans*. The subassociation is markedly similar to the association *Festuco vaginatae-Pinetum* described form the continental part of Europe (Hungary, Ukraine) by Soó (1971) or to the association *Diantho arenarii-Pinetum* described from Brandenburg (Krausch, 1962) through these populations. However, Oberdorfer et al. (1992) considers these two associations to be a part of *Pyrolo-Pinetum*.

Subassociation stands colonize the upper thirds of dune sides with southern aspect especially (SE, SW). Podzols and more often also spodic Dystric Arenosols are typical soil types here. The pH values are as low as in the soils of the whole association. Shallower layer of raw humus is more typical here, often with sterile sandy topsoil only. These conditions suit to xerothermous taxa, to main differentiation species *Dianthus serotinus* especially. The stands of this subassociation are mainly those, which floristic composition ranks the pine communities of the study area (Bor in Záhorská nížina Lowland) among suboceanic-subcontinental vegetation types. Phytocoenoses of this subassociation communicate with secondary pine forests planted on no-forested sites of the *Corynephorion* alliance, classified by Ružička (1960a,b) as *Cladonio-Pinetum,* in some cases. Some sporadic presence of lichens of *Cladonia* genus proves this idea (rels. 45, 46, 52, 53, 56 etc.).

Based on the phytoindication, higher soil acidity is indicated in the subassociations (Tab. 1). Following the empirical experiences we can say that the factor of soil acidity in sense of Ellenberg (1979) complexly indicates rather the microelement deficiency than the real soil reaction. This deficiency manifests itself in sterile sandy sediment in similar way as in calcareous rocks. This could be why calciphilous species accompany the acidophilous ones.

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Appendix 1. Headings to the Table 2

relevè	cadastre	latitude	longitude	altitude (ft)	date (D/M/Y)	E3 (%)	E2 (%)	E1 (%)	E0 (%)	slope (°)	exp. pos.
1	Jabloňové (Výmoľ)	N 48-2.3-002	E 17-03-374	618	9.5.01	70	1	70	80	5	S
2	Studienka (Žliabok)	N 48-31-1.19	E 17-09-970	720	1.1.5.01	70	1	70	65	4	N
3	Studienka (Žliabok)	N 48-31-350	E 17-10-376	680	2.1.5.01	65	15	70	75	0	0
4	Lakšárska N. Ves – Červený rybník	N 48-35-397	E 17-09-326	797	1.1.5.01	80	10	65	75	5	W
5	Lakšárska N. Ves – Červený rybník	N 48-35-394	E 17-09-375	785	1.5.01	80	1	65	75	5	W
6	Mor. Sv. Ján (NE of Dúbrava lodge)	N 48-33-737	E 17-00-385	605	14.6.00	80	1	65	75	0	0
7	Mor. Sv. Ján (NNW of Závod)	N 48-33-516	E 17-01-208	685	14.6.00	65	5	75	80	0	0
8	Malacky (Bahenná mláka)	N 48-30-676	E 17-10-387	653	19.4.01	70	1	65	85	0	0
9	Studienka (S of Vŕšok Žilavého)	N 48-30-637	E 17-10-404	735	26.5.01	70	15	65	90	5	S
10	Studienka (S of Vŕšok Žilavého)	N 48-31-168	E 17-1.1-300	740	26.5.01	70	30	65	75	10	N
11	Mikulášov (N of Mláka)	N 48-33-198	E 17-16-430	860	9.5.01	70	20	70	90	0	0
12	Malacky (Orlie vŕšky)	N 48-28-2.37	E 17-05-103	836	2.1.5.01	75	20	75	95	10	W
13	Mikulášov (N of Mláka)	N 48-32-495	E 17-14-254	860	2.2.6.01	70	0	70	90	2	E
14	Hlboké (E of Pri chotári)	N 48-35-890	E 17-19-202	834	2.2.6.01	60	0	75	90	5	E
15	Malacky (U Holbičkov)	N 48-30-790	E 17-07-052	713	19.4.01	80	1	65	0	0	0
16	Studienka (U Tančibokov)	N 48-30-575	E 17-06-186	732	1.2.6.01	70	0	75	70	0	0
17	Studienka (NE of Vlčie jamy)	N 48-30-906	E 17-07-615	705	1.2.6.01	80	20	65	65	0	0
18	Lakšárska N. Ves (Červený rybník)	N 48-34-390	E 17-07-52.2	690	14.6.01	70	20	65	95	5	S
19	Pernek (Malinská)	N 48-24-515	E 17-04-485	609	9.5.01	65	1	75	95	2	S
20	Pernek (Malinská)	N 48-24-528	E 17-04-756	644	9.5.01	65	1	65	90	0	0
21	Pernek (S of Malinská)	N 48-24-242	E 17-04-838	684	9.5.01	65	0	80	90	0	0
22	Jabloňové (N of Výmoľ)	N 48-2.3-454	E 17-04-100	650	9.5.01	65	0	70	85	0	0
23	Studienka (N of vŕšok Žilavého)	N 48-30-667	E 17-10-403	744	14.6.01	70	35	65	70	2	NW
24	Lakšárska N. Ves (S of Horné Valy)	N 48-33-984	E 17-07-500	700	14.6.01	70	25	70	70	10	W
25	Mikulášov (E of Bozaj vŕšok)	N 48-33-715	E17-04-01.2	720	19.4.01	70	15	60	85	0	0
26	Lakš.N. Ves (N of Studienka cesta)	N 48-35-271	E 17-07-697	717	2.1.5.01	75	20	75	70	5	N
27	Šastín (Šaštínsky les)	N 48-34-897	E 17-07-52.1	849	2.1.5.01	75	10	75	80	15	E
28	Mikulášov (SW of Haluška lodge)	N 48-33-280	E 17-13-845	760	9.5.01	65	10	85	65	0	0
29	Malacky (Červený kríž)	N 48-28-560	E 17-04-049	697	1.5.01	65	1	65	65	5	W
30	Malacky (E of Červený kríž)	N 48-28-326	E 17-04-056	703	2.1.5.01	65	1	65	90	2	W
31	Malacky (E of Červený kríž)	N 48-28-605	E 17-04-050	737	1.1.9.01	60	1	75	100	0	0
32	Mikulášov (reznisko)	N 48-31-81.2	E17-15-074	760	26.5.01	70	1	80	100	3	NW
33	Hlboké (E of Pri chotári)	N 48-33-162	E 17-16-254	868	1.2.5.01	70	5	65	95	10	E
34	Prievaly (S of Nad Čiernym jarkom)	N 48-35-267	E 17-18-308	800	1.2.6.01	60	1	85	90	3	W
35	Hlboké (E of Pri chotári)	N 48-35-916	E 17-19-302	826	26.5.01	60	20	70	100	5	E
36	Mikulášov (NW of Olšáky)	N 48-35-906	E 17-19-31.1	808	9.5.01	70	1	65	95	0	0
37	Mikulášov (E of U studienky)	N 48-33-535	E 17-14-2.33	760	1.1.9.01	75	5	80	75	7	N
38	Malacky (S of Teplica)	E 48-29-363	E 17-04-791	641	1.5.01	70	5	5	95	0	0
39	Malacky (Červený kríž)	N 48-28-573	E 17-04-030	715	1.5.01	70	0	70	90	0	0
40	Studienka (NW of Kaňúr)	N 48-29-345	E 17-05-953	737	26.5.01	70	0	75	95	3	W
41	Studienka (NE of Teplica)	N 48-29-718	E 17-05-775	698	1.2.5.01	70	0	80	85	3	W
42	Studienka (Kaňúr)	N 48-29-484	E 17-05-885	743	1.2.5.01	70	0	80	75	6	E

