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Syntaxonomical classification of wet woodlands with *Picea abies* in Slovakia

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Abstract. Wet woodlands with domination of Norway spruce are floristically and ecologically distinctive element of coniferous forest vegetation. However, specialized studies on this vegetation are considerably rare. In this survey the syntaxonomical classification of 145 relevés of *Sphagnum*-rich and other wet woodlands with *Picea abies* from Slovakia is proposed. Eight plant communities in the rank of association were differentiated. A distinctive feature of the association *Sphagno acutifolii-Piceetum* Zukrigl 1973 is the co-occurrence of species typical for climax supramontane woodlands on silicate bedrock of the alliance *Piceion excelsae* Pawłowski ex Pawłowski et al. 1928 and species characteristic for woodlands of the class *Vaccinio uliginosi-Pinetea* Passarge 1968. Consequently, this association is classified within the order *Piceetalia abietis* Pawłowski ex Pawłowski et al. 1928 and alliance *Piceion excelsae* Pawłowski ex Pawłowski et al. 1928. The rest of wet *Picea* woodland associations are azonal stable communities (Dauergesellschaften) distributed mostly in the montane zone and they differ floristically as well. Therefore those associations are separated in the floristically well distiguishable order *Sphagno palustris-Piceetalia* P. Kučera 2019 and they are subdivided into three syntaxa in the rank of alliance: (1) alliance *Sphagno palustris-Piceion* P. Kučera 2019 comprising the communities limited to nutrient-poor habitats with a shallow peat layer or hydromorphic soils with a substantial raw humus layer: *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939, *Leucobryo glauci-Piceetum abietis* Šomšák ex P. Kučera 2019, *Sphagno palustris-Piceetum* Šomšák 1979, *Equiseto sylvatici-Piceetum* Šmarda 1950, and the *Carex rostrata-Picea abies* community; (2) alliance *Stellario nemorum-Abietion albae* P. Kučera 2019 with the species-rich spring related association *Stellario nemorum-Abietetum albae* P. Kučera 2019; (3) base rich alliance *Valeriano dioicae-Abietion albae* P. Kučera 2019 with the association *Valeriano dioicae-Abietetum* P. Kučera 2019. Formal definitions and description of species composition of the units are given, as well as brief information on their distribution in Slovakia. Several syntaxonomical and nomenclatural notes are provided in the supplement.

Keywords: *Abies alba*, nomenclature, phytocoenology, *Picea abies*, plant communities, Western Carpathians

Supplementary Material. Electronic Supplements: A1, Figure 1, A2, A3; B1(Table 1); B2(Table 4), pp. e1—e19, are available in the online version of this article at: https://ukrbotj.co.ua/76/4/316

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Кучера П. 2019. **Синтаксономічна класифікація вологих лісових масивів із участю ялини (*Picea abies*) у Словаччині.** *Український ботанічний журнал*, 76(4): 316–343.

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Реферат. Вологі ліси з домінуванням ялини звичайної (*Picea abies*) є флористично та екологічно відмінним елементом рослинності хвойних лісів. Однак спеціальні дослідження цієї рослинності є доволі рідкісними. У нашому дослідженні проведено синтаксономічну класифікацію 145 геоботанічних описів сфагнових та інших вологих лісових масивів із участю *Picea abies* зі Словаччини. Відмічені вісім рослинних угруповань у ранзі асоціації. Відмінною рисою асоціації *Sphagno acutifolii-Piceetum* Zukrigl 1973 є трапляння як видів, характерних для кліматичних супрамонтанних лісових масивів на силікатних породах з союзу *Piceion excelsae* Pawłowski ex Pawłowski et al. 1928, так і видів, характерних для лісових масивів із класу *Vaccinio uliginosi-Pinetea* Passarge 1968. Отже, ця асоціація належить до порядку *Piceetalia abietis* Pawłowski ex Pawłowski et al. 1928 та союзу *Piceion excelsae* Pawłowski ex Pawłowski et al. 1928. Решта асоціацій вологих лісів із участю ялини – це азональні стійкі угруповання (Dauergesellschaften), які поширені переважно в монтанній зоні і є флористично відмінними. Тому ці асоціації відокремлюються у флористично чітко відокремленому порядку *Sphagno palustris-Piceetalia* P. Kučera 2019 і поділяються на три синтаксони у ранзі союзу: (1) союзу *Sphagno palustris-Piceion* P. Kučera 2019, що включає угруповання, пов'язані з бідними на поживні речовини оселищами з поверхневим торфовим шаром або гідроморфними ґрунтами із значним шаром гумусу: *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939, *Leucobryo glauci-Piceetum abietis* Šomšák ex P. Kučera 2019, *Sphagno palustris-Piceetum* Šomšák 1979, *Equiseto sylvatici-Piceetum* Šmarda 1950 та угруповання *Carex rostrata-Picea abies*; (2) союзу *Stellario nemorum-Abietion albae* P. Kučera 2019 з асоціацією *Stellario nemorum-Abietetum albae* P. Kučera 2019 з різноманітними весняними видами; (3) союзу *Valeriano dioicae-Abietion albae* P. Kučera 2019 на багатих основами ґрунтах з асоціацією *Valeriano dioicae-Abietetum* P. Kučera 2019. Подано формальні визначення та описи видового складу цих одиниць, а також стислу інформацію про їхнє поширення у Словаччині. Деякі синтаксономічні та номенклатурні примітки наведено в додатку.

Ключові слова: Західні Карпати, номенклатура, рослинні угруповання, фітоценологія, *Abies alba, Picea abies*

Introduction

Woodlands with the natural dominance of *Picea abies* are distributed in the Western Carpathians predominantly in the mountains where they form a distinctive belt, the supramontane altitudinal vegetation zone, mostly above 1400 m a.s.l. (Domin, 1923; Kučera, 2012). In syntaxonomy, plant communities of this mountain forest are classified as the class *Piceetea excelsae* Klika 1948[1] in the phytocoenological literature (Hadač et al., 1969; Šoltés, 1976; Fajmonová, 1978; Matuszkiewicz, 2002; Kučera, 2012).

Apart from the supramontane zone of the Western Carpathians, *Picea abies* naturally dominates (or codominates with *Abies alba*) on locally distributed special habitats, especially on more or less ground-water and/or above-ground-water influenced areas (Šomšák, 1979, 1983; Šomšák et al., 1993, 1996; Bujakiewicz, 1981; Majzlanová, 1983; Staszkiewicz, 1993; Kasprowicz, 1996; Parusel, 2007; Wilczek et al., 2015; and others) in the lower montane elevations of the *Fagus sylvatica-Abies alba* forest zone (class *Carpino-Fagetea* Jakucs ex Passarge 1968).

Depending on the origin of the habitat, level of the ground water and time of its influence (or sometimes overflooding), several types of wet *Picea* woodlands are recognized in Slovakia and adjacent countries.

In Austria (Exner, 2007) they are further splitted between two alliances (order *Piceetalia* Pawłowski ex Pawłowski et al. 1928) following the traditional approach of German-speaking phytocoenologists: (1) *Abieti-Piceion* (Br.-Bl. in Br.-Bl. et al. 1939) Soó 1963[2] with associations *Carici brizoidis-Abietetum* Trinajstič 1974, *Equiseto-Abietetum* Moor ex Kuoch 1954; (2) *Piceion excelsae* Pawłowski ex Pawłowski et al. 1928[3] with *Equiseto-Piceetum* Šmarda 1950, *Sphagno-Piceetum* Zukrigl 1973.

In the recent vegetation survey of the Czech Republic (Chytrý et al., 2013) wet *Picea* woodlands are classified and divided into alliances differently (without indication of the rank of order): (1) *Piceion excelsae* Pawłowski ex Pawłowski et al. 1928 containing associations *Equiseto-Piceetum* Šmarda 1950, *Soldanello montanae-Piceetum* Volk in Br-Bl. et al. 1939; (2) *Vaccinio uliginosi-Pinion sylvestris* Passarge 1968 where bog woodland of *Vaccinio uliginosi-Piceetum* Schubert 1972 is one of the four distiguished associations (minority of floristically almost identical bog woodlands are by a decision delimited to non-forest vegetation of the alliance *Sphagnion magellanici* Kästner et Flössner 1933; Hájková et al. 2011) .

The natural distribution range of *Picea abies* in Poland is divided to (1) the outskirts of the hemiboreal forest zone in northeastern Poland and (2) the larger disjunctive Central European areal associated with Sudetian-Carpathian mountain ranges (see Szafer, 1959). All known wet *Picea* woodlands are classified within *Piceion excelsae* Pawłowski ex Pawłowski et al. 1928 (Matuszkiewicz, 2002). Associations *Querco-Piceetum* W. Matuszkiewicz et Polakowska 1955 and *Sphagno girgensohnii-Piceetum* Polakowski 1962 are described from the boreal *Picea* range. The association *Betulo pubescentis-Piceetum* Sokołowski 1980 described by Sokołowski (1980) also from this region is not recognized in the surveys of J. Matuszkiewicz (2002) and W. Matuszkiewicz (2014).

Occurrence of the association *Bazzanio-Piceetum* (Schmid et Gaisberg 1936) Br.-Bl. et Sissingh in Br-Bl. et al. 1939[4] is reported from the mountains of southern Poland; stands of the association *Calamagrostio villosae-Pinetum* Staszkiewicz 1958 known from the Orava-Nowy Targ Basin north of the Tatras have a special position in respect of the presence of *Picea abies*.

Wet *Picea* woodlands of Ukraine are similarly known from two parts of the natural *Picea abies* distribution areas: (1) the southern limit of the hemiboreal *Picea abies* distribution range (Polissya zone) where three associations are distiguished: *Querco-Piceetum* W. Matuszkiewicz et Polakowska 1955, *Sphagno girgensohnii-Piceetum* Polakowski 1962 and *Betulo pubescentis-Piceetum* Sokołowski 1980; and (2) the Eastern Carpathians with associations *Bazzanio-Piceetum* (Schmid et Gaisberg 1936) Br.-Bl. et Sissingh in Br-Bl. et al. 1939, *Equiseto-Piceetum* Šmarda 1950 and *Sphagno-Piceetum* Zukrigl 1973 (Budzhak, Onyshchenko, 2004; Shelyag-Sosonko et al., 2006; Solomakha, 2008; Solomakha et al., 2016).

A comprehensive evaluation of wet *Picea* woodlands of Slovakia has not been published so far and the syntaxonomical survey of the class *Piceetea excelsae* Klika 1948 (Kučera, 2012) was focused on the forest communities of the supramontane vegetation zone. However, basic ecological differentiation of *Sphagnum*-rich Norway spruce communities (*Sphagno-Piceetum* auct.) was presented (Kučera, 2012, p. 249–251).

[1] Syn. *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. et al. 1939 pro parte min. [cf. Braun-Blanquet et al., 1939], nom. inval., Art. 2b, 3m, 25; see Kučera (2010, 2012), Kučera, Kliment (2011), cf. Theurillat in Willner et al. (2015).

[2] Cf. Kučera (2008a), p. 168.

[3] Cf. Kučera, Kliment (2011), p. 88.

[4] See below subchapter *Soldanello montanae-Piceetum*.

Traditionally, the following associations were distinguished in Slovakia: *Bazzanio-Abietetum* (Kuoch 1954) Ellenberg et Klötzli 1972 and *Bazzanio-Piceetum* (Schmid et Gaisberg 1936) Br.-Bl. et Sissingh in Br-Bl. et al. 1939,[1] *Equiseto-Abietetum* Moor 1952, *Sphagno palustris-Piceetum* Šomšák 1979, "*Leucobryo-Piceetum* Stefanovič 1961"[2] (Kontriš, 1981; Majzlanová, 1983, 1993; Šomšák, 1979, 1983; Šomšák et al., 1993, 1996; Kubíček, Šomšák, 1993; Kubíček et al., 1997a, b) and "*Sphagno-Piceetum* Hartm."[3] (Staszkiewicz, 1993). Many phytocoenological relevés of wet *Picea* communities from Slovakia remain unpublished (master's theses, dissertations, research reports). Some of them were recently included in the descriptions of new associations *Leucobryo glauci-Piceetum abietis* Šomšák ex P. Kučera 2019 and *Stellario nemorum-Abietetum albae* P. Kučera 2019 (Kučera, 2019), all of the sources are here cited within the particular syntaxa.

The aim of this study is to present formal descriptions and differentiation of the plant communities of wet woodlands with *Picea abies* (and *Abies alba*) based on both published and unpublished relevés from Slovakia.

Material and methods

The initial set of phytocoenological relevés of wet woodlands with *Picea abies* (especially *Sphagnum*-rich wet woodlands) was prepared using the Turboveg for Windows database software (Hennekens, 2016; cf. Hennekens, Schaminée, 2001) from the dataset provided for the prepared monograph *Plant communities of Slovakia, Forest and shrub vegetation* (Valachovič et al., in prep.) stored in *Centrálna databáza...* (2016).

The detailed description of the next methodological steps due to the length of the paper are provided in Electronic Supplement A1 where a dendrogram used as the basis for syntaxa classification is also given. The resulting formal characteristic species combinations of the distiguished associations are given in Electronic Supplement A2.

Nomenclature of the vascular plants and bryophytes follows the lists of Marhold et al. (1998) and Kubinská, Janovicová (1998); if otherwise then with an author citation, the name *Orthodicranum undulatum* is given according to Šomšák's (1976) original data (= *Dicranum bergeri* Blandow ?). Syntaxa nomenclature rules are applied in accordance with the *International Code of Phytosociological Nomenclature* (Weber et al., 2000).

[1] See below subchapter *Soldanello montanae-Piceetum*.

[2] See below subchapter *Leucobryo glauci-Piceetum*.

[3] Probably *Sphagno-Piceetum* (Tüxen 1937) Hartmann 1953.

Results and discussion

Division of the class *Piceetea excelsae* into basic floristic-ecological groups

Until present, natural Central European *Picea abies* woodlands constituting the class *Piceetea excelsae* Klika 1948 (syn. *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. et al. 1939 nom. inval., see above) were usually divided into two orders following the strong differences in the species composition of communities on the two main habitat types (Hadač et al., 1969; Kučera, 2010, 2012): (1) *Athyrio-Piceetalia* sensu auct. non Hadač 1962[4] (= *Cortuso matthioli-Piceetalia* P. Kučera nom. prov.) on carbonates and (2) *Piceetalia excelsae* Pawłowski ex Pawłowski et al. 1928 on silicate bedrock (granites, quartzites etc.).

The number of species positively differentiating the supramontane *Picea* forests of the order *Piceetalia excelsae* in Slovakia is very small and they have weak and very small differential value: *Calamagrostis villosa*, *Dryopteris dilatata*, *Vaccinium myrtillus*, *Avenella flexuosa*. On the contrary, supramontane *Picea* forests of the order *Cortuso-Piceetalia* in Slovakia are characterized by numerous species and with a considerable higher differential value: *Valeriana tripteris*, *Primula elatior*, *Phyteuma spicatum*, *Cortusa matthioli*, *Polygonatum verticillatum*, *Mycelis muralis*, *Cirsium erisithales*, *Calamagrostis varia* etc. (see Kučera, 2012, tab. 3, columns 10–11).

Comparison of these two units with the collected relevés of wet woodlands with *Picea abies* revealed strong floristic individuality of the wet woodlands expressed by presence of the species group specific to wet woodlands: *Equisetum sylvaticum*, *Luzula pilosa*, *Caltha palustris*, *Deschampsia cespitosa*, *Potentilla erecta*, *Lysimachia vulgaris*, *Polytrichum commune*, *Sphagnum palustre* agg. etc. (Tab. 1, col. 1 – in Electronic Supplement B1). The significance of differences in the plant species composition is equivalent to the phytocoenotic differential value of the order *Cortuso-Piceetalia*.

Therefore, the presented wet woodlands with *Picea abies* (and *Abies alba*) are here evaluated as a separate unit in the rank of order – *Sphagno palustris-Piceetalia* P. Kučera 2019 ordo nov. (see below). The arrangement of *Picea abies* woodlands of the class *Piceetea excelsae* Klika 1948 into three orders reflects prime floristic differences based on the major ruling ecological patterns applicable on the continental scale.

[4] The question of incorrect syntaxonomical use of the validly published name *Athyrio-Piceetalia* Hadač 1962 in the most of geobotanical and syntaxonomical studies will be discussed in another paper.

Each of the orders *Piceetalia excelsae* Pawłowski ex Pawłowski et al. 1928 and *Cortuso matthioli-Piceetalia* P. Kučera nom. prov. (= *Athyrio-Piceetalia* sensu auct. non Hadač 1962) comprises only one alliance of *Picea* woodlands in the Western Carpathians (Kučera, 2012). It is a result of the regional floristic uniformity (phytogeography) of the subordinated associations.

On the contrary, associations of the order *Sphagno palustris-Piceetalia* P. Kučera 2019 can be grouped into three superior units, each of them with a specific set of species reflecting distinctive ecological conditions (Table 2). In total, eight types of wet woodlands with *Picea abies* (and *Abies alba*) from Slovakia are recognized in this study (Table 3).

A syntaxonomic overview of *Picea abies* wet woodland communities (class *Piceetea excelsae* Klika 1948) in Slovakia is provided below:

***Piceetalia excelsae* Pawłowski ex Pawłowski et al. 1928**
***Piceion excelsae* Pawłowski ex Pawłowski et al. 1928**
Sphagno acutifolii-Piceetum Zukrigl 1973
***Sphagno palustris-Piceetalia abietis* P. Kučera 2019 ordo nov.**
***Sphagno palustris-Piceion abietis* P. Kučera 2019 all. nov.**
Soldanello montanae-Piceetum Volk in Br.-Bl. et al. 1939
Carex rostrata-Picea abies community
Leucobryo glauci-Piceetum abietis Šomšák ex P. Kučera 2019
Sphagno palustris-Piceetum Šomšák 1979
Equiseto sylvatici-Piceetum Šmarda 1950
(*Calamagrostio villosae-Pinetum* Staszkiewicz 1958)
***Stellario nemorum-Abietion albae* P. Kučera 2019 all. nov.**
Stellario nemorum-Abietetum albae P. Kučera 2019
(*Petasito albi-Piceetum* Samek 1961)
***Valeriano dioicae-Abietion albae* P. Kučera 2019 all. nov.**
Valeriano dioicae-Abietetum P. Kučera 2019 ass. nov.

Description of syntaxa of wet woodlands with *Picea abies* from Slovakia

I. *Piceetalia excelsae* Pawłowski ex Pawłowski et al. 1928

This order comprises natural plant communities forming in the Western Carpathians a separate altitudinal vegetation zone of climax *Picea abies* woodland, in the Tatras also with *Pinus cembra* and *Larix decidua* (Kučera, 2012, 2017; Zięba et al., 2018).

On the bog ecotones, a series of vegetation types between communities of the classes *Oxycocco-Sphagnetea* Br.-Bl. et Tx. ex Westhof et al. 1964 and *Piceetea excelsae* develops, regularly including spatially more or less developed forest (or krummholz-forest) bog communities of the class *Vaccinio uliginosi-Pinetea* Passarge 1968.

Bogside ecotones or groundwater-influenced habitats confined to gentle (moderate) slopes adjacent to mountain plateaus of some West Carpathians mountain ranges bear forest communities (stable communities, Dauergesellschaften) with subsiding occurrence of *Eriophorum vaginatum*, *Carex nigra* and selected *Sphagnum* species other than *S. girgensohnii*. At the same time they still support the constant presence of species characteristic to climax supramontane *Picea* forests on acid soils, i.e. *Athyrium distentifolium*, *Dryopteris expansa*, *D. dilatata*, *Homogyne alpina*, *Polytrichum formosum*. Therefore these phytocoenoses are here classified as a peripheral member of the alliance **(I. A.) *Piceion excelsae* Pawłowski ex Pawłowski et al. 1928** close to the class *Vaccinio uliginosi-Pinetea* Passarge 1968. This group is positively differentiated by *Juncus filiformis* and *Sphagnum capillifolium* in the frame of the evaluated relevé set from Slovakia (Tab. 3).

Until present, only six relevés were published from Slovakia, although the community has wider distribution (Kučera, in prep.). Within the group of wet *Picea* communities, their species composition has close relations to the association *Sphagno acutifolii-Piceetum* Zukrigl 1973 s. str. (i.e. in the sense of the lectotype relevé).

1. *Sphagno acutifolii-Piceetum* Zukrigl 1973

Original diagnosis: Zukrigl (1973), p. 152, tab. 6.

Nomenclatural type: Zukrigl (1973), p. 152, tab 6, rel. 2, lectotype; Willner, Zukrigl (1999), p. 154.

Characteristic species combination: see Electronic Supplement A2.

Data: Kučera (2005): p. 65, rel. 3; Kučera (2012): p. 311–312, rel. 74–77, p. 317, rel. 97.

Relevés from Slovakia presented here correspond to the association *Sphagno acutifolii-Piceetum* Zukrigl 1973 (cf. Electronic Supplement A3, section I). Stands of this association in the Western Carpathians are dominated by *Picea abies*, which is in accordance with the community distribution mostly in the supramontane altitudinal vegetation zone. Sometimes *Sorbus aucuparia* is admixed, partial *Pinus mugo* occurrence is connected with adjacent krummholz stands.

Table 2. **Differential table of alliances of the order *Sphagno palustris-Piceetalia abietis* P. Kučera 2019 with fidelity (φ (× 100) ≥ 25) and constancy (%) in the exponent**
A – *Sphagno palustris-Piceion abietis* P. Kučera 2019
B – *Stellario nemorum-Abietion albae* P. Kučera 2019
C – *Valeriano dioicae-Abietion albae* P. Kučera 2019

	A	B	C
No. of relevés	89	36	13
Trees and shrubs			
E_3			
Abies alba	—^{6}	**62^{78}**	—^{23}
Fagus sylvatica	—·	43^{25}	—·
Pinus sylvestris	—^{31}	—·	47^{62}
Alnus glutinosa	—^{15}	—·	38^{38}
Alnus incana	—^{21}	—^{3}	38^{46}
Betula pendula	—^{17}	—·	37^{38}
E_2			
Picea abies	31^{94}	—^{64}	—^{69}
Fagus sylvatica	—·	**57**^{42}	—·
Sorbus aucuparia	—^{8}	37^{56}	—^{31}
Lonicera xylosteum	—·	34^{17}	—·
Acer pseudoplatanus	—·	31^{14}	—·
Salix caprea	—^{1}	29^{14}	—·
Sambucus racemosa	—^{1}	25^{11}	—·
Frangula alnus	—^{11}	—·	49^{46}
Viburnum opulus	—·	—·	41^{23}
Lonicera nigra	—^{3}	11^{44}	37^{62}
E_1			
Betula pubescens	31^{18}	—^{3}	—·
Salix aurita	28^{11}	—·	—·
Fagus sylvatica	—^{4}	33^{22}	—·
Lonicera xylosteum	—·	31^{14}	—·
Abies alba	—^{22}	25^{72}	21^{69}
Daphne mezereum	—·	—·	48^{31}
Lonicera nigra	—^{16}	—^{11}	43^{54}
Viburnum opulus	—·	—·	41^{23}
Sorbus aucuparia	—^{47}	—^{56}	40^{92}
Frangula alnus	—^{12}	—·	33^{31}
Betula pendula	—^{7}	—·	31^{23}
Ribes petraeum	—^{1}	—·	31^{15}
Differential field layer species (E_1)			
Vaccinium vitis-idaea	46^{94}	—^{25}	—^{69}
Carex canescens	36^{31}	—^{3}	—^{8}
Ranunculus flammula	33^{16}	—·	—·
Juncus effusus	33^{16}	—·	—·
Melampyrum sylvaticum	33^{16}	—·	—·
Agrostis canina	32^{25}	—·	—^{8}
Potentilla erecta	31^{38}	—·	—^{23}
Agrostis stolonifera	31^{18}	—^{3}	—·
Carex echinata	30^{30}	—·	—^{15}
Trientalis europaea	29^{12}	—·	—·
Lysimachia vulgaris	29^{36}	—·	—^{23}
Valeriana simplicifolia	26^{10}	—·	—·

	A	B	C
No. of relevés	89	36	13
Stellaria nemorum	—^{1}	**83^{78}**	—·
Chrysosplenium alternifolium	—^{2}	**69^{69}**	—^{8}
Petasites albus	—^{1}	**68^{67}**	—^{8}
Lysimachia nemorum	—^{1}	**62^{50}**	—·
Geranium robertianum	—·	**55**^{39}	—·
Cardamine trifolia	—·	**55**^{39}	—·
Adenostyles alliariae	—·	**55**^{39}	—·
Luzula luzulina	—·	**52**^{36}	—·
Homogyne alpina	—^{21}	**51^{58}**	—·
Impatiens noli-tangere	—·	**51**^{44}	—^{8}
Urtica dioica	—^{8}	**50**^{44}	—·
Rubus hirtus	—·	**50**^{33}	—·
Gentiana asclepiadea	—^{3}	49^{67}	—^{31}
Galium odoratum	—·	48^{31}	—·
Prenanthes purpurea	—^{1}	46^{61}	—^{31}
Dryopteris dilatata	—^{1}	46^{31}	—·
Phegopteris connectilis	—^{3}	43^{31}	—·
Milium effusum	—·	43^{25}	—·
Ranunculus lanuginosus	—·	40^{22}	—·
Ranunculus platanifolius	—·	40^{22}	—·
Oxalis acetosella	—^{54}	39^{100}	—^{77}
Senecio ovatus	—^{19}	37^{83}	17^{69}
Phyteuma spicatum	—·	37^{19}	—·
Rubus idaeus	—^{35}	37^{83}	—^{54}
Chaerophyllum hirsutum	—^{11}	35^{78}	23^{69}
Luzula sylvatica	—^{3}	35^{22}	—·
Cardamine flexuosa	—·	34^{17}	—·
Calamagrostis epigejos	—·	34^{17}	—·
Poa remota	—·	34^{17}	—·
Veronica anagallis-aquatica	—·	34^{17}	—·
Equisetum sylvaticum	—^{72}	32^{100}	—^{77}
Dryopteris filix-mas	—^{12}	32^{53}	—^{31}
Cicerbita alpina	—·	31^{14}	—·
Geum rivale	—^{2}	30^{39}	—^{23}
Carex sylvatica	—·	30^{31}	—^{15}
Calamagrostis arundinacea	—^{22}	29^{61}	—^{38}
Deschampsia cespitosa	—^{33}	29^{53}	—^{15}
Ranunculus repens	—^{17}	25^{39}	—^{15}
Doronicum austriacum	—^{1}	25^{11}	—·
Rubus saxatilis	—^{1}	—·	**93^{92}**
Valeriana dioica	—^{4}	—·	**79^{77}**
Polygonatum verticillatum	—^{2}	—^{6}	**70^{69}**
Caltha palustris	—^{38}	—^{19}	**67^{100}**
Crepis paludosa	—^{35}	—^{28}	**65^{100}**
Luzula pilosa	9^{65}	—^{11}	**59^{100}**
Cirsium oleraceum	—·	—·	**54**^{38}

Table 2. Continuation

No. of relevés	A 89	B 36	C 13
Clematis alpina	—·	—·	**54**^{38}
Maianthemum bifolium	—^{53}	—^{44}	**51**^{100}
Filipendula ulmaria	—^{3}	—^{14}	**50**^{54}
Thalictrum aquilegiifolium	—·	—·	48^{31}
Carex alba	—·	—·	48^{31}
Galium schultesii	—·	—^{3}	44^{31}
Fragaria vesca	—^{3}	—^{25}	42^{54}
Solidago virgaurea	—^{10}	—^{31}	41^{62}
Melica nutans	—·	—·	41^{23}
Astrantia major	—·	—·	41^{23}
Paris quadrifolia	—^{6}	—·	40^{31}
Equisetum palustre	—^{3}	—^{3}	40^{31}
Dactylorhiza maculata	—^{1}	—·	39^{23}
Carex digitata	—·	—·	33^{15}
Actaea spicata	—·	—·	33^{15}
Carex remota	—^{4}	—^{8}	33^{31}
Epipactis palustris	—^{1}	—·	31^{15}
Bistorta major	—^{2}	—·	29^{15}
Polygonatum multiflorum	—·	—^{3}	28^{15}
Valeriana tripteris	—·	—^{3}	28^{15}
Angelica sylvestris	—^{1}	—^{3}	26^{15}
Differential ground layer species (E_0)			
Polytrichum commune	38^{61}	—^{36}	—^{8}
Lepidozia reptans	31^{31}	—·	—^{15}
Pohlia nutans	30^{24}	—·	—^{8}
Sphagnum recurvum agg.	28^{11}	—·	—·
Chiloscyphus pallescens	26^{10}	—·	—·
Herzogiella seligeri	25^{9}	—·	—·
Plagiomnium affine	—^{12}	**54**^{72}	—^{23}
Cirriphyllum piliferum	—^{1}	**51**^{36}	—·
Plagiothecium undulatum	—^{2}	39^{25}	—·
Plagiomnium undulatum	—^{4}	33^{31}	—^{8}
Plagiothecium curvifolium	—^{24}	31^{44}	—^{8}
Plagiomnium rostratum	—·	31^{14}	—·
Conocephalum conicum	—·	31^{14}	—·
Thuidium tamariscinum	—·	28^{11}	—·
Trichocolea tomentella	—^{1}	—·	39^{23}
Eurhynchium angustirete	—^{9}	—·	37^{31}
Tetraphis pellucida	—^{11}	—·	34^{31}

Vaccinium myrtillus is the dominant species of the field layer, constantly accompanied by *Homogyne alpina*, *Avenella flexuosa*, *V. vitis-idaea*, more frequent are also species *Calamagrostis villosa*, *Dryopteris dilatata*, *Athyrium distentifolium*. The differential attribute against the other communities of the alliance *Piceion excelsae* Pawłowski ex Pawłowski et al. 1928 (especially *Vaccinio myrtilli-Piceetum* Šoltés 1976) is occurrence of *Eriophorum vaginatum* and *Juncus filiformis*, *Carex canescens*, *C. nigra*, (*Nardus stricta*); however, also *C. echinata* or *C. pauciflora* could be present.

