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AN OVERLOOKED SUB-ASSOCIATION IN SECONDARY SPRUCE ASSOCIATION

PREZRTA SUBASOCIACIJA V SEKUNDARNI SMREKOVI ZDRUŽBI

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ABSTRACT UDC:582.47(497.4)

An overlooked sub-association in secondary spruce association

A new sub-association of secondary spruce forest Aposerido-Piceetum Zupančič 1999 galietosum rotundifolii subass. nova is described.

Key words: phytocoenology, ecology, *Picea abies*, Slovenia

IZVLEČEK UDK: 582.47(497.4)

Prezrta subasociacija v sekundarni smrekovi združbi

Opisana je nova subasociacija sekundarnega smrekovega gozda Aposerido-Piceetum Zupančič 1999 galietosum rotundifolii subass. nova.

Ključne besede: fitocenologija, ekologija, *Picea abies*, Slovenija

INTRODUCTION

During a review of the material on spruce phytocoenoses, we found that we had overlooked five phytocoenological relevés on rather problematic spruce phytocoenoses. These relevés had not actually been overlooked but we had been unable to decide in which spruce phytocoenosis to place them, so we did not present them in the monograph on spruce forests of Slovenia (Zupančič 1999). We did not rush into publication of these relevés for a number of reasons, one of the main ones of which was that it concerns a secondary spruce phytocoenosis on beech habitat, which is not so important for operational forestry but interesting from a scientific point of view because of its synsystematic classification and increasing the biodiversity of forest vegetation. In terms of floristic and vegetation research, we hesitated between two possible solutions; whether it is the new central European spruce association, not yet recognised here, *Galio rotundifolii-Piceetum* J. & M. Bartsch 1940 or a sub-association of our local secondary association *Aposerido-Piceetum* Zupančič 1999. This paper provides an answer to this synsystematic question.

The phytocoenological relevés shown in the phytocoenological table were recorded in 1962 on the slopes between Podvolovljek and Veža – Planica in the foothills of the Savinja Alps (Savinjska dolina, Štajerska).

The processing of the vegetation material has been done according to the standard Central European method (Braun-Blanquet 1964). In naming the flora, we respected Mala flora Slovenije (Martinčič et al. 2007). For the determination of horological groups and biological forms of flora, we used Poldini's atlas (Poldini 1991).

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DISCUSSION

The dilemma indicated in the introduction, of the syntaxonomical classification of the spruce phytocoenosis shown in the Phytocoenological Table with five relevés, guided us in two directions. The first, superficial view of the phytocoenological relevés suggested that the relevés should be classified in the Central European spruce association *Galio rotundifolii-Piceetum* J. & M. Bartsch 1940. The association was described by J. & M. Bartsch (1940) in a monograph on the vegetation of Schwarzwald, then designated *Picea-Galium rotundifolium*-ass., with four relevés. Oberdorfer (1957) later designated it correctly synsystematically as *Galio rotundifolii-Piceetum* and presented it with twenty-four relevés in synthesised tables. He classified the already published relevés of J. & M. Bartsch among these relevés. The association was supposed to be distributed not only in southern Germany but also in Austria (Wallnöfer in Mucina et al. 1993). What reminded us of a similarity with the association *Galio rotundifolii-Piceetum*? Primarily the presence of the diagnostically important species *Galium rotundifolium* with piceetal species and the relatively considerable presence of fagetal species in both the Bartsch and Oberdorfer relevés and in our tables and the similarity in terms of the characteristic and differential species of the association. There was also similarity in the occurrence of the phytocoenosis, its syndynamics and, partially, also soil conditions. From the description of J. & M. Bartsch, it is evident that the association is secondary on habitats of beech forest, although they do not mention this particularity but say that the association *Galio-Piceetum* sometimes eats into fagetal forest, which means that it overgrows beech habitats. There are even often whole carpets of the species *Oxalis acetosella* in the association, because of which they believe that it is a type of beech forest. Their finding is important that the association *Galio-Piceetum* approaches the vegetation of broad-leaved forest. The soils, similar to here, are fresh, moderately deep, light. There is a great difference in the geological base, whereby in Germany it consists of gneiss and variable sandstones (*Buntsandstein*) (Bartsch 1940), and here a carbonate base with very acid humus (pH 3.6–5.1) (Zupančič 1999).

It is similar with the description of the association by Oberdorfer (1957), when he says that it is rich in species of mixed fir forest on a silicate base. When he compares the vitality of beech in the association *Galio-Piceetum* he says that this is always better than in the association *Piceo-Abietetum* in western Schwarzwald. He stresses that the habitat of the association *Galio-Piceetum,* is richer than in the western fringe mountains (of Schwarzwald). He finds that the soils are fresh, mull humus, in basins brown, skeletal. The geological base or bedrock consists of granite and gneiss.

From these two descriptions and on the basis of the phytocoenological tables of J. & M. Bartsch (1940) and Oberdorfer (1957) it is clear that the association *Galio-Piceetum* in the area of Schwarzwald is of secondary emergence on habitats of acid beech forest.

The difference between our phytocoenosis and the Schwarzwald association *Galio-Piceetum* at first site is in the geological base. In Schwarzwald this is non-carbonate (silicate), and the bedrock here is carbonate (limestone and dolomite). The soils also differ, although they are sometimes similar since, because of decades (or centuries) long culture of spruce, they have changed and can be distric, deep brown, moderate podsol or there is a range of soils, from rendzina to moderately deep brown soils, with poor absorption capacities. Floristic analysis showed that our phytocoenosis is species richer and more varied than the association *Galio-Piceetum*. Comparison between them shows low similarity, the index according to Sørensen is 42 and by Jaccard only 27. The low indexes confirm the difference of the phytocoenoses, so that our phytocoenosis cannot be classified in the association *Galio rotundifolii-Piceetum*, although it is fairly close to it.

We were additionally interested in the presentation of the association *Galio-Piceetum* in Austria (Wallnöfer in Mucina et al. 1993). Wallnöfer selected only the species *Galium rotundifolium* as characteristic, which she says is poor and transgressional. She adds the distinguishing species: *Anemone nemorosa*, *Doronicum austriacum*, *Primula elatior* and additionally some others in relation to the association *Veronico latifoliae-Piceetum* and dominant and constant accompanying species of the association *Galio-Piceetum*. She says that piceetal species predominate in the association and that it settles montane and the lower subalpine zone on silicate, mineral rich and moderately acid bedrocks, in which there are deep, fresh, sometimes podzol brown soils with mull or moder humus. She concludes that the association *Galio rotundifolii-Piceetum* is a climactic association.

We were encouraged to present the opinion of Wallnöfer about the association *Galio-Piceetum* because of her classification of M. Wraber's (1959) association *Galio rotundifolii-Abietetum* M. Wraber (1955) 1959 in the association *Galio rotundifolii-Piceetum* J. & M. Bartsch 1940. She considers the fir association of M. Wraber to be a synonym for Bartsch's spruce association. Willner & Grabherr (2007) are of the same opinion as Wallnöfer. Comparison between the associations *Galio-Piceetum* in Schwarzwald and *Galio-Abietetum* in Slo-

venia showed a difference in the associations, which is confirmed by the index of similarity, which is 51 according to Sørensen and 34 according to Jaccard. Comparison between our spruce association and M. Wraber's association *Galio-Abietetum* shows an index of even smaller similarity: 42 by Sørensen and 25 by Jaccard. Wallnöfer's claim, therefore, that M. Wraber's association *Galio-Abietetum* is a synonym for Bartsch's association *Galio-Piceetum*, does not hold. The associations are independent and syntaxonomically stable.

In line with the above findings, we continued with comparisons among secondary spruce phytocoenoses known in Slovenia. We found that the spruce phytocoenosis is most comparable with the secondary spruce association *Aposerido-Piceetum* Zupančič (1978) 1999. The characteristic species of *Aposeris foetida* is present in four relevés, with a solid medium cover value of 400 and sociability (1-2) and a high level of presence (V = 80%). A considerable representation of fagetal species is characteristic of the secondary association *Aposerido-Piceetum* on habitats of primary basiphilous beech association. The presence is also important of characteristic species of the Illyrian alliance of beech forests *Aremonio-Fagion*, among which are distinguishing species for a geographic variant of the secondary spruce association *Aposerido-Piceetum* var. geogr. *Helleborus niger* Zupančič 1999.

In our case, it is an original habitat of pre-Alpine fir-beech forest *Homogyno sylvestris-Fagetum*, in which spruce have advanced. Part of the spruce is planted, part has settled spontaneously. Because of the many years of impact of the fall of spruce needles, exhaustion of the upper soil horizons (Oh, A) and the activity of the spruce root system, the soils have worsened over the course of time, above all become more acid and enabled the settlement of acidophilic piceetal flora. The carbonate bedrock has enabled the survival of neutral and moderately basiphilous fagetal flora. This secondary spruce phytocoenosis thus contains a mosaic of intermixed piceetal and fagetal flora in fairly equal ratio in terms of surface coverage, and in terms of number of species a prevalence of fagetal species. Of fagetal species, eight species are present from the Illyrian alliance of beech forests *Aremonio-Fagion*, three of which are distinguishing species for the geographic variant: *Helleborus niger* subsp. *niger*, *Cyclamen purpurascens* and *Cardamine trifolia* with the piceetal species *Homogyne sylvestris*, and eleven Southeasteuropean-Illyrian species are represented in our spruce phytocoenosis.

In relation to the above floristic similarities, which are clearly shown in the phytocoenological table, we calculated an index of similarity according to Sørensen (σ_s) and Jaccard (σ_j) between our spruce phytocoenosis and a) the Bavarian association *Galio-Piceetum*, for which $\sigma_s = 42$ and $\sigma_j = 27$, and b) the association *Aposerido-Piceetum* Zupančič 1999 (Zupančič 1999, Table 11), for which $\sigma_s = 59$ and $\sigma_j = 42$.

Floristic analysis, together with the index of similarity of the phytocoenoses, indicates a relatedness of our secondary spruce phytocoenosis with the association *Aposerido-Piceetum*; although not very convincingly, satisfactorily. However, the index of similarity with the association *Galio-Piceetum* is smaller and does not achieve optimality. The difference is in the floristic content of the phytocoenoses, above all the number of fagetal species - there are fewer than half of these in the association *Galio-Piceetum* - and partly also in species of the classes *Betulo-Adenostyletea* (=*Mulgedio-Aconitetea*), *Trifolio-Geranietea* and *Asplenietea trichomanis*, which are all more or less basiphilous. In terms of coverage, acidophilic and basiphilous species are equally divided in the association *Galio-Piceetum*.