43	Studienka (E of Teplica)	N 48-29-552	E 17-05-150	665	9.5.01	75	0	85	90	0	0
44	Studienka (Kaňúr)	N 48-29-199	E 17-06-030	687	9.5.01	70	0	75	80	2	S
45	Lakšárska N. Ves (W of village)	N 48-34-892	E 17-09-678	810	1.1.9.01	65	0	60	60	20	E
46	Lakšárska N. Ves (W of village)	N 48-34-909	E 17-09-803	805	5.5.01	70	1	85	50	25	NE
47	Lakšárska N. Ves (W of village)	N 48-34-832	E 17-09-813	786	5.5.01	70	5	80	45	20	NE
48	Lakšárska N. Ves (NE of Šišoláky)	N 48-34-835	E 17-09-508	740	10.5.01	65	0	65	45	15	E
49	Lakšárska N. Ves (NE of Šišoláky)	N 48-34-804	E 17-09-348	740	1.2.5.01	70	1	85	40	20	E
50	Lakšárska N. Ves (NE of Šišoláky)	N 48-34-727	E 17-09-166	730	9.5.01	75	0	75	40	25	E
51	Mor.Sv. Ján (NNW of Závod)	N 48-37-504	E 17-01-402	620	1.2.6.01	75	0	80	55	0	0
52	Mor.Sv. Ján (S of Posvätné)	N 48-34-644	E 17-01-892	700	1.2.6.01	60	0	80	40	0	0
53	Studienka (S of Nová hájovňa)	N 48-30-792	E 17-09-726	760	1.5.01	70	1	75	45	15	SW
54	Studienka (S of Nová hájovňa)	N 48-30-742	E 17-09-72.1	700	1.5.01	70	0	65	40	10	SW
55	Mikulášov (NW of Olšáky)	N 48-38-053	E 17-16-2.17	835	9.5.01	65	0	60	55	8	NE
56	Pernek (Pernecké jazero)	N 48-2.3-419	E 17-05-479	72.3	26.5.01	70	0	60	55	15	NE