Ground layer is defined by *Polytrichum commune*, *P. formosum*, *Sphagnum capillifolium*, *Dicranum scoparium*, less frequent are *S. girgensohnii* and *Plagiothecium curvifolium*. Other peat moss species were also recorded (in one of total six relevés): *S. rubellum* and *S. russowii*.

Phytocoenological records of the association *Sphagno acutifolii-Piceetum* come from Martinské hole (Veterné hole Mts) and Kubínska hoľa Mt. (Oravská Magura Mts). Stands are distributed above 1 390 m a.s.l., only ocassionally below 1 300 m (Kubínska hoľa Mt.) and then in more species-rich variant.

Variability of the association in Slovakia is poorly known as only six relevés were published. However, some differences could be identified in the species composition either of field layer or ground layer (see Kučera, 2012, rel. 74–77 vs. Kučera, 2005, rel. 3 vs. Kučera, 2012, rel. 97).

Nomenclatural and syntaxonomical note on the name type "*Sphagno-Piceetum*"

As shown in Electronic Supplement A3, section I (Willner, 2007; Kučera, 2012; Chytrý et al., 2013), application of names with the species combination *Sphagnum-Picea* should strictly follow determination of the validly published original diagnosis of a particular syntaxon. At the same time, their careful consideration is needed because they could label different syntaxa. For example, the proposal of Chytrý et al. (2013) to reject *Sphagno-Piceetum* (Tüxen 1937) Hartmann 1953 as a *nomen ambiguum* (cf. Art. 36) does not solve problems of later multiple descriptions of "*Sphagno-Piceetum*" syntaxa from which several are not homonyms what Chytrý et al. (2013) stated.

Selected cases are briefly discussed in Electronic Supplement A3; however, the necessary nomenclatural proposals are given here to assure their effective publication in the respect of the current version of the ICPN (Weber et al. 2000, Art. 1):

A) Completion of the name *Piceetum excelsae sphagnetosum* Tüxen 1937 **(**see Tüxen 1937, p. 123**)** according to ICPN Rec. 10C:

Table 3. **Differential table of all associations of the wet woodlands with *Picea abies* with constancy (%) and fidelity (φ (× 100) ≥ 25) in the exponent**

I – order *Piceetalia excelsae* Pawłowski ex Pawłowski et al. 1928
A – alliance *Piceion excelsae* Pawłowski ex Pawłowski et al. 1928
1 – *Sphagno acutifolii-Piceetum* Zukrigl 1973
II – order *Sphagno palustris-Piceetalia abietis* P. Kučera 2019
B – alliance *Sphagno palustris-Piceion abietis* P. Kučera 2019
2 – *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939
3 – *Carex rostrata-Picea abies* community (with cover-abundance values in italics)
4 – *Leucobryo glauci-Piceetum abietis* Šomšák ex P. Kučera 2019
5 – *Sphagno palustris-Piceetum* Šomšák 1979
6 – *Equiseto sylvatici-Piceetum* Šmarda 1950
C – alliance *Stellario nemorum-Abietion albae* P. Kučera 2019
7 – *Stellario nemorum-Abietetum albae* P. Kučera 2019
D – alliance *Valeriano dioicae-Abietion albae* P. Kučera 2019
8 – *Valeriano dioicae-Abietetum* P. Kučera 2019

Field and ground layer species with constancy less than 10 % in a single column are omitted (except *Sphagnum* subsp.) as well as one relevé records of *Salix* sp. (E_1), *Athyrium* sp., *Taraxacum* sect. *Ruderalia*, *Ranunculus acris* (in group No. 1).

Order	**I**	**II**					**II**	**II**
Alliance	**A**	**B**					**C**	**D**
Group No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
No. of relevés	6	24	1	15	37	13	36	13
Differential tree and shrub species								
E_3								
Sorbus aucuparia	33^{41}	4^{-}	.	.$^{-}$	.$^{-}$	8^{-}	6^{-}	.$^{-}$
Abies alba	.$^{-}$	17^{-}	.	.$^{-}$	.$^{-}$	8^{-}	**78^{64}**	23^{-}
Fagus sylvatica	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	25^{47}	.$^{-}$
Pinus sylvestris	.$^{-}$	17^{-}	.	47^{17}	32^{-}	38^{-}	.$^{-}$	**62^{30}**
Alnus incana	.$^{-}$	4^{-}	.	7^{-}	32^{14}	38^{-}	3^{-}	46^{29}
Alnus glutinosa	.$^{-}$	.$^{-}$	.	20^{-}	19^{-}	23^{-}	.$^{-}$	38^{28}
E_2								
Pinus mugo	**33^{55}**	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$
Pinus sylvestris	.$^{-}$	8^{27}	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$
Alnus incana	.$^{-}$	.$^{-}$	.	.$^{-}$	22^{10}	46^{40}	.$^{-}$	23^{-}
Fagus sylvatica	17^{-}	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	42^{49}	.$^{-}$
Lonicera xylosteum	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	17^{38}	.$^{-}$
Acer pseudoplatanus	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	14^{35}	.$^{-}$
Sorbus aucuparia	17^{-}	4^{-}	.	7^{-}	.$^{-}$	38^{-}	**56^{33}**	31^{-}
Salix caprea	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	8^{-}	14^{26}	.$^{-}$
Viburnum opulus	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	23^{45}
Frangula alnus	.$^{-}$	4^{-}	.	13^{-}	11^{-}	23^{-}	.$^{-}$	46^{38}
Lonicera nigra	.$^{-}$	.$^{-}$	.	.$^{-}$	3^{-}	15^{-}	44^{29}	**62^{47}**
E_1								
Pinus mugo	**33^{55}**	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$
Salix aurita	.$^{-}$	.$^{-}$	.	7^{-}	24^{39}	.$^{-}$	.$^{-}$	.$^{-}$
Corylus avellana	.$^{-}$	.$^{-}$	.	.$^{-}$	8^{27}	.$^{-}$	.$^{-}$	.$^{-}$
Lonicera xylosteum	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	14^{35}	.$^{-}$
Fagus sylvatica	.$^{-}$	17^{-}	.	.$^{-}$	.$^{-}$	.$^{-}$	22^{30}	.$^{-}$
Daphne mezereum	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	**31^{53}**
Viburnum opulus	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	23^{45}
Ribes petraeum	.$^{-}$	.$^{-}$	.	.$^{-}$	3^{-}	.$^{-}$	.$^{-}$	15^{33}
Sorbus aucuparia	**67^{-}**	21^{-}	.	**60^{-}**	**54^{-}**	**62^{-}**	**56^{-}**	**92^{28}**
Frangula alnus	.$^{-}$	4^{-}	.	20^{-}	19^{-}	.$^{-}$	.$^{-}$	31^{27}
Lonicera nigra	.$^{-}$	4^{-}	.	.$^{-}$	19^{-}	46^{28}	11^{-}	**54^{36}**
Abies alba	17^{-}	38^{-}	.	7^{-}	11^{-}	46^{-}	**72^{30}**	**69^{27}**

Order	I	II					II	II
Alliance	A	B					C	D
Group No.	1	2	3	4	5	6	7	8
No. of relevés	6	24	1	15	37	13	36	13
Other tree and shrub species								
E_3								
Picea abies	**100**$^{-}$	**100**$^{-}$	*2*$^{n/a}$	**100**$^{-}$	**100**$^{-}$	**100**$^{-}$	**100**$^{-}$	**100**$^{-}$
Betula pubescens	.$^{-}$	29^{-}	.	7^{-}	30^{14}	23^{-}	.$^{-}$	31^{-}
Betula pendula	.$^{-}$	17^{-}	.	7^{-}	14^{-}	38^{25}	.$^{-}$	38^{25}
Larix decidua	.$^{-}$	.$^{-}$	.	13^{-}	3^{-}	.$^{-}$	.$^{-}$	8^{-}
Salix cinerea	.$^{-}$	4^{-}	.	.$^{-}$	3^{-}	.$^{-}$	.$^{-}$	.$^{-}$
Salix ×multinervis	.$^{-}$	.$^{-}$	.	.$^{-}$	3^{-}	.$^{-}$	.$^{-}$	.$^{-}$
Frangula alnus	.$^{-}$	.$^{-}$	.	.$^{-}$	3^{-}	.$^{-}$	.$^{-}$	.$^{-}$
Salix pentandra	.$^{-}$	.$^{-}$	.	.$^{-}$	3^{-}	.$^{-}$	.$^{-}$	.$^{-}$
E_2								
Picea abies	**50**$^{-}$	**96**^{16}	*2*$^{n/a}$	**93**$^{-}$	**95**^{15}	**92**$^{-}$	**64**$^{-}$	**69**$^{-}$
Abies alba	.$^{-}$	8^{-}	.	.$^{-}$	.$^{-}$	15^{-}	17^{13}	15^{-}
Alnus glutinosa	.$^{-}$	.$^{-}$	.	13^{-}	5^{-}	15^{-}	.$^{-}$	8^{-}
Betula pubescens	.$^{-}$	4^{-}	.	.$^{-}$	5^{-}	15^{-}	.$^{-}$	.$^{-}$
Sambucus racemosa	.$^{-}$	4^{-}	.	.$^{-}$	.$^{-}$	.$^{-}$	11^{25}	.$^{-}$
Salix cinerea	.$^{-}$	4^{-}	.	.$^{-}$	3^{-}	8^{-}	.$^{-}$	.$^{-}$
Pinus ×celakovskiorum A. et Gr.	.$^{-}$	4^{-}	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$
Sambucus nigra	.$^{-}$	4^{-}	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$
Salix aurita	.$^{-}$	.$^{-}$	.	.$^{-}$	3^{-}	.$^{-}$	.$^{-}$	.$^{-}$
Juniperus communis	.$^{-}$	.$^{-}$	.	.$^{-}$	3^{-}	.$^{-}$	.$^{-}$	.$^{-}$
Larix decidua	.$^{-}$	.$^{-}$	.	.$^{-}$	3^{-}	.$^{-}$	.$^{-}$	.$^{-}$
Betula pendula	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	8^{-}	.$^{-}$	.$^{-}$
Padus avium	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	8^{-}
E_1								
Picea abies	**67**$^{-}$	**92**$^{-}$	.	**93**$^{-}$	**89**$^{-}$	**100**$^{-}$	78^{-}	**100**$^{-}$
Alnus incana	.$^{-}$	8^{-}	.	13^{-}	27^{24}	8^{-}	3^{-}	8^{-}
Betula pubescens	.$^{-}$	12^{-}	.	7^{-}	24^{20}	23^{-}	3^{-}	.$^{-}$
Acer pseudoplatanus	.$^{-}$	17^{-}	.	.$^{-}$	.$^{-}$	15^{-}	11^{-}	15^{-}
Betula pendula	.$^{-}$	8^{-}	.	7^{-}	3^{-}	15^{-}	.$^{-}$	23^{23}
Alnus glutinosa	.$^{-}$	.$^{-}$	.	20^{21}	5^{-}	8^{-}	.$^{-}$	15^{-}
Salix caprea	.$^{-}$	.$^{-}$	.	7^{-}	3^{-}	8^{-}	8^{-}	.$^{-}$
Rosa pendulina	.$^{-}$	.$^{-}$	.	.$^{-}$	5^{-}	.$^{-}$	6^{-}	15^{-}
Salix aurita	.$^{-}$	.$^{-}$	.	7^{-}	8^{-}	.$^{-}$	.$^{-}$	.$^{-}$
Salix cinerea	.$^{-}$	4^{-}	.	.$^{-}$	.$^{-}$	8^{-}	.$^{-}$	8^{-}
Pinus sylvestris	.$^{-}$	4^{-}	.	7^{-}	.$^{-}$	8^{-}	.$^{-}$	.$^{-}$
Padus avium	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	8^{-}	.$^{-}$	8^{-}
Sambucus racemosa	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	6^{-}	.$^{-}$
Ribes uva-crispa	.$^{-}$	.$^{-}$	.	.$^{-}$	3^{-}	.$^{-}$	.$^{-}$	.$^{-}$
Salix silesiaca	.$^{-}$	.$^{-}$	+$^{n/a}$	.$^{-}$	.$^{-}$	.$^{-}$	3^{-}	.$^{-}$
Differential field layer species (E_1)								
Juncus filiformis	**83**^{87}	.$^{-}$	.	.$^{-}$	5^{-}	.$^{-}$	.$^{-}$	.$^{-}$
Eriophorum vaginatum	**83**^{81}	17^{3}	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$
Dryopteris dilatata	**83**^{72}	4^{-}	.	.$^{-}$	.$^{-}$	.$^{-}$	31^{15}	.$^{-}$
Athyrium distentifolium	**67**^{72}	.$^{-}$	.	.$^{-}$	5^{-}	.$^{-}$	6^{-}	.$^{-}$
Dryopteris expansa	**50**^{66}	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	3^{-}	.$^{-}$
Nardus stricta	**67**^{63}	12^{-}	.	.$^{-}$	14^{-}	.$^{-}$	3^{-}	.$^{-}$
Homogyne alpina	**100**^{57}	42^{-}	*2*$^{n/a}$	.$^{-}$	16^{-}	23^{-}	**58**^{21}	.$^{-}$
Carex nigra	**67**^{50}	12^{-}	+$^{n/a}$	7^{-}	27^{9}	.$^{-}$	3^{-}	15^{-}

Order	I	II					II	II
Alliance	A	B					C	D
Group No.	1	2	3	4	5	6	7	8
No. of relevés	6	24	1	15	37	13	36	13
Carex canescens	**67**^{38}	21^{-}	.	20^{-}	49^{21}	15^{-}	3^{-}	8^{-}
Avenella flexuosa	**83**^{35}	21^{-}	.	**67**^{21}	41^{-}	15^{-}	42^{-}	23^{-}
Listera cordata	.$^{-}$	12^{29}	.	.$^{-}$	.$^{-}$	.$^{-}$	3^{-}	.$^{-}$
Thelypteris palustris	.$^{-}$	8^{27}	+$^{n/a}$	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$
Melampyrum sylvaticum	.$^{-}$	4^{-}	.	47^{49}	14^{-}	8^{-}	.$^{-}$	.$^{-}$
Luzula luzuloides	.$^{-}$	4^{-}	.	47^{32}	32^{16}	.$^{-}$	22^{-}	15^{-}
Calluna vulgaris	.$^{-}$	4^{-}	.	20^{30}	.$^{-}$	8^{-}	.$^{-}$	.$^{-}$
Agrostis canina	.$^{-}$	4^{-}	.	7^{-}	**54**^{59}	.$^{-}$	.$^{-}$	8^{-}
Viola palustris	.$^{-}$	.$^{-}$	.	.$^{-}$	41^{54}	.$^{-}$	.$^{-}$	8^{-}
Ranunculus flammula	.$^{-}$	.$^{-}$	.	7^{-}	35^{50}	.$^{-}$	.$^{-}$	.$^{-}$
Juncus effusus	.$^{-}$	4^{-}	.	.$^{-}$	32^{44}	8^{-}	.$^{-}$	.$^{-}$
Potentilla erecta	.$^{-}$	12^{-}	.	20^{-}	65^{43}	31^{-}	.$^{-}$	23^{-}
Agrostis stolonifera	.$^{-}$	4^{-}	.	7^{-}	35^{41}	8^{-}	3^{-}	.$^{-}$
Carex rostrata	.$^{-}$	.$^{-}$	*2*$^{n/a}$	.$^{-}$	16^{38}	.$^{-}$	.$^{-}$	.$^{-}$
Valeriana simplicifolia	.$^{-}$	.$^{-}$	.	.$^{-}$	22^{36}	8^{-}	.$^{-}$	.$^{-}$
Ajuga reptans	.$^{-}$	.$^{-}$	.	7^{-}	24^{32}	.$^{-}$	3^{-}	8^{-}
Carex pallescens	.$^{-}$	.$^{-}$	.	.$^{-}$	11^{31}	.$^{-}$	.$^{-}$	.$^{-}$
Moneses uniflora	.$^{-}$	.$^{-}$	.	.$^{-}$	16^{29}	8^{-}	.$^{-}$	.$^{-}$
Senecio "nemorensis"	.$^{-}$	4^{-}	.	.$^{-}$	14^{29}	.$^{-}$	.$^{-}$	.$^{-}$
Galium palustre	.$^{-}$	4^{-}	.	.$^{-}$	19^{27}	8^{-}	3^{-}	.$^{-}$
Peucedanum palustre	.$^{-}$	.$^{-}$	.	.$^{-}$	8^{27}	.$^{-}$	.$^{-}$	.$^{-}$
Galium uliginosum	.$^{-}$	.$^{-}$	.	.$^{-}$	8^{27}	.$^{-}$	.$^{-}$	.$^{-}$
Melampyrum pratense	.$^{-}$	.$^{-}$	.	.$^{-}$	8^{27}	.$^{-}$	.$^{-}$	.$^{-}$
Orthilia secunda	.$^{-}$	8^{-}	.	33^{-}	51^{26}	31^{-}	.$^{-}$	46^{-}
Trientalis europaea	.$^{-}$	8^{-}	.	.$^{-}$	11^{-}	38^{45}	.$^{-}$	.$^{-}$
Veratrum album subsp. *lobelianum*	.$^{-}$	12^{-}	+$^{n/a}$	.$^{-}$	8^{-}	38^{27}	22^{-}	23^{-}
Stellaria nemorum	.$^{-}$	.$^{-}$	.	.$^{-}$	3^{-}	.$^{-}$	**78**^{85}	.$^{-}$
Chrysosplenium alternifolium	.$^{-}$	.$^{-}$	.	.$^{-}$	5^{-}	.$^{-}$	**69**^{73}	8^{-}
Petasites albus	.$^{-}$	4^{-}	.	.$^{-}$	.$^{-}$	.$^{-}$	**67**^{72}	8^{-}
Lysimachia nemorum	.$^{-}$	.$^{-}$	.	.$^{-}$	3^{-}	.$^{-}$	**50**^{66}	.$^{-}$
Adenostyles alliariae	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	39^{59}	.$^{-}$
Cardamine trifolia	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	39^{59}	.$^{-}$
Geranium robertianum	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	39^{59}	.$^{-}$
Impatiens noli-tangere	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	44^{58}	8^{-}
Luzula luzulina	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	36^{57}	.$^{-}$
Prenanthes purpurea	.$^{-}$	.$^{-}$	.	.$^{-}$	3^{-}	.$^{-}$	61^{57}	31^{-}
Gentiana asclepiadea	.$^{-}$	4^{-}	.	.$^{-}$	3^{-}	8^{-}	67^{56}	31^{-}
Rubus hirtus	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	33^{55}	.$^{-}$
Galium odoratum	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	31^{52}	.$^{-}$
Milium effusum	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	25^{47}	.$^{-}$
Urtica dioica	.$^{-}$	.$^{-}$	.	.$^{-}$	14^{-}	15^{-}	44^{45}	.$^{-}$
Ranunculus lanuginosus	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	22^{44}	.$^{-}$
Ranunculus platanifolius	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	22^{44}	.$^{-}$
Phyteuma spicatum	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	19^{41}	.$^{-}$
Geum rivale	.$^{-}$	.$^{-}$	.	.$^{-}$	5^{-}	.$^{-}$	39^{41}	23^{-}
Carex sylvatica	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	31^{40}	15^{-}
Veronica anagallis-aquatica	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	17^{38}	.$^{-}$
Cardamine flexuosa	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	17^{38}	.$^{-}$
Calamagrostis epigejos	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	17^{38}	.$^{-}$

Order	I	II					II	II
Alliance	A	B					C	D
Group No.	1	2	3	4	5	6	7	8
No. of relevés	6	24	1	15	37	13	36	13
Poa remota	.–	.–	.	.–	.–	.–	17[38]	.–
Phegopteris connectilis	.–	.–	.	.–	3–	15–	31[38]	.–
Rubus idaeus	.–	12–	.	20–	49–	**54**–	83[37]	**54**–
Oxalis acetosella	.–	**50**–	.	40–	**51**–	**85**–	**100**[35]	**77**–
Cicerbita alpina	.–	.–	.	.–	.–	.–	14[35]	.–
Dryopteris filix-mas	.–	8–	.	7–	14–	23–	**53**[35]	31–
Luzula sylvatica	.–	12–	.	.–	.–	.–	22[32]	.–
Epilobium montanum	.–	.–	.	.–	8–	.–	33[31]	31–
Cardamine amara	.–	.–	.	.–	11–	.–	25[28]	15–
Poa palustris	.–	.–	.	.–	3–	.–	17[27]	8–
Symphytum tuberosum	.–	.–	.	.–	.–	.–	8[27]	.–
Sanicula europaea	.–	.–	.	.–	.–	.–	8[27]	.–
Rubus saxatilis	.–	.–	.	.–	3–	.–	.–	**92**[94]
Valeriana dioica	.–	.–	.	7–	5–	8–	.–	**77**[75]
Polygonatum verticillatum	.–	.–	.	.–	3–	8–	6–	**69**[71]
Clematis alpina	.–	.–	.	.–	.–	.–	.–	38[59]
Cirsium oleraceum	.–	.–	.	.–	.–	.–	.–	38[59]
Filipendula ulmaria	.–	.–	.	.–	8–	.–	14–	54[56]
Crepis paludosa	.–	4–	.	20–	**54**[14]	**54**–	28–	**100**[53]
Thalictrum aquilegiifolium	.–	.–	.	.–	.–	.–	.–	31[53]
Carex alba	.–	.–	.	.–	.–	.–	.–	31[53]
Caltha palustris	.–	8–	.	33–	**54**[13]	**54**–	19–	**100**[52]
Galium schultesii	.–	.–	.	.–	.–	.–	3–	31[50]
Fragaria vesca	.–	.–	.	.–	5–	8–	25[14]	**54**[49]
Melica nutans	.–	.–	.	.–	.–	.–	.–	23[45]
Astrantia major	.–	.–	.	.–	.–	.–	.–	23[45]
Solidago virgaurea	.–	.–	.	13–	8–	31–	31[10]	**62**[41]
Maianthemum bifolium	.–	8–	.	**67**–	**68**[13]	**77**–	44–	**100**[39]
Carex remota	.–	.–	.	.–	11–	.–	8–	31[38]
Dactylorhiza maculata	.–	.–	.	.–	.–	8–	.–	23[37]
Carex digitata	.–	.–	.	.–	.–	.–	.–	15[37]
Actaea spicata	.–	.–	.	.–	.–	.–	.–	15[37]
Equisetum palustre	.–	.–	.	.–	3–	15–	3–	31[37]
Epipactis palustris	.–	.–	.	.–	3–	.–	.–	15[33]
Valeriana tripteris	.–	.–	.	.–	.–	.–	3–	15[33]
Polygonatum multiflorum	.–	.–	.	.–	.–	.–	3–	15[33]
Paris quadrifolia	.–	.–	.	.–	5–	23[21]	.–	31[33]
Angelica sylvestris	.–	.–	.	.–	3–	.–	3–	15[30]
Dentaria glandulosa	.–	.–	.	.–	.–	.–	19[23]	23[29]
Bistorta major	.–	.–	.	7–	3–	.–	.–	15[26]
Calamagrostis arundinacea	.–	.–	.	**67**[35]	24–	8–	**61**[30]	38–
Lysimachia vulgaris	.–	4–	.	20–	**54**[30]	**62**[37]	.–	23–
Equisetum sylvaticum	17–	42–	.	**60**–	**86**–	**100**[27]	**100**[27]	**77**–
Chaerophyllum hirsutum	.–	.–	.	7–	19–	15–	**78**[47]	**69**[39]
Senecio ovatus	.–	.–	.	13–	24–	46–	**83**[43]	**69**[31]
Luzula pilosa	.–	4–	.	**93**[32]	**86**[26]	**85**[25]	11–	**100**[37]
Other field layer species (E_1)								
Vaccinium myrtillus	**100**–	**100**–	+[n/a]	**100**–	**97**–	**100**–	**75**–	**100**–
Vaccinium vitis-idaea	**83**–	**100**[21]	.	**93**–	**92**[13]	**92**–	25–	**69**–