Floristic and, consequently, vegetation analysis show that our secondary spruce phytocoenosis can be classified in the association *Aposerido-Piceetum,* but as a new sub-association, which we have named after the species *Galium rotundifolium*, so *Aposerido-Piceetum galietosum rotundifolii* subass. nova or *Aposerido-Piceetum* var. geogr. *Helleborus niger galietosum rotundifolii* subass. nova. The sub-association *A.-P. galietosum* shows a partial link or relatedness with the association *Galio-Piceetum*, as the indexes of similarity of the phytocoenoses according to Sørensen and Jaccard confirm.

FLORISTIC AND SOCIOLOGICAL COMPOSITION OF THE SUB-ASSOCIATION

In the presentation of the association *Aposerido-Piceetum* (Zupančič 1999), because of the extensiveness of the monograph on spruce phytocoenoses, we left out some of the elements of the sociological composition of the association, and we are taking this opportunity to complete them. It is primarily a matter of supplementing the characteristic combinations of species, stratification, life form spectrum, phytocoenological and horological groups of the association. Before that, we must additionally describe the choice of differential species of the sub-association.

The floristic table, with five relevés, shows the subassociation *Aposerido-Piceetum galietosum rotundifolii* subass. nova with 153 plant species. There are 123 flow-

ering plants, 8 ferns, 21 mosses and 1 fungus. Relevés 5 and 1 have the lowest number of floristic species (61, 62), relevés 4 and 2 have the most (88, 81), and relevé 3 has 71 species. The relevés are sufficiently homogeneous.

The ecological conditions of the sub-association do not differ essentially from those previously described for the association *Aposerido-Piceetum*. Mean annual temperature is between 4 and 8 °C with annual precipitation of 1750 mm and more. Soils are brown (carbonate), acid to moderately acid with pH_{KCl} below 4 in Oh and around 6 in horizons A and B (Zupančič 1999).

The distinguishing species for the sub-association *Aposerido-Piceetum galietosum rotundifolii* are *Galium rotundifolium* and *Goodyera repens*. Their ecological and vegetation designations are summarised on the basis of Oberdorfer (1979) and our own observations.

The species *Galium rotundifolium* L. appears in fir, spruce and mixed fir-spruce and, more rarely, in acid beech forests. It is found here and there in dwarf pine. It grows on fresh, nutrient and base moderately rich, but lime poor, moderately acid soils with moder humus. It is classified among shade-loving species. Synsystematically, it is described as a species of the sub-alliance *Abieti-Piceenion* or *Galio-Abietion*. Phytogeographically it belongs among Subatlantic-Submediterrannean or Euroasian species.

The species *Goodyera repens* (L.) R. Br. grows in fir, spruce and acid Austrian pine forests, rarely in scrub pine. It inhabits moderately dry to fresh habitats where the soils are more or less base-rich (with acidic moder humus). It is a semi-shade species, which tends to appear among acidophilic mosses in the acidic needle-fall of fir, spruce or Austrian pine. For the most part, it is classified as a characteristic species of the order *Vaccinio-Piceetalia*. Phytogeographically, this is a Northeastcontinental-Circumpolar or Circumboreal species.

The characteristic combination of species gives the following picture:

CHARACTERISTIC SPECIES
*Aposeris foetida**
DISTINGUISHING SPECIES OF THE GEOGRAPHIC VARIANT
Helleborus niger subsp. *niger**
*Cardamine trifolia**
*Cyclamen purpurascens**
DISTINGUISHING SPECIES OF THE SUB-ASSOCIATION
Galium rotundifolium
VACCINIO-PICEETEA s. lat.
Galium rotundifolium
Melampyrum sylvaticum
Mnim punctatum
Picea abies
Hieracium sylvaticum
Vaccinium myrtillus
Larix decidua
Polytrichum formosum
Atrichum undulatum
Luzula luzuloides
Hylocomium splendens
Rhytidiadelphus triquetrus
Hypnum cupressiforme
*Aposeris foetida**
Maianthemum bifolium
Gentiana asclepiadea
Peltigera leucophlebia
Luzula pilosa
Oxalis acetosella
QUERCO-FAGETEA s. lat.
Helleborus niger subsp. *niger**
*Cyclamen purpurascens**
*Aremonia agrimonioides**
*Cardamine trifolia**
Knautia drymeia subsp. *drymeia**
Fagus sylvatica
Sanicula europaea
Mycelis muralis
Mercurialis perennis
Acer pseudoplatanus
Daphne mezereum
Eurhynchium zettersledtii
Salvia glutinosa
Epipactis helleborine
Lamiastrum flavidum
Stachys sylvatica
Viola reichenbachiana
Euphorbia amygdaloides
Melica nutans
Pteridium aquilinum
Veronica officinalis
Digitalis grandiflora
*Campanula witasekiana**
Hypericum montanum
Ctenidium molluscum
Carex digitata

ERICO-PINETEA s. lat.
Carex alba — *Buphthalmum salicifolium*
Polygala chamaebuxus — *Calamagrostis varia*
Rubus saxatilis
BETULO-ADENOSTYLETEA s. lat. *(=MULGEDIO-ACONITETEA* s. lat.*)*
Senecio fuchsii
TRIFOLIO-GERANIETEA s. lat.
Cruciata glabra — *Clinopodium vulgare*
MOLINIO-ARRHENATHERETEA s. lat.
Ajuga reptans
ASPLENIETEA TRICHOMANIS s. lat.
Asplenium trichomanes
OTHER SPECIES
Fragaria vesca — *Euphorbia cyparissias*
Cladonia pyxidata
* Southeasteuropean-Illyrian species

As the table shows, the chosen characteristic species include the characteristic species of the association *Aposeris foetida*, three distinguishing species of the geographic variant *Helleborus niger* subsp. *niger*, *Cyclamen purpurascens* and *Cardamine trifolia* and the distinguishing species of the sub-association *Galium rotundifolium,* which confirms our decision on membership of the sub-association *Aposerido-Piceetum* (var. geogr. *Helleborus niger*). Species are balanced between the classes *Vaccinio-Piceetea* s. lat. and *Querco-Fagetea* s. lat., which signifies confirmation of our finding that it is a secondary spruce phytocoenosis on original beech (fir-beech) habitats. The association *Aposerido-Piceetum* must certainly be placed in the class *Vaccinio-Piceetea*. The modest position of species of the classes *Erico-Pinetea* s. lat., *Betulo-Adenostyletea* s. lat. (=*Mulgedio-Aconitetea* s. lat.), *Molinio-Arrhenatheretea* s. lat. and »other species«, of which there are a total of twelve, additionally shows the secondary nature and partial degradation of the habitat.

The stratification of the sub-association *Aposerido-Piceetum galietosum rotundifolii* is simple and divides into upper stand layers of majority spruce and minority beech, with here and there the presence of trees of *Larix decidua*, *Prunus avium* and *Fraxinus ornus*. Other tree species, *Acer pseudoplatanus*, *A. campestre*, *Fraxinus excelsior, Ostrya carpinifolia*, *Sorbus aria* and *Juglans regia* appear only in the shrub layer and, with other shrubs, cover from 0 to 60 % of the surface. The herb layer is not particularly richly developed and, as has already been said, is balanced between piceetal and fagetal species. The moss layer is for the most part modest, but here and there also strongly represented.

The plant life spectrum of the phytocoenosis shows the more or less calm living conditions, which predominate in the moderate zone. The increasing presence of phanerophytes indicates warmer conditions, although it is not always the case, since they are for the most part shrub growth (13.7 %) and, with the slightly increased share of chaemophytes, indicate a shift towards slightly more unfavourable conditions than prevail in the moderate zone. These living conditions are more favourable for secondary spruce phytocoenoses than for primary spruce phytocoenoses. The life form spectrum indicates living conditions of the habitat between original beech (fir-beech) phytocoenoses and the partial influence of secondary spruce phytocoenoses. Spruce worsens the soil through its needle-fall, shallow roots and constant shad-

PLANT LIFE FORMS SPECTRUM

	No	%	Total	%
PHANEROPHYTA			**31**	**20,2**
P. caespitosa	11	7,2		
P. scaposa	10	6,5		
Nano P.	8	5,2		
P. scandentia (P. lian.)	2	1,3		
CHAMAEPHYTA			**27**	**17,7**
Ch. suffrutescentia	2	1,3		
Ch. fruticosa	2	1,3		
Ch. reptantia	1	0,7		
Ch. succulenta.	1	0,7		
Ch. briophyta	16	10,4		
Ch. lichenosa	5	3,3		
HEMICRYPTOPHYTA			**65**	**42,4**
H. scaposa	33	21,5		
H. caespitosa	15	9,8		
H. rosulata	11	7,2		
H. reptantia	4	2,6		
H. biennis	2	1,3		
GEOPHYTA			**27**	**17,7**
G. rhizomata	22	14,4		
G. bulbosa	4	2,6		
G. parasitica	1	0,7		
THEROPHYTA			**1**	**0,7**
T. scaposa	1	0,7		
UNIDENTIFIED SPECIES	2	1,3	**2**	**1,3**
Total	**153**	**100**	**153**	**100**

Table 1: Plant life forms spectrum

ing of the habitat. There is ongoing acidification of the soil through needle-fall, which poorly decomposes, with unilateral exploitation of nutrients of the upper horizons.

Analysis of the horological groups shows that more than two thirds of the geoelements are cool loving (70.5%). We included mosses and lichens within the cool group (vascular flora 56.8% and moss-lichen flora 13.7%). There are most European, Circumboreal and Euroasiatic geoelements, closely followed by Paleotemperate and Eurosiberian geoelements. All this confirms that the secondary spruce phytocoenosis thrives in somewhat harsher living conditions, as the life form spectrum also indicates.

GEOELEMENTS	No	%
Mediterranean-montane	15	9,8
Circum-Boreal	23	15,0
European	28	18,3
Eurasiatic	17	11,1
Paleotemperate	10	6,5
Eurosiberian	9	5,9
Northeast-Illyrian	7	4,7
South-Illyrian	2	1,3
Southeast-European	2	1,3
Euro-Mediterranean	2	1,3
Pontic	3	2,0
Mediterranean-Pontic	3	2,0
Mediterranean-Atlantic	2	1,3
Cosmopolitan	6	3,9
Cultivated species	1	0,6
Mosses and lichens	21	13,7
Unidentified species	2	1,3
Total	**153**	**100,00**

Table 2: Horological groups

Table 3 shows the ratio among phytocoenological groups. It is to be expected that fagetal species of the original beech (fir-beech) phytocoenoses are best represented (45.8 %). In view of the carbonate bedrock there are most basiphilous species (54.3 %) from the classes *Querco-Fagetea* s. lat., *Betulo-Adenostyletea* s. lat. (=*Mulgedio-Aconitetea* s. lat.), *Trifolio-Geranietea* s. lat. and *Asplenietea trichomanis* s. lat. Then follow piceetal species (24.8 %), which have become established after long 'sprucification' of the habitat and are acidophilic. We classify as acidophilic species, in addition to the class *Vaccinio-Piceetea* s. lat., also *Erico-Pinetea* s. lat. and moss and lichen flora (34.6 %). There are fewer neutral species (11.1 %) from the class *Molinio-Arrhenatheretea* s. lat. and »other species«. The picture of the phytocoenological groups confirms the secondary nature of the spruce phytocoenosis.