Order	I	II					II	II
Alliance	A	B					C	D
Group No.	1	2	3	4	5	6	7	8
No. of relevés	6	24	1	15	37	13	36	13
Calamagrostis villosa	**83**$^{-}$	**62**$^{-}$	*2*$^{n/a}$	**60**$^{-}$	**81**$^{-}$	**100**^{24}	**61**$^{-}$	**69**$^{-}$
Dryopteris carthusiana	.$^{-}$	42^{-}	.	**67**$^{-}$	**76**^{19}	**77**$^{-}$	**58**$^{-}$	46^{-}
Athyrium filix-femina	.$^{-}$	8^{-}	.	**67**$^{-}$	**73**^{18}	**62**$^{-}$	**75**^{20}	**69**$^{-}$
Deschampsia cespitosa	17^{-}	8^{-}	*1*$^{n/a}$	13^{-}	**54**^{23}	38^{-}	**53**^{22}	15^{-}
Hieracium murorum	.$^{-}$	12^{-}	.	40^{-}	16^{-}	31^{-}	**53**^{23}	38^{-}
Myosotis palustris spojene	.$^{-}$	4^{-}	.	7^{-}	41^{22}	15^{-}	36^{-}	31^{-}
Carex echinata	33^{-}	4^{-}	*1*$^{n/a}$	40^{-}	46^{22}	23^{-}	.$^{-}$	15^{-}
Ranunculus repens	.$^{-}$	.$^{-}$	.	7^{-}	27^{-}	31^{-}	39^{24}	15^{-}
Gymnocarpium dryopteris	.$^{-}$	4^{-}	.	7^{-}	22^{-}	23^{-}	19^{-}	31^{-}
Veronica officinalis	.$^{-}$	.$^{-}$	.	13^{-}	32^{22}	23^{-}	14^{-}	15^{-}
Lycopodium annotinum	33^{-}	38^{25}	.	13^{-}	.$^{-}$	.$^{-}$	8^{-}	15^{-}
Glyceria nemoralis	.$^{-}$	.$^{-}$	.	.$^{-}$	24^{23}	.$^{-}$	19^{-}	15^{-}
Mycelis muralis	.$^{-}$	.$^{-}$	.	.$^{-}$	19^{-}	8^{-}	17^{-}	23^{-}
Anemone nemorosa	.$^{-}$	.$^{-}$	.	.$^{-}$	3^{-}	15^{-}	19^{18}	15^{-}
Huperzia selago	.$^{-}$	4^{-}	.	7^{-}	5^{-}	8^{-}	6^{-}	23^{24}
Cirsium palustre	.$^{-}$	.$^{-}$	.	7^{-}	16^{18}	8^{-}	3^{-}	8^{-}
Glyceria fluitans	.$^{-}$	.$^{-}$	.	13^{-}	16^{23}	.$^{-}$	3^{-}	.$^{-}$
Oxycoccus palustris	.$^{-}$	12^{-}	.	.$^{-}$	8^{-}	.$^{-}$	.$^{-}$	.$^{-}$
Soldanella hungarica	.$^{-}$	.$^{-}$	.	.$^{-}$	11^{18}	8^{-}	3^{-}	.$^{-}$
Pyrola rotundifolia	.$^{-}$	.$^{-}$	.	.$^{-}$	11^{21}	.$^{-}$	.$^{-}$	8^{-}
Calamagrostis canescens	.$^{-}$	.$^{-}$	.	.$^{-}$	8^{-}	.$^{-}$	.$^{-}$	15^{-}
Prunella vulgaris	.$^{-}$	.$^{-}$	.	.$^{-}$	3^{-}	8^{-}	3^{-}	15^{-}
Doronicum austriacum	.$^{-}$	.$^{-}$	.	.$^{-}$	.$^{-}$	8^{-}	11^{21}	.$^{-}$
Alchemilla sp.	17^{-}	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	6^{-}	.$^{-}$
Rumex alpinus	17^{-}	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	3^{-}	.$^{-}$
Carex pauciflora	17^{-}	4^{-}	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$
Hypericum maculatum	.$^{-}$	4^{-}	+$^{n/a}$	.$^{-}$	.$^{-}$	8^{-}	.$^{-}$	.$^{-}$
Differential ground layer species (E_0)								
Sphagnum capillifolium	**83**^{58}	12^{-}	.	7^{-}	16^{-}	23^{-}	.$^{-}$	23^{-}
Sphagnum rubellum	33^{55}	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$
Lophocolea heterophylla	33^{43}	.$^{-}$	.	7^{-}	.$^{-}$	8^{-}	.$^{-}$	.$^{-}$
Polytrichum formosum	**83**^{41}	25^{-}	.	47^{-}	22^{-}	8^{-}	22^{-}	38^{-}
Calypogeia azurea	33^{40}	4^{-}	.	.$^{-}$	.$^{-}$	8^{-}	.$^{-}$	8^{-}
Dicranum fuscescens	17^{38}	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$
Polytrichum alpinum	17^{38}	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$
Barbilophozia floerkei	17^{38}	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$
Sphagnum fuscum	17^{38}	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$
Barbilophozia attenuata	17^{38}	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$
Pleuridium subulatum	17^{38}	.$^{-}$	.	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$
Polytrichum commune	**100**^{37}	**75**^{17}	*4*$^{n/a}$	47^{-}	**57**$^{-}$	**62**$^{-}$	36^{-}	8^{-}
Leucobryum glaucum	.$^{-}$	.$^{-}$	.	**100**^{84}	11^{-}	8^{-}	.$^{-}$	15^{-}
Orthodicranum undulatum	.$^{-}$	.$^{-}$	.	13^{34}	.$^{-}$	.$^{-}$	.$^{-}$	.$^{-}$
Hylocomium splendens	.$^{-}$	8^{-}	.	**53**^{32}	46^{24}	15^{-}	19^{-}	8^{-}
Brachythecium starkei	.$^{-}$	.$^{-}$	.	.$^{-}$	14^{30}	.$^{-}$	3^{-}	.$^{-}$
Lepidozia reptans	.$^{-}$	.$^{-}$	.	33^{-}	49^{30}	38^{-}	.$^{-}$	15^{-}
Sphagnum palustre agg.	.$^{-}$	**50**$^{-}$	*1*$^{n/a}$	27^{-}	**70**^{28}	46^{-}	3^{-}	**62**$^{-}$
Chiloscyphus pallescens	.$^{-}$	.$^{-}$	.	7^{-}	19^{27}	8^{-}	.$^{-}$	.$^{-}$
Sphagnum quinquefarium	.$^{-}$	.$^{-}$	.	.$^{-}$	8^{27}	.$^{-}$	.$^{-}$	.$^{-}$
Rhodobryum roseum	.$^{-}$	.$^{-}$	.	.$^{-}$	8^{27}	.$^{-}$	.$^{-}$	.$^{-}$

Order	I	II					II	II
Alliance	A	B					C	D
Group No.	1	2	3	4	5	6	7	8
No. of relevés	6	24	1	15	37	13	36	13
Cephalozia bicuspidata	.–	.–	.	.–	8[27]	.–	.–	.–
Calliergon cordifolium	.–	.–	.	.–	8[27]	.–	.–	.–
Plagiochila asplenioides	.–	.–	.	7–	43[26]	23–	17–	38–
Lophocolea bidentata	.–	.–	.	.–	19[14]	38[41]	.–	8–
Sphagnum recurvum agg.	.–	4–	.	.–	16[17]	23[29]	.–	.–
Bazzania trilobata	.–	29[16]	.	.–	5–	38[27]	.–	31–
Cirriphyllum piliferum	.–	.–	.	.–	3–	.–	36[55]	.–
Plagiomnium affine	.–	4–	.	20–	8–	31–	**72**[48]	23–
Plagiothecium undulatum	.–	8–	.	.–	.–	.–	25[39]	.–
Plagiomnium rostratum	.–	.–	.	.–	.–	.–	14[35]	.–
Conocephalum conicum	.–	.–	.	.–	.–	.–	14[35]	.–
Plagiomnium undulatum	.–	.–	.	.–	5–	15–	31[32]	8–
Thuidium tamariscinum	.–	.–	.	.–	.–	.–	11[31]	.–
Trichocolea tomentella	.–	.–	.	.–	.–	8–	.–	23[37]
Eurhynchium angustirete	.–	.–	.	7–	14–	15–	.–	31[30]
Tetraphis pellucida	.–	.–	.	7–	19[12]	15–	.–	31[28]
Other ground layer species (E_0)								
Dicranum scoparium	**83**–	**67**–	.	**93**–	**81**–	**92**–	**61**–	**85**–
Sphagnum girgensohnii	**67**–	**83**[22]	*2b*[n/a]	47–	**65**–	38–	**53**–	46–
Pleurozium schreberi	33–	**54**–	.	**80**[21]	**65**[8]	**69**–	11–	**69**–
Plagiothecium curvifolium	**67**–	8–	.	27–	24–	46–	44[11]	8–
Rhytidiadelphus triquetrus	.–	4–	.	27–	46[24]	31–	6–	38–
Rhizomnium punctatum	.–	.–	.	13–	27–	23–	36[20]	23–
Sphagnum squarrosum	.–	17–	+[n/a]	.–	30[17]	31–	6–	23–
Pohlia nutans	17–	8–	.	20–	35[22]	23–	.–	8–
Calypogeia integristipula	33–	.–	.	20–	22[7]	8–	.–	23–
Dicranum montanum	33–	4–	.	.–	14–	15–	.–	15–
Mnium sp.	.–	.–	.	7–	22[22]	15–	.–	8–
Climacium dendroides	.–	.–	.	.–	22[22]	15–	.–	15–
Dicranella heteromalla	17–	4–	.	27[22]	8–	.–	.–	15–
Sphagnum sp.	.–	8–	.	20–	3–	8–	.–	15–
Herzogiella seligeri	.–	.–	.	7–	14[16]	15–	.–	.–
Pellia sp.	.–	.–	.	7–	11[16]	8–	.–	.–
Sphagnum russowii	17–	.–	.	.–	8–	8–	.–	.–
Dicranum polysetum	.–	4–	.	.–	11[24]	.–	.–	.–
Plagiothecium laetum	17–	.–	.	7–	.–	.–	3–	8–
Barbilophozia lycopodioide	17–	4–	.	.–	.–	.–	.–	8–
Sphagnum magellanicum	.–	.–	*1*[n/a]	7–	3–	.–	.–	.–
Sphagnum flexuosum	.–	.–	*1*[n/a]	.–	3–	8–	.–	.–
Sphagnum subnitens	.–	4–	.	.–	.–	.–	.–	.–
Sphagnum fallax	.–	.–	.	.–	3–	.–	.–	.–
Sphagnum obtusum	.–	.–	.	.–	3–	.–	.–	.–
Sphagnum cuspidatum	.–	.–	.	.–	3–	.–	.–	.–
Sphagnum riparium	.–	.–	.	.–	.–	8–	.–	.–
Sphagnum teres	.–	.–	.	.–	.–	8–	.–	.–

Other species in the column 3 only:
Agrostis tenuis +, *Eriophorum angustifolium* +, *Drepanocladus fluitans* +.

***Piceetum excelsae sphagnetosum quinquefarii* Tüxen 1937**

Consequently, the association name published by Hartmann (1953) is to be completed as follows:

***Sphagno quinquefarii-Piceetum* (Tüxen 1937) Hartmann 1953**; see Hartmann (1953), Anhang, p. XIII.

B) Lectotypes for the association *Sphagno girgensohnii-Piceetum* Polakowski 1962 nom. cons. propos. and its subunits (ICPN Def. VIII, Art. 19):

***Sphagno girgensohnii-Piceetum* Polakowski 1962 nom. cons. propos.**

Nomenclatural type: Polakowski (1962), tab. 4, rel. 29; lectotypus hoc loco.

Sphagno girgensohnii-Piceetum lycopodietosum annotini Polakowski 1962

Nomenclatural type: Polakowski (1962), tab. 4, rel. 29; lectotypus hoc loco.

Sphagno girgensohnii-Piceetum vaccinietosum myrtilli Polakowski 1962 (Art. 14)

Nomenclatural type: Polakowski (1962), tab. 4, rel. 54; lectotypus hoc loco.

II. *Sphagno palustris-Piceetalia* P. Kučera ordo nov. hoc loco

Original diagnosis: *Sphagno palustris-Piceion abietis* P. Kučera 2019 all. nov., *Sphagno girgensohnii-Piceion* (Kielland-Lund 1981) P. Kučera 2019 stat. nov., *Stellario nemorum-Abietion albae* P. Kučera 2019 all. nov., *Valeriano dioicae-Abietion albae* P. Kučera 2019 all. nov.

Nomenclatural type: *Sphagno palustris-Piceion* P. Kučera 2019 all. nov., holotypus hoc loco.

Differential species (φ (× 100) ≥ 25) (145 relevés, Tab. 1 – in Electronic Supplement B1):

E_3: *Pinus sylvestris* (42), *Abies alba* (38), *Alnus incana* (36), *Betula pendula* (31), *Alnus glutinosa* (29), *B. pubescens* (27),

E_2: *Picea abies* (48), *Alnus incana* (29), *Frangula alnus* (28),

E_1: *Abies alba* (47), *Picea abies* (43), *Alnus incana* (29) *Frangula alnus* (27), *Salix aurita* (26),

Equisetum sylvaticum (82), *Luzula pilosa* (63), *Caltha palustris* (52), *Deschampsia cespitosa* (45), *Dryopteris carthusiana* (43), *Potentilla erecta* (43), *Lysimachia vulgaris* (42), *Maianthemum bifolium* (39), *Myosotis palustris* agg. (38), *Carex echinata* (38), *Carex canescens* (37), *Ranunculus repens* (34), *Agrostis canina* (33), *Orthilia secunda* (32), *Vaccinium vitis-idaea* (32), *Lysimachia nemorum* (30), *Athyrium filix-femina* (30), *Carex nigra* (30), *Glyceria nemoralis* (29), *Agrostis stolonifera* (29), *Veronica officinalis* (28), *Viola palustris* (28), *Filipendula ulmaria* (27), *Impatiens noli-tangere* (26), *Juncus effusus* (26), *Cardamine trifolia* (26), *Ranunculus flammula* (26), *Valeriana dioica* (26), *Petasites albus* (25),

E_0: *Polytrichum commune* (55), *Sphagnum palustre* agg. (54), *S. girgensohnii* (48), *S. squarrosum* (33), *Leucobryum glaucum* (31), *Plagiomnium affine* (30), *Pohlia nutans* (30), *Pleurozium schreberi* (28).

The order *Sphagno palustris-Piceetalia* P. Kučera 2019 constitutes a separate unit of the class *Piceetea excelsae* Klika 1948 alongside with the orders *Cortuso-Piceetalia* (*Athyrio-Piceetalia* sensu auct. non Hadač 1962) and *Piceetalia excelsae* Pawłowski ex Pawłowski et al. 1928. It comprises all types of wet woodlands with dominating trees *Picea abies* (occasionally *Abies alba*), its peripheral phytocoenoses mediate connections to the classes *Vaccinio uliginosi-Pinetea* Passarge 1968 and *Alnetea glutinosae* Br.-Bl. et Tüxen ex Westhoff et al. 1946.

Formal floristic differentiation of the order *Sphagno palustris-Piceetalia* in Slovakia consists for the great part of species exclusive to wet woodlands within the class *Piceetea excelsae* Klika 1948: *Pinus sylvestris*, *Alnus glutinosa* + *A. incana*, *Betula pubescens*, *Equisetum sylvaticum*, *Caltha palustris*, *Deschampsia cespitosa*, *Potentilla erecta*, *Lysimachia vulgaris*, *Sphagnum palustre* agg. etc. (see Tab. 1 – in Electronic Supplement B1).

On the base of floristic differences which reflect specific ecological conditions of the seven differentiated communities from Slovakia (Tab. 3; Tab. 4 – in Electronic Supplement B2), three subunits of the order *Sphagno palustris-Piceetalia* are distinguished in this study (Tab. 2) and they are given the rank of alliance:

(1) *Sphagno palustris-Piceion* P. Kučera 2019 all. nov. with oligotrophic communities on nutrient-poor shallow peat layers of histosols or other poor hydromophic soils (gleysols, stagnosols) with raw humus layer (*Sphagno palustris-Piceetum* Šomšák 1979, *Equiseto sylvatici-Piceetum* Šmarda 1950, *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939 and *Carex rostrata-Picea abies* community) or on temporarily flooded humic podzols on the margin of mires (*Leucobryo glauci-Piceetum abietis* Šomšák ex P. Kučera 2019);

(2) *Stellario nemorum-Abietion albae* P. Kučera 2019 all. nov. with communities on minerotrophic habitats of spring areas and small creeks on gentle (moderate) slopes or wet flatlands (*Stellario nemorum-Abietetum albae* P. Kučera 2019);

(3) *Valeriano dioicae-Abietion albae* P. Kučera 2019 all. nov. with communities on base-rich minerotrophic habitats – fens and other water-influenced habitats (*Valeriano dioicae-Abietetum* P. Kučera 2019 ass. nov.).

Still problematic is the classification of the associations *Querco-Piceetum* W. Matuszkiewicz et Polakowska 1955, *Betulo pubescentis-Piceetum* Sokołowski 1980 and *Sphagno girgensohnii-Piceetum* Polakowski 1962 described from the northeastern Poland as they come from a different phytogeographical region of the outskirts of the boreal *Picea abies* distribution range. This difference is expressed for example by partial presence of *Quercus robur*, a species exotic to communities of the aforementioned three alliances. Especially the last mentioned association is similar to *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939.

Scandinavian wet woodlands with *Picea abies* were included by Kielland-Lund (1981, 1994) into the separate suballiance *Sphagno-Piceenion* Kielland-Lund 1981 (association *Chamaemoro-Piceetum* Kielland-Lund 1962). Although they are parallel to communities of the alliance *Sphagno palustris-Piceion* P. Kučera 2019, they form a distinct phytogeographical group of phytocoenoses (occurrence of the species *Rubus chamaemorus* L., *Carex vaginata*, *Linnaea borealis*, *Calamagrostis purpurea* (Trin.) Trin.). Therefore they are here classified as a separate unit in the rank of alliance:

***Sphagno girgensohnii-Piceion* (Kielland-Lund 1981) P. Kučera 2019 stat. nov. hoc loco**

Raised name: *Sphagno [girgensohnii]-Piceenion* Kielland-Lund 1981; Kielland-Lund (1981), p. 150; cf. Art. 3g Example 2, Recomm. 10C.

II. B. *Sphagno palustris-Piceion abietis* P. Kučera all. nov. hoc loco

Original diagnosis: *Sphagno palustris-Piceetum* Šomšák 1979, *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939, *Equiseto sylvaticae-Piceetum* Šmarda 1950, *Betulo pubescentis-Abietetum albae* Lemée ex Thébaud 2008, *Leucobryo glauci-Piceetum abietis* Šomšák ex P. Kučera 2019.

Nomenclatural type: *Sphagno palustris-Piceetum* Šomšák 1979; Šomšák (1979), p. 23–29, tab. 3, holotypus hoc loco.

Differential species (φ (× 100) ≥ 25) (89 relevés, Tab. 2):

E_3: –,

E_2: *Picea abies* (31),

E_1: *Betula pubescens* (31), *Salix aurita* (28), *Vaccinium vitis-idaea* (46), *Carex canescens* (36), *Ranunculus flammula* (33), *Juncus effusus* (33), *Melampyrum sylvaticum* (33), *Agrostis canina* (32), *Potentilla erecta* (31), *Agrostis stolonifera* (31), *Carex echinata* (30), *Trientalis europaea* (29), *Lysimachia vulgaris* (29), *Valeriana simplicifolia* (26),

E_0: *Polytrichum commune* (38), *Lepidozia reptans* (31), *Pohlia nutans* (30), *Sphagnum recurvum* agg. (28), *Chiloscyphus pallescens* (26), *Herzogiella seligeri* (25).

The alliance comprises the majority of known types of wet woodlands with *Picea abies* (Tab. 4 – in Electronic Supplement B2). From the view of natural altitudinal vegetation zonation they mostly represent habitats with the extragradal natural occurrence of *Picea abies* (Kučera, 2019).

Picea abies is the canopy dominant in the wind undisturbed stands, *Abies alba* was a natural component of some communities being a competitor of Norway spruce. *Fagus sylvatica* occurred occasionally on dryer habitats. Depending on the type of habitat and the succession stage other tree species could be admixed (or temporarily dominating): *Pinus sylvestris*, *Betula pendula*, *B. pubescens*, *Alnus incana*, *A. glutinosa*.

The common character of phytocoenoses is the dominance of *Polytrichum commune* and *Sphagnum* species (especially *S. girgensohnii*, *S. centrale*, *S. palustre*), in seasonally dry habitats adjoining some mires they are replaced by *Leucobryum glaucum*. *Dicranum scoparium* and *Pleurozium schreberi* are their frequent companions. *Bazzania trilobata* is considered as the character species of the association *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939; however, the species is not frequent in available relevé data from Slovakia and it is frequently present also in the relevés assigned to *Equiseto sylvatici-Piceetum* Šmarda 1950.

Field layers of all communities are dominated usually by constant *Vaccinium myrtillus* and *V. vitis-idaea*, less frequently accompanied by *Calamagrostis villosa*, *Oxalis acetosella* and *Equisetum sylvaticum*; *Dryopteris carthusiana* is frequently present. Species *Luzula pilosa*, *Athyrium filix-femina* and *Maianthemum bifolium* for the most part positively differentiate the group of communities *Leucobryo glauci-Piceetum abietis* Šomšák ex P. Kučera 2019, *Sphagno palustris-Piceetum* Šomšák 1979, *Equiseto sylvatici-Piceetum* Šmarda 1950 against species-poor *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939.

Depending on a particular community/community group, other following species/species groups have differential value:

(1) *Eriophorum vaginatum*, *Oxycoccus palustris*, (*Carex nigra*);

(2) *Lycopodium annotinum*;

(3) *Caltha palustris*, *Lysimachia vulgaris*, *Crepis paludosa*, *Deschampsia cespitosa*;

(4) *Agrostis canina* (+ *stolonifera*), *Potentilla erecta*, *Viola palustris*, *Glyceria nemoralis* (+ *fluitans*); *Juncus effusus*, *Ranunculus flammula*.

The alliance *Sphagno palustris-Piceion* P. Kučera 2019 also includes *Calamagrostio villosae-Pinetum* Staszkiewicz 1958 (original form of the name "*Pineto-Calamagrostidetum villosae*"; cf. W. Matuszkiewicz, 1981; and others) described by Staszkiewicz (1958) from remarkable wet woodlands of Nowy Targ surroundings (northerly of the Tatras), eastwards of the Slovak-Polish state border dividing the Orava region. A speciality of the recorded stands (Staszkiewicz, 1958; Staszkiewicz, Szeląg, 2003) is the dominance of *Pinus sylvestris* over (sometimes missing) *Picea abies* (successional stage in part of localities?). Species-poor composition with mostly constantly present *Carex nigra* indicates presumable classification of this community into *Soldanello montanae-Piceetum caricetosum fuscae* Kasprowicz ex P. Kučera 2019.

The association *Betulo pubescentis-Abietetum albae* Lemée ex Thébaud 2008 was described from France (Thébaud 2006, p. 78) and documented from the Massif Central (a mountain range outside the natural occurrence of *Picea abies*) and from the Vosges (cf. Boeuf et al. 2014). This plant community is syntaxonomically close to *Soldanello-Piceetum* Volk in Br.-Bl. et al. 1939, but its species composition reflects more nutrient habitat conditions.

2. *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939

Original diagnosis: Braun-Blanquet et al. (1939), p. 31–32.

Nomenclatural type: Petermann and Seibert (1979), tab. 1, rel. b2 (Aufnahme Nr. 621), neotypus hoc loco.

Pseud.: *Bazzanio-Piceetum* (= *Mastigobryo-Piceetum*) sensu auct. non (Schmid et Gaisberg 1936) Br.-Bl. et Sissingh in Br.-Bl. et al. 1939.

Characteristic species combination: see Electronic Supplement A2.

In respect of the number of recorded species this association is a species-poor wet *Picea* woodland without own "character species". However, the community represents a distinct separate syntaxon within the alliance *Sphagno palustris-Piceion* P. Kučera 2019. It differs by (almost total) absence of species frequently found in the remaining asociations of the alliance: *Luzula pilosa*, *Athyrium filix-femina*, *Maianthemum bifolium*, or *Deschampsia cespitosa, Caltha palustris*, *Crepis paludosa*, *Lysimachia vulgaris*, *Senecio ovatus*.

The canopy and understorey are dominated by *Picea abies*, sporadically *Betula pubescens* and *Pinus sylvestris* were recorded with higher cover-abundance values. Recorded presence of *Abies alba* (cf. also Braun-Blanquet et al., 1939; Trautmann, 1952, tab. 2), especially in the field layer, as well as data of Kasprowicz (1996) from the Polish part of Orava suggest that silver fir occurrence in the stands was strongly reduced by human influence. Even *Fagus sylvatica* grows here marginally. Questionable is the possibility of the total replacement of *P. abies* with *A. alba* in localities distant from the continuous natural areal of Norway spruce.

The field layer is mostly dominated by *Vaccinium myrtillus*, *V. vitis-idaea* is a constant companion. *Calamagrostis villosa* and *Oxalis acetosella* are sometimes admixed with higher cover, similarly also *Lycopodium annotinum*, *Homogyne alpina*. *Equisetum sylvaticum* is either absent or (sub-)dominant compound of the phytocoenoses.

The name-giving species of the association, *Soldanella montana* Willd., is known in Slovakia undoubtly from only one locality in the Pieniny Mts only, other localities are under consideration (Kochjarová et al., 2016). In the relevés of the order *Sphagno palustris-Piceetalia* P. Kučera 2019 from Slovakia, only *S. hungarica* was recorded until present, mostly within the association *Sphagno palustris-Piceetum* Šomšák 1979.

Sphagnum girgensohnii is mostly dominat species of the ground layer, in records from Slovakia also occasionally *S. palustre* agg. (incl. *S. centrale*). Numerous other peat moss species were recorded. Constant species are also *Polytrichum commune*, *Dicranum scoparium* and *Pleurozium schreberi*; data on *Polytrichum formosum* are partly doubtful (cf. Staszkiewicz, 1993). *Bazzania trilobata*, a character liverwort species of this association (Braun-Blanquet et al. 1939, Trautmann 1952), growing abundantly in this community also in the Western Carpathians (Bujakiewic, 1981; Kasprowicz, 1996; Parusel, 2007) was recorded less frequently in Slovakia.

The association was recorded in Slovakia only at the foothills southerly and northerly of the Tatras and in the Babia Hora Mt. surroundings, one relevé is from the Tichá Dolina in the Tatras (Kobzáková, 1987).

Although *Sodanello montanae-Piceetum* is a very species-poor community, floristic variability allow differentiation of the ecologically interpretable subcommunities. Part of them were described under the name *Mastigobryo-Piceetum/Bazzanio-Piceetum* (Schmid et Gaisberg 1936) Br.-Bl. et Sissingh in Br.-Bl. et al. 1939 due to inadequate identification of *Soldanello-Piceetum* with *Bazzanio-Piceetum*. On the other side, misidentification of *Soldanello-Piceetum* with *Lophozio-Piceetum* Volk in Br.-Bl. et al. 1939 (see Oberdorfer, 1957) led to differentiation of subassociation *barbilophozietosum* which actually does not belong to *Soldanello-Piceetum* (see below). Selected syntaxonomical notes on the association are provided in Electronic Supplement A3, section II.

2a. *Soldanello montanae-Piceetum sphagnetosum recurvi* (Trautmann 1952) P. Kučera 2019 comb. nov. hoc loco

Basionym (in the original form of the name): *Mastigobryo-Piceetum* (Schmid et Gaisberg 1936) Br.-Bl. et Sissingh in Br.-Bl. et al. 1939 Subass. von *Sphagnum recurvum* Trautmann 1952; Trautmann (1952), p. 292.

Original diagnosis: Trautmann (1952), p. 292–293, tab. 2, second column (Subassoziation von *Sphagnum recurvum*).

Nomenclatural type: not established yet. Trautmann (1952) published a synoptic table of relevés from the Bavarian Forest, thus no relevé is available for lectotypification in his work. Relevés from that region and most probably identical with Trautmann's (1952) data were published by Hartmann, Jahn (1967) in tab. 3a; however, they were published under the name "*Mastigobryo-Piceetum*, Subassoziation nach *Carex brizoides* und *Equisetum sylvaticum*" nom. illeg. (Def. V), thus cannot be used directly for neotypification (cf. Art. 21).

The subassociation is characterized by intensified presence of *Carex brizoides* and *Equisetum sylvaticum* (Trautmann 1952) and by (mostly) absence of the species characteristic for the other subassociations (e.g. *Lycopodium annotinum*, *Homogyne alpina*, *Oxycoccus palustris*).

Kasprowicz (1996, tab. 1, rel. 11) published a relevé with dominance of *Carex brizoides* from the Polish part of Orava, slightly differing by occurrence of *Agrostis stolonifera* and *Calamagrostis canescens*. No data on the syntaxon were published from Slovakia; however, stands with *Carex brizoides* were observed in Orava flatlands (Bernátová, Kučera, 2007–2008, not.).

This subassociation could be confused with the association *Carici brizoidis-Abietetum* Trinajstić 1974. Though, the latter unit represent stands of different species-richer montane wet woodland (with *Carex remota*) first described from the Dinarides (cf. Trinajstić, 1974).

The name-giving species of the subassociation – *Sphagnum recurvum* P. Beauv. – has not been found in Europe (Flatberg, 1992). Possible renaming of the subassociation (Art. 43) (i.e. most probably *S. fallax*; if the species identity was identified correctly within *S. recurvum* agg.) should be based on reevaluation of the original material of Trautmann (1952) and other documented relevés of this subassociation from his study area (the Bavarian Forest).

2b. *Soldanello montanae-Piceetum homogynetosum alpinae* (Trautmann 1952) P. Kučera 2019 comb. nov. hoc loco

Basionym (in the original form of the name): *Mastigobryo-Piceetum* (Schmid et Gaisberg 1936) Br.-Bl. et Sissingh in Br.-Bl. et al. 1939 Subass. von *Homogyne alpina* Trautmann 1952; Trautmann (1952), p. 292.

Original diagnosis: Trautmann (1952), p. 292–293, tab. 2, third column (Subassoziation von *Homogyne alpina*).

Nomenclatural type: not established yet. Trautmann (1952) published a synoptic table of relevés from the Bavarian Forest (Bavaria), thus no relevé is available for lectotypification in his work. Similar relevés were partly published by Neuhäuslová, Eltsova (2002a: tab. 1, 2002b: tab. 1.2) but the neotypification was not accomplished because: (1) these relevés come from the southern Bohemia (bordering to Bavaria) and (2) they were published under the names "*Soldanello-Piceetum*" resp. "*Bazzanio-Piceetum typicum* var. *lycopodiosum*" (cf. Art. 21).

Syn.: *Soldanello montanae-Piceetum equisetetosum* Oberdorfer 1957 nom. superfluum (Art. 29c). Oberdorfer (1957, p. 382) transferred Trautmann's (1952) relevés of the subassociation *Mastigobryo-Piceetum homogynetosum alpinae* Trautmann 1952[1]

[1] Trautmann (1952) considered *Mastigobryo-Piceetum* and *Soldanello-Piceetum* for synonyms.

(synoptic table) into the association *Soldanello-Piceetum*, however without retaining the original epithet (cf. Art. 26).

Data: Šoltés (1989): tab. 7a, rel. 2–4; Staszkiewicz (1993): tab. 1, rel. 10–11; Šomšák et al. (1996): tab. 3, rel. 1 + tab. 4, rel. 3; Kubíček et al. (1997a): tab. 1, rel. 1; Vačko (2000), p. 60 (rel. 1).

Stands of the subassociation are usually recognizable by presence (or dominance) of *Homogyne alpina*, *Oxalis acetosella*, less frequent species *Equisetum sylvaticum* and *Lycopodium annotinum* could be codominant. *Vaccinium myrtillus* (dominant), *V. vitis-idaea* are constantly present, but the latter species usually reaches only small cover-abundance values (+, 1) in comparison to the following subassociation. *Dryopteris filix-mas*, *Athyrium filix-femina*, *Hieracium murorum*, *Luzula sylvatica* and other more nutrient demanding species usually positively differentiate this subunit against the subassociation *bazzanietosum* (see below).

Sphagnum girgensohnii is the most frequently dominating peat moss species documented in the available relevés, sometimes accompanied (or altered) especially by *S. palustre* and *S. squarrosum* in Slovakian relevés. Other less constant mosses are *Polytrichum commune*, *Dicranum scoparium*, *Bazzania trilobata* was recorded sporadically in Slovakia.

This subcommunity was found on the southern (Šoltés, 1989) and northern foothills of the Tatras (Šomšák et al., 1996; Kubíček et al., 1997a; Vačko, 2000) as well as in the Oravské Beskydy Mts (Staszkiewicz, 1993).

2c. *Soldanello montanae-Piceetum bazzanietosum trilobatae* Petermann et Seibert ex P. Kučera 2019 subas. nov. hoc loco

Validated name: *Soldanello montanae-Piceetum bazzanietosum trilobatae* Petermann et Seibert 1979, nom. inval. (Art. 3o).

Original diagnosis: Petermann and Seibert (1979), tab. 1.

Nomenclatural type: Petermann and Seibert (1979), tab. 1, rel. a11 (Aufnahme Nr. 1209), holotypus hoc loco.

Data: Šoltés (1989): tab. 7a, rel. 5; Viceníková (1991): tab. 4, rel. 5; Šomšák et al. (1996): p. 74 + tab. 3, rel. 3–5; Kuderavá et al. (2000): p. 211, rel. 2.

This subassociation comprises the most species-poor phytocoenoses of the association. More nutrient-demanding species are absent, species composition of the field layer often consists only of *Vaccinium myrtillus*, *V. vitis-idaea* with less frequent *Calamagrostis villosa*, *Lycopodium annotinum* (*Dryopteris carthusiana*, *Oxalis acetosella*, *Avenella flexuosa*).

The ground layer is dominated by peat moss species, in Slovakia *S. girgensohnii* and less frequently *S. palustre* agg., further are present *Polytrichum commune* (subdominant), *Dicranum scoparium*, *Pleurozium schreberi*, *Bazzania trilobata*.

This subcommunity was found on the southern (Šoltés, 1989; Viceníková, 1991) and northern foothills of the Tatras (Šomšák et al., 1996) as well as in the flatlands of Orava region (Kuderavá et al., 2000) where it has wider distribution (Kučera, 2010, not.).

Only some smaller portion of the original relevés of *Soldanello montanae-Piceetum bazzanietosum trilobatae* published by Petermann, Seibert (1979, tab. 1) belong to this unit because (1) the authors did not recognize *Soldanello montanae-Piceetum homogynetosum alpinae* (or even *Equiseto-Piceetum* Šmarda 1950, *Petasito albi-Piceetum* Samek 1961) and part of the relevés represent secondary communities of originally mixed woodlands with *Fagus sylvatica* (similar to [1] *Bazzanio-Piceetum* (Schmid et Gaisberg 1936) Br.-Bl. et Sissingh in Br.-Bl. et al. 1939, or to [2] *Luzulo nemorosae-Piceetum* (Schmid et Gaisberg 1936) Br.-Bl. et Sissingh in Br.-Bl. et al. 1939; cf. Schmid, Gaisberg, 1936, tab. III; Kučera, 2009b, p. 27–28; Kučera, 2010, p. 834; Kučera, 2012, p. 241–242).

2d. *Soldanello montanae-Piceetum caricetosum fuscae* Kasprowicz ex P. Kučera 2019 subass. nov. hoc loco

Validated name and basionym: *Bazzanio-Piceetum caricetosum fuscae* Kasprowicz 1996 nom. inval. (Art. 5); Kasprowicz (1996), tab. 1, p. 150.

Original diagnosis: Kasprowicz (1996), tab. 1, p. 150–152.

Nomenclatural type: Kasprowicz (1996), tab. 1, rel. 2; lectotypus hoc loco.

Data: Bujakiewicz (1981): tab. 14, rel. 2; Kobzáková (1987): p. 61; Staszkiewicz (1993): tab. 1, rel. 9; Viceníková (1998): tab. 4, rel. 3, 6 + tab. 14, rel. 31; Šomšák et al. (1996): tab. 3, rel. 2; Kubíček et al. (1997b), tab. 1, rel. 3.

Transitional phytocoenoses of the association, often on bogside ecotones, characterised by occurrence of *Carex nigra* (cf. Kasprowicz, 1996) and/or *Eriophorum vaginatum*, *Oxycoccus palustris*, occasionally also *Vaccinium uliginosum*; marginal phytocoenoses with only *Carex nigra* (Bujakiewicz, 1981; Kobzáková, 1987: with *C. pauciflora*), *C. echinata* (Viceníková, 1998, tab. 4, rel. 6) are probably to place here. When the

population of *Pinus mugo* (s. str.) is/was present at the site, hybrid series of *Pinus* ×*celakovskiorum* Asch. & Graebn. (= *P. mugo* × *P. sylvestris*; Businský, 1998) could be present.

In Slovakia, *Sphagnum girgensohnii* was recorded as the dominant of the ground layer, accompanied by *S. palustre* agg., *S. capillifolium*. Frequently occurring *Polytrichum commune*, *Pleurozium schreberi*, *Dicranum scoparium* were recorded only sporadically.

This subcommunity was recorded in the Tatras (Kobzáková, 1987) and on their southern (Viceníková, 1998) and northern foothills (Šomšák et al., 1996; Kubíček et al., 1997b) as well as in the Oravské Beskydy Mts and their foothills (Bujakiewicz, 1981; Staszkiewicz, 1993).

Stands published under the name *Calamagrostio villosae-Pinetum* Staszkiewicz 1958 eastwards of the Slovak-Polish border presumably belong into this subassociation, propably as a separate *Pinus sylvestris* variant.

3. *Carex rostrata-Picea abies* community

With one relevé Šoltés (1989, tab. 7a, rel. 1[1]) documented a plant community with herb layer dominants *Calamagrostis villosa*, *Homogyne alpina* and *Carex rostrata*, whereas dominating mosses were *Polytrichum commune* and *Sphagnum girgensohnii*. Significant feature of the overall species composition is lack of species specific for below presented associations of the alliance, i.e. *Leucobryo-Piceetum* Šomšák ex P. Kučera 2019, *Sphagno palustris-Piceetum* Šomšák 1979 and *Equiseto-Piceetum* Šmarda 1950, while at the same time differing from subunits of *Soldanello montanae-Piceetum* (see above and Tab. 2).

A somewhat similar community was published by Zukrigl (1973, p. 152, tab. 6, rel. 1) within *Sphagno acutifolii-Piceetum* Zukrigl1973; however, the latter author documented a non-forest community transitional towards the class *Scheuchzerio-Caricetea nigrae* Tüxen 1937.

As the *Carex rostrata-Picea* wet woodland data consist of only one relevé, this "group" was excluded from fidelity calculations for associations presented in this survey.

4. *Leucobryo glauci-Piceetum abietis* Šomšák ex P. Kučera 2019

Original diagnosis: Kučera (2019), tab. 1, p. 28–31.

Nomenclatural type: Kučera (2019), tab. 1, rel. 9, holotype.

Characteristic species combination: see Electronic Supplement A2.

Data: for published relevés see Kučera (2019, tab. 1) = Šomšák (1976): tab. 4, rel. 1, 2, 4; Ferančíková (1994), tab. 1, rel. 2–6, tab. 3, rel. 4; Maťová (1994), p. 44; Viceníková (1998), tab. 7, rel. 1–2, tab. 15, rel. 90–91; Novotková (1999), tab. 1, rel. 3.

The association *Leucobryo glauci-Piceetum* comprises specific stands located on plains of dryer margins of mires where water from snow melting and rains remains considerable long above the soil surface (Šomšák, 1976; Šomšák et al., 1993), though, growth of *Picea abies* trees is not limited by water regime (Šomšák, 1976). This wet woodland was formerly labelled by a nomen fictum "*Leucobryo-Piceetum* Stefanović 1961" (see Šomšák et al., 1993) in the theses of Šomšák (1976) and his students (Feračíková, 1994; Maťová, 1994; Viceníková, 1998) (see nomenclatural notes: Kučera, 2012, p. 247).

The floristic characteristics of the association published Kučera (2019); however, the recorded overall species composition, especially considering bryophytes, is biased towards the field expertise of relevant author: more detailed species records are given in the relevés of Šomšák (1976; collaboration with J. Foltínová) (cf. Kučera, 2019, tab. 1).

Stands of this plant community are characterized by dominance of *Picea abies*; this species is also a determining component of the understorey. Of other trees a higher constancy is reached only by *Pinus sylvestris*.

The most characteristic feature of phytocoenoses of this association is the dominance of *Leucobryum glaucum* in the ground layer. Also other bryophytes are constant: *Sphagnum* spp. usually with the high dominance (most frequently *S. girgensohnii*, *S. palustre* agg.), *Dicranum scoparium*, *Pleurozium schreberi*, less frequent *Hylocomium splendens*, *Polytrichum commune* and others.

The field layer consists of stable association of *Vaccinium myrtillus*, *Luzula pilosa*, *V. vitis-idaea*, *Avenella flexuosa*, *Calamagrostis arundinacea*, *Maianthemum bifolium*, *Dryopteris carthusiana*, *Athyrium filix-femina*, *Calamagrostis villosa* as well as *Equisetum sylvaticum* and *Melampyrum sylvaticum*.

Till present, *Leucobryo glauci-Piceetum* was found only in the Popradská kotlina – in the glacifluvial terrain southerly of the Tatras (Šomšák, 1976; Ferančíková,

[1] The correct cover-abundance value for *Picea abies* (E_3) is "3" (cf. cover value of tree layer in relevé = "40 %") (R. Šoltés, in e-mail).

1994; Maťová, 1994; Viceníková, 1998; Novotková, 1999).

Two subassociations were distinguished within the unit (Kučera, 2019): *typicum* and *agrostietosum caninae*.

5. *Sphagno palustris-Piceetum* Šomšák 1979

Original diagnosis: Šomšák (1979), tab. 3, p. 26–28.

Nomenclatural type: Šomšák (1979), tab. 3, rel. 13, holotype (ut "neotype").

Characteristic species combination: see Electronic Supplement A2.

Data: Šomšák (1976): tab. 4, rel. 3; Šomšák (1979): tab. 3, rel. 1–11, 13; Šomšák (1980): p. 20; Kontriš (1981): p. 23, rel. above; Marková (1991): tab. 5, rel. 1–3; Viceníková (1991): tab. 4, rel. 3; Kubíček and Šomšák (1993): tab. 2, rel. 9; Ferančíková (1994): p. 44 + tab. 3, rel. 1–3; Holotová (1994): tab. 3, rel. 2; Maťová (1994): tab. 3, rel. 1–2 + tab. 4, rel. 1–2; Viceníková (1998): tab. 4, rel. 1–2, 4–5 + tab. 8, rel. 1–3; Dítě (2003, not.): 1 relevé.

This wet *Picea* woodland is the most species-rich association of the alliance *Sphagno palustris-Piceion* P. Kučera 2019; however, the recorded overall species composition, especially considering bryophytes, is author biased (cf. Šomšák, 1979 vs. most of the later relevés; see above). It is floristically and geographically related to *Eriophoro vaginati-Betuletum* sensu Šomšák 1979 (Šomšák, 1979 and works of his students; Šomšák et al., 1993) belonging to the class *Vaccinio uliginosi-Pinetea* Passarge 1968.

The dominant tree is *Picea abies*, admixed are *Pinus sylvestris*, *Betula pubescens* or *Alnus incana* (*A. glutinosa*), sporadically *B. pendula*. Norway spruce dominates also the understorey; however, more species could participate in the species composition: *Sorbus aucuparia*, *Salix aurita*, *Frangula alnus* and others.

The herb layer is usually dominated by combination or one of the following species: *Vaccinium myrtillus*, *Equisetum sylvaticum*, *Calamagrostis villosa*, *Luzula pilosa*, higher cover-abundance values could be reached by *Caltha palustris* subsp. *laeta*, *Oxalis acetosella* and other species. More species have high constancy (see above). The characteristic attribute of this association is combination of species *Agrostis canina* (+ *A. stolonifera*), *Potentilla erecta*, *Viola palustris*, *Glyceria nemoralis* (+ *G. fluitans*), *Juncus effusus*, *Ranunculus flammula*, *Moneses uniflora*, *Ajuga reptans*, *Soldanella hungarica* and *Carex nigra*.

The ground layer is dominated by either *Sphagnum palustre* agg. (*centrale* + *palustre*) or *S. girgensohnii*; however also other peat moss species were recorded (*S. squarrosum*, *S. fallax*, *S. capillifolium* etc.). *Dicranum scoparium* is the constant species, accompanied by *Pleurozium schreberi* and *Polytrichum commune*. In the relevés of Šomšák (1979; collaboration with J. Foltínová as bryophyte specialist), other moss species reach relatively high constancy: *Lepidozia reptans*, *Hylocomium splendens*, *Plagiochila asplenioides*, *Pohlia nutans*, *Plagiothecium curvifolium*, *Chiloscyphus pallecens*, *Lophocolea bidentata*, *Sphagnum squarrosum*, *S. fallax* [ut *S. recurvum*].

Till the present, the association *Sphagno palustris-Piceetum* Šomšák 1979 was recorded only in the southern foothills of the Tatras, exceptionally on foothills of the Babia hora Mt. in the northermost part of Slovakia (Šomšák, 1980).

Exner (2007) included the unit *Sphagno palustris-Piceetum* Šomšák 1979 into the association *Equiseto-Piceetum* Šmarda 1950; however, the presented relevé data (synoptic table) of the latter association from Austria (Willner et al., 2007, tab. 39) do not indicate representation of wet woodlands equivalent to *Sphagno palustris-Piceetum* Šomšák 1979. Moreover, the syntaxon bearing the name *Sphagno palustris-Piceetum* Šomšák 1979 is not freely interchangeable with other syntaxa with name combination "*Sphagno-Piceetum*" (cf. Chytrý et al., 2013, p. 432) because of its distinct original diagnosis.

6. *Equiseto sylvatici-Piceetum* Šmarda 1950

Original diagnosis: Šmarda (1950), p. 147–148.

Nomenclatural type: Šmarda (1950), p. 147, rel. 2, lectotype; Jirásek (1996), p. 239.

Characteristic species combination: see Electronic Supplement A2.

Data: Šomšák (1976): tab. 4, rel. 5; Šomšák (1979): tab. 3, rel. 12; Marková (1991): tab. 4, rel. 3; + p. 51 (rel. 4); Viceníková (1991): p. 24 + tab. 4, rel. 2; Holotová (1994): tab. 3, rel. 1 + p. 45; Maťová (1994): tab. 4, rel. 3; Kučerová (1996): tab. 6, rel. 1–2; Šomšák et al. (1996): tab. 2, rel. 1–2.

Association *Equiseto sylvatici-Piceetum* Šmarda 1950 represent a moderately species-rich wet woodland of the alliance *Sphagno palustris-Piceion* P. Kučera 2019, with a position between *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939 and *Sphagno palustris-Piceetum* Šomšák 1979. Lectotypification by Jirásek (1996) determined a clear differentiation of the unit from the very species-poor wet woodlands of the association

Soldanello montanae-Piceetum Volk in Br.-Bl. et al. 1939 (cf. Braun-Blanquet et al., 1939; Trautmann, 1952).

The dominant tree species is again *Picea abies* in the relevés recorded from Slovakia. Locally other species could reach high cover in the canopy (partly the influence of the past wind disturbance): *Pinus sylvestris*, *Betula pendula* (*B. pubescens*), *Alnus incana*. *P. abies* dominates also in lower vegetation layers, admixed are *A. incana*, *Sorbus aucuparia*, *Abies alba*, *Lonicera nigra*. Presence of *S. aucuparia* and *A. alba* support the idea of the human-driven decline of silver fir at least in a part of the stands (cf. Jirásek, 1996). Questionable is the possibility of the total replacement of *P. abies* with *A. alba* in localities distant from the continuous natural areal of Norway spruce.

Constant and at the same time dominant species of the field layer are *Calamagrostis villosa*, *Equisetum sylvaticum*, *Vaccinium myrtillus*, sporadic (co-)dominants could be *Oxalis acetosella*, *Veratrum album* subsp. *lobelianum*. Other constant species are *Vaccinium vitis-idaea*, *Luzula pilosa*, *Oxalis acetosella*, high frequency have also *Dryopteris carthusiana*, *Maianthemum bifolium, Lysimachia vulgaris*, *Athyrium filix-femina*.

The most frequent ground layer species are *Dicranum scoparium*, *Pleurozium schreberi*, *Polytrichum commune*. The prevailing part of relevés assigned here to this association show only presence data for bryophytes. Though, from the data on the total ground layer cover and from the rest of the relevés it could be deduced that the dominating species for almost every relevé is from the genus *Sphagnum*. Most frequently recorded were *Sphagnum palustre* agg. and *S. girgensohnii*, with the decreasing constancy also: *S. squarrosum*, *S. recurvum* agg., *S. capillifolium* and only once each *S. russowii*, *S. riparium*, *S. flexuosum* and *S. teres*. Higher cover-abundance values were also reached probably by *Polytrichum commune*. *Bazzania trilobata* was recorded in almost half of the relevés from Slovakia.

Association *Equiseto sylvatici-Piceetum* Šmarda 1950 was documented in Slovakia mostly in the southern foothills of the Tatras, Šomšák et al. (1996) published two records from the northern foothills of the Tatras.

Jirásek (1996, 2002) proposed differentiation of two subassociations: *deschampsietosum cespitosae* (with two of the total three original relevés of Šmarda (1950)) and *typicum* (with two variants). Relevé data from Slovakia do not reproduce the proposed division (cf. Jirásek, 1996, tab. 3).

II. C. *Stellario nemorum-Abietion albae* P. Kučera 2019 all. nov. hoc loco

Original diagnosis: *Stellario nemorum-Abietetum albae* P. Kučera 2019 (Kučera 2019, tab. 2), *Petasito albi-Piceetum* Samek 1961 (Samek 1961, p. 75, tab. II, rel. 3, 5, 9, 11, 18), *Carici remotae-Abietetum* Husová 1998 (Husová, 1998, tab. 1).

Nomenclatural type: *Stellario nemorum-Abietetum albae* P. Kučera 2019 (Kučera, 2019, p. 27–44, tab. 2), holotypus hoc loco.

Differential species (φ ($\times$ 100) $\geq$ 25) (36 relevés, Tab. 2):

E_3: *Abies alba* (62), *Fagus sylvatica* (43)

E_2: *Fagus sylvatica* (57), *Sorbus aucuparia* (37), *Lonicera xylosteum* (34), *Acer pseudoplatanus* (31), *Salix caprea* (29), *Sambucus racemosa* (25)

E_1: *Fagus sylvatica* (33), *Lonicera xylosteum* (31), *Abies alba* (25)

Stellaria nemorum (83), *Chrysosplenium alternifolium* (69), *Petasites albus* (68), *Lysimachia nemorum* (62), *Geranium robertianum* (55), *Cardamine trifolia* (55), *Adenostyles alliariae* (55), *Luzula luzulina* (52), *Homogyne alpina* (51), *Impatiens noli-tangere* (51), *Urtica dioica* (50), *Rubus hirtus* (50), *Gentiana asclepiadea* (49), *Galium odoratum* (48), *Prenanthes purpurea* (46), *Dryopteris dilatata* (46), *Phegopteris connectilis* (43), *Milium effusum* (43), *Ranunculus lanuginosus* (40), *R. platanifolius* (40), *Oxalis acetosella* (39), *Senecio ovatus* (37), *Phyteuma spicatum* (37), *Rubus idaeus* (37), *Chaerophyllum hirsutum* (35), *Luzula sylvatica* (35), *Cardamine flexuosa* (34), *Calamagrostis epigejos* (34), *Poa remota* (34), *Veronica anagallis-aquatica* (34), *Equisetum sylvaticum* (32), *Dryopteris filix-mas* (32), *Cicerbita alpina* (31), *Geum rivale* (30), *Carex sylvatica* (30), *Calamagrostis arundinacea* (29), *Deschampsia cespitosa* (29), *Ranunculus repens* (25), *Doronicum austriacum* (25).

E_0: *Plagiomnium affine* (54), *Cirriphyllum piliferum* (51), *Plagiothecium undulatum* (39), *Plagiomnium undulatum* (33), *Plagiothecium curvifolium* (31), *Plagiomnium rostratum* (31), *Conocephalum conicum* (31), *Thuidium tamariscinum* (28).

This alliance unites wet woodland types considerably differing from the communities of the alliance *Sphagno palustris-Piceion* P. Kučera 2019. The species composition (see Tabs 2–4 in Electronic Supplement B2) and habitat type show its affinities to spatially adjacent *Fagus-Abies* woodlands of the class *Carpino-Fagetea* Jakucs ex Passarge 1968 while constant presence of *Equisetum sylvaticum* (dominance in the association

Stellario nemorum-Abietetum albae P. Kučera 2019) – together with *Polytrichum commune*, *Sphagnum girgensohnii*, *Deschampsia cespitosa* – are attributes of the order *Sphagno palustris-Piceetalia* P. Kučera 2019.

Group of hygrophiles *Chaerophyllum hirsutum*, *Chrysosplenium alternifolium*, *Impatiens noli-tangere*, *Lysimachia nemorum*, *Stellaria nemorum*, *Petasites albus* growing together with species as *Gentiana asclepiadea*, *Prenanthes purpurea*, *Fragaria vesca*, *Plagiomnium affine* etc. (Kučera, 2019, tab. 2), and constantly without *Carex echinata*, *Lysimachia vulgaris*, *Trientalis europaea* (*Vaccinium vitis-idaea*), justify the separation of the spring-related association *Stellario nemorum-Abietetum albae* P. Kučera 2019 from the alliance *Sphagno palustris-Piceion* Kučera 2019 into a separate unit of the rank of alliance.

Association *Petasito albi-Piceetum* Samek 1961 (non *Petasito [albae?]-Piceetum* Zupančič 1999 nom. illeg. (Art. 31), or nom. inval. (Art. 3g)[1]) is a related unit to *Stellario-Abietetum* P. Kučera 2019 (cf. Kučera, 2019) and belongs to the alliance *Stellario nemorum- Abietetum albae* P. Kučera 2019 as well. It was described from the southern Bohemia (Czech Republic) by Samek (1961). *Petasito albi-Piceetum* Samek 1961 was not recognized or at least mentioned as a synonym neither in the new vegetation survey of the Czech Republic (Chytrý et al., 2013) nor in the older unfinished series edited by J. Moravec (Jirásek, 2002). Records of *Petasito albi-Piceetum* Samek 1961 are not known from Slovakia till present.

Association *Carici remotae-Abietetum* Husová 1998 represents another wet woodland belonging to the alliance *Stellario nemorum-Abietion* P. Kučera 2019. However, only relevé data phytocoenotically close to the nomenclatural type of the association should be considered (cf. Husová 1998, tab. 1).

In the alliance should be included the association *Chaerophyllo hirsuti-Abietetum albae* Boeuf et Simler in Boeuf 2011 and probably also the phytocoenoses delimited in the subassociation *Carici pendulae-Abietetum albae caricetosum brizoidis* Boeuf 2011 nom. inval. (Art. 3i) (cf. Boeuf, 2010). The subassociation *Carici pendulae-Abietetum albae typicum* Boeuf 2011 nom. inval. (Art. 3i) most probably belongs to the water influenced *Abies alba* woodlands of the class *Carpino-Fagetea* Jakucs ex Passarge 1968.

[1] The only place in the whole monograph of Zupančič (1999) where the taxon name is specified is photo appendix (p. 221) in the end of book. This unit syntaxonomically belongs to the class *Carpino-Fagetea* Jakucs ex Passarge 1968.

7. *Stellario nemorum-Abietetum albae* P. Kučera 2019

Original diagnosis: Kučera (2019), tab. 2, p. 32–41.

Nomenclatural type: Kučera (2019), tab. 2, rel. 8, holotypus

Syn.: *Equiseto sylvatici-Abietetum* sensu auct. slov. non Moor 1952.

Characteristic species combination: see Electronic Supplement A2.

Data for the respective subassociations:

calamagrostietosum – for published relevés see Kučera (2019, tab. 2) = Majzlanová (1982): tab. 13, rel. 15–21 and Majzlanová (s. d.): tab. 2, rel. 2, 3, 5, 10;

crepidetosum – for published relevés see Kučera (2019, tab. 2) = Šomšák (1983): tab. 2, col. VI, rel. 1–4 and Majzlanová (s. d.): tab. 2, rel. 12; Šomšák et al. (1996): tab. 4, rel. 1, 2; Kubíček et al. (1997b): tab. 1, rel. 2; Kučera (2012): p. 295, rel. 31 + p. 296, rel. 32;

petasitetosum – for published relevés see Kučera (2019, tab. 2) = Majzlanová (1982): tab. 13, rel. 1–14 and Majzlanová (s. d.): tab. 2, rel. 6.

The floristic composition of the association was described by Kučera (2019): stands of the relevés recorded until present are determined by *Picea abies* and *Abies alba*. These two tree species are accompanied by *Fagus sylvatica*, sometimes *Sorbus aucuparia* was recorded. The understorey consists of the all four mentioned species, the most constant shrub species are *Lonicea nigra* and *L. xylosteum*.

The field layer is dominated by *Oxalis acetosella* and *Equisetum sylvaticum*, higher cover-abundance values are reached also by *Stellaria nemorum*, *Petasites albus*, rarely *Chaerophyllum hirsutum*. Except *Oxalis* and *Equisetum*, constant species are *Senecio ovatus*, *S. nemorum*, *Ch. hirsutum*, *Rubus idaeus*, *Chrysosplenium alternifolium*, *Vaccinium myrtillus*, *Gentiana asclepiadea*, *Athyrium filix-femina* and *Calamagrostis arundinacea*.

The most abundant ground layer species is *Plagiomnium affine* accompanied by *Dicranum scoparium* and/or *Sphagnum girgensohnii*, the less frequent bryophytes are *Plagiothecium curvifolium*, *Cirriphyllum piliferum* and *Polytrichum commune*.

Stands of *Stellario nemorum-Abietetum* are bound to habitat of spring areas and other more wet localities (Majzlanová, 1983, 1993; Šomšák, 1983; Šomšák et al., 1996). Until present, they were recorded prevailingly in the flysch mountains of northern Slovakia: Oravská Magura, Oravské Beskydy (Šomšák, 1983) and Skorušinské vrchy (Majzlanová, 1982). A separate variant of higher elevations was recorded in the Veľká Fatra Mts at spring habitats on granodiorites (Kučera,

2012). Transitional phytocoenoses were found at the northern foothills of the Tatras near Podspády (cf. Šomšák et al., 1996, tab. 4, rel. 1, 2; Kubíček et al., 1997b, tab. 1, rel. 2).