CLASS	No	%
VACCINIO-PICEETEA	38	24,8
QUERCO-FAGETEA	70	45,8
ERICO-PINETEA	7	4,6
BETULO-ADENOSTYLETEA (MULGEDIO-ACONITETEA)	5	3,3
TRIFOLIO-GERANIETEA	4	2,6
MOLINIO-ARRHENATHERETEA	6	3,9
ASPLENIETEA TRICHOMANIS	4	2,6
OTHER SPECIES	11	7,2
MOSES AND LICHENES	8	5,2
Total	**153**	**100,0**

Table 3: Phytocoenological groups

CONCLUSION

In accordance with the floristic and vegetation analysis of the secondary spruce phytocoenosis, we found that we can place it in the association *Aposerido-Piceetum* Zupančič 1999 as an independent sub-association *Aposerido-Piceetum galietosum rotundifolii* subass. nova. The **holotype of the sub-association is relevé 2 from the phytocoenological table 1.**

The sub-association *Aposerido-Piceetum galietosum rotundifolii*, in terms of its floristic composition, is close to the Central European *Galio rotundifolii-Piceetum* J. & M. Bartsch 1940. There is partial (lesser) similarity or (distant) relatedness between them. It must also be taken into account that the associations are located in different floral provinces. The association *Aposerido-Piceetum* is in the Illyrian floral province, as is already indicated by the designation of the association according to Southeasteuropean-Illyrian species and the characteristic species of the association, *Aposeris foetida*. In addition to the characteristic species, other Southeasteuropean-Illyrian species appear in the association: *Helleborus niger* subsp. *niger*, *Cyclamen purpurascens*, *Anemone trifolia*, *Homogyne sylvestris*, *Cardamine trifolia*; which defined the association for us as a geographic variant of the Illyrian floral province *Aposerido-Piceetum* var. geogr. *Helleborus niger* Zupančič 1999. The association *Galio rotundifolii-Piceetum* J. & M. Bartsch 1940 is native to the Central European floral province.

After several generations of spruce forest on a beech habitat, basiphilous Southeasteuropean-Illyrian and fagetal species will gradually disappear, especially those that are strictly bound to carbonate bedrock. At that time, the secondary spruce phytocoenosis would very similar to those from the Central European province, e.g., the association *Galio-Piceetum*.

Finally, we would draw attention to the comparison between the associations *Galio rotundifolii-Piceetum* J. & M. Bartsch 1940 and *Galio rotundifolii-Abietetum* M. Wraber (1955) 1959. Despite the claims of Central European phytocoenologists (Mucina, Grabherr & Wallnöfer 1993, Willner & Grabherr 2007), that it is the same association in both cases, thus the originally described *Galio-Piceetum* (the name of the association *Galio-Abietetum* is claimed to be a synonym), this is not the case. Comparative analysis according to Sørensen and Jaccard clearly showed that they are two different associations, i.e., secondary spruce and primary fir phytocoenoses.

The finding of a new forest phytocoenosis is a further contribution to the great biodiversity of forest vegetation in Slovenia. It is caused by the phytogeographic position, the diversity of the geological base, mezoclimatic and microclimatic conditions and, not least, the orographic articulation of Slovenia, as well as other, less well-known biotic and abiotic factors.

POVZETEK

Uvod

Pri pregledu gradiva o smrekovih fitocenozah smo ugotovili, da smo prezrli pet fitocenoloških popisov o nekoliko problematični smrekovi fitocenozi. Pravzaprav ti popisi niso bili prezrti, temveč se nismo mogli odločiti, v katero smrekovo fitocenozo bi jih uvrstili, zato jih v monografiji o smrekovih gozdovih Slovenije (Zupančič 1999) nismo predstavili. Z objavo teh popisov nismo hiteli iz več razlogov. Med glavnimi razlogi je bilo dejstvo, da gre za sekundarno smrekovo fitocenozo na bukovem rastišču, ki za operativno gozdarstvo ni tako pomembna, zanimiva pa je z znanstvenega vidika, in sicer zaradi njene sinsistematske uvrstitve in povečanja biodiverzitete gozdne vegetacije. Glede na floristične in vegetacijske raziskave smo omahovali med dvema mogočima rešitvama, in sicer, ali gre za novo, pri nas še neuveljavljeno srednjeevropsko smrekovo asociacijo *Galio rotundifolii-Piceetum* J. & M. Bartsch 1940 ali za subasociacijo naše znane sekundarne asociacije *Aposerido-Piceetum* Zupančič 1999. Odgovor na to sinsistematsko vprašanje je v tej razpravi.

Fitocenološki popisi, prikazani v Fitocenološki tabeli, so bili posneti v letu 1962 na pobočju med Podvolovljekom in Vežo - Planico v podnožju Savinjskih Alp (Savinjska dolina, Štajerska).

Obdelava vegetacijskega gradiva je urejena po standardni srednjeevropski metodi (Braun-Blanquet 1964). Pri poimenovanju flore smo upoštevali Malo floro Slovenije (Martinčič et al. 2007). Za določitev horoloških skupin in bioloških oblik flore smo uporabili Poldinijev atlas (Poldini 1991).

Razprava

V uvodu nakazana dilema sintaksonomskega uvrščanja smrekove fitocenoze, kot jo prikazuje Fitocenološka tabela s petimi popisi, nas je vodila v dve smeri. Prvič, površen pregled fitocenoloških popisov nam je narekoval, da popise uvrstimo v srednjeevropsko smrekovo asociacijo *Galio rotundifolii-Piceetum* J. & M. Bartsch 1940. Asociacijo sta popisala zakonca Bartsch (1940) v monografiji o vegetaciji Schwarzwalda, tedaj pod imenom *Picea-Galium rotundifolium*-ass. s štirimi popisi. Kasneje jo je Oberdorfer (1957) sinsistematsko pravilno poimenoval *Galio rotundifolii-Piceetum* in jo predstavil s štiriindvajsetimi popisi v sintezni tabeli. Med te popise je uvrstil že objavljene popise zakoncev Bartsch. Asociacija naj ne bi bila razširjena le v južni Nemčiji, temveč tudi v Avstriji (Wallnöfer v Mucina et al. 1993). Kaj nas je spominjalo na podobnost z asociacijo *Galio rotundifolii-Piceetum*? Predvsem zastopanost diagnostično pomembne vrste *Galium rotundifolium* s piceetalnimi vrstami in razmeroma precejšnja navzočnost fagetalnih vrst tako v Bartschevi in Oberdorfejevi kot v naši tabeli ter podobnosti z značilnimi oziroma diferencialnimi vrstami asociacije. Podobnost pa je bila tudi pri nastanku fitocenoze, njeni sindinamiki in deloma v talnih razmerah. Iz opisa zakoncev Bartsch je razvidno, da je asociacija sekundarna na rastišču bukovih gozdov, čeprav tega posebej ne navajata, govorita pa, da se asociacija *Galio-Piceetum* včasih zajeda v fagetalne gozdove, kar pomeni, da porašča bukova rastišča. Večkrat so v asociaciji cele preproge vrste *Oxalis acetosella,* za katero menita, da je vrsta bukovih gozdov. Pomembna je njuna ugotovitev, da se asociacija *Galio-Piceetum* približuje vegetaciji listnatih gozdov. Tla so, podobno kot pri nas, sveža, zmerno globoka, rahla. Velika razlika je v geološki podlagi, kjer so v Nemčiji gnajsi in pisani peščenjaki (*Buntsandstein*) (Bartsch 1940), pri nas pa karbonatna podlaga z zelo kislim humusnim horizontom (pH 3,6–5,1) (Zupančič 1999).

Podobno je z opisom združbe Oberdorferja (1957), ko ta pravi, da je bogata z vrstami mešanega jelovega gozda na silikatni podlagi. Ko primerja vitalnost

bukve v asociaciji *Galio-Piceetum* pove, da je ta vedno boljša kot v asociaciji *Piceo-Abietetum* v zahodnem Schwarzwaldu. Poudarja, da je rastišče asociacije *Galio-Piceetum* v primerjavi z zahodnim obrobjem gorovja (Schwarzwalda) bogatejše. Ugotavlja, da so tla sveža, sprsteninasta, v kotanjah rjava, skeletna. Geološko podlago sestavljata granit in gnajs.

Iz teh dveh opisov in na osnovi fitocenoloških tabel zakoncev Bartsch (1940) in Oberdorferja (1957) se jasno vidi, da je asociacija *Galio-Piceetum* na območju Schwarzwalda sekundarno nastala na rastišču kislih bukovih gozdov.

Razlika med našo fitocenozo in schwarzwaldsko asociacijo *Galio-Piceetum* je na prvi pogled v geološki podlagi. V Schwarzwaldu je nekarbonatna (silikatna), matična podlaga pri nas pa je karbonatna (apnenčasta in dolomitna). Tudi tla se razlikujejo, vendar so včasih podobna, saj so se zaradi večdesetletne (stoletne) kulture smreke spremenila in so lahko distrična, globoka rjava, zmerno opodzoljena oziroma imamo serijo tal od rendzin do srednje globokih rjavih tal s slabo adsorpcijsko sposobnostjo. Floristična analiza pa je pokazala, da je naša fitocenoza vrstno bogatejša in raznovrstnejša od asociacije *Galio-Piceetum*. Primerjava med njima kaže majhno podobnost fitocenoz, po Sørensenu je indeks 42 in po Jaccardu le 27. Nizka indeksa potrjujeta različnost fitocenoz, tako da naše fitocenoze ne moremo uvrstiti v asociacijo *Galio rotundifolii-Piceetum*, čeprav se ji nekoliko približuje.