The association *Stellario nemorum-Abietetum albae* P. Kučera 2019 is a newly described unit from Slovakia. Its spatial distribution in the northern regions of the country bordering to Poland suggests a high probability of its occurrence in Poland as well as in the Carpathians' mountain ranges of Moravia and Silesia, and also in Ukraine (most probably also in Romania). It is possible that some phytocoenoses from Switzerland included by Kuoch (1954) into the subassociation *Equiseto-Abietetum hylocomietosum* Kuoch 1954 belongs to the alliance *Stellario nemorum-Abietion albae* P. Kučera 2019 or even to the association *Stellario nemorum-Abietetum* P. Kučera 2019 (see below notes to *Equiseto-Abietetum*).

Kučera (2019) differentiated three subassociations within the association *Stellario nemorum-Abietetum*: *calamagrostietosum villosae* Majzlanová ex P. Kučera 2019, *crepidetosum paludosae* P. Kučera 2019 and *petasitetosum albi* Majzlanová ex P. Kučera 2019

II. D. *Valeriano dioicae-Abietion albae* P. Kučera 2019 all. nov. hoc loco

Original diagnosis: *Equiseto sylvatici-Abietetum albae* Moor 1952 (Moor, 1952, p. 66–72, tab. 5), *Valeriano dioicae-Abietetum* P. Kučera 2019 ass. nov.

Nomenclatural type: *Equiseto sylvatici-Abietetum albae* Moor 1952 (Moor, 1952), holotypus hoc loco.

Characteristic species: *Cirsium oleraceum*, *Filipendula ulmaria*, *Fragaria vesca*, *Rubus saxatilis*, *Valeriana dioica*.

Differential species (derived from the relevé group of this alliance from Slovakia) (φ ($\times$ 100) $\geq$ 25) (13 relevés, Tab. 2):

E_3: *Pinus sylvestris* (47), *Alnus glutinosa* (38), *A. incana* (38), *Betula pendula* (37),

E_2: *Frangula alnus* (49), *Viburnum opulus* (41), *Lonicera nigra* (37),

E_1: *Daphne mezereum* (48), *Lonicera nigra* (43), *Viburnum opulus* (41), *Sorbus aucuparia* (40), *Frangula alnus* (33), *Betula pendula* (31), *Ribes petraeum* (31),

Rubus saxatilis (93), *Valeriana dioica* (79), *Polygonatum verticillatum* (70), *Caltha palustris* (67), *Crepis paludosa* (65), *Luzula pilosa* (59), *Cirsium oleraceum* (54), *Clematis alpina* (54), *Maianthemum bifolium* (51), *Filipendula ulmaria* (50), *Thalictrum aquilegiifolium* (48), *Carex alba* (48), *Galium schultesii* (44), *Fragaria vesca* (42), *Solidago virgaurea* (41), *Melica nutans* (41), *Astrantia major* (41), *Paris quadrifolia* (40), *Equisetum palustre* (40), *Dactylorhiza maculata* (agg.) (39), *Carex digitata* (33), *Actaea spicata* (33), *Carex remota* (33), *Epipactis palustris* (31), *Bistorta major* (29), *Polygonatum multiflorum* (28), *Valeriana tripteris* (28), *Angelica sylvestris* (26),

E_0: *Trichocolea tomentella* (39), *Eurhynchium angustirete* (37), *Tetraphis pellucida* (34).

This alliance comprises wet woodland types with *Abies alba* and *Picea abies* (and probably constant presence of *Fagus sylvatica*) on base-rich habitats which determine the presence of species group *Valeriana dioica*, *Cirsium oleraceum*, *Filipendula ulmaria*, with *Equisetum sylvaticum*, *Caltha palustris*, *Crepis paludosa*, *Deschampsia cespitosa* along with calciphilous plants as *Aconitum vulparia*, *Carex alba*, *C. flacca*, Kuoch (1954) recorded also *Bellidiastrum michelii* and *Calamagrostis varia*. Overall floristic composition of the alliance is poorly known as this type of communities was never properly recognized.

Tree species composition could also contain *Fraxinus excelsior*, *Acer pseudoplatanus*, *Sorbus aria* (Moor, 1952), *Alnus incana* (+ *glutinosa*) and other species in various proportion, depending on the successional stage of a particular stand (wind and other type of natural disturbance). Shrub species *Lonicera nigra*, *L. xylosteum*, *Viburnum* spp. are present.

It is questionable if *Picea abies* could extinct locally on the habitats under consideration during the Holocene due to interspecific competition, especially in the mountain ranges without development of the natural *Picea* altitudinal vegetation zone and other types of refugia. However, artificially forced expansion of Norway spruce (plantations) could result in the reintroduction of this species to localities where it would be naturally absent.

The association *Equiseto sylvatici-Abietetum* originally described by Moor (1952) and classified within the alliance *Valeriano dioicae-Abietion albae* P. Kučera 2019 has a distinctive set of constant species *Equisetum sylvaticum*, *Cirsium oleraceum*, *Crepis paludosa*, *Deschampsia cespitosa*, *Lysimachia nemorum*, *Carex flacca*, *Hordelymus europaeus*, *C. sylvatica*, *Primula elatior*, *Knautia maxima* along with other less constant species *Aconitum vulparia*, *Valeriana dioica*, *Caltha palustris*, *Filipendula ulmaria*, *V. officinalis*, *Equisetum arvense*, *Athyrium filix-femina*, *Fragaria vesca* etc.; with constant presence of *Fagus sylvatica* in the canopy.

Relevés from Slovakia assigned to this alliance do not strictly reproduce the described floristic characteristics of *Equiseto sylvatici-Abietetum* Moor 1952. Although the Slovak phytocoenoses are similar to the latter unit with their species composition, e.g. by occurrence of *Caltha palustris*, *Cirsium oleraceum*, *Crepis paludosa*, *Valeriana dioica*, they lack species *Aconitum vulparia*, *Carex flacca*, *Geranium sylvaticum*, *Hordelymus europaeus*, *Lonicera alpigena*, *Primula elatior*, *Salix appendiculata*. The combination of the constant species *Valeriana dioica*, *Crepis paludosa*, *Caltha palustris* with *Cirsium oleraceum*, *Filipendula ulmaria* constitute a specific relevé group including at the same time species *Thalictrum aquilegiifolium*, *Clematis alpina*, *Equisetum sylvaticum*, *Chaerophyllum hirsutum*, *Rubus saxatilis* or *Polygonatum verticillatum*; partly the *Carex alba* group (see below).

Although it is clear that some of the recorded relevés document transitional phytocoenoses (e.g. Viceníková, 1991, tab. 4, rel. 1: with *Viola palustris*, *Molinia caerulea*, *Poa palustris*, *Carex flava*, *Anemone nemorosa* etc.), this group as an unit differs noticeably from all of the above described associations. Taking into account certain lack of knowledge about the plant community corresponding to Moor (1952, tab. 5) *Equiseto-Abietetum*, presented Slovak relevés are included into the new association *Valeriano dioicae-Abietetum* P. Kučera 2019 ass. nov.

For nomenclatural purposes a lectotypification of the association *Equiseto sylvatici-Abietetum* is here given:

***Equiseto sylvatici-Abietetum* Moor 1952**

Original diagnosis: Moor (1952), tab. 5.

Nomenclatural type: Moor (1952), tab. 5, rel. 1, lectotypus hoc loco.

Nomenclatural and syntaxonomical note to the association is given in Electronic Supplement A3, section III.

8. *Valeriano dioicae-Abietetum* P. Kučera 2019 ass. nov. hoc loco

Original diagnosis: Šomšák (1979, relevé on the p. 25), the below specified nomenclatural type and Kučera (in prep.; most of the included relevés are found in various unpublished theses).

Nomenclatural type: Marková (1991), tab. 4, rel. 1 (unpublished master's thesis), locality: Western Carpathians, Popradská kotlina Basin, near Tatranská Kotlina, forest stand 1356a, altitude 760 m a.s.l., 6. 8. 1989.

E_3 (cover 80%): *Abies alba* 2, *Picea abies* 2;

E_0 (cover 5%): *Lonicera nigra* 1;

E_1 (cover 95%): *Abies alba* 2, *Picea abies* 2, *Lonicera nigra* 1, *Padus avium* +, *Sorbus aucuparia* +,

Equisetum sylvaticum 3, *Oxalis acetosella* 3, *Maianthemum bifolium* 2, *Rubus saxatilis* 2, *Valeriana tripteris* 2, *Caltha palustris* subsp. *laeta* 1, *Hieracium murorum* 1, *Luzula pilosa* 1, *Polygonatum verticillatum* 1, *Rubus idaeus* 1, *Senecio ovatus* 1, *Solidago virgaurea* 1, *Vaccinium myrtillus* 1, *Ajuga reptans* r, *Athyrium filix-femina* +, *Astrantia major* +, *Carex alba* +, *Clematis alpina* +, *Dryopteris carthusiana* +, *D. filix-mas* +, *Fragaria vesca* +, *Galium schultesii* +, *Gymnocarpium dryopteris* +, *Melica nutans* r, *Mycelis muralis* +, *Valeriana dioica* +, *Calamagrostis arundinacea* r, *Cirsium oleraceum* r, *Crepis paludosa* r, *Dentaria glandulosa* r, *Filipendula ulmaria* r, *Geum rivale* r, *Orthilia secunda* r, *Polygonatum multiflorum* r,

E_0 (cover 45 %, only presence of the species is noted): *Dicranum scoparium*, *Plagiomnium affine*, *Polytrichum formosum*.

Characteristic species combination: see Electronic Supplement A2.

Data: Šomšák (1979): p. 25; Marková (1991): tab. 4, rel. 1–2, 4–5; Viceníková (1991): tab. 4, rel. 1, 4, 6 + tab. 5, rel. 1–2; Viceníková (1998): tab. 14, rel. 30, 44, 45.

Documented relevés show domination of *Picea abies* in the canopy; *Abies alba* is codominant in a small part of relevés. I assume that the latter species was constantly present (and dominant) in all of the documented stands which come from the foothills of the Belianske Tatry Mts and close vicinity, and that *Fagus sylvatica* was also present there (cf. Kučera, 2008b, 2009). High frequence of *Pinus sylvestris* is partly the result of the historical human influence on the forest in the region. Other tree species were documented less frequently (*Alnus incana* + *glutinosa*, *Betula pubescens* + *pendula*). Most frequent young trees are *Picea abies*, *Sorbus aucuparia* and *Abies alba*, from shrubs *Lonicera nigra*. *Daphne mezereum*, *Viburnum opulus*, *Rosa pendulina*, even *Ribes petraeum,* are sporadic.

A set of constant herb layer species comprise *Crepis paludosa*, *Caltha palustris*, *Vaccinium myrtillus*, *Luzula pilosa*, *Maianthemum bifolium*, *Rubus saxatilis, Equisetum sylvaticum*, *Valeriana doica* and *Oxalis acetosella*; overall species composition is rich.

Two subunits are differentiated here, at present in the rank of variant regarding the lack of knowledge of the overall variability of this plant community:

(1) *Carex alba* variant (4 relevés): with exclusive species group *Carex alba* (constant), *Astrantia major*,

Galium schultesii, *Melica nutans*, *Actea spicata*, *Mycelis muralis*, *Valeriana tripteris*, *Carex sylvatica*, with other species concentrated here – *Dryopteris filix mas*, *Prenanthes purpurea*, *Gymnocarpium dryopteris*, *Hieracium murorum*. The role of *Sphagnum* subsp. is insufficiently known.

(2) *Calamagrostis villosa* variant (9 relevés): with *Vaccinium vitis-idaea* and *Calamagrostis villosa* (exceptionally also in the previous variant), less frequent (sporadic) species *Epilobium montanum*, *Lysimachia vulgaris*, *Potentilla erecta*, *Huperzia selago*, *Avenella flexuosa*, *Dactylorhiza maculata* agg. Peat moss species (*Sphagnum girgensohnii*, *S. palustre* agg., or others) could reach high cover-abundance values. Also *Bazzania trilobata* was recorded in the stands of this variant.

Characterization of the ground layer is difficult: except one relevé of Šomšák (1979, p. 25), the rest of total 13 relevés come from theses whose authors recorded only presence data of bryophytes. Constant is only *Dicranum scoparium*, other more frequent species are *Pleurozium schreberi*, *Rhytidiadelphus triquetrus*, *Plagiochila asplenioides* and *Polytrichum formosum*. From the cover data of the ground layer in the relevés could be expected that species of genus *Sphagnum* (*S. palustre* agg., *S. girgensohnii*, occassionally *S. capillifolium*, *S. squarrosum*) dominate in the stands of *Calamagrostis villosa*-variant of this unit (with *Bazzania trilobata* present infrequently).

Relevés of this wet woodland were recorded only on the south-eastern foothils of the easternmost part of the Tatras – the carbonate Belianske Tatry Mts as well as in the close adjacent area to the south-west (surroundings of Kežmarské Žľaby).

Conclusions

The presented phytocoenological revision of the wet woodlands with *Picea abies* in Slovakia revealed that diversity of the respective plant communities (6 associations and 1 community) is comparable to other Norway spruce-dominated communities which are syntaxonomically classified within the orders *Piceetalia excelsae* Pawłowski ex Pawłowski et al. 1928 and *Cortuso-Piceetalia* (*Athyrio-Piceetalia* sensu auct. non Hadač 1962) of the supramontane altitudinal vegetation zone of the Western Carpathians.

Except for one association (*Sphagno acutifolii-Piceetum* Zukrigl 1973), the wet woodlands under consideration form a specific floristic and ecological unit of azonal *Picea abies* (and *Abies alba*) wet woodlands distributed in the mostly lower altitudes of the montane *Fagus-Abies* zone, here classified within the newly proposed order *Sphagno palustris-Piceetalia* P. Kučera 2019. Plant communities of this order distinguished from the available Slovak relevé data are according to the distinct floristic differences splitted into three alliances: *Sphagno palustris-Piceion* P. Kučera 2019, *Stellario nemorum-Abietion albae* P. Kučera 2019 and *Valeriano dioicae-Abietion albae* P. Kučera 2019.

Surveys from other European countries (e.g. Moor, 1952; Kielland-Lund 1981; Husová, 1998; Exner, 2007; Chytrý et al., 2013; Boeuf et al., 2014;) indicate that the proposed syntaxonomical system of the order *Sphagno palustris-Piceetalia* P. Kučera 2019 is applicable for the whole European region.

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REFERENCES

Bartsch J., Bartsch M. 1940. Vegetationskunde des Schwarzwaldes. *Pflanzensoziologie*, 4: 1–234.

Bick H. 1985. Die Moorvegetation der zentralen Hochvogesen. *Dissertationes botanicae*, 91: 290 S. + tab. appendix and errata + supplements dated "1986".

Boeuf R. 2010 [recte 2011]. Le référentiel des types forestiers d'Alsace: apports phytosociologiques. *Revue Forestière Française* 62: 331–364, tab. suppl. https://doi.org/10.4267/2042/38948

Boeuf R., Simler N., Holveck P., Hum Ph., Cartier D., Ritz F. 2014. *Les végétations forestières d'Alsace, vol. I (Textes): Référentiel des types forestiers du type générique au type élémentaire – Relations entre les stations forestières, les communautés forestières, les habitats et les espèces végétales patrimoniales*. Drulingen: Editions Scheurer, 372 pp.

Braun-Branquet J., Sissingh G., Vlieger J. 1939. *Prodromus der Pflanzengesellschaften*: *Prodrome des Groupements végétaux*. *Fasz. 6. Klasse der Vaccinio-Piceetea* (*Nadelholz- und Vaccinienheiden-Verbände der eurosibirisch-nordamerikanischen Region*). *s. l.:* Comité International du Prodrome Phytosociologique, 124 pp.

Budzhak V.V., Onyshchenko V.A. 2004. *Naukovyi visnyk Chernivetskoho universitetu. Series Biology*, 223: 282–296. [Буджак В.В., Онищенко, В.А. 2004. Різноманіття лісової рослинності верхньої частини басейну р. Чорний Черемош. *Науковий вісник Чернівецького університету. Серія Біологія*, 223: 282–296].

Bujakiewicz A. 1981. Grzyby Babiej Góry. II. Wartość wskaźnikowa macromycetes w zespołach leśnych.

a. Uwagi wstępne i charakterystyka lasów regla dolnego. *Acta Mycologica*, 17(1–2): 63–124.

Centrálna databáza fytocenologických zápisov [disc]. 2016. Administrators K. Hegedüšová, J. Šibík. Bratislava: Botanický ústav SAV, Oddelenie geobotaniky, 2016 [1997– (cont. updated)]. Available at: http://ibot.sav.sk/cdf/index.html

Chytrý M., Tichý L., Holt J., Botta-Dukát Z. 2002. Determination of diagnostic species with statistical fidelity measures. *Journal of Vegetation Science*, 13(1): 79–90. https://doi.org/10.1111/j.1654-1103.2002.tb02025.x

Chytrý M., Zelený D., Navrátilová J., Sádlo J. 2013. Boreokontinentální jehličnaté lesy (Vaccinio-Piceetea). In: *Vegetace České republiky*, *vol. 4. Lesní a křovinová vegetace*. Ed. M. Chytrý. Praha: Nakladatelství Academia, pp. 372–379, 380–432.

Czerwiński A. 1966. Les forets d'epicéas des marecages du voïvodat de Białystok (la Pologne du nord-est). *Bulletin de la Société des amis des sciences et des lettres Poznań. D. Sciences biologiques*, 7: 17–36.

Domin K. 1923. A Phytogeographical Outline of the Zonal Division in the Western Carpathians, besides some general remarks on the main forest trees. *Spisy vydávané Přírodovědeckou Fakultou Karlovy University*, 1: 44 pp.

Ellenberg H., Klötzli F. 1972. [recte 1974]. Waldgesellschaften und Waldstandorte der Schweiz. *Mitteilungen der Schweizerischen Anstalt für das Forstliche Versuchswesen*, 48(4): 587–930.

Exner A. 2007. *Piceetalia* Pawł. 1928. In: *Die Wälder und Gebüsche Österreichs : Ein Bestimmungswerk mit Tabellen*, vol. 1. Textband. Eds W. Willner, G. Grabherr. München: Elsevier, pp. 184–208.

Fajmonová E. 1978. K syntaxonómii spoločenstiev radu Athyrio-Piceetalia Hadač 62 v Západných Karpatoch. *Biológia* (*Bratislava*), 33(7): 551–563.

Ferančíková H. 1994. *Vegetačná mapa lesov Podtatranskej kotliny: časť Tatranská Polianka*. Dipl. thesis. Bratislava, 75 pp. (manuscript). Depon. in Katedra botaniky Prírodovedeckej fakulty Univerzity Komenského, Bratislava.

Flatberg K. I. 1992. The European taxa in the *Sphagnum recurvum* complex. 1. *Sphagnum isoviitae* sp. nov. *Journal of Bryology*, 17(1): 1–13. https://doi.org/10.1179/jbr.1992.17.1.1

Hadač E. 1987. Plant Ecological Notes from Belianske Tatry Mts. *Biologické pracé*, 33(3): 1–96.

Hadač E., Březina P., Ježek V. et al. 1969. *Die Pflanzengesellschaften des Tales "Dolina Siedmich prameňov" in der Belaer Tatra*. Series Vegetácia ČSSR, vol. 2. Bratislava: Vydavateľstvo Slovenskej akadémie vied, 344 pp.

Hartmann F.K. 1953. Waldgesellschaften der deutschen Mittelgebirge und des Hügellandes: Nach ihren wichtigsten soziologischen und standörtlichen Merkmale in einer vorläufiger Übersicht zusammengestellt. *Umschaudienst Forschungsausschusses "Landschaftspflege und Landschaftsgestaltung" der Akademie für Raumforschung und Landesplanung*, 4–6: 139–182, I–XIV, suppl.

Hartmann F.-K., Jahn G. 1967. *Ökologie der Wälder und Landschaften. Band 1. Waldgesellschaften des mitteleuropäischen Gebirgsraumes nördlich der Alpen : Tabellen, Grundlagen und Erläuterungen*, 2 vols. Stuttgart: Gustav Fischer.

Hájková P., Navrátilová J., Hájek M. 2011. Vegetace vrchovišť (*Oxycocco-Sphagnetea*). In: *Vegetace České republiky*, vol. 3. *Vodní a mokřadní vegetace*. Ed. M. Chytrý. Praha: Nakladatelství Academia, pp. 705–736.

Hennekens S. M. Turboveg for Windows [disc]. 2016. Ver 2.124. S. M. Hennekens, Wageningen: s.n., 2016, info on the software package at: http://www.synbiosys.alterra.nl/turboveg/

Hennekens S.M., Schaminée J.H.J. 2001. Turboveg, a comprehensive database management system for vegetation data. *Journal of Vegetation Science*, 12(4): 589–591. https://doi.org/10.2307/3237010

Holotová E. 1994. *Vegetačná mapa lesov Podtatranskej kotliny – časť Smokovce*. Dipl. thesis. Bratislava, 65 pp. (manuscript). Depon. in Katedra botaniky Prírodovedeckej fakulty Univerzity Komenského, Bratislava.

Husová M. 1998. Syntaxonomické a nomenklatorické poznámky ke společenstvům jedlin České republiky. *Preslia*, 70(2): 165–178.

Jirásek J. 1996. Společenstva přirozených smrčin České republiky. *Preslia*, 67(3/4): 225–259.

Jirásek J. 2002. Třída: *Vaccinio-Piceetea* Br.-Bl. in Braun-Blanquet, Sissingh et Vlieger 1939. In: *Přehled vegetace České republiky. Svazek 3. Jehličnaté lesy*. Red. J. Moravec. Praha: Academia, pp. 18–86.

Kasprowicz M. 1996. Górska świerczyna na torfie *Bazzanio-Piceetum* Br.-Bl. et Siss. 1939 w masywie Babiej Góry. *Badania Fizjografia nad Polską Zachodnią, Seria B – Biologia*, 45: 147–158.

Kästner M., Flößner W. 1933. *Die Pflanzengesellschaften des westsächsischen Berg- und Hügellandes* (*Flußgebiet der Freiberger und Zwickauer Mulde*). *II. Teil. Die Pflanzengesellschaften der erzgebirgischen Moore*, vol. 8, Dresden: Verlag des Landesvereins Sächsischer Heimatschutz zu Dresden, 208 pp., photo + map suppl.

Kielland-Lund J. 1981. Die Waldgesellschaften SO-Norwegens. *Phytocoenologia*, 9(1–2): 53–250.

Kielland-Lund J. 1994. Syntaxonomy of Norwegian forest vegetation 1993. *Phytocoenologia*, 24: 299–310.

Klika J. 1948. *Rostlinná sociologie* (*Fytocoenologie*). Praha: Melantrich, 384 pp.

Kobzáková D. 1987. *Fytocenologicko-ekologické pomery klimaxových smrečín pravých svahov Tichej doliny v Západných Tatrách*. Dipl. thesis. Bratislava, 79 pp. (manuscript). Depon. in Prírodovedecká fakulta Univerzity Komenského, Bratislava.

Kochjarová J., Kučera J., Slovák M., Štubňová E. 2016. *Soldanella L.* In: *Flóra Slovenska*, vol. 4, issue 4. Eds K. Goliašová, E. Michalková. Bratislava: VEDA, vydavateľstvo Slovenskej akadémie vied, pp. 645–659.

Kontriš J. 1981. Pôdnoekologické a fytocenologické pomery lužných lesov Liptovskej kotliny. *Biologické práce*, 27(3): 168 pp.

Krisai R. 1986. Untersuchungen zur Vegetation und Genese Lungauer Moore. Ein Vorbericht. *Sauteria*, 1: 51–64.

Kubíček F., Šomšák L. 1993. Ecological analysis of the herb and moss layer in several fir and spruce forests (Vysoké Tatry Mountains). *Ekológia* (*Bratislava*), 12(1): 45–59.

Kubíček F., Bedrna Z., Šimonovič V. 1997a. Production-ecological and soil characteristic of the bogmoss communities at the State Nature Reserves Čikovská and Pavlová (Podspády), The Tatra National Park. *Ekológia* (*Bratislava*), 16(4): 371–383.

Kubíček F., Šimonovič V., Viceníková A., Mačor S. 1997b. Productivity of the herb and moss layer in forest ecosystems at the Nature Reserve Bor (Podspády); The Tatra National Park. *Štúdie o Tatranskom národnom parku*, 2: 143–160.

Kubinská A., Janovicová K. 1998. Bryophytes. In: *Checklist of non-vascular and vascular plants of Slovakia*. Eds K. Marhold, F. Hindák. Bratislava: VEDA, vydavateľstvo Slovenskej akadémie vied, pp. 297–331.

Kučera P. 2005. Vrchoviská a kľukva na Lúčanských Veterných holiach. *Bulletin Slovenskej botanickej spoločnosti*, 27: 63–66.

Kučera P. 2007. *Západokarpatské smrečiny: Komentovaný literárny prehľad*. Thesis, Supervisor: RNDr. Ján Kliment, CSc. Blatnica: Univerzita Komenského v Bratislave, Botanická záhrada, pracovisko Blatnica, Blatnica, 222 pp.

Kučera P. 2008a. Remarks on higher-ranked syntaxa with *Abies alba* in Central Europe: their concepts and nomenclature. *Hacquetia*, **7**(2): 161–172. https://doi.org/10.2478/v10028-008-0009-0

Kučera P. 2008b. Buk na severovýchode Popradskej kotliny. *Bulletin Slovenskej botanickej spoločnosti*, 30(2): 213–226.

Kučera P. 2009a. Buk v Doline Siedmich prameňov. *Štúdie o Tatranskom národnom parku*, 9: 171–182.

Kučera P. 2009b. Some remarks on Slovak syntaxa of *Galio-Abietenion* and *Vaccinio-Abietenion*. *Acta botanica Universitatis Comenianae*, 44: 21–32.

Kučera P. 2010. Nomenclatural types of *Picea abies* syntaxa reported from Slovakia. *Biologia* (*Bratislava*), 65(5): 832–836. https://doi.org/10.2478/s11756-010-0103-x

Kučera P. 2012. *Vegetačný stupeň smrečín v Západných Karpatoch – rozšírenie a spoločenstvá : Spis so zvláštnym zreteľom na pohorie Veľká Fatra*. Blatnica: Botanická záhrada UK v Bratislave, pracovisko Blatnica, 342 pp.

Kučera P. 2013. Horské bukové lesy v Západných Karpatoch. [2.2] Veterné hole, skupina Hornej lúky. *Natura Carpatica*, 54: 17–34.

Kučera P. 2017. Two groups of *Pinus cembra* forest communities in the Tatras. *Acta Botanica Hungarica*, 59(3–4): 389–425. https://doi.org/10.1556/034.59.2017.3-4.7

Kučera P. 2019. Two new wet woodlands with Norway spruce from the Western Carpathians. *Thaiszia – Journal of Botany*, 29(1): 23–49.

Kučera P., Kliment J. 2011. On the nomenclature and syntaxonomy of the phytosociological survey "Die Wälder und Gebüsche Österreichs": examples of the class *Piceetea excelsae* Klika 1948. *Thaiszia – Journal of Botany*, 21(2): 85–92.

Kučerová K. 1996. *Pokus o rekonštrukciu porastov Podtatranskej kotliny* (*časť Kežmarské Žľaby, Národná rezervácia "Mokriny"*). Dipl. thesis. Bratislava, 84 pp., (manuscript). Depon. in Prírodovedecká fakulta Univerzity Komenského, Bratislava.

Kuderavá Z., Galvánek D., Tomáň P., Eliáš P., Pietorová E. 2000. Zhodnotenie výsledkov botanickej sekcie na 35. tábore ochrancov prírody v CHKO Horná Orava. *Zbornik Oravského múzea*, 17: 202–219.

Kuoch R. 1954. Wälder der Schweizer Alpen im Verbreitungsgebiet der Weißtanne. *Mitteilungen der Schweizerischen Anstalt für das Forstliche Versuchswesen*, 30: 133–260, tab. suppl.

Magic D. 1986. *Smrekové lesy zamokrené*. In: *Geobotanická mapa ČSSR. Slovenská socialistická republika*. Eds J. Michalko, J. Berta, D. Magic. Textová časť. Bratislava: Veda, pp. 122–123.