Zanimala nas je še predstavitev asociacije *Galio-Piceetum* v Avstriji (Wallnöfer v Mucina et al. 1993). Wallnöferjeva je izbrala za značilnico le vrsto *Galium rotundifolium*, za katero pravi, da je slaba in transgresijska. Doda pa razlikovalnice: *Anemone nemorosa*, *Doronicum austriacum*, *Primula elatior* in še druge glede na asociacijo *Veronico latifoliae-Piceetum* ter dominantne in stalne spremljevalke asociacije *Galio-Piceetum*. Pravi, da v asociaciji prevladujejo piceetalne vrste in da združba naseljuje montanski in spodnji subalpski pas na silikatni, mineralno bogati in zmerno kisli geološki podlagi, kjer so globoka, sveža, včasih podzoljena rjava tla s sprsteninastim ali prhninastim humusom. Ugotavlja, da je asociacija *Galio rotundifolii-Piceetum* klimaksna združba.

Da predstavimo mnenje Wallnöferjeve o asociaciji *Galio-Piceetum*, nas je spodbudila njena uvrstitev M. Wraberjeve (1959) asociacije *Galio rotundifolii-Abietetum* M. Wraber (1955) 1959 v asociacijo *Galio rotundifolii-Piceetum* J. & M. Bartsch 1940. Jelovo združbo M. Wraberja ima za sinonim Bartscheve smrekove asociacije. Enakega mnenja kot Wallnöferjeva sta Willner & Grabherr (2007). Primerjava med asociacijama *Galio-Piceetum* v Schwarzwaldu in *Galio-Abietetum* v Sloveniji je pokazala različnost asociacij, kar potrjujeta indeksa podobnosti, in sicer po Sørensenu 51 in po Jaccardu 34. Primerjava med našo smrekovo fitocenozo in M. Wraberjevo jelovo asociacijo *Galio-Abietetum* kaže indeks še manjše podobnosti, in sicer po Sørensenu 42 in po Jaccardu 25. Torej trditev Wallnöferjeve, da gre pri M. Wraberjevi asociaciji *Galio-Abietetum* za sinonim Bartscheve asociacije *Galio-Piceetum*, ne drži. Asociaciji sta samostojni in sintaksonomsko stabilni.

Skladno z gornjimi ugotovitvami smo nadaljevali s primerjavami med pri nas znanimi sekundarnimi smrekovimi fitocenozami. Ugotovili smo, da je smrekova fitocenoza najbolj primerljiva s sekundarno smrekovo asociacijo *Aposerido-Piceetum* Zupančič (1978) 1999. Značilnica asociacije *Aposeris foetida* je prisotna v štirih popisih s solidno srednjo pokrovno vrednostjo 400 in sociabilnostjo (1–2) ter visoko stopnjo navzočnosti (prezenca V = 80 %). Za sekundarno asociacijo *Aposerido-Piceetum* na rastišču primarne bazifilne bukove združbe je značilna precejšnja zastopanost fagetalnih vrst. Pomembna je tudi prisotnost značilnic ilirske zveze bukovih gozdov *Aremonio-Fagion*, med katerimi so razlikovalnice za geografsko varianto sekundarne smrekove asociacije *Aposerido-Piceetum* var. geogr. *Helleborus niger* Zupančič 1999.

V našem primeru gre za prvotno rastišče predalpskega jelovo-bukovega gozda *Homogyno sylvestris-Fagetum*, na katerem so pospeševali smreko. Del smreke je sajen, del se je naselil spontano. Zaradi dolgoletnega vpliva opada smrekovih iglic, izčrpavanja zgornjih horizontov tal (Oh, A) in delovanja smrekovega koreninskega sistema so se tla sčasoma slabšala, predvsem zakisovala in omogočala naselitev acidofilne piceetalne flore. Karbonatna matična podlaga pa je omogočala preživetje nevtralni in zmerno bazični fagetalni flori. Tako imamo v tej sekundarni smrekovi fitocenozi mozaično prepletanje piceetalne in fagetalne flore v precej enakomernem sorazmerju glede zastiranja površine, po številu vrst pa prednjačijo fagetalne vrste. Od fagetalnih vrst je iz ilirske zveze bukovih gozdov *Aremonio-Fagion* prisotnih osem vrst, od tega tri, ki so razlikovalnice za geografsko varianto: *Helleborus niger* subsp. *niger*, *Cyclamen purpurascens* in *Cardamine trifolia* s piceetalno vrsto *Homogyne sylvestris*, sicer pa je v naši smrekovi fitocenozi zastopanih enajst jugovzhodnoevropsko-ilirskih vrst.

Glede na gornje floristične podobnosti, ki jih nazorno kaže Fitocenološka tabela, smo izračunali indekse podobnosti po Sørensenu (σ_s) in Jaccardu (σ_j) med našo smrekovo fitocenozo in a) bavarsko asociacijo *Galio-Piceetum*, kjer je $\sigma_s = 42$ in $\sigma_j = 27$, in b) asociacijo *Aposerido-Piceetum* Zupančič 1999 (Zupančič 1999, tabela 11), kjer je $\sigma_s = 59$ in $\sigma_j = 42$.

Floristična analiza z indeksom podobnosti fitocenoz kaže na sorodnost naše sekundarne smrekove fitocenoze z asociacijo *Aposerido-Piceetum*, sicer ne zelo prepričljivo, vendar zadovoljivo, indeks podobnosti z asociacijo *Galio-Piceetum* pa je manjši in ne dosega optimalnosti. Razlika je v floristični vsebnosti fitocenoz, predvsem v številčnosti fagetalnih vrst; teh je več kot polovica manj v asociaciji *Galio-Piceetum* in deloma še v vrstah razredov *Betulo-Adenostyletea* (=*Mulgedio-Aconitetea*), *Trifolio-Geranietea* in *Asplenietea trichomanis*, ki so vse bolj ali manj bazične. Glede zastrtosti pa si v asociaciji *Galio-Piceetum* acidofilne in bazifilne vrste enakomerno delijo prostor.

Floristična in posledično vegetacijska analiza sta pokazali, da lahko našo sekundarno smrekovo fitocenozo uvrstimo v asociacijo *Aposerido-Piceetum,* vendar kot novo subasociacijo, ki smo jo poimenovali po vrsti *Galium rotundifolium*, torej *Aposerido-Piceetum galietosum rotundifolii* subass. nova oziroma *Aposerido-Piceetum* var. geogr. *Helleborus niger galietosum rotundifolii* subass. nova. Subasociacija *A.-P. galietosum* kaže delno povezavo oziroma sorodnost z asociacijo *Galio-Piceetum*, kar nam potrjujejo tudi indeksi podobnosti fitocenoz po Sørensenu in Jaccardu.

Floristična in sociološka sestava subasociacije

Pri predstavitvi asociacije *Aposerido-Piceetum* (Zupančič 1999) smo zaradi obširnosti monografije o smrekovih fitocenozah opustili nekatere prvine sociološke sestave asociacije, ob tej priložnosti pa bi jih dopolnili. Gre predvsem za dopolnitev karakteristične kombinacije vrst, stratifikacije, biološkega spektra, fitocenoloških in horoloških skupin združbe. Pred tem pa moramo še opisati izbiro razlikovalnih vrst subasociacije.

Floristična tabela s petimi popisi prikazuje subasociacijo *Aposerido-Piceetum galietosum rotundifolii* subass. nova s 153 rastlinskimi vrstami. Cvetnic je 123, 8 praproti, 21 mahov in 1 gliva. Najmanjše število florističnih vrst imata popisa 5 in 1 (61, 62), največ pa popisa 4 in 2 (88, 81), popis 3 ima 71 vrst. Popisi so zadosti homogeni.

Ekološke razmere subasociacije se ne razlikujejo bistveno od prej opisanih za asociacijo *Aposerido-Piceetum*. Srednja letna temperatura se giblje med 4 in 8 ^{0}C z letno namočenostjo 1750 mm in več. Tla so rjava (karbonatna), kisla do zmerno kisla s pH_{KCl} v Oh pod 4 ter v A in B horizontu okoli 6 (Zupančič 1999).

Razlikovalnici za subasociacijo *Aposerido-Piceetum galietosum rotundifolii* sta *Galium rotundifolium* in *Goodyera repens*. Njune ekološke in vegetacijske oznake so povzete po Oberdorferju (1979) in po naših opažanjih.

Vrsta *Galium rotundifolium* L. se pojavlja v jelovih, smrekovih, mešanih jelovo-smrekovih in redkeje v kislih bukovih gozdovih. Tu in tam jo dobimo v ruševju. Porašča sveža, s hranili in bazami zmerno bogata, toda z apnencem revna, zmerno kisla tla s prhninastim humusom. Uvrščamo jo v sencoljubne vrste. Sinsistematsko je opredeljena kot vrsta podzveze *Abieti-Piceenion* oziroma *Galio-Abietion*. Fitogeografsko spada med subatlantsko-submediteranske oziroma evroazijske vrste.

Vrsta *Goodyera repens* (L.) R. Br. raste v jelovih, smrekovih in kislih borovih gozdovih, redkeje v ruševju. Naseljuje zmerno suha do sveža rastišča, kjer so tla bolj ali manj bogata z bazami (s kislim prhninastim humusom). Je polsenčna vrsta, ki se rada pojavlja med kisloljubnimi mahovi ali na kislem opadu iglic jelke, smreke ali bora. Večinoma jo uvrščamo kot značilnico reda *Vaccinio-Piceetalia*. Fitogeografsko je to severovzhodno kontinentalna-cirkumpolarna oziroma cirkumborealna vrsta.

Karakteristična kombinacija vrst kaže naslednjo podobo:

ZNAČILNICA	
*Aposeris foetida**	
RAZLIKOVALNICE GEOGRAFSKE VARIANTE	
Helleborus niger subsp. *niger**	*Cyclamen purpurascens**
*Cardamine trifolia**	
RAZLIKOVALNICA SUBASOCIACIJE	
Galium rotundifolium	
VACCINIO-PICEETEA s. lat.	
Galium rotundifolium	*Hylocomium splendens*
Melampyrum sylvaticum	*Rhytidiadelphus triquetrus*
Mnim punctatum	*Hypnum cupressiforme*
Picea abies	*Aposeris foetida**
Hieracium sylvaticum	*Maianthemum bifolium*

Vaccinium myrtillus
Larix decidua
Polytrichum formosum
Atrichum undulatum
Luzula luzuloides
QUERCO-FAGETEA s. lat.
Helleborus niger subsp. *niger**
*Cyclamen purpurascens**
*Aremonia agrimonioides**
*Cardamine trifolia**
Knautia drymeia subsp. *drymeia**
Fagus sylvatica
Sanicula europaea
Mycelis muralis
Mercurialis perennis
Acer pseudoplatanus
Daphne mezereum
Eurhynchium zettersledtii
Salvia glutinosa
ERICO-PINETEA s.lat.
Carex alba
Polygala chamaebuxus
Rubus saxatilis
BETULO-ADENOSTYLETEA s. lat. *(=MULGEDIO-ACONITETEA* s. lat.*)*
Senecio fuchsii
TRIFOLIO-GERANIETEA s. lat.
Cruciata glabra
MOLINIO-ARRHENATHERETEA s. lat.
Ajuga reptans
ASPLENIETEA TRICHOMANIS s. lat.
Asplenium trichomanes
OSTALE VRSTE
Fragaria vesca
Cladonia pyxidata

Gentiana asclepiadea
Peltigera leucophlebia
Luzula pilosa
Oxalis acetosella

Epipactis helleborine
Lamiastrum flavidum
Stachys sylvatica
Viola reichenbachiana
Euphorbia amygdaloides
Melica nutans
Pteridium aquilinum
Veronica officinalis
Digitalis grandiflora
*Campanula witasekiana**
Hypericum montanum
Ctenidium molluscum
Carex digitata

Buphthalmum salicifolium
Calamagrostis varia

Clinopodium vulgare

Euphorbia cyparissias

* Jugovzhodnoevropsko-ilirske vrste

Kot kaže preglednica, so med izbranimi karakterističnimi vrstami značilnica asociacije *Aposeris foetida*, tri razlikovalnice geografske variante *Helleborus niger* subsp. *niger*, *Cyclamen purpurascens, Cardamine trifolia* in razlikovalnica subasociacije *Galium rotundifolium,* kar potrjuje našo odločitev o pripadnosti subasociacije asociaciji *Aposerido-Piceetum* (var. geogr. *Helleborus niger*). Uravnotežene so vrste med razredoma *Vaccinio-Piceetea* s. lat. in *Querco-Fagetea* s. lat., kar pomeni potrditev naše ugotovitve, da gre za sekundarno smrekovo fitocenozo na prvotnem bukovem (jelovo-bukovem) rastišču. Vsekakor pa moramo asociacijo *Aposerido-Piceetum* uvrstiti v razred *Vaccinio-Piceetea*. Skromna uvrstitev vrst razredov *Erico-Pinetea* s. lat., *Betulo-Adenostyletea* s. lat. (=*Mulgedio-Aconitetea* s. lat.), *Molinio-Arrhenatheretea* s. lat. in »ostalih« vrst, ki jih je skupno dvanajst, pa dodatno kaže na njeno sekundarnost in delno degradacijo rastišča.

Stratifikacija subasociacije *Aposerido-Piceetum galietosum rotundifolii* je preprosta in se deli v nadstojno plast večinske smreke in manjšinske bukve s tu in tam prisotnimi drevesi *Larix decidua*, *Prunus avium* in *Fraxinus ornus*. Druge drevesne vrste *Acer pseudoplatanus*, *A. campestre*, *Fraxinus excelsior*, *Ostrya carpinifolia*, *Sorbus aria* in *Juglans regia* so le v grmovni plasti in z drugimi grmovnicami pokrivajo od 0 do 60 % površine. Zeliščna plast ni posebno bogato razvita in je, kot že rečeno, uravnotežena med piceetalnimi in fagetalnimi vrstami. Mahovna plast je večinoma skromna, tu in tam tudi močneje zastopana.

Biološki spekter fitocenoze kaže na bolj ali manj umirjene življenjske razmere, ki vladajo v zmernem pasu. Nekoliko je povečan delež fanerofitov in hamefitov. Povečanje fanerofitov kaže na toplejše razmere, čeprav ni vedno tako, saj so večinoma grmovne rasti

(13,7 %) in kažejo z nekoliko povečanim deležem hamefitov odmik v smeri nekoliko neugodnejših razmer, kot vladajo v zmernem pasu. Za sekundarno smrekovo fitocenozo so te življenjske razmere v primerjavi s primarnimi smrekovimi fitocenozami ugodne. Biološki spekter kaže na življenjske razmere rastišča med prvotno bukovo (jelovo-bukovo) fitocenozo in na delni vpliv sekundarne smrekove fitocenoze. Smreka s svojim opadom iglic, plitvim koreninjenjem in stalnim zasenčenjem rastišča slabša tla. Prisotno je kontinuirano zakisovanje tal z opadom, ki se slabo razkraja z enostransko izrabo hranil zgornjih horizontov.

BIOLOŠKI SPEKTER

	Št.	%	Skupaj	%
FANEROFITI-PHANEROPHYTA			**31**	**20,2**
Šopasti f. (P. caesp.)	11	7,2		
Steblasti f. (P. scap.)	10	6,5		
Nano f. (NP)	8	5,2		
Vzpenjalni f. (P. scand.)	2	1,3		
HAMEFITI-CHAMAEPHYTA			**27**	**17,7**
Polgrmičasti h. (Ch. suffr.)	2	1,3		
Grmovni h. (Ch. frut.)	2	1,3		
Plazeči h. (Ch. rept.)	1	0,7		
Sukulentni h. (Ch. succ.)	1	0,7		
Mahovni h. (Ch. brio.)	16	10,4		
Lišajni h. (Ch. lich.)	5	3,3		
HEMIKRIOPTOFITI-HEMICRYPTOPHYTA			**65**	**42,4**
Steblasti h. (H. scap.)	33	21,5		
Šopasti h. (H. caesp.)	15	9,8		
Rozetni h. (H. ros.)	11	7,2		
Plazeči h. (H. rept.)	4	2,6		
Dvoletni h. (H. bien.)	2	1,3		
GEOFITI-GEOPHYTA			**27**	**17,7**
G. s koreniko (G. rhiz.)	22	14,4		
G. z gomolji (G. bulb.)	4	2,6		
G. paraziti (G. par.)	1	0,7		
TEROFITI-THEROPHYTA			**1**	**0,7**
Steblasti t. (T. scap.)	1	0,7		
NEOPREDELJENI VRSTI	2	1,3	**2**	**1,3**
Skupaj	**153**	**100,0**	**153**	**100,00**

Tabela 1: Biološki spekter

Analiza horoloških skupin kaže, da je več kot dve tretjini geoelementov hladnih (70,5 %). K hladnim skupinam smo prišteli mahove in lišaje (vaskularna flora 56,8 % in mahovno-lišajna flora 13,7 %). Največ je evropskih, cirkumborealnih in evroazijskih geoelementov, ne zaostajajo pa niti paleotemperatni in evrosibirski geoelementi. Vsi ti potrjujejo, da sekundarna smrekova fitocenoza uspeva v nekoliko ostrejših življenjskih razmerah, kar nam kaže tudi biološki spekter.

Tabela 3 kaže razmerja med fitocenološkimi skupinami. Pričakovano je, da so najbolj zastopane fagetalne vrste prvotne bukove (jelovo-bukove) fitocenoze (45,8 %). Glede na karbonatno geološko podlago pa je največ bazifilnih vrst (54,3 %) iz razredov *Querco-Fagetea* s. lat., *Betulo-Adenostyletea* s. lat. (=*Mulgedio-Aconitetea* s. lat.), *Trifolio-Geranietea* s. lat. in *Asplenietea trichomanis* s. lat. Nato sledijo piceetalne vrste (24,8 %), ki so se uveljavile po dolgotrajni zasmrečitvi rastišča in so acidofilne. K acidofilnim vrstam uvrščamo poleg razreda *Vaccinio-Piceetea* s. lat. še *Erico-Pinetea* s. lat. ter mahovno in lišajno floro (34,6 %). Manj je nevtralnih vrst (11,1 %) iz razreda *Molinio-Arrhenatheretea* s. lat. in »ostalih« vrst. Podoba fitocenoloških skupin nam potrjuje sekundarnost smrekove fitocenoze.

Geoelementi	**Št.**	**%**
Mediteransko-montanski	15	9,8
Cirkumborealni	23	15,0
Evropski	28	18,3
Evroazijski	17	11,1
Paleotemperatni	10	6,5
Evrosibirski	9	5,9
Severnoilirski	7	4,7
Južnoilirski	2	1,3
Jugovzhodnoevropski	2	1,3
Evromediteranski	2	1,3
Pontski	3	2,0
Mediteransko-pontski	3	2,0
Mediteransko-atlantski	2	1,3
Kozmopolitski	6	3,9
Kultivirana vrsta	1	0,6
Mahovi in lišaji	21	13,7
Nedoločeni vrsti	2	1,3
Skupaj	**153**	**100,00**

Tabela 2: Horološke skupine

Razred	**št.**	**%**
VACCINIO-PICEETEA	38	24,8
QUERCO-FAGETEA	70	45,8
ERICO-PINETEA	7	4,6
BETULO-ADENOSTYLETEA (MULGEDIO-ACONITETEA)	5	3,3
TRIFOLIO-GERANIETEA	4	2,6
MOLINIO-ARRHENATHERETEA	6	3,9
ASPLENIETEA TRICHOMANIS	4	2,6
OSTALE VRSTE	11	7,2
MAHOVI IN LIŠAJI	8	5,2
Skupaj	**153**	**100,0**

Tabela 3: Fitocenološke skupine

Zaključek

Skladno s floristično in vegetacijsko analizo sekundarne smrekove fitocenoze smo ugotovili, da jo lahko uvrstimo v asociacijo *Aposerido-Piceetum* Zupančič 1999 kot njeno samostojno subasociacijo *Aposerido-Piceetum galietosum rotundifolii* subass. nova. **Holotip subasociacije je popis 2 iz Fitocenološke tabele 1.**

Subasociacija *Aposerido-Piceetum galietosum rotundifolii* se glede na svojo floristično sestavo približuje sre-

dnjeevropski asociaciji *Galio rotundifolii-Piceetum* J. & M. Bartsch 1940. Med njima je delna (manjša) podobnost oziroma (daljna) sorodnost. Upoštevati pa moramo, da se asociaciji nahajata v različnih flornih provincah. Asociacija *Aposerido-Piceetum* je v ilirski florni provinci, kar pove že ime asociacije po jugovzhodnoevropsko-ilirski vrsti in značilnici asociacije *Aposeris foetida*. Poleg značilnice se v asociaciji pojavljajo še druge jugovzhodnoevropsko-ilirske vrste: *Helleborus niger* subsp. *niger*, *Cyclamen purpurascens*, *Anemone trifolia*, *Homogyne sylvestris*, *Cardamine trifolia*; te so nam asociacijo opredelile kot geografsko varianto ilirske florne province *Aposerido-Piceetum* var. geogr. *Helleborus niger* Zupančič 1999. Asociacija *Galio rotundifolii-Piceetum* J. & M. Bartsch 1940 je doma v srednjeevropski florni provinci.