Majzlanová E. 1982. *Fytocenologická a produkčno ekologická charakteristika lesov Skorušinských vrchov*. Diss. thesis. Bratislava, 113 pp. (manuscript). Depon. in Prírodovedecká fakulta Univerzity Komenského, Bratislava.

Majzlanová E. 1983. Phytozönologisch-ökologische Charakteristik von Waldgesellschaften des Unterverbandes *Vaccinio-Abietenion* Oberd. 1962. im Gebirge Skorušinské vrchy. *Acta Facultatis Rerum Naturalium Universitatis Comenianae*. *Botanica*, 30: 47–64.

Majzlanová E. 1993. Syntetické spracovanie lesných spoločenstiev Skorušinských vrchov. *Zbornik Oravského múzea*, sine design.: 4–16.

Majzlanová E., s.d. *Klasifikácia lesných spoločenstiev Slorušinských vrchov*. [Further details on the study unkown to the present.]

Marhold K., Goliašová K., Hegedüšová Z. et al. 1998. Ferns and Flowering Plants. Ed. K. Marhold. In: *Checklist of non-vascular and vascular plants of Slovakia*. Eds K. Marhold, F. Hindák. Bratislava: Veda, pp. 333–687.

Marková Ľ. 1991. *Mapa lesných spoločenstiev fluvioglaciálu Vysokých Tatier – časť Tatranská Kotlina*. Dipl. thesis. Bratislava, 66 pp. (manuscript). Depon. in Prírodovedecká fakulta Univerzity Komenského, Bratislava.

Maťová H. 1994. *Vegetačná mapa lesov Podtatranskej kotliny*: *časť Tatranské Zruby*. Dipl. thesis. Bratislava, 86 pp. (manuscript). Depon. in Katedra botaniky Prírodovedeckej fakulty Univerzity Komenského, Bratislava.

Matuszkiewicz W. 1964. Tymczasowa klasyfikacja zespołów leśnych Polski. *Materiały zakładu fitosojologii stosowanej Uniwerzitetu Warszawskiego*, 4: 5 pp.

Matuszkiewicz J. 1977. Przegląd fitosocjologiczny zbiorowisk leśnych Polski. Cz. 4. Bory świerkowe i jodłowe. *Phytocoenosis*, 6(3): 151–226.

Matuszkiewicz W. 1981. *Przewodnik do oznaczania zbiorowisk roślinnych Polski*. 1 wyd. Warszawa: Państwowe Wydawnictwo Naukowe, 300 pp.

Matuszkiewicz J.M. 2002. *Zespoły leśne Polski*. 1. wyd., dodruk. Warszawa: Wydawnictwo Naukowe PWN, 360 pp.

Matuszkiewicz W. 2014. *Przewodnik do oznaczania zbiorowisk roślinnych Polski*. Wyd. nowe (III. zm. I uzup.) – 9 dodruk. Warszawa: Wydawnictwo Naukowe PWN, 540 pp.

Matuszkiewicz W., Matuszkiewicz J.M. 1996. Przegląd fitosocjologiczny zbiorowisk leśnych Polski. (Synteza). – *Phytoceonosis* (*N. S.*), 8(Seminarium geobotanicum 3): 3–79.

Medwecka-Kornaś A. 1972. Zespoły leśne i zaroślowe. In: Szafer W., Medwecka-Kornaś A., Kornaś J. et al. *Szata roślinna Polski*, tom 1. 2 wyd. Warszawa: Państwowe Wydawnictwo Naukowe, pp. 383–441.

Moor M. 1952. Die Fagion-Gesellschaften im Schweizer Jura. *Beitrage Geobot. Landesaufn. Schweiz.*, 31: 1–202, fig., tab. suppl.

Neuhäuslová-Novotná Z. 1968. Podmáčené smrčiny. In: *Geobotanická mapa ČSSR. 1. České země*. Ed. R. Mikyškaet. Praha: Academia, nakladatelství Československé akademie věd, pp. 87–90.

Neuhäuslová Z., Eltsova V. 2002a. Das *Soldanello-Piceetum* in Südböhmen. *Verhandlungen der zoologisch-botanischen Gesellschaft in Österreich*, 139: 123–133.

Neuhäuslová Z., Eltsova V. 2002b. The *Bazzanio-Piceetum* in the Bohemian Forest (Šumava Mts.), Czech Republic. *Feddes Repertorium*, 113(5–6): 367–379.

Novotková H. 1999. Rekonštrukcia lesov TANAP-u na základe peľových analýz surového humusu (časť Tatranská Polianka). *Štúdie o Tatranskom národnom parku*, 4: 21–40.

Oberdorfer E. 1957. Süddeutsche Pflanzengesellschaften. *Pflanzensoziologie*, 18(10): 1–564.

Parusel J.B. 2007. Zespół *Bazzanio-Piceetum* Br. Bl. et Siss. 1939 w Beskidzie Śląskim i Paśmie Babiogórskim (Beskid Żywiecki). *Natura Silesiae Superioris*, 10: 45–51.

Petermann R., Seibert P. [mit Beiträgen von G. Kaule und K. Thiele]. 1979. *Die Pflanzengesellschaften des Nationalparks Bayerischer Wald mit einer farbigen Vegetationskarte*. s. l.: Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten, 144 pp., mp., tab. suppl. Nationalpark Bayerischer Wald, Heft 4.

Pilous Z. 1971. *Flora ČSSR, C, řada bryologická*, Sv. 1: *Bryophyta*, *Mechorosty*, *Sphagnidae – Mechy rašeliníkové*. Praha: Academia, nakladatelství Československé akademie věd, 414 pp., fig. suppl.

Podani J. 2001a. *SYNTAX 2000* [CD]. *Multivariate data analysis package*. Budapest: s. n., info on the software package at: http://ramet.elte.hu/~podani/subindex.html

Podani J. 2001b. *SYN-TAX 2000: Computer program for data analysis in ecology and systematics. User's manual.* Budapest: Scientia Publishing, 56 pp.

Polakowski B. 1962. Bory świerkowe na torfowiskach (zespół *Piceo-Sphagnetum Girgensohnii*) w północno-wschodniej Polsce. *Fragmenta Floristica et Geobotanica*, 8(2): 139–156, tab., fig. suppl.

Richard J.-L. 1961. Les forêts acidophiles du Jura: Étude phytosociologique et écologique. *Matériaux pour le levé géobotanique de la Suisse*, 38: 1–164, tab. suppl.

Rodwell J.S., Pigott C.D., Ratcliffe D.A., Malloch A.J.C., Birks H.J.B., Proctor M.F., Shimwell D.W., Huntley J.P., Radford E., Wigginton M.J., Wilkins P. 1991. *British plant communities. I. Woodlands and scrub*. Cambridge: Cambridge University Press, 398 pp.

Ružička M. 1961. Problémy mapovania vegetačného krytu v ČSSR : (Sborník referátov zo sympózia 28–30. 11 1960). *Biologické práce*, 7(12): 1–164.

Samek V. 1961. Lesní společenstva rezervace Boubín. *Ochrana přírody* (*Praha*), 16: 74–78.

Schmid H., von Gaisberg E. 1936. Untersuchungen über Standort und Ertragsleistung der Fichte in württembergischen Waldgebieten. *Mitteilungen der Württembergischen Forstlichen Versuchsanstalt*, 1: 129 pp., tab. suppl.

Seibert P. 1992. Klasse: *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. et al. 39. In: *Süddeutsche Pflanzengesellschaften*, Teil IV. *Wälder und Gebüsche. A.* Textband. Ed. E. Oberdorfer. Jena: Gustav Fischer, pp. 53–80.

Shelyag-Sosonko Ju.R., Kuzemko A.A., Didukh Ja.P., Dubyna D.V., Tymoshenko P.A. 2006. *Roslynnist Ukrainy. Klasy: Vaccinio-Piceetea, Erico-Pinetea, Pulsatillo-Pinetea sylvestris*. Kyiv: Fitosotsiotsentr, 137 pp. [Шеляг-Сосонко Ю.Р., Куземко А.А., Дідух Я.П., Дубина Д.В., Тимошенко П.А. 2006. *Рослинність України. Класи Vaccinio-Piceetea, Erico-Pinetea, Pulsatillo-Pinetea sylvestris*. Київ: Фітосоціоцентр, 137 с.].

Sofron J. 1981. Přirozené smrčiny západních a jihozápadních Čech. *Studie Československé akademie věd*, 7: 1–128.

Sokołowski A.W. 1980. Zbiorowiska leśne północno-wschodniej Polski. *Monographiae botanicae*, 60: 1–208.

Solomakha V.A. 2008. *Syntaksonomiia roslynnosti Ukrainy. Tretie nablizhennia*. Kyiv: Fitosotsiotsentr, 296 pp. [Соломаха В.А. 2008. *Синтаксономія рослинності України. Третє наближення*. Київ: Фітосоціоцентр, 296 с.].

Solomakha V.A., Vorobiov Ye.O., Derbak M.Yu., Tiukh Yu.Yu., Solomakha I.V., Senchylo O.O., Shevchyk V.L., Yakushenko D.M. 2016. *Natsionalnyi prirodnyi park "Synevyr". Roslynnyi svit* (*National Nature Park "Synevyr". Plant world*). Kyiv: Fitosotsiotsentr, 332 pp. [Соломаха В.А., Воробйов Є.О., Дербак М.Ю., Тюх Ю.Ю., Соломаха І.В., Сенчило О.О., Шевчик В.Л., Якушенко Д.М. 2016. *Національний природний парк "Синевир". Рослинний світ*. Київ: Фітосоціоцентр, 332 с.].

Staszkiewicz J. 1958. Zespoły sosnowe Borów Nowotarskich. *Fragmenta Floristica et Geobotanica*, 3(2): 105–129, tab. suppl.

Staszkiewicz J. 1993. Plant communities of the Tisovnica Nature Reserve in the upper Orava region (Slovakia). *Polish Botanical Studies*, 5: 43–47.

Szafer W. 1959. *Zasięgi geograficzne drzew oraz ważniejszych krzewów i krzewiniek w Polsce*. In: *Szata roślinna Polski*, vol. 2. Ed. W. Szafer. Warszawa: Państwowe wydawnictwo naukowe, map suppl. 1 : 5 000 000.

Šmarda J. 1950. Květena Hrubého Jesenníku. *Časopis Moravského musea v Brně,* 35(1): 78–156.

Šoltés, R. 1976. Phytozönotische Analyse des Verbandes Vaccinio-Piceion Br.-Bl. 1938 in den Westkarpaten. *Acta*

Facultatis rerum naturalium Universitatis Comenianae, Botanica, 2: 139–167, tab. suppl.

Šoltés R. 1989. Ekologicko-syntaxonomické hodnotenie bryocenóz Vysokých a Belianskych Tatier. *Biologické práce*, sine design.: 148 pp.

Šomšák L. 1976. *Flóra a vegetácia Tatier. Téma č. 2: Lesné spoločenstvá glacifluviálu Vysokých Tatier*. Final report (VI-1-4-18a), Katedra geobotaniky Prírodovedeckej fakulty UK, Bratislava. Bratislava, 74 pp. (manuscript). Depon. in Výskumná stanica a múzeum TANAP-u, Štátne lesy TANAP-u, Tatranská Lomnica.

Šomšák L. 1979. Torfwälder fluvioglazialen Ablagerungen der Hohen Tatra. *Acta Facultatis rerum naturalium Universitatis Comenianae, Botanica,* 27: 1–38.

Šomšák L. 1983. Spruce Forests and Fir-Spruce Communities of the Western Part of the Slovenské Beskydy and Oravská Magura Mountains. *Folia Geobotanica et Phytotaxonomica*, 18(2): 137–160.

Šomšák L., Viceníková A., Marková Ľ., Šoltés R. 1993. Vegetačná mapa lesov Podtatranskej kotliny (časť I). *Zborník prác o Tatranskom národnom parku*, 33: 179–192, mp. suppl.

Šomšák L., Viceníková A., Mačor S. 1996. Fytocenologická mapa prírodnej rezervácie Bor pri Podspádoch. *Štúdie o Tatranskom národnom parku*, 1: 71–87.

Tichý L. 2002. JUICE, software for vegetation classification. *Journal of Vegetation Science*, 2002, 13(3): 451–453. https://doi.org/10.1111/j.1654-1103.2002.tb02069.x

Tichý L. 2016. *JUICE* [disc]. Ver. 7.0.181. Program for analysis and classification of phytosociological tables and other quantitative ecological data sets. Brno: s. n., info on the softare package at: http://www.sci.muni.cz/botany/juice/

Tichý L., Chytrý M. 2006. Statistical determination of diagnostic species for site groups of unequal size. *Journal of Vegetation Science*, 17(6): 809–818. https://doi.org/10.1111/j.1654-1103.2006.tb02504.x

Thébaud G. 2006 [recte 2008]. Associations végétales récemment décrites dans le Massif central oriental français: typification et validation nomenclaturale. *Revue des sciences naturelles d'Auvergne,* 70: 75–95.

Trautmann W. 1952. Pflanzensoziologische Untersuchungen der Fichtenwälder des Bayerischen Waldes. *Forstwissenschaftliches Centralblatt.* 71(9/10): 289–313.

Trinajstić I. 1974. Acidofilne, močvarne šume jele – as. *Carici brizoidis-Abietetum* Gorskog Kotara i Velike Kapele u Hrvatskoj. *Acta Botanica Croatica*, 33: 175–182.

Tüxen R. 1937. Die Pflanzengesellschaften Nordwestdeutschlands. *Mitteilungen der Floristisch-Soziologischen Arbeitsgemeinschaft*, 3: 1–170.

Vačko R. 2000. *Postglaciálny vývoj lesov Ždiarskej brázdy*. Diss. thesis. Bratislava, 107 pp. (manuscript). Depon. in Katedra pedológie, Prírodovedecká fakulta Univerzity Komenského, Bratislava.

Viceníková A. 1991. *Mapa lesných spoločenstiev fluvioglaciálu Vysokých Tatier – časť Kežmarské Žľaby*. Dipl. thesis. Bratislava, 70 pp. (manuscript). Depon. in Prírodovedecká fakulta Univerzity Komenského, Bratislava.

Viceníková A. 1998. *Lesné spoločenstvá glaciálno-fluviálnych sedimentov Podtatranskej kotliny*. Diss. thesis. Bratislava, 109 pp. (manuscript). Depon. in Prírodovedecká fakulta Univerzity Komenského, Bratislava.

Wallnöfer S. 1993. *Vaccinio-Piceetea*. In: *Die Pflanzengesellschaften Österreichs*, *Teil 3. Wälder und Gebüsche*. Eds L. Mucina, G. Grabherr, S. Wallnöfer. Jena: Gustav Fischer, pp. 283–337.

Weber H.E., Moravec J., Theurillat J.-P. 2000. International Code of Phytosociological Nomenclature. 3rd ed. *Journal of Vegetation Science*, 11(5): 739–768. https://doi.org/10.2307/3236580

Wilczek Z., Wytyczak K., Barć A., Zarzycki W. 2015. Problemy ochrony fitocenoz podmokłej świerczyny górskiej *Bazzanio-Piceetum* w Beskidzie Śląskim (Karpaty Zachodnie). *Chrońmy Przyrodę Ojczystą*, 71(1): 45–52.

Willner W. 2007. *Nomenklatorischer Anhang*. In: Willner W., Grabherr G., Drescher A. *Die Wälder und Gebüsche Österreichs: Ein Bestimmungswerk mit Tabellen*. 1 Textband. Eds W. Willner, G. Grabherr. München: Elsevier, pp. 219–245.

Willner, W., Zukrigl, K. 1999. Nomenklatorische Typisierung und Validisierung einiger aus Österreich beschriebener Waldgesellschaften. *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Österreich*, 136: 149–180.

Willner W., Grabherr G., Drescher A. 2007. *Die Wälder und Gebüsche Österreichs: Ein Bestimmungswerk mit Tabellen*, 2 Tabellenband. Eds W. Willner, G. Grabherr. München: Elsevier, 290 pp.

Willner W., Theurillat J.-P., Pallas J., Mucina L. 2015. On the nomenclature of some high-rank syntaxa of European forest vegetation. *Phytocoenologia*, 45(1–2): 175–181. https://doi.org/10.1127/phyto/2015/0036

Zięba A., Różański W., Szwagrzyk J. 2018. Syntaxononomy of relic Swiss stone pine (*Pinus cembra*) forests in the Tatra Mountains. *Tuexenia*, 38: 155–176. https://doi.org/ 10.14471/2018.38.004

Zukrigl K. 1973. Montane und subalpine Waldgesellschaften am Alpenostrand : unter mitteleuropäischem, pannonischem und illyrischem Einfluß. *Mitteilungen der forstlichen Bundes-versuchanstalt Wien*, 101: 1–387, tab. suppl.

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Supplement A1: Detailed description of methods and the resulting dendrogram

The initial set of phytocoenological relevés of wet woodlands with *Picea abies* (especially *Sphagnum*-rich wet woodlands) was prepared using the Turboveg for Windows database software (Hennekens, 2016; cf. Hennekens, Schaminée, 2001) from the dataset provided for the prepared monograph *Plant communities of Slovakia, Forest and shrub vegetation* (Valachovič et al., in prep.) stored in *Centrálna databáza...* (2016).

Subsequently, the following data were deleted: duplicitous relevés, non-forest relevés, relevés of *Alnus incana* and *A. glutinosa* phytocoenoses (class *Alnetea glutinosae* Br.-Bl. et Tx. ex Westhoff et al. 1946), relevés belonging to (krummholz-)forest peatland communities of the class *Vaccinio uliginosi-Pinetea sylvestris* Passarge 1968 (stable communities with open canopy cover and *Oxycoccus palustris* agg., *Vaccinium uliginosum*, *Ledum palustre*, *Eriophorum vaginatum* etc.) as well as *Picea abies-Sphagnum* spp./*Pinus cembra-Sphagnum* spp. relevés classified as climax woodlands of the class *Piceetea excelsae* Klika 1948 (cf. Kučera, 2012, 2017). Finally, the dataset was actualised with missing relevés of Šomšák (1976, 1979, 1983) (cf. Kučera, 2019). For purposes of this paper all available relevés irrespective of their plot size are used due to small number of recorded relevés.

A subfinal dataset of 153 relevés was exported for further modifications in the JUICE software package (Tichý, 2016; cf. Tichý, 2002). Using JUICE, taxa with unequal taxonomic rank were merged to the nearest mutual rank (*Caltha palustris* – *C. palustris* subsp. *laeta*; *Cardamine amara* – *C. amara* subsp. *opicii*; *Galeobdolon luteum* agg. – *G. luteum* – *G. montanum*; *Myosotis palustris* agg. – *M. scorpioides*) as well as *Sphagnum palustre* and *S. centrale* as the latter species was not recognized in older works. Other *Sphagnum* species were retained, including infrequent data on "*Sphagnum* sp." for preservation of the information on the *Sphagnum* taxa presence.

For the statistical comparison of higher syntaxa (Tab. 1) other merged taxa were set: *Aconitum firmum* s. l., *Alchemilla* spp., *Campanula rotundifolia* agg., *Cardaminospis arenosa* agg., *Chiloscyphus polyanthos* s. l., *Cladonia squamosa* (incl. var.), *Crepis jacquinii*, *Luzula luzuloides*, *Pellia* spp., *Primula elatior* (incl. subsp. *tatrensis*), *Senecio nemorensis* agg., *Soldanella hungarica* (incl. "*montana*", subsp. *hungarica*), *Solidago virgaurea* (incl. subsp. *minuta*), *Sorbus aucuparia* (incl. subsp. *glabrata*).

Data on taxa of the *Dryoteris carthusiana* group were retained for the purpose of maintaining the important floristic information for higher syntaxa comparison: undetermined "*Dryopteris carthusiana* agg." occurred only two times in the whole dataset. Similarly, other species were not merged with very sporadic data on the undetermined taxa: *Aconitum* sp. (1×), *Glyceria* sp. (1×), *Juncus* sp. (1×), *Lepidozia* sp. (1×), *Myosotis* sp. (1×), *Polytrichum* sp. (1×), *Potentilla* sp. (2×), *Salix* sp. (E_1, 5×),* *Soldanella* sp. (4×), *Sphagnum* sp. (10×).

The subfinal dataset was further analysed within JUICE and basic types of communities were identified. Consequently, relevés which represent secondary Norway spruce stands or transitional phytocoenoses to *A. glutinosa* communities were excluded (8 relevés: Majzlanová, 1982, tab. 13, rel. 22; Majzlanová, s. d., tab. 2, rel. 4, 7, 8, 9; Kobzáková, 1987, p. 64; Viceníková, 1991, tab. 5, rel. 3; Olekšák, 1995, tab. 6). Thus, the final dataset of wet *Picea* woodlands counted 145 relevés.

Statistical analysis of the final dataset was performed by the software package SYN-TAX 2000 (Podani, 2001a). Hierarchical clustering was executed using the coefficient Podani's discordance (see more Podani, 2001b), using also variants without E_3+E_2 species and also without E_0 species (i.e. with E_1 species only). However, the final relevé classification follows a manual rearrangement of several relevés to reach more compact species delimitation of basic units (associations) (fig. 1). The main reason for this modification is a supposed author bias (see the next four paragraphs and fig. 1):

– Although relevé groups from the opposite parts of diversity range (*Sphagno acutifolii-Piceetum*, *Soldanello-Piceetum*, (*Leucobryo-Piceetum*) vs. *Stellario-Abietetum*, *Equiseto-Abietetum*[-*Carex alba* subunit]) were constantly or with only insignificant variation reproduced as distinctive separate units within the performed variants of the numerical classification, the most of remaining relevés (*Sphagno palustris-Piceetum*, *Equiseto-Piceetum*) were vaguely grouped.

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* E_3 = canopy (trees), E_2 = understorey (shrubs), E_1 = field layer (herbs, grasses, dwarf shrubs etc.), E_0 = ground layer (bryophytes, lichens) (Klika, 1948, pp. 29–30; Rodwell et al., 1991).

– Detailed examination of those relevés revealed that their species composition is biased towards the respective author. The most species-rich relevés – irrespective of their final classification here – come from the studies of the recognized Slovak geobotanist Prof L. Šomšák (1976, 1979) in collaboration with Dr J. Foltínová as the bryophyte specialist. The reported species richness applies especially to bryophytes: no other author recorded similarly species-abundant relevés within the particular unit.

– In contrast, Šomšák's students recorded in general (markedly) less abundant species composition in their unpublished theses. Moreover, relevé data on bryophytes were frequently recorded as the presence data only. The author bias is probably also displayed in marked alternation of species *Agrostis canina/A. stolonifera* and *Glyceria nemoralis/G. fluitans* in the respective relevés (missidentification?). Determination of *Sphagnum* species and their recognition in the field could also be a source of inaccuracy.

– Thus, the species-rich relevés of *Leucobryum glaucum*-dominated wet *Picea* woodland (author Šomšák; see Kučera 2019) were usually classified outside of the corresponding group. Similarly, species less abundant relevés of the group defined by set of species unique to community *Sphagno palustris-Piceetum* described by Šomšák (1979) were partially mixed with the relevés classified here as *Equiseto-Piceetum*.

The differential attributes of the respective syntaxa (fidelity and frequency values, rounded to units) and resulting tables were elaborated within JUICE (Tichý, 2016); the concept of fidelity was used (Chytrý et al., 2002; phi coefficient – φ). The characteristics of associations are derived from final dataset without one relevé "group" of the *Carex rostrata-Picea abies* community (see below). Fidelity calculation was based on the presence/absence data with a standardization of relevé groups to an equal size. Performing the Fisher's exact test, zero fidelity was given to species with significance $P > 0.05$ in a particular cluster (Tichý, Chytrý, 2006).

Fidelity values in the descriptions of the units of wet *Picea* woodland alliances of the order *Sphagno palustris-Piceetalia* (units 2–7, see Tab. 4 – in electronical appendix B2) are computed from the final dataset reduced by another 6 relevés of the supramontane community belonging to the alliance *Piceion excelsae* Pawłowski ex Pawłowski et al. 1928 (see below).

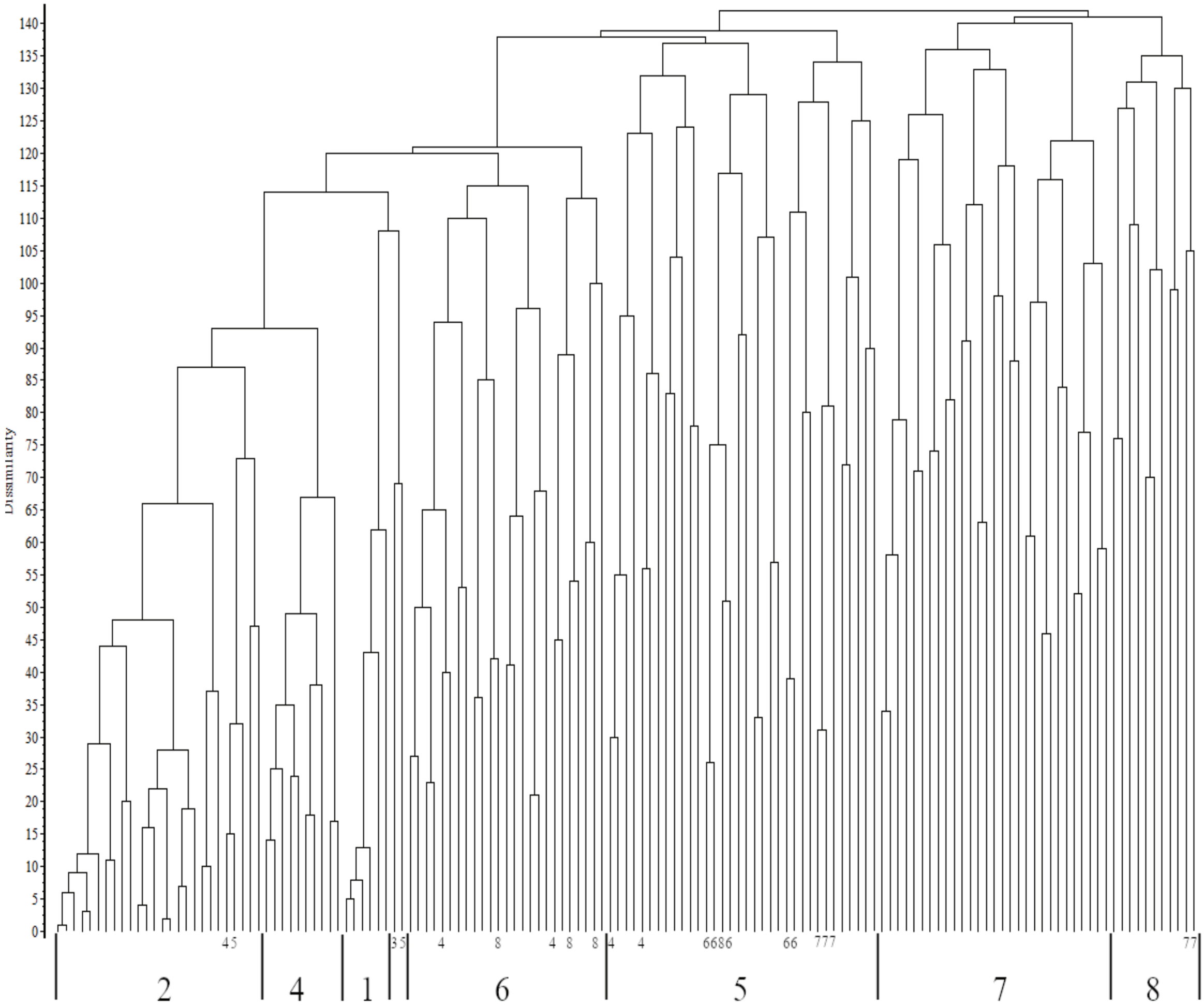

Figure 1. Dendrogram of hierarchical clustering of the relevés of wet *Picea* communities from Slovaki**a**

1 – *Sphagno acutifolii-Piceetum* Zukrigl 1973

2 – *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939

3 – *Carex rostrata-Picea abies* community (1 relevé)

4 – *Leucobryo glauci-Piceetum abietis* Šomšák ex P. Kučera 2019

5 – centre of relevés of *Sphagno palustris-Piceetum* Šomšák 1979

6 – centre of relevés of *Equiseto sylvatici-Piceetum* Šmarda 1950 (with admixed relevés of *Sphagno palustris-Piceetum*)

7 – *Stellario nemorum-Abietetum albae* P. Kučera 2019

8 – *Valeriano dioicae-Abietetum* P. Kučera 2019 ass. nov.