Po več generacijah smrekovega gozda na bukovem rastišču bodo sčasoma izginile bazifilne jugovzhodnoevropsko-ilirske in fagetalne vrste, predvsem tiste, ki so strogo vezane na karbonatna tla. Takrat bi bila sekundarna smrekova fitocenoza zelo podobna tistim iz srednjeevropske province, npr. asociaciji *Galio-Piceetum*.

Na koncu naj opozorimo na primerjavo med asociacijama *Galio rotundifolii-Piceetum* J. & M. Bartsch 1940 in *Galio rotundifolii-Abietetum* M. Wraber (1955) 1959. Kljub trditvam srednjeevropskih fitocenologov (Mucina, Grabherr & Wallnöfer 1993, Willner & Grabherr 2007), da gre v obeh primerih za isto asociacijo, torej za prvo opisano *Galio-Piceetum* (ime asociacije *Galio-Abietetum* naj bi bil sinonim), to ne drži. Primerjalni analizi po Sørensenu in Jaccardu sta jasno pokazali, da gre za dve različni asociaciji, to je za sekundarno smrekovo in primarno jelovo fitocenozo.

Ugotovitev nove gozdne fitocenoze je nadaljnji prispevek k veliki biotski različnosti (biodiverziteti) gozdne vegetacije v Sloveniji. Njen vzrok je v fitogeografskem položaju, različnosti geološke podlage, mezoklimatskih in mikroklimatskih razmerah in ne nazadnje v orografski razčlenjenosti Slovenije ter še drugih, manj znanih biotskih in abiotskih dejavnikih.

LITERATURA

Bartsch, J. & M. Bartsch, 1940: *Vegetationskunde des Schwarzwaldes*. Pflanzensoziologie (Jena) 4: 1–229.

Braun-Blanquet, J., 1964: *Pflanzensoziologie*. Wien-New York.

Martinčič, A., T. Wraber, N. Jogan, A. Podobnik, B. Turk & B. Vreš, 2007: *Mala flora Slovenije*. Ljubljana.

Mucina, L., G. Grabherr & S. Wallnöfer, 1993: *Die Pflanzengesselschaften Österreichs. Teil III. Wälder und Gebüsche*. Jena-Stuttgart-New York.

Oberdorfer, E., 1957: *Süddeutische Pflanzengesellschaften*. Pflanzensoziologie (Jena) 10: 1–564.

Oberdorfer, E., 1979: *Pflanzensoziologische Exkursions Flora*. Stuttgart.

Poldini, L., 1991: *Atlante corologico delle piante vascolari nel Friuli-Venezia Giulia*. Udine.

Willner, W. & G. Grabherr, 2007: *Die Wälder und Gebüsche Österreichs*. München. (Textband und Tabellenband).

Zupančič, M., 1999: *Smrekovi gozdovi Slovenije*. Dela SAZU (Ljubljana) 36: 1–212.

PHYTOCOENOLOGICAL TABLE (Fitocenološka tabela) 1:
APOSERIDO-PICEETUM Zupančič (1978) 1999 GALIETOSUM ROTUNDIFOLII Zupančič & Žagar subass. nova

Sinsistematical characteristic (Sinsistematska pripadnost)								Presence (Prezenca)
	Number of relevé (Zaporedna številka popisa)		1	2	3	4	5	
	Working No of relevé (Delovna številka popisa)		116/62	115/62	118/62	112/62	114/62	
	Date (Datum)		23.8.62	23.8.62	23.8.62	23.8.62	23.8.62	
	Altitude in m (Nadmorska višina v m)		1170	1060	1070	680	970	
	Aspect (Nebesna lega)		S	SSE	SE	SSE	SE	
	Slope in degrees (Nagib v stopinjah)		15–20	5–10	0–5	20	15	
	Bedrock (Geološka podlaga)		lime dolo	lime, dolo	lime, dolo	lime	lime, dolo	
	Stoniness in % (Kamnitost v %)		10	0	5	70	5	
	Cover (Pokrovnost) %: Tree layer (drevesna pl.)	I	90	80	90	80	90	
	Shrub layer (grmovna plast)	II	0	40	10	60	5	
	Herb layer (zeliščna plast)	III	40	80	80	60	40	
	Moss layer (mahovna plast)	IV	10	30	10	50	70	
	Relevé (Velikost popisne ploskve) m2		400	400	400	400	400	
	Location (Kraj popisov)		Covc	Planica	Za tesnicami	Zamorsko	Zamorski vrh	
			Veža – Planica					
	Province (Pokrajina)		Savinjska dolina					
			Štajerska					
	CHARACTERISTIC SPECIES OF THE ASSOCIATION (Značilnica za asociacijo) APOSERIDO-PICEETUM Zupančič 1999							
			1	2	3	4	5	
• VP_3	Aposeris foetida	III	1.1	1.2	1.1	1.1	.	4
	DIFERENTIAL SPECIES OF THE GEOGRAPHICAL VARIANT(Razlikovalnice geografske variante) HELLEBORUS NIGER Zupančič 1999							
			1	2	3	4	5	
• F_1	Helleborus niger subsp. niger	III	+	2.2	2.2	2.1	1.2	5
• F_1	Cyclamen purpurascens		1.1	1.1	+	1.1	1.2	5
• F_1	Cardamine trifolia		+	1.1	+	.	.	3
• VP_2	Homogyne sylvestris		+	.	.	.	+	2
	DIFERENTIAL SPECIES OF THE SUBASSOCIATION (Razlikovalnici subasociacije) GALIETOSUM ROTUNDIFOLII Zupančič & Žagar subass. nova							
			1	2	3	4	5	
AP	Galium rotundifolium	III	(+)	+	1.2	+	+	5
VP_2	Goodyera repens		.	1.1	.	.	2.1	2
AP	ABIETI-PICEENION Br.-Bl. 1939 in Br.-Bl. et al. 1939							
			1	2	3	4	5	
	Galium rotundifolium	III	(+)	+	1.2	+	+	5
	Abies alba	I	.	1.1	.	+	.	2 2
		II	.	1.2	.	-	.	1 2
	Valeriana tripteris	III	.	+	.	+	.	2
	Veronica urticifolia		.	+	.	.	.	1
	Adenostyles glabra		.	.	+0 .	.	.	1
RV	RHODODENDRO-VACCINIENION Br.-Bl. in Br.-Bl. & Jeny 1926 & VACCINIO-PICEENION Oberd. 1957							
			1	2	3	4	5	
	Melampyrum sylvaticum	III	1.2	2.2	1.2	.	+	4
	Mnium punctatum	IV	.	+.3	+	+	1.5	4
	Luzula luzulina	III	.	+	.	.	.	1
	Homogyne alpina		+	.	.	.	.	1
	Pyrola minor		.	.	.	.	+	1
	Vaccinium vitis-idaea		.	.	+	.	.	1
VP_{1-2}	VACCINIO-PICEION Br.-Bl. (1938) 1939 & VACCINIO-PICEETALIA Br.-Bl. in Br.-Bl. 1939 emend. K.-Lund 1967							
			1	2	3	4	5	
		I	5.5	3.2	5.5	4.1	5.5	5
VP_1	Picea abies	II	+	2.2	1.1	3.2	+	5 5
		III	+	1.1	+	+	+	5
VP_1	Hieracium sylvaticum		+	1.2	+	+	+	5
VP_2	Vaccinium myrtillus		+	1.2	+	.	+.2	4

VP_2	Larix decidua	I	+	.	2.1	.	1.1	3
VP_2	Polytrichum formosum	IV	.	+.2	+	+	.	3
VP_2	Atrichum undulatum		+	.	+	+	.	3
VP_2	Goodyera repens	III	.	1.1	.	.	2.1	2
VP_2	Monotropa hypopitys		.	.	+.2	.	+	2
• VP_2	Homogyne sylvestris		+	.	.	.	+	2
VP_2	Cantharellus cibarius		.	+.2	.	.	.	1
VP_2	Orthilia secunda		.	+.2	.	.	.	1
VP_2	Rosa pendulina	II	.	.	.	.	+	1
VP_3	VACCINIO-PICEETEA Br.-Bl. in Br.-Bl. et al. 1939 em. Zupančič (1980) 2000 s. lat.							
			1	2	3	4	5	
	Hylocomium splendens	IV	+	+.3	1.5	1.5	2.5	5
	Rhytidiadelphus triquetrus		+	1.5	2.5	1.3	+.3	5
	Hypnum cupressiforme		2.5	1.2	+.3	2.5	.	4
•	Aposeris foetida	III	1.1	1.2	1.1	1.1	.	4
	Maianthemum bifolium		1.1	1.1	1.1	+	.	4
	Dicranum scoparium	IV	.	+.3	+	+.3	1.3	4
	Gentiana asclepiadea	III	+	1.1	+	.	+	4
	Peltigera leucophlebia	IV	.	+	+	+	+	4
	Luzula pilosa	III	+	.	1.1	+	.	3
	Oxalis acetosella		+	.	1.1	+	.	3
	Luzula luzuloides		+	+	+.2	.	.	3
	Grimmia pulvinata	IV	+	+	.	.	.	2
	Solidago virgaurea	III	+	+	.	.	.	2
	Pleurozium schreberi	IV	.	.	.	.	1.5	1
EP	Laserpitium peucedanoides	III	.	.	.	+	.	1
• F_1	AREMONIO-FAGION (Ht. 1938) Török, Podani & Borhidi 1989							
			1	2	3	4	5	
	Helleborus niger subsp. niger	III	+	2.2	2.2	2.1	1.2	5
	Cyclamen purpurascens		1.1	1.1	+	1.1	1.2	5
	Aremonia agrimonoides		+	+	+	+	+	5
	Cardamine trifolia		+	1.1	+	.	.	3
	Knautia drymeia subsp. drymeia		.	+	+	.	+	3
	Dentaria enneaphyllos		+	.	.	.	.	1
	Lamium orvala		.	+	.	.	.	1
	Rhamnus fallax	II	.	.	.	+	.	1
F_2	FAGETALIA SYLVATICAE Pawl. 1928							
			1	2	3	4	5	
	Fagus sylvatica	I	1.1	+	-	2.1	+	5
		II	+	1.1	+.2	1.1	+	5
	Sanicula europaea	III	+.2	1.1	+	1.1	+	5
	Mycelis muralis		+	+	1.1	1.1	+	5
	Mercurialis perennis		2.2	+	+	+	+	5
	Acer pseudoplatanus	II	+	+	+	+	+	5
	Daphne mezereum		+	+	+	+	+	5
	Eurhynchium zetterstedtii	IV	.	1.5	1.3	2.5	+.3	4
	Salvia glutinosa	III	.	1.1	+	1.1	+	4
	Epipactis helleborine		+	+	+	.	+	4
	Galeobdolon flavidum		+	+	+	+	.	4
	Stachys sylvatica		+	+	+	.	+	4
	Viola reichenbachiana		.	+	+	+	+	4
	Euphorbia amygdaloides		1.1	1.1	+	.	.	3
	Melica nutans		+	+	.	+	.	3
	Brachypodium sylvaticum		.	.	+.2	.	1.1	2
	Rosa arvensis	II	.	+	.	1.1	.	2
	Actaea spicata	III	.	.	.	+	+	2
	Cephalanthera damasonium		+	+	.	.	.	2
	Geranium robertianum		.	.	+	+	.	2
	Gymnocarpium robertianum		.	.	+	+	.	2
	Lonicera alpigena	II	.	+	.	.	+	2
	Paris quadrifolia	III	+	.	+	.	.	2
	Campanula trachelium		.	.	.	1.1	.	1

	Asarum europaeum		.	.	.	+	.	1
	Fraxinus excelsior	II	.	.	.	+	.	1
•	Galium laevigatum	III	.	.	+	.	.	1
	Poa nemoralis		.	+	.	.	.	1
	Polystichum aculeatum		.	+	.	.	.	1
	Prenanthes purpurea		.	+	.	.	.	1
	Pulmonaria officinalis		.	+	.	.	.	1
	Ranunculus lanuginosus		.	.	+	.	.	1
	Scrophularia nodosa		.	.	.	+	.	1
	Symphytum tuberosum		+	.	.	.	.	1
	Galium odoratum		.	.	.	+0	. .	1
RP_2	QUERCETALIA ROBORIS-PETRAEAE R. Tx. (1931) 1937 s. lat.							
			1	2	3	4	5	
	Pteridium aquilinum	III	+	+	.	+	+	4
	Veronica officinalis		+	.	+	+	+	4
	Polypodium vulgare		.	.	+	+	.	2
	Frangula alnus	II	.	.	.	+	.	1
Q_2	QUERCETALIA PUBESCENTIS Br.-Bl. 1931 s. lat.							
			1	2	3	4	5	
	Digitalis grandiflora	III	+	+	.	1.1	.	3
	Campanula witasekiana		+	+	.	.	+	3
	Hypericum montanum		.	+	+	.	+	3
	Fraxinus ornus	I	.	.	.	1.1	.	1 1
		II	.	.	.	2.2	.	1 1
	Ostrya carpinifolia		.	.	.	+	.	1
	Sorbus aria		.	+	.	.	.	1
P	PRUNETALIA SPINOSAE R. Tx. 1952 s. lat.							
			1	2	3	4	5	
	Berberis vulgaris	II	.	.	.	+	.	1
	Crataegus monogyna		.	.	.	+	.	1
	Juniperus communis		.	.	.	+	.	1
	Pyrus pyraster		.	.	.	+	.	1
	Viburnum lantana		.	.	.	+	.	1
F_3	QUERCO-FAGETEA Br.-Bl. & Vlieger in Vlieger 1937							
			1	2	3	4	5	
	Ctenidium molluscum	IV	1.3	1.5	1.3	3.5	2.5	5
	Carex digitata	III	+	+	+	+	+	5
	Hepatica nobilis		1.1	+	.	2.2	.	3
	Corylus avellana	II	.	+	.	1.1	.	2
	Lonicera xylosteum		.	.	.	+	1.1	2
	Anemone nemorosa	III	+	+	.	.	.	2
	Clematis vitalba	II	.	.	.	+	+	2
	Isothecium myurum	IV	.	+	.	+	.	2
	Platanthera bifolia	III	.	+	+	.	.	2
	Acer campestre	II	.	.	.	+	.	1
	Hedera helix		.	.	.	+	.	1
	Listera ovata	III	.	.	+	.	.	1
	Prunus avium	II	.	.	.	+	.	1
EP_3	ERICO-PINETEA Ht. 1959 s. lat.							
			1	2	3	4	5	
	Carex alba	III	1.1	+.2	2.3	+	1.3	5
	Polygala chamaebuxus		.	+	+	1.2	1.2	4
	Buphthalmum salicifolium		+	.	+	1.1	.	3
	Calamagrostis varia		+.2	+.2	.	.	+	3
	Rubus saxatilis	II	+	+	.	.	+	3
	Pimpinella saxifraga	III	.	.	.	+	+	2
	Gymnadenia odoratissima		.	.	+	.	.	1
A3	BETULO-ADENOSTYLETEA Br.-Bl. & R. Tx. 1943 s. lat. (=MULGEDIO-ACONITETEA Hadač & Klika in Klika & Hadač 1944)							
			1	2	3	4	5	
	Senecio fuchsii	III	+	+	+	+	+	5

	Polygonatum verticillatum		2.1	+	+	.	.	3
	Dryopteris filix-mas		.	+	.	+	.	2
	Athyrium filix-femina		+	.	.	.	.	1
	Ranunculus platanifolius		.	.	+	.	.	1
TG	TRIFOLIO-GERANIETEA Th. Müller 1961 s. lat.							
			1	2	3	4	5	
	Cruciata glabra	III	.	+	+	+	1.1	4
	Clinopodium vulgare		.	+	.	1.1	+	3
	Vincetoxicum hirundinaria		.	.	.	+	+	2
	Origanum vulgare		.	.	.	+	.	1
MA	MOLINIO-ARRHENATHERETEA Tx. 1937 s. lat.							
			1	2	3	4	5	
	Ajuga reptans	III	1.1	1.1	1.1	+	+	5
	Dactylis glomerata (s.lat.)		.	.	+	.	+	2
SC	Dactylorhiza maculata		.	+	+	.	.	2
	Ranunculus sp.		.	.	+	.	+	2
	Angelica sylvestris		.	.	+	.	.	1
	Cirsium palustre		.	.	+	.	.	1
AS	ASPLENIETEA TRICHOMANIS Br.-Bl. in Meier & Br.-Bl. 1934 corr. Oberd. 1977 s. lat.							
			1	2	3	4	5	
	Asplenium trichomanes	III	+	.	+	+.2	.	3
	Asplenium ruta-muraria		.	.	.	+	+	2
	Asplenium viride		.	.	.	+	+	2
	Moehringia muscosa		.	.	.	+.3	.	1
O	OTHER SPECIES (Ostale vrste)							
			1	2	3	4	5	
E	Fragaria vesca	III	.	1.1	+	+	+	4
FB	Euphorbia cyparissias		.	.	+	+	+	3
	Phyteuma sp.		.	+	.	.	+	2
AR	Urtica dioica		+	.	.	+	.	2
AR	Aegopodium podagraria		.	.	.	+	.	1
S	Campanula cochleariifolia		.	.	+	.	.	1
	Juglans regia	II	.	.	.	+	.	1
NC	Potentilla erecta	III	.	+	.	.	.	1
	Rubus fruticosus	II	.	.	.	+	.	1
S	Saxifraga crustata	III	.	.	.	+	.	1
	Sorbus aucuparia	II	.	+	.	.	.	1
ML	MOSSES AND LICHENS (Mahovi in lišaji)							
			1	2	3	4	5	
	Cladonia pyxidata	IV	+	+	.	.	+	3
	Plagiochila asplenioides		.	1.3	.	+	.	2
	Tortella tortuosa		+.2	.	.	+	.	2
	Neckera crispa		1.3	.	.	.	.	1
	Anomodon viticulosus		.	.	.	+.3	.	1
	Cladonia rangiferina		.	+	.	.	.	1
	Cladonia squamosa		+	.	.	.	.	1
	Metzgeria furcata		+	.	.	.	.	1

LEGEND (Legenda)

Sinsistematical characteristic (Sinsistematska pripadnost)

EM Erico-Pinion mugi Leibundgut 1948 nom. inv.
SC Scheuchzerio-Caricetea fuscae (Nordh. 1936) R. Tx. 1937
E Epilobietea angustifolii R. Tx. & Prsg. 1950
FB Festuco-Brometea Br.-Bl. & R. Tx. 1943
AR Artemisietea Lohm., Prsg. & R. Tx. in R. Tx.1950
NC Nardo-Callunetea Preising 1949
S Seslerietea Br.-Bl. 1948 em. Oberd. 1978
• Southeast European species (Jugovzhodno evropske vrste)

Bedrock (Geološka podlaga)

lime limestone (apnenec)
dolo dolomíte (dolomit)

PHYTOCOENOLOGICAL TABLE (Fitocenološka tabela) 2: GALIO ROTUNDIFOLII-PICEETUM J. et M. Bartsch 1940 s. lat.

Sinsistematical characteristic (Sinsistematska pripadnost)								
	Number of anal. tab. (Številka analitične tabele)		1	2	3	4	5	6
	Author of anal. table (Avtor analitične tabele)		Zupančič	Bartsch	Oberdorfer	Oberdorfer	M. Wraber	Zupančič
	Altitude (Nadmorska višina)		680-1170	850-990	750-1000	700-800	380-1230	930-1570
	Aspect (Nebesna lega)		S-SE	N-NW			all (vse)	N-S
	Bedrock (Geološka podlaga)		apn	gna, gra, bsa, mor	gna, gra	gna, gra	grd, gna, ble	apn, dol
	Stonines (Kamnitost)		0-70	0-10			15-45	0-40
	Location, province, state (Kraj popisov, pokrajina, država)		Veža-Planica Savinjska dolina Štajesko Slovenija	Schwarzwald Bayern Deutschland	Schwarzwald Bayern Deutschland	Schwarzwald Bayern Deutschland	Pohorje Štajesko Slovenija	Štajesko Gorenjsko Koroško Slovenija
	Number of relevé (Število popisov)		5	4	12	12	38	25
	CHARACTERISTIC SPECIES OF THE ASSOCIATION (Značilnica za asociacijo) APOSERIDO-PICEETUM Zupančič 1999							
			1	2	3	4	5	6
VP_3	Aposeris foetida	III	V [1]	.	.	.	.	V^{1-4}
	DIFFERENTIAL SPECIES OF THE ASSOCIATION (Razlikovalnice za asociacijo) APOSERIDO-PICEETUM Zupančič 1999							
			1	2	3	4	5	6
	Helleborus niger subsp. niger	III	V^{+-2}	.	.	.	.	V^{+-2}
	Cyclamen purpurascens		V^{+-1}	.	.	.	.	III^{+-1}
	Cardamine trifolia		IV^{+-1}	.	.	.	II^{+-2}	IV^{+-2}
VP_2	Homogyne sylvestris		III^{+}	.	.	.	.	III^{+-3}
	CHARACTERISTIC SPECIES OF THE ASSOCIATION (Značilnice za asociacijo) GALIO ROTUNDIFOLII-PICEETUM J. et M. Bartsch 1940							
			1	2	3	4	5	6
		I	V^{3-5}	4^{4-5}	II	V	V^{1-4}	V^{3-5}
VP_1	Picea abies	II	V^{+-3}	-	-	-	V^{1-2}	V^{+-2}
		III	V^{+-1}	-	-	-	III^{+-1}	III^{+}
AP	Galium rotundifolium		V^{+-1}	3^{+-1}	III	(I)	V^{1-3}	.
	CHARACTERISTIC SPECIES OF THE ASSOCIATION (Značilnice za asociacijo) GALIO ROTUNDIFOLII-ABIETETUM M. Wraber (1955) 1959							
			1	2	3	4	5	6
VP_3	Rubus hirtus	II	.	.	.	.	V^{+-2}	.
VP_1	Hieracium rotundatum	III	.	.	.	.	IV^{+-2}	.
VP_3	Thuidium tamariscinum	IV	.	.	.	.	IV^{+-2}	.
	DIFFERENTIAL SPECIES OF THE ASSOCIATION (Razlikovalnice za asociacijo) GALIO ROTUNDIFOLII-ABIETETUM M. Wraber (1955) 1959							
			1	2	3	4	5	6
		I	.	.	.	.	II^{+-2}	
RP_2	Castanea sativa	II	.	.	.	.	II^{+-2}	.
		III	.	.	.	.	II^{+-1}	.
RP_2	Betula pendula	I	.	.	.	.	I^{+}	.
RP_2	Carex montana	III	.	.	.	.	I^{+}	.
AP	ABIETI-PICEENION Br.-Bl. in Br.-Bl. et al. 1939							
			1	2	3	4	5	6
	Galium rotundifolium	III	V^{+-1}	3^{+-1}	III	(I)	V^{1-3}	.
	Abies alba	I	III^{+-1}	3^{+-2}	V	IV	V^{1-5}	II^{+-1}
		II	II^{1}	-	-	-	V^{+-3}	.
	Valeriana tripteris	III	III^{+}	.	.	.	.	IV^{+-1}
	Veronica urticifolia		II^{+}	.	.	.	.	III^{+-1}