Supplement A2: Formal characteristics of the distinguished associations

1. *Sphagno acutifolii-Piceetum* Zukrigl 1973

Characteristic species combination within the whole dataset of wet woodlands with *Picea abies* in Slovakia (6 relevés, Tab. 3):

A) differential species (φ (× 100) ≥ 25):

E_3: *Sorbus aucuparia* (41),

E_2: *Pinus mugo* (55),

E_1: *Pinus mugo* (55),

Juncus filiformis (87), *Eriophorum vaginatum* (81), *Dryopteris dilatata* (72), *Athyrium distentifolium* (72), *Dryopteris expansa* (66), *Nardus stricta* (63), *Homogyne alpina* (57), *Carex nigra* (50), *Carex canescens* (38), *Avenella flexuosa* (38),

E_0: *Sphagnum capillifolium* (58), *S. rubellum* (55), *Lophocolea heterophylla* (43), *Polytrichum formosum* (41), *Calypogeia azurea* (40), *Dicranum fuscescens* (38), *Polytrichum alpinum* (38), *Barbilophozia floerkei* (38), *Sphagnum fuscum* (38), *Barbilophozia attenuata* (38), *Pleuridium subulatum* (38), *Polytrichum commune* (37);

B) frequent species (constancy ≥ 50%):

E_3: *Picea abies,*

E_2: *Pinus mugo* (50),

E_1: *Picea abies* (67), *Sorbus aucuparia* (67),

Vaccinium myrtillus (100), *Homogyne alpina* (100), *Avenella flexuosa* (83), *Vaccinium vitis-idaea* (83), *Eriophorum vaginatum* (83), *Calamagrostis villosa* (83), *Dryopteris dilatata* (83), *Juncus filiformis* (83), *Athyrium distentifolium* (67), *Carex canescens* (67), *Nardus stricta* (67), *Carex nigra* (67), *Dryopteris expansa* 50),

E_0: *Polytrichum commune* (100), *Polytrichum formosum* (83), *Sphagnum capillifolium* (83), *Dicranum scoparium* (83), *S. girgensohnii* (67), *Plagiothecium curvifolium* (67).

2. *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939

Characteristic species combination (24 relevés, Tab. 4 – in the electronical appedix B2):

A) differential species (φ (× 100) ≥ 25):

E_3: –,

E_2: *Pinus sylvetris* (27),

E_1: *Eriophorum vaginatum* (38), *Lycopodium annotinum* (34), *Listera cordata* (28), *Thelypteris palustris* (27),

E_0: *Sphagnum girgensohnii* (25), *Polytrichum commune* (25);

B) constant species (constancy ≥ 40%):

E_3: *Picea abies* (100),

E_2: *Picea abies* (96),

E_1: *Picea abies* (92),

Vaccinium myrtillus (100), *V. vitis-idaea* (100), *Calamagrostis villosa* (63), *Oxalis acetosella* (50), *Equisetum sylvaticum* (42), *Homogyne alpina* (42), *Dryopteris carhusiana* (42),

E_0: *Sphagnum girgensohnii* (83), *Polytrichum commune* (75), *Dicranum scoparium* (67), *Pleurozium schreberi* (54), *S. palustre* agg. (50).

4. *Leucobryo glauci-Piceetum abietis* Šomšák ex P. Kučera 2019

Characteristic species combination (15 relevés, Tab. 4 – in the electronical appedix B2):

A) differential species (φ (× 100) ≥ 25):

E_3: –,

E_2: –,

E_1: *Melampyrum sylvaticum* (48), *Calamagrostis arundinacea* (32), *Avenella flexuosa* (30), *Luzula luzuloides* (30), *Calluna vulgaris* (29), *Luzula pilosa* (28),

E_0: *Leucobryum glaucum* (83), *Orthodicranum undulatum* (34), *Hylocomium splendens* (29), *Dicranella heteromalla* (27);

B) frequent species (constancy ≥ 50%):

E_3: *Picea abies* (100),

E_2: *Picea abies* (93),

E_1: *Picea abies* (93), *Sorbus aucuparia* (60),

Vaccinium myrtillus (100), *Luzula pilosa* (93), *V. vitis-idaea* (93), *Avenella flexuosa* (67), *Athyrium filix-femina* (67), *Calamagrostis arundinacea* (67), *Dryopteris carthusiana* (67), *Maianthemum bifolium* (67), *Calamagrostis villosa* (60), *Equisetum sylvaticum* (60),

E_0: *Leucobryum glaucum* (100), *Dicranum scoparium* (93), [*Sphagnum* spp. (80)], *Pleurozium schreberi* (80), *Hylocomium splendens* (53).

5. *Sphagno palustris-Piceetum* Šomšák 1979

Characteristic species combination (37 relevés, Tab. 4 – in the electronical appedix B2):

A) differential species (φ ($\times$ 100) $\geq$ 25):

E_3: –,

E_2: –,

E_1: *Salix aurita* (39), *Corylus avellana* (26),

Agrostis canina (58), *Viola palustris* (53), *Ranunculus flammula* (49), *Juncus effusus* (43), *Potentilla erecta* (41), *Agrostis stolonifera* (39), *Carex rostrata* (37), *Valeriana simplicifolia* (35), *Carex canescens* (33), *Ajuga reptans* (31), *Carex pallescens* (30), *Moneses uniflora* (28), *Senecio nemorensis* agg. (ut *S. nemorensis*) (28), *Carex echinata* (27), *Lysimachia vulgaris* (27), *Peucedanum palustre* (26), *Galium uliginosum* (26), *Melampyrum pratense* (26), *Galium palustre* (26),

E_0: *Brachythecium starkei* (30), *Lepidozia reptans* (28), *Sphagnum quinquefarium* (26), *Cephalozia bicuspidata* (26), *Calliergon cordifolium* (26), *Rhodobryum roseum* (26), *Chiloscyphus pallescens* (26), *Sphagnum palustre* agg. (25);

B) frequent species (constancy $\geq$ 50%):

E_3: *Picea abies* (100),

E_2: *Picea abies* (95),

E_1: *Picea abies* (89), *Sorbus aucuparia* (54),

Vaccinium myrtillus (97), *V. vitis-idaea* (92), *Equisetum sylvaticum* (86), *Luzula pilosa* (86), *Calamagrostis villosa* (81), *Dryopteris carthusiana* (76), *Athyrium filix-femina* (73), *Maianthemum bifolium* (68), *Potentilla erecta* (65), *Caltha palustris* (54), *Deschampsia cespitosa* (54), *Agrostis canina* (54) [*A. canina* + *A. stolonifera* (86)], *Crepis paludosa* (54), *Lysimachia vulgaris* (54), *Orthilia secunda* (51), *Oxalis acetosella* (51),

E_0: *Dicranum scoparium* (81), *Sphagnum palustre* agg. (70), *S. girgensohnii* (65), *Pleurozium schreberi* (65), *Polytrichum commune* (57).

6. *Equiseto sylvatici-Piceetum* Šmarda 1950

Characteristic species combination (13 relevés, Tab. 4 – in the electronical appedix B2):

A) differential species (φ ($\times$ 100) $\geq$ 25):

E_3: –,

E_2: *Alnus incana* (39),

E_1: *Lonicera nigra* (26),

Trientalis europaea (44), *Lysimachia vulgaris* (35), *Calamagrostis villosa* (28), *Veratrum album* subsp. *lobelianum* (25),

E_0: *Lophocolea bidentata* (40), *Bazzania trilobata* (25);

B) frequent species (constancy $\geq$ 50%):

E_3: *Picea abies* (100),

E_2: *Picea abies* (92),

E_1: *Picea abies* (100), *Sorbus aucuparia* (62),

Calamagrostis villosa (100), *Equisetum sylvaticum* (100), *Vaccinium myrtillus* (100), *V. vitis-idaea* (92), *Luzula pilosa* (85), *Oxalis acetosella* (85), *Dryopteris carthusiana* (77), *Maianthemum bifolium* (77), *Lysimachia vulgaris* (62), *Athyrium filix-femina* (62), *Crepis paludosa* (54), *Caltha palustris* (54), *Rubus idaeus* (54),

E_0: *Dicranum scoparium* 92), *Pleurozium schreberi* (69), *Plagiothecium curvifolium* (62).

7. *Stellario nemorum-Abietetum albae* P. Kučera 2019

Characteristic species combination (36 relevés, Tab. 4 – in the electronical appedix B2):

A) differential species (φ ($\times$ 100) $\geq$ 25):

E_3: *Abies alba* (63), *Fagus sylvatica* (47),

E_2: *Fagus sylvatica* (61), *Lonicera xylosteum* (38), *Sorbus aucuparia* (35), *Acer pseudoplatanus* (34), *Lonicera nigra* (26), *Salix caprea* (25),

E_1: *Lonicera xylosteum* (34), *Fagus sylvatica* (29), *Abies alba* (29),

Stellaria nemorum (84), *Chrysosplenium alternifolium* (72), *Petasites albus* (71), *Lysimachia nemorum* (65), *Geranium robertianum* (59), *Cardamine trifolia* (59), *Adenostyles alliariae* (59), *Luzula luzulina* (57), *Impatiens noli-tangere* (57), *Prenanthes purpurea* (56), *Gentiana asclepiadea* (55), *Rubus hirtus* (54), *Galium odoratum* (52), *Dryopteris dilatata* (47), *Milium effusum* (47), *Chaerophyllum hirsutum* (45), *Urtica dioica* (44), *Ranunculus lanuginosus* (44), *R. platanifolius* (44), *Phyteuma spicatum* (41), *Senecio ovatus* (40), *Geum rivale* (39), *Carex sylvatica* (39), *Cardamine flexuosa* (38), *Poa remota* (38), *Calamagrostis epigejos* (38), *Veronica anagallis-aquatica* (38), *Homogyne alpina* (37), *Phegopteris connectilis* (37), *Cicerbita alpina* (34), *Rubus idaeus* (34), *Dryopteris filix-mas* (32), *Luzula sylvatica* (31), *Oxalis acetosella* (31), *Epilobium montanum* (29), *Symphytum tuberosum* (27), *Sanicula europaea* (27), *Calamagrostis arundinacea* (27), *Cardamine amara* (26), *Poa palustris* (26),

E_0: *Cirriphyllum piliferum* (54), *Plagiomnium affine* (47), *Plagiothecium undulatum* (38), *Conocephalum conicum* (34), *Plagiomnium rostratum* (34), *Plagiomnium undulatum* (31), *Thuidium tamariscinum* (31);

B) frequent species (constancy $\geq$ 50%):

E_3: *Picea abies* (100), *Abies alba* (78),

E_2: *Picea abies* (64), *Sorbus aucuparia* (56),

E_1: *Picea abies* (78), *Abies alba* (72), *Sorbus aucuparia* (56),

Equisetum sylvaticum (100), *Oxalis acetosella* (100), *Senecio ovatus* (83), *Rubus idaeus* (83), *Stellaria nemorum* (78), *Chaerophyllum hirsutum* (78), *Vaccinium myrtillus* (75), *Athyrium filix-femina* (75), *Chrysosplenium alternifolium* (69), *Gentiana asclepiadea* (67), *Petasites albus* (67), *Prenanthes purpurea* (61), *Calamagrostis arundinacea* (61), *C. villosa* (61), *Dryopteris carthusiana* (58), *Homogyne alpina* (58), *Hieracium murorum* (53), *Dryopteris filix-mas* (53), *Deschampsia cespitosa* (53), *Lysimachia nemorum* (50),

E_0: *Plagiomnium affine* (72), *Dicranum scoparium* (61), *Sphagnum girgensohnii* (53).

8. *Valeriano dioicae-Abietetum* P. Kučera 2019 ass. nov.

Characteristic species combination (13 relevés from Slovakia, Tab. 4 – in the electronical appedix B2):

A) differential species (φ ($\times$ 100) $\geq$ 25):

E_3: *Pinus sylvestris* (28), *Alnus incana* (26), *A. glutinosa* (26),

E_2: *Viburnum opulus* (45), *Lonicera nigra* (45), *Frangula alnus* (36),

E_1: *Daphne mezereum* (55), *Viburnum opulus* (45), *Lonicera nigra* (34), *Ribes petraeum* (32), *Sorbus aucuparia* (32), *Abies alba* (26),

Rubus saxatilis (94), *Valeriana dioica* (74), *Polygonatum verticillatum* (71), *Clematis alpina* (59), *Cirsium oleraceum* (59), *Filipendula ulmaria* (55), *Thalictrum aquilegiifolium* (52), *Carex alba* (52), *Crepis paludosa* (51), *Caltha palustris* (50), *Galium schultesii* (49), *Fragaria vesca* (48), *Astrantia major* (45), *Melica nutans* (45), *Solidago virgaurea* (39), *Chaerophyllum hirsutum* (37), *Dactylorhiza maculata* (agg.) (36), *Carex remota* (36), *Actaea spicata* (36), *Carex digitata* (36), *Maianthemum bifolium* (36), *Equisetum palustre* (35), *Luzula pilosa* (34), *Epipactis palustris* (32), *Polygonatum multiflorum* (32), *Valeriana tripteris* (32), *Paris quadrifolia* (31), *Angelica sylvestris* (29), *Senecio ovatus* (27), *Bistorta major* (25),

E_0: *Trichocolea tomentella* (39), *Eurhynchium angustirete* (28), *Tetraphis pellucida* (26);

B) frequent species (constancy $\geq$ 50%):

E_3: *Picea abies* (100), *Pinus sylvestris* (62),

E_2: *Picea abies* (69), *Lonicera nigra* (62),

E_1: *Picea abies* (100), *Sorbus aucuparia* (92), *Abies alba* (69), *Lonicera nigra* (54),

Crepis paludosa (100), *Caltha palustris* (100), *Vaccinium myrtillus* (100), *Luzula pilosa* (100), *Maianthemum bifolium* (100), *Rubus saxatilis* (92), *Equisetum sylvaticum* (77), *Valeriana dioica* (77), *Oxalis acetosella* (77), *V. vitis-idaea* (69), *Chaerophyllum hirsutum* (69), *Senecio ovatus* (69), *Calamagrostis villosa* (69), *Athyrium filix-femina* (69), *Polygonatum verticillatum* (69), *Solidago virgaurea* (62), *Filipendula ulmaria* (54), *Rubus idaeus* (54), *Fragaria vesca* (54),

e6 E_0: *Dicranum scoparium* (85), *Pleurozium schreberi* (69), *Sphagnum girgensohnii* (62).

Supplement A3: Nomenclatural and syntaxonomical notes to selected syntaxa

Section I) Nomenclatural and syntaxonomical notes to the association *Sphagno acutifolii-Piceetum* Zukrigl 1973

The association was described by Zukrigl (1973) under the name "*Sphagno-Piceetum*", thus creating a name similar to earlier and also later descriptions of *Sphagnum-Picea abies* woodland units (cf. Exner, 2007; Kučera, 2012; Chytrý et al., 2013). The relevé table 6 of Zukrigl (1973) comprises in a matter of fact four different phytocoenoses with varying peat moss species participation:

– rel. 1 is a non-forest community on a montane bog with height-reduced trees (canopy cover 10 %, understorey cover 20 %) of the class *Scheuchzerio-Caricetea nigrae* Tüxen 1937;

– rel. 2 shows an example of phytocoenosis with elements of both climax supramontane *Picea* forest and bog communities;

– rel. 3 presents a different (semiforest?) phytocoenosis of the bog rand with *Molinia*;

– rels 4–6 represent a phytocoenosis similar to *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939 (probably subass. *caricetosum fuscae* Kasprowicz ex P. Kučera 2019).

Typification of the association by Willner, Zukrigl (1999) considerably consolidated the syntaxonomical content of the syntaxon as a good interpretable and useful phytocoenological unit. As only one peat mos species was mentioned in the type relevé, the association name could be specified as "*Sphagno acutifolii-Piceetum*" (Recommend. 10C; Weber et al., 2000, p. 749).

Remarks on the name type "*Sphagno-Piceetum*"

***Sphagno-Piceetum* (Tüxen 1937) Hartmann 1953**

There is a striking difference between the characteristics of the association by Hartmann (1953) (= "Moor-Fichtenwald") and the supplied original diagnosis which consists of the subassociation *Piceetum excelsae sphagnetosum* Tüxen 1937 (= humid slope forest phytocoenoses with numerous *Sphagnum*-pillows) (Willner, 2007; Kučera 2007, 2012). The name *Sphagno-Piceetum* (Tüxen 1937) Hartmann 1953 (often with various author citations) was repeatedly used in the Hartmann's incorrect concept until recently (e.g. Jirásek, 2002); however, Hartmann later changed his syntaxonomical evaluation and did not use the label *Sphagno-Piceetum* (cf. Hartmann, Jahn, 1967).

Tüxen (1937) presented three peat moss species in his original diagnose in the form of a synoptic table consisting of total 8 relevés, all of them were labelled as differential species: *Sphagnum capillifolium* (ut *S. acutifolium* Russ. et Warnst.) in 4 relevés, *S. quinqefarium* in 2 relevés and *S. girgensohnii* in 2 relevés. According to the differences in ecology of these peat moss species (Pilous 1971) and at the same time in compliance with Tüxen (1937), I propose the following completion of Tüxen's name following the Code (Weber et al., 2000, Rec. 10C):

***Piceetum excelsae sphagnetosum quinquefarii* Tüxen 1937**; see Tüxen (1937), p. 123.

Consequently, the association name published by Hartmann (1953) is to be completed as follows:

***Sphagno quinquefarii-Piceetum* (Tüxen 1937) Hartmann 1953**; see Hartmann (1953), Anhang, p. XIII.

***Sphagno-Piceetum* Kuoch 1954 (with one subassociation *thuidietosum*)**

The name is a nomen superfluum (Willner 2007, p. 240; Art. 29c) because Kuoch (1954, p. 227) proposed the name as a unit including also communities *Soldanello-Piceetum* Volk in Br.-Bl. et al. 1939 as well as *Bazzanio-Piceetum* (Schmid et Gaisberg 1936) Br.-Bl. et Sissingh in Br.-Bl. et al. 1939 (cf. Kučera, 2007). Provided relevés (Kuoch, 1954, tab. 13) actually display affinities to *Soldanello-Piceetum* Volk in Br.-Bl. et al. 1939 and part of them also towards *Equiseto-Piceetum* Šmarda 1950.

Kuoch (1954, p. 227, also Tab. 13) in express words stated that *S. girgensohnii* is a provisional character species of the association. Also other peat moss species are recorded in Kuoch's relevés. As the name is nomen superfluum, completion of the name according the Art. 10 (Rec. 10C) is redundant.

***Sphagno-Piceetum* Richard 1961**

Sphagno-Piceetum Richard 1961 is cited by Šomšák (1979) and Chytrý et al. (2013) as a separate association name. However, Richard (1961, p. 110) stated that he labelled the unit "according to Moor and Kuoch" and described two new subassociations. Thus, the author actually used the name *Sphagno-Piceetum* Kuoch 1954 and did not describe a new association, therefore also completion of this name to "*Sphagno girgensohnii-Piceetum* (Moor 1942) Richard 1961" (cf. Art. 10C) made by Boeuf et al. (2014, p. 111) was redundant.

Species composition of Richard's relevés are in accordance with concept of Kuoch (1954) and the relevés of his two subassociations belong to the association *Soldanello-Piceetum* Volk in Br.-Bl. et al. 1939 (see above) and partly to *Equiseto-Piceetum* Šmarda 1950.

***Sphagno girgensohnii-Piceetum* Polakowski 1962 nom. cons. propos.**

The association was described with the original form of the name *Piceo-Sphagnetum Girgensohnii* by Polakowski (1962) from the north-east Poland where outskirts of boreal *Picea abies* distribution range extend. The correct inverted form of the name (Art. 10b) was proposed already by Czerwiński (1966) and was used since then (Medwecka-Kornaś, 1972; J. Matuszkiewicz, 1977; Sokołowski, 1980) and at the same time is recognized as a distinct syntaxon in the national surveys till the recent time (cf. W. Matuszkiewicz, 1964; J. Matuszkiewicz, 1977, 2002; W. Matuszkiewicz 1981 till 2014; W. Matuszkiewicz, J. Matuszkiewicz, 1996).

The long and well established use of this unit is the reason for preservation of the name and for preferential conservation against a potential older homonymous name. A competing name could be *Sphagno-Piceetum* (Tüxen 1937) Hartmann 1953; however, completion of the latter name (see above) to *Sphagno quinquefarii-Piceetum* (Tüxen 1937) Hartmann 1953 (see above) solve that question.

For nomenclatural purposes, lectotypes are here chosen for the association *Sphagno girgensohnii-Piceetum* Polakowski 1962 and its subunits:

Sphagno girgensohnii-Piceetum Polakowski 1962 nom. cons. propos.
Nomenclatural type: Polakowski (1962), tab. 4, rel. 29; lectotypus hoc loco.
Sphagno girgensohnii-Piceetum lycopodietosum annotini Polakowski 1962
Nomenclatural type: Polakowski (1962), tab. 4, rel. 29; lectotypus hoc loco.
Sphagno girgensohnii-Piceetum vaccinietosum myrtilli Polakowski 1962 (Art. 14)
Nomenclatural type: Polakowski (1962), tab. 4, rel. 54; lectotypus hoc loco.

***Sphagno-Piceetum* Zukrigl 1973**

Zukrigl (1973) described a new association. The name could be completed to *Sphagno acutifolii-Piceetum* Zukrigl 1973 (see above), thus it is questionable to label it as a later homonymum (cf. Chytrý et al., 2013, p. 432).

***Sphagno-Piceetum* Ellenberg et Klötzli 1974**

Ellenberg, Klötzli (1972) (on the correct publication date see Willner 2007, p. 239) actually differentiated two separate communities: *Sphagno-Piceetum typicum* Ellenberg et Klötzli 1972 and *Sphagno-Piceetum calamagrostietosum villosae* Ellenberg et Klötzli 1972. However, from the nomenclatural point of view the first subassociation is a nomen superfluum (Art. 29c) to *Sphagno-Piceetum betuletosum* Richard 1961 in the first succession. Similarly, *Sphagno-Piceetum calamagrostietosum villosae* should be nomenclaturally treated as a nomen superfluum to *Sphagno-Piceetum thuidietosum* Kuoch 1954 even though the supposed syntaxonomical content was different.

In both cases, *Sphagno-Piceetum* Ellenberg et Klötzli 1974 leads nomenclaturally directly to *Soldanello-Piceetum* Volk in Br.-Bl. et al. 1939 (see above).

***Sphagno palustris-Piceetum* Šomšák 1979**

Along with the description of a new association Šomšák (1979) specified the name-giving *Sphagnum* species, thus the unit was clearly differentiated from older *Sphagnum-Picea* names. It represents distinct wet woodland with *Picea abies*.

***Sphagno-Piceetum* sensu Sofron 1981 non (Tüxen 1937) Hartmann 1953**

This is the most common example of the approach when an author used the concept of bog woodland intended by Hartmann (1953), but the nomenclatural implications were not followed (see above). Application of the incorrect use of the association name continued more decades (cf. Jirásek, 1996, 2002 vs. Chytrý et al., 2013).

***Sphagno acutifolii-Piceetum* (Březina et Hadač in Hadač et al. 1969) Hadač 1987**

Hadač (1987) published the nomen novum for *Sphagno-Piceetum excelsae tatricum* (Art. 34) and at the same time specified the peat moss species used in the association name. Nevertheless, Hadač's name is a younger homonym to *Sphagno acutifolii-Piceetum* Zukrigl 1973 (Art. 31).

Only few relevés of this community was published from Slovakia. According to my field knowledge, it represents strongly human-influenced *Picea-Abies* forests on habitat where *Fagus sylvatica* was originally naturally present (Kučera, 2009a, 2012, p. 250).

***Sphagno magellanici-Piceetum* Bick ex Boeuf in Boeuf et al. 2014**

Boeuf (Boeuf et al. 2014, p. 109; cf. also p. 306, 316) proposed this new name since the name of Bick (1952; *Pino rotundatae-Sphagnetum piceetosum* Bick 1985) was considered invalidly published due to the absence of the required typification (Art. 3o etc.). However, Bick (1985, p. 166) published his subassociation name validly (Art. 2b, 5) therefore Boeuf's proposal should be assessed as raising of the rank (Art. 27d).

Proposal to complete the association name with the epiteth "*magellanici*" (cf. Recom. 10C) is also problematic because the original diagnosis cited by Bick (1985), i.e. facies "*Pinetum uncinatae piceosum*" by Kästner, Flößner (1933, tab. XXII), does not contain *Sphagnum magellanicum* (table 18 of Bick contains this species).

Moreover, the name *Sphagno magellanici-Piceetum* (proposed by Boeuf) would be a later homonym to the name *Piceo abietis-Sphagnetum magellanici* Krisai 1986 (Art. 31d) (cf. Wallnöfer 1993, p. 309). While the subassociation *Pino rotundatae-Sphagnetum piceetosum abietis* Bick 1985 (cf. Art. 10b) represents a plant community of the class *Vaccinio uliginosi-Pinetea* Passarge 1968, the name *Piceo abietis-Sphagnetum magellanici* Krisai 1986 belongs to a plant community of non-forest vegetation of the class *Oxycocco-Sphagnetea* Br.-Bl. et Tx. ex Westhoff et al. 1946.

Section II) Chosen syntaxonomical notes to the association *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939

Although the original characteristics of the association *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939 published by Braun-Blanquet et al. (1939, p. 32) was very distinctive and explicit, the unit was repeatedly confused with other syntaxa in the past (cf. also Sofron, 1981, p. 56–60). In brief:

(1) Trautmann (1952) united this association with *Mastigobryo-Piceetum* (= *Bazzanio-Piceetum*) (Schmid et Gaisberg 1936) Br.-Bl. et Sissingh in Br.-Bl. et al. 1939 from the Black Forest [Schwarzwald], probably following the occurrence pattern of *Bazzania trilobata* (cf. Braun-Blanquet et al. 1939). Although Oberdorfer (1957) formally retained the label *Bazzanio-Piceetum*, it seems that the determining factor of the later application of the name (cf. Wallnöfer, 1993) was simultaneous presentation of the species *Bazzania trilobata* along with the name *Bazzanio-Piceetum*.

Most of the authors in the former Czechoslovakia and in Poland followed the concept of assignment of stands with *Bazzania trilobata* to the association *Bazzanio-Piceetum* (Schmid et Gaisberg 1936) Br.-Bl. et Sissingh in Br.-Bl. et al. 1939 (auctorum (excl. Zlatník, p. 63 in Ružička, 1961); Samek, 1961; Magic, 1966, 1986; Neuhäuslová-Novotná, 1968; Šomšák, 1979; Bujakiewicz, 1981; and other later authors in the respective country).

However, the association *Bazzanio-Piceetum* (Schmid et Gaisberg 1936) Br.-Bl. et Sissingh in Br.-Bl. et al. 1939 is defined by the subassociations *Piceetum myrtilletosum* and *Piceetum vaccinietosum* both described by Schmid, von Gaisberg (1936) from which only the second one marginally contains wet *Picea* woodlands (cf. Braun-Blanquet et al., 1939; Bartsch, Bartsch, 1940; Kučera, 2007, p. 62, 2010, p. 834, 2012, p. 242). In contrast to these units,

association *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939 represents true wet woodland (Braun-Blanquet et al. 1939, Trautmann 1952, tab. 2).

(2) The second (and in the eastern Central Europe only sporadical) source of confusion is Oberdorfer's (1957) integration of the supramontane *Lophozio-Piceetum* Volk in Br.-Bl. et al. 1939 into *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939 (cf. also Willner, 2007, p. 240) expressed by *Soldanella montana* Willd. as proposed character species of the latter association. These two communities co-occurre in the Bohemian Forest but they are floristically and ecologically distinct units.

Similarly Samek (1961) in the former Czechoslovakia misidentified *Soldanello-Piceetum* with a supramontane *Picea* woodland of the (Czech part of) Bohemian Forest labelled by him *Homogyno-Piceetum* Samek 1961 (= syntax. syn. of *Lophozio-Piceetum* Volk in Br.-Bl. et al. 1939). Šoltés (1969) applied Volk's name *Soldanello-Piceetum* to Western Carpathians' supramontane *Picea* woodlands; however, later he used only the name *Vaccinio myrtilli-Piceetum* Šoltés 1976 (Šoltés 1976).

Concept of fusion of *Soldanello montanae-Piceetum* and *Lophozio-Piceetum* was preserved by German and Austrian phytocoenologists (see Seibert, 1992; Wallnöfer, 1993); however, Exner (2007, p. 205–207) correctly separated corresponding wet woodland (subass. *Soldanello-Piceetum equisetetosum* Oberdorfer 1957 nom. inval., Art. 3m = *Mastigobryo-Piceetum homogynetosum alpinae* Trautmann 1952, Art. 14) from the climax supramontane woodland.

(3) Lately Exner (2007) unified "*Soldanello montanae-Piceetum* s. str." (= *homogynetosum* Trautmann 1952; ut *S.-P. equisetetosum* Oberdorfer 1957) with *Equiseto-Piceetum* Šmarda 1950. Again, these two units represent two separate associations which was demonstrated also by Chytrý et al. (2013); proposal of conservation of the name *Equiseto-Piceetum* against *Soldanello montanae-Piceetum* (Willner, 2007, p. 240) is therefore controversial.

Section III) Nomenclatural and syntaxonomical note to the association *Equiseto sylvatici-Abietetum* Moor 1952

Although Willner (2007, p. 239) lectotypified the association with the name "*Equiseto-Abietetum* Moor ex Kuoch 1954" (see the notes below), the lectotype was chosen from Kuoch's (1954) relevés and not from the original data for the association already provided by Moor (1952). Such manner of lectotype choice should be rejected and a corresponding rule should be implemented into International Code of Phytosociological Nomenclature (cf. latest edition: Weber et al., 2000).

In the recent vegetation surveys of the surrounding countries there are no mentions of the association *Equiseto sylvatici-Abietetum* Moor 1952 except for Exner (2007). However, the used association concept might not be corresponding to the original description of the syntaxon by Moor (1952) as Exner (2007) included in this association several units including *Petasito-Piceetum* Samek 1961 which is floristically and ecologically non-related unit (see this paper and Samek, 1961).

Moreover, Exner (2007) used the name "*Equiseto-Abietetum* Moor ex Kuoch 1954" indicating the suggestion that Kuoch (1954) validated (Art. 3b) the name proposed by Moor (1952). It should be emphasized that Moor (1952) only in the p. 68 gave provisional statement on the association name, though, he clearly adopted the name *Equiseto-Abietetum* throughout his whole study and in the relevé table as well as he did not use the expressions "nom. prov." or "ass. prov." (cf. Art 3b, Weber et al. 2000, p. 745). Nor was the name treated by Kuoch (1954) as provisionally described by Moor as the original author.

I propose that such clear adoption of a name by the original author should be accepted, which was explained already in the case of the name *Aceri pseudoplatani-Fagetum* J. Bartsch et M. Bartsch 1940 (Kučera, 2007, 2013, p. 23).

It is possible that a part of Kuoch's (1954) relevés classified to the association *Equiseto sylvatici-Abietetum* Moor 1952 really belong to this unit. Data on species as *Calamagrostis varia* and *Bellidiastrum michelii* indicate different phytocoenological quality which is here classified as a separate syntaxon in the rank of an alliance – *Valeriano dioicae-Abietion albae* P. Kučera 2019. More extensive examination of phytocoenoses resembling Moor's (1952) description of *Equiseto sylvatici-Abietetum* Moor 1952, relevés of Kuoch (1954, tab. 8) and the presented data from Slovakia included, would facilitate establishment of floristic patterns for division of phytocoenoses between the base-rich alliance *Valeriano dioicae-Abietion albae* P. Kučera 2019 and the less nutrient-rich alliance *Stellario nemorum-Abietion albae* P. Kučera 2019.

Supplement B1: Table 1. Differential tables of orders of the class *Piceetea excelsae* Klika 1948 with fidelity (φ (× 100) ≥ 25) and constancy (%) in the exponent

A – *Sphagno palustris-Piceetalia abietis* P. Kučera 2019
B – *Piceetalia excelsae* Pawłowski ex Pawłowski et al. 1928
C – *Cortuso matthioli-Piceetalia abietis* P. Kučera nom. prov. (= *Athyrio-Piceetalia* sensu auct. non Hadač 1962)
Species with constancy less than 10 % in a single column are omitted.

Group	A	B	C
No. of relevés	145	234	97
Differential tree and shrub species			
E_3			
Pinus sylvestris	42^{25}	—·	—·
Abies alba	38^{25}	—·	—^{3}
Alnus incana	36^{18}	—·	—·
Betula pendula	31^{14}	—·	—·
Alnus glutinosa	29^{12}	—·	—·
Betula pubescens	27^{18}	—^{1}	—^{4}
Pinus cembra	—·	46^{42}	—^{10}
Sorbus aucuparia	—^{4}	7^{31}	28^{44}
Acer pseudoplatanus	—·	—·	28^{11}
E_2			
Picea abies	$48^{\mathbf{83}}$	—^{40}	—^{24}
Alnus incana	29^{12}	—·	—·
Frangula alnus	28^{11}	—·	—·
Ribes petraeum	—·	—^{1}	37^{21}
Salix silesiaca	—·	—^{3}	29^{16}
E_1			
Abies alba	47^{39}	—^{2}	—^{4}
Picea abies	$43^{\mathbf{88}}$	—^{51}	—^{33}
Alnus incana	29^{12}	—·	—·
Frangula alnus	27^{10}	—·	—·
Salix aurita	26^{10}	—·	—·
Sorbus aucuparia	—^{54}	$29^{\mathbf{88}}$	—$^{\mathbf{64}}$
Daphne mezereum	—^{3}	—·	$\mathbf{60}^{49}$
Ribes petraeum	—^{2}	—^{4}	40^{31}
Salix silesiaca	—^{1}	—^{2}	26^{14}
Other tree and shrub species			
E_3			
Picea abies	—$^{\mathbf{100}}$	—$^{\mathbf{99}}$	—$^{\mathbf{98}}$
E_2			
Sorbus aucuparia	—^{22}	—^{21}	12^{33}
Pinus mugo	—^{1}	19^{22}	—^{15}
Lonicera nigra	22^{19}	—^{1}	—^{8}
Fagus sylvatica	20^{11}	—^{1}	—^{3}
E_1			
Lonicera nigra	—^{17}	—^{12}	24^{35}

Group	A	B	C
No. of relevés	145	234	97
Pinus cembra	—·	21^{17}	—^{8}
Acer pseudoplatanus	—^{8}	—^{1}	22^{18}
Betula pubescens	20^{12}	—·	—^{4}
Rosa pendulina	—^{4}	—^{1}	17^{10}
Differential field layer species (E_1)			
Equisetum sylvaticum	**82^{77}**	—^{1}	—·
Luzula pilosa	**63^{52}**	—^{2}	—·
Caltha palustris	**52^{37}**	—·	—^{1}
Deschampsia cespitosa	45^{36}	—^{2}	—^{4}
Dryopteris carthusiana	43^{59}	—^{15}	—^{18}
Potentilla erecta	43^{26}	—·	—·
Lysimachia vulgaris	42^{24}	—·	—·
Maianthemum bifolium	39^{52}	—^{4}	—^{27}
Myosotis palustris agg.	38^{25}	—^{1}	—^{2}
Carex echinata	38^{22}	—^{1}	—·
Carex canescens	37^{23}	—^{3}	—·
Ranunculus repens	34^{21}	—·	—^{3}
Agrostis canina	33^{16}	—·	—·
Orthilia secunda	32^{25}	—·	—^{7}
Vaccinium vitis-idaea	32^{74}	—^{49}	—^{30}
Lysimachia nemorum	30^{13}	—·	—·
Athyrium filix-femina	30^{57}	—^{22}	—^{31}
Carex nigra	30^{15}	—^{1}	—·
Glyceria nemoralis	29^{12}	—·	—·
Agrostis stolonifera	29^{12}	—·	—·
Veronica officinalis	28^{17}	—^{1}	—^{3}
Viola palustris	28^{11}	—·	—·
Filipendula ulmaria	27^{10}	—·	—·
Impatiens noli-tangere	26^{12}	—·	—^{1}
Juncus effusus	26^{10}	—·	—·
Cardamine trifolia	26^{10}	—·	—·
Ranunculus flammula	26^{10}	—·	—·
Valeriana dioica	26^{10}	—·	—·
Petasites albus	25^{18}	—^{1}	—^{6}
Dryopteris dilatata	—^{12}	**53^{79}**	—^{36}
Avenella flexuosa	—^{38}	44^{88}	—^{44}
Homogyne alpina	—^{32}	34^{88}	—^{74}
Vaccinium myrtillus	—^{93}	25^{99}	—^{71}
Valeriana tripteris	—^{2}	—^{3}	**75^{71}**
Primula elatior	—^{2}	—^{1}	**66^{57}**
Cortusa matthioli	—·	—·	**60^{46}**
Phyteuma spicatum	—^{5}	—^{2}	**59^{54}**
Myosotis sylvatica	—^{3}	—·	**59^{48}**
Polygonatum verticillatum	—^{9}	—^{6}	**59^{62}**

Group	A	B	C
No. of relevés	145	234	97
Cirsium erisithales	—·	—·	**56**^{40}
Calamagrostis varia	—·	—·	**54**^{38}
Astrantia major	—^{2}	—^{1}	**53**^{41}
Asplenium viride	—·	—·	**53**^{37}
Galeobdolon luteum agg.	—^{3}	—^{2}	**52**^{43}
Polystichum lonchitis	—·	—·	**52**^{36}
Geranium sylvaticum	—·	—^{1}	**52**^{37}
Heracleum sphondylium	—·	—·	**51**^{35}
Viola biflora	—^{1}	—^{2}	**50**^{39}
Leucanthemum rotundifolium	—^{1}	—^{1}	**50**^{36}
Bellidiastrum michelii	—·	—·	45^{28}
Cardaminopsis arenosa agg.	—·	—·	45^{28}
Clematis alpina	—^{3}	—·	44^{32}
Galium schultesii	—^{3}	—^{1}	44^{33}
Mercurialis perennis	—·	—·	43^{26}
Cicerbita alpina	—^{3}	—^{11}	43^{43}
Mycelis muralis	—^{12}	—^{1}	43^{41}
Sesleria albicans	—·	—·	42^{25}
Tanacetum clusii	—^{1}	—·	40^{24}
Adenostyles alliariae	—^{10}	4^{42}	40$^{\mathbf{67}}$
Hieracium murorum	—^{30}	—^{7}	39$^{\mathbf{57}}$
Soldanella hungarica	—^{4}	—^{17}	39^{44}
Luzula sylvatica	—^{8}	23^{67}	38$^{\mathbf{77}}$
Moneses uniflora	—^{5}	—^{1}	37^{28}
Ranunculus platanifolius	—^{6}	—^{3}	37^{31}
Lilium martagon	—·	—^{1}	37^{20}
Prenanthes purpurea	—^{19}	—^{29}	37$^{\mathbf{61}}$
Pimpinella major	—·	—·	36^{19}
Fragaria vesca	—^{13}	—·	36^{34}
Senecio subalpinus	—^{1}	—^{1}	34^{20}
Senecio nemorensis agg.	—^{42}	—^{36}	34$^{\mathbf{75}}$
Aconitum variegatum	—·	—·	34^{16}
Dentaria enneaphyllos	—·	—·	34^{16}
Epilobium montanum	—^{13}	—^{2}	34^{34}
Soldanella carpatica	—·	—^{8}	34^{27}
Thalictrum aquilegiifolium	—^{3}	—·	34^{21}
Cystopteris fragilis	—·	—^{2}	34^{20}
Campanula rotundifolia agg.	—·	—^{2}	33^{19}
Phyteuma orbiculare	—·	—·	33^{15}
Alchemilla spp.	—^{2}	—^{1}	32^{19}
Carduus glaucinus	—·	—·	32^{14}
Cystopteris montana	—·	—·	32^{14}
Crepis jacquini	—·	—·	31^{13}
Sesleria tatrae	—·	—·	31^{13}

Group	A	B	C
No. of relevés	145	234	97
Carex digitata	—[1]	—·	30[15]
Ranunculus oreophilus	—·	—·	29[12]
Poa alpina	—·	—·	29[12]
Carex sempervirens subsp. *laxiflora* (Schur) Jáv.	—·	—·	29[12]
Doronicum austriacum	—[3]	—[9]	28[27]
Campanula cochleariifolia	—·	—·	28[11]
Veratrum album subsp. *lobelianum*	—[16]	—[17]	27[41]
Tofieldia calyculata	—·	—·	27[10]
Dryopteris filix-mas	—[23]	—[9]	26[40]
Campanula serrata	—·	—[1]	26[10]
Ranunculus lanuginosus	—[6]	—[1]	26[18]
Poa stiriaca	—·	—·	25[9]
Carex ornithopoda	—·	—·	25[9]
Corallorrhiza trifida	—[1]	—·	25[10]
Swertia perennis	—[1]	—·	25[10]
Euphorbia amygdaloides	—[1]	—·	25[10]
Paris quadrifolia	—[6]	—[3]	25[21]
Calamagrostis villosa	24[72]	25[72]	—[20]
Other field layer species (E_1)			
Oxalis acetosella	—[65]	12[85]	—[85]
Rubus idaeus	—[47]	—[49]	—[39]
Gentiana asclepiadea	—[21]	—[39]	24[55]
Luzula luzuloides	—[21]	19[42]	—[27]
Calamagrostis arundinacea	—[32]	—[22]	11[38]
Solidago virgaurea	—[19]	—[19]	12[30]
Stellaria nemorum	—[20]	—[14]	14[29]
Crepis paludosa	22[37]	—·	18[35]
Athyrium distentifolium	—[6]	12[23]	—[21]
Gymnocarpium dryopteris	—[17]	—[15]	—[22]
Chaerophyllum hirsutum	20[32]	—[2]	14[29]
Lycopodium annotinum	—[12]	18[20]	—[3]
Huperzia selago	—[7]	—[13]	—[15]
Melampyrum sylvaticum	—[10]	—[6]	21[23]
Rumex alpestris	—[1]	7[13]	14[16]
Chrysosplenium alternifolium	13[19]	—·	14[20]
Milium effusum	—[6]	—[8]	17[19]
Geum rivale	9[13]	—·	14[15]
Urtica dioica	19[16]	—[1]	—[8]
Rubus saxatilis	—[9]	—[1]	21[18]
Phegopteris connectilis	—[10]	—[5]	—[6]
Hypericum maculatum	—[2]	—[2]	19[10]
Geranium robertianum	19[10]	—·	—[3]
Aconitum firmum s. l.	—[1]	—[2]	21[10]

Group	A	B	C
No. of relevés	145	234	97
Differential ground layer species (E_0)			
Polytrichum commune	**55**^{52}	–^{9}	–·
Sphagnum palustre agg.	**54**^{40}	–^{1}	–^{1}
Sphagnum girgensohnii	48^{59}	–^{22}	–^{4}
Sphagnum squarrosum	33^{17}	–^{1}	–·
Leucobryum glaucum	31^{15}	–·	–^{1}
Plagiomnium affine	30^{28}	–^{10}	–^{2}
Pohlia nutans	30^{16}	–^{2}	–·
Pleurozium schreberi	28^{50}	–^{27}	–^{19}
Polytrichum formosum	–^{28}	39^{64}	–^{20}
Lophozia ventricosa	–·	28^{11}	–·
Bazzania tricrenata	–^{1}	26^{11}	–·
Calypogeia integristipula	–^{12}	25^{23}	–·
Mnium spinosum	–^{1}	–^{1}	**56**^{42}
Ctenidium molluscum	–·	–·	40^{23}
Tortella tortuosa	–·	–^{3}	39^{26}
Other ground layer species (E_0)			
Dicranum scoparium	–^{76}	11^{79}	–^{61}
Plagiothecium curvifolium	–^{29}	14^{40}	–^{25}
Hylocomium splendens	–^{26}	–^{31}	12^{40}
Rhytidiadelphus triquetrus	–^{23}	–^{14}	–^{24}
Lepidozia reptans	19^{21}	–^{11}	–^{4}
Rhizomnium punctatum	17^{21}	–^{3}	–^{15}
Plagiochila asplenioides	21^{21}	–^{2}	–^{12}
Plagiothecium undulatum	–^{8}	13^{14}	–^{4}
Sphagnum capillifolium	15^{14}	–^{9}	–^{2}
Tetraphis pellucida	–^{10}	–^{9}	–^{5}
Dicranella heteromalla	–^{8}	–^{10}	–^{3}
Blepharostoma trichophyllum	–^{1}	17^{12}	–^{6}
Bazzania trilobata	17^{12}	–^{5}	–^{2}
Mylia taylorii	–^{1}	21^{10}	–^{2}
Eurhynchium angustirete	5^{8}	–^{1}	11^{10}
Plagiomnium undulatum	20^{11}	–^{2}	–^{2}
Cirriphyllum piliferum	12^{10}	–·	–^{7}
Brachythecium velutinum	–^{1}	–^{2}	22^{12}

Data:
Col. A: – Relevé dataset of wet woodlands with *Picea abies* used in this study.
Col. B: – 135 relevés of *Piceion excelsae* Pawłowski ex Pawłowski et al. 1928 prepared for the survey *Plant communities of Slovakia, Forest and shrub vegetation* (Kučera *in* Valachovič *et al.*, in prep.),
– 2 relevés of *Piceion excelsae* Pawłowski ex Pawłowski et al. 1928 excluded from that survey (relevé plot sizes 100 m^2),
– 93 relevés of *Homogyno alpinae-Pinion cembrae* P. Kučera 2017 from Slovakia (see Kučera 2017),
– 4 lately published relevés of *Homogyno alpinae-Pinion cembrae* P. Kučera 2017, included in the survey *Plant communities of Slovakia, Forest and shrub vegetation* (Kučera *in* Valachovič *et al.*, in prep.).
Col. C: – 76 relevés of *Cortuso-Piceion* P. Kučera nom. prov. (*Oxalido-Piceion* sensu Hadač et al. 1969) prepared for the survey *Plant communities of Slovakia, Forest and shrub vegetation* (Kučera *in* Valachovič *et al.*, in prep.),
– 11 relevés of *Cortuso-Piceion* P. Kučera nom. prov. excluded from that survey (relevé plot sizes 150 m^2 and 100 m^2),
– 10 relevés of *Calamagrostio variae-Pinion cembrae* P. Kučera 2017 (see Kučera 2017).

Supplement B2: Table 4. Differential table of associations of the order *Sphagno palustris-Piceetalia abietis* P. Kučera 2019 with fidelity (φ (× 100) ≥ 25)

B – alliance *Sphagno palustris-Piceion abietis* P. Kučera 2019
2 – *Soldanello montanae-Piceetum* Volk in Br.-Bl. et al. 1939
4 – *Leucobryo glauci-Piceetum abietis* Šomšák ex P. Kučera 2019
5 – *Sphagno palustris-Piceetum* Šomšák 1979
6 – *Equiseto sylvatici-Piceetum* Šmarda 1950
C – alliance *Stellario nemorum-Abietion albae* P. Kučera 2019
7 – *Stellario nemorum-Abietetum albae* P. Kučera 2019
D – alliance *Valeriano dioicae-Abietion albae* P. Kučera 2019
8 – *Valeriano dioicae-Abietetum* P. Kučera 2019

Alliance	B				C	D
Group No.	**2**	**4**	**5**	**6**	**7**	**8**
No. of relevés	24	15	37	13	36	13
Trees and shrubs						
E_3						
Abies alba	–	–	–	–	**63**	–
Fagus sylvatica	–	–	–	–	47	–
Pinus sylvestris	–	–	–	–	–	28
Alnus incana	–	–	12	–	–	26
Alnus glutinosa	–	–	–	–	–	26
E_2						
Pinus sylvestris	27	–	–	–	–	–
Alnus incana	–	–	8	39	–	–
Fagus sylvatica	–	–	–	–	**61**	–
Lonicera xylosteum	–	–	–	–	38	–
Sorbus aucuparia	–	–	–	–	35	–
Acer pseudoplatanus	–	–	–	–	34	–
Salix caprea	–	–	–	–	25	–
Sambucus racemosa	–	–	–	–	24	–
Viburnum opulus	–	–	–	–	–	45
Frangula alnus	–	–	–	–	–	36
Lonicera nigra	–	–	–	–	26	45
E_2						
Salix aurita	–	–	39	–	–	–
Corylus avellana	–	–	26	–	–	–
Lonicera xylosteum	–	–	–	–	34	–
Fagus sylvatica	–	–	–	–	29	–
Daphne mezereum	–	–	–	–	–	**52**
Viburnum opulus	–	–	–	–	–	45
Ribes petraeum	–	–	–	–	–	32
Sorbus aucuparia	–	–	–	–	–	32
Frangula alnus	–	–	–	–	–	25
Lonicera nigra	–	–	–	26	–	34
Abies alba	–	–	–	–	29	26
Differential field layer species (E_1)						
Eriophorum vaginatum	38	–	–	–	–	–
Lycopodium annotinum	34	–	–	–	–	–
Listera cordata	28	–	–	–	–	–
Thelypteris palustris	27	–	–	–	–	–
Melampyrum sylvaticum	–	48	–	–	–	–
Avenella flexuosa	–	30	–	–	–	–

Alliance	B				C	D
Group No.	**2**	**4**	**5**	**6**	**7**	**8**
No. of relevés	24	15	37	13	36	13
Luzula luzuloides	–	30	–	–	–	–
Calluna vulgaris	–	29	–	–	–	–
Agrostis canina	–	–	**58**	–	–	–
Viola palustris	–	–	**53**	–	–	–
Ranunculus flammula	–	–	49	–	–	–
Juncus effusus	–	–	43	–	–	–
Potentilla erecta	–	–	41	–	–	–
Agrostis stolonifera	–	–	39	–	–	–
Carex rostrata	–	–	37	–	–	–
Valeriana simplicifolia	–	–	35	–	–	–
Carex canescens	–	–	33	–	–	–
Ajuga reptans	–	–	31	–	–	–
Carex pallescens	–	–	30	–	–	–
Moneses uniflora	–	–	28	–	–	–
Senecio "nemorensis"	–	–	28	–	–	–
Carex echinata	–	–	27	–	–	–
Galium uliginosum	–	–	26	–	–	–
Peucedanum palustre	–	–	26	–	–	–
Melampyrum pratense	–	–	26	–	–	–
Galium palustre	–	–	26	–	–	–
Trientalis europaea	–	–	–	44	–	–
Calamagrostis villosa	–	–	–	28	–	–
Veratrum album subsp. *lobelianum*	–	–	–	25	–	–
Stellaria nemorum	–	–	–	–	**84**	–
Chrysosplenium alternifolium	–	–	–	–	**72**	–
Petasites albus	–	–	–	–	**71**	–
Lysimachia nemorum	–	–	–	–	**65**	–
Geranium robertianum	–	–	–	–	**59**	–
Cardamine trifolia	–	–	–	–	**59**	–
Adenostyles alliariae	–	–	–	–	**59**	–
Impatiens noli-tangere	–	–	–	–	**57**	–
Luzula luzulina	–	–	–	–	**57**	–
Prenanthes purpurea	–	–	–	–	**56**	–
Gentiana asclepiadea	–	–	–	–	**55**	–
Rubus hirtus	–	–	–	–	**54**	–
Galium odoratum	–	–	–	–	**52**	–
Dryopteris dilatata	–	–	–	–	47	–
Milium effusum	–	–	–	–	47	–
Urtica dioica	–	–	–	–	44	–
Ranunculus lanuginosus	–	–	–	–	44	–
Ranunculus platanifolius	–	–	–	–	44	–
Phyteuma spicatum	–	–	–	–	41	–
Geum rivale	–	–	–	–	39	–
Carex sylvatica	–	–	–	–	39	–
Cardamine flexuosa	–	–	–	–	38	–
Poa remota	–	–	–	–	38	–
Calamagrostis epigejos	–	–	–	–	38	–
Veronica anagallis-aquatica	–	–	–	–	38	–
Homogyne alpina	–	–	–	–	37	–
Phegopteris connectilis	–	–	–	–	37	–

Alliance	B				C	D
Group No.	**2**	**4**	**5**	**6**	**7**	**8**
No. of relevés	24	15	37	13	36	13
Cicerbita alpina	–	–	–	–	34	–
Rubus idaeus	–	–	–	–	34	–
Dryopteris filix-mas	–	–	–	–	32	–
Luzula sylvatica	–	–	–	–	31	–
Oxalis acetosella	–	–	–	–	31	–
Epilobium montanum	–	–	–	–	29	–
Symphytum tuberosum	–	–	–	–	27	–
Sanicula europaea	–	–	–	–	27	–
Cardamine amara		–	–	–	26	
Poa palustris	–	–	–	–	26	–
Rubus saxatilis	–	–	–	–	–	**94**
Valeriana dioica	–	–	–	–	–	**74**
Polygonatum verticillatum	–	–	–	–	–	**71**
Clematis alpina	–	–	–	–	–	**59**
Cirsium oleraceum	–	–	–	–	–	**59**
Filipendula ulmaria	–	–	–	–	–	**55**
Thalictrum aquilegiifolium	–	–	–	–	–	**52**
Carex alba	–	–	–	–	–	**52**
Crepis paludosa	–	–	10	–	–	**51**
Caltha palustris	–	–	8	–	–	**50**
Galium schultesii	–	–	–	–	–	49
Fragaria vesca	–	–	–	–	12	48
Astrantia major	–	–	–	–	–	45
Melica nutans	–	–	–	–	–	45
Solidago virgaurea	–	–	–	–	–	39
Dactylorhiza maculata	–	–	–	–	–	36
Carex remota	–	–	–	–	–	36
Actaea spicata	–	–	–	–	–	36
Carex digitata	–	–	–	–	–	36
Maianthemum bifolium	–	–	–	–	–	36
Equisetum palustre	–	–	–	–	–	35
Epipactis palustris	–	–	–	–	–	32
Polygonatum multiflorum	–	–	–	–	–	32
Valeriana tripteris	–	–	–	–	–	32
Paris quadrifolia	–	–	–	20	–	31
Angelica sylvestris	–	–	–	–	–	29
Persicaria bistorta	–	–	–	–	–	25
Calamagrostis arundinacea	–	32	–	–	27	–
Luzula pilosa	–	28	22	20	–	34
Lysimachia vulgaris	–	–	27	35	–	–
Equisetum sylvaticum	–	–	–	24	24	–
Chaerophyllum hirsutum	–	–	–	–	45	37
Senecio ovatus	–	–	–	–	40	27
Differential ground layer species (E_0)						
Sphagnum girgensohnii	25	–	–	–	–	–
Polytrichum commune	25	–	–	–	–	–
Leucobryum glaucum	–	**83**	–	–	–	–
Orthodicranum undulatum	–	34	–	–	–	–
Hylocomium splendens	–	29	22	–	–	–
Dicranella heteromalla	–	27	–	–	–	–

Alliance	B				C	D
Group No.	**2**	**4**	**5**	**6**	**7**	**8**
No. of relevés	24	15	37	13	36	13
Brachythecium starkei	–	–	30	–	–	–
Lepidozia reptans	–	–	28	–	–	–
Sphagnum quinquefarium	–	–	26	–	–	–
Cephalozia bicuspidata	–	–	26	–	–	–
Calliergon cordifolium	–	–	26	–	–	–
Rhodobryum roseum	–	–	26	–	–	–
Chiloscyphus pallescens	–	–	26	–	–	–
Sphagnum palustre agg.	–	–	25	–	–	–
Lophocolea bidentata	–	–	12	40	–	–
Bazzania trilobata	14	–	–	25	–	–
Cirriphyllum piliferum	–	–	–	–	**54**	–
Plagiomnium affine	–	–	–	–	47	–
Plagiothecium undulatum	–	–	–	–	38	–
Conocephalum conicum	–	–	–	–	34	–
Plagiomnium rostratum	–	–	–	–	34	–
Plagiomnium undulatum	–	–	–	–	31	–
Thuidium tamariscinum	–	–	–	–	31	–
Trichocolea tomentella	–	–	–	–	–	36
Eurhynchium angustirete	–	–	–	–	–	28
Tetraphis pellucida	–	–	10	–	–	26