	Adenostyles glabra		II^{+0}	.	.	.	.	.
	Dryopteris dilatata		.	2^{+-1}	III	.	II^{+-1}	.
	Circaea alpina		.	.	.	I	.	.
	Plagiochila asplenioides var. major	IV	.	.	.	.	II^{+-1}	I^{+}
RV	RHODODENDRO-VACCINIENION Br.-Bl. in Br.-Bl. et Jenny 1926 Br.-Bl. 1939 & VACCINIO-PICEENION Oberd. 1957							
			1	2	3	4	5	6
	Melampyrum sylvaticum	III	V^{+-2}	2^{+-1}	V	V	IV^{+-2}	IV^{+-3}
	Rhizomnium punctatum	IV	V^{+-1}	.	.	.	.	I^{+}
	Luzula luzulina	III	II^{+}	.	.	.	I^{+-2}	IV^{+-1}
	Homogyne alpina		II^{+}	.	.	.	.	IV^{+-1}
	Pyrola minor		II^{+}	.	.	.	.	.
	Vaccinium vitis-idaea		II^{+}	.	.	.	I^{+}	IV^{+-1}
	Rhytidiadelphus loreus	IV	.	3^{+-1}	III	V	.	.
	Listera cordata	III	.	2^{+-1}	I	.	.	I^{+}
	Lonicera nigra	II	.	2^{+}	IV	IV	I^{+}	I^{+}
	Luzula sylvatica subsp. sylvatica	III	.	2^{+}	I	I	I^{+}	III^{+-1}
	Plagiothecium undulatum	IV	.	2^{+}	.	.	.	I^{+}
	Lycopodium annotinum	III	.	1^{+}	I	.	.	.
	Moneses uniflora		.	.	.	I	.	III^{+-1}
	Ptilium crista-castrensis	IV	.	.	.	I	.	.
VP_1	VACCINIO-PICEION Br.-Bl. in Br.-Bl. et al. 1939							
			1	2	3	4	5	6
		I	V^{3-5}	4^{4-5}	II	V	V^{1-4}	V^{3-5}
	Picea abies	II	V^{+-3}	-	-	-	V^{1-2}	V^{+-2}
		III	V^{+-1}	-	-	-	III^{+-1}	III^{+}
	Hieracium sylvaticum		V^{+-1}	.	IV	V	V^{+-2}	V^{+-2}
	Thelypteris limbosperma		.	2^{+}	I	.	III^{+-1}	I^{+}
	Blechnum spicant		.	1^{+}	.	.	I^{+}	I^{+}
	Gymnocarpium dryopteris		.	.	III	.	II^{+}	IV^{+-1}
	Hieracium rotundatum		.	.	.	.	IV^{+-2}	.
	Bazzania trilobata	IV	.	.	.	.	III^{+-1}	II^{+-1}
VP_2	VACCINIO-PICEETALIA Br.-Bl. in Br.-Bl. et al. 1939 emend. K.-Lund 1967							
			1	2	3	4	5	6
	Vaccinium myrtillus	III	V^{+-1}	.	V	IV	IV^{+-3}	V^{+-3}
	Larix decidua	I	IV^{+-2}	.	.	.	.	
	Polytrichum formosum	IV	IV^{+}	3^{1-4}	IV	II	V^{1-2}	II^{+-1}
	Atrichum undulatum		IV^{+}	.	II	.	III^{+-1}	I^{+}
	Goodyera repens	III	III^{1-2}	.	.	.	.	I^{+}
	Monotropa hypopitys		III^{+}	.	.	.	.	.
•	Homogyne sylvestris		III^{+}	.	.	.	.	III^{+-3}
	Cantharellus cibarius		II^{+}	.	.	.	I^{+}	.
	Orthilia secunda		II^{+}	.	I	.	.	II^{+-1}
	Rosa pendulina	II	II^{+}	.	I	.	.	II^{+}
	Avenella flexuosa	III	.	2^{1-4}	IV	III	V^{1-4}	I^{+}
	Thelypteris phegopteris		.	2^{+}	II	.	.	II^{+}
	Plagiothecium neglectum	IV	.	.	.	.	II^{+}	II^{+-1}
	Dicranum majus		.	.	.	.	I^{+-1}	.
VP_3	VACCINIO-PICEETEA Br.-Bl. in Br.-Bl. et al. 1939 emend. Zupančič (1980) 2000							
			1	2	3	4	5	6
	Hylocomium splendens	IV	V^{+-2}	4^{+-5}	V	.	III^{+-2}	I^{+}
	Rhytidiadelphus triquetrus		V^{+-2}	2^{+-1}	III	.	II^{+-2}	I^{+-3}
	Hypnum cupressiforme		V^{+-2}	.	.	.	V^{+-2}	III^{+-1}
•	Aposeris foetida	III	V^{1}	.	.	.	.	V^{1-4}
	Maianthemum bifolium		V^{+-1}	3^{+-1}	II	I	II^{+}	IV^{+-2}
	Dicranum scoparium	IV	V^{+-1}	.	I	III	III^{+-2}	IV^{+-1}
	Gentiana asclepiadea	III	V^{+-1}	.	.	.	II^{+-2}	IV^{+-1}
	Peltigera leucophlebia	IV	V^{+}	.	.	.	I^{+-1}	.
	Luzula pilosa	III	IV^{+-1}	1^{+}	II	II	V^{+-2}	IV^{+-1}
	Oxalis acetosella		IV^{+-1}	4^{3-4}	V	IV	V^{+-2}	V^{+-2}
	Luzula luzuloides		IV^{+}	.	IV	V	V^{+-3}	III^{+-4}

	Grimmia pulvinata	IV	III^{+}	.	.	.	.	II^{+}
	Solidago virgaurea	III	III^{+}	.	II	V	II^{+-1}	IV^{+}
	Pleurozium schreberi		II1	.	.	.	II^{+-3}	I^{+-1}
EP	Laserpitium peucedanoides		II+	.	.	.	.	.
	Sphagnum sp.	IV	.	2^{+}	.	.	.	.
	Hieracium sp.	III	.	1^{+}	.	.	.	.
	Calamagrostis arundinacea		.	.	III	V	II^{+-4}	I^{+}
	Rubus hirtus	II	.	.	.	.	V^{+-2}	.
	Thuidium tamariscinum	IV	.	.	.	.	IV^{+-2}	I^{+}
	Solidago virgaurea subsp. minuta (=Solidago virgaurea subsp. alpestris)	III	.	.	.	.	I$^{1-2}$	.
	Leucobryum glaucum	IV	.	.	.	.	I^{+}	I+

• F_1	AREMONIO-FAGION (Ht. 1938) Török, Podani & Borhidi in Borhidi 1989							
			1	2	3	4	5	6
	Helleborus niger subsp. niger	III	V^{+-2}	.	.	.	.	V^{+-2}
	Cyclamen purpurascens		V^{+-1}	.	.	.	.	III^{+-1}
	Aremonia agrimonoides		V^{+}	.	.	.	.	IV^{+}
	Cardamine trifolia		IV^{+-1}	.	.	.	II^{+-2}	IV^{+-2}
	Knautia drymeia subsp. drymeia		IV^{+}	.	.	.	I^{+}	III^{+}
	Dentaria enneaphyllos		II^{+}	.	.	.	.	III^{+}
	Lamium orvala		II^{+}	.	.	.	.	I^{+}
	Rhamnus fallax	II	II^{+}	.	.	.	.	.

F_2	FAGETALIA SYLVATICAE Pawlowski 1928							
			1	2	3	4	5	6
	Fagus sylvatica	I	V^{+-2}	2^{+-1}	IV	V	IV^{+-2}	III^{+-1}
		II	V^{+-1}	-	-	-	V^{+-2}	III^{+-}1
	Mercurialis perennis	III	V^{+-2}	.	II	II	.	III^{+-2}
	Eurhynchium zetterstedtii	IV	V^{+-2}	.	.	.	III^{+-3}	II^{+-1}
	Mycelis muralis	III	V^{+-1}	.	III	.	V^{+-1}	III^{+}
	Sanicula europaea		V^{+-1}	.	.	.	II^{+}	I^{+}
	Salvia glutinosa		V^{+-1}	.	.	.	III^{+}	II^{+}
	Acer pseudoplatanus	II	V^{+}	2^{+}	II	I	III^{+-1}	II^{+-1}
	Daphne mezereum		V^{+}	.	I	II	.	V^{+-1}
	Epipactis helleborine	III	V^{+}	.	I	.	.	I^{+}
	Galeobdolon flavidum (=Lamiastrum flavidum)		V^{+}	.	III	II	II^{+}	IV^{+}
	Stachys sylvatica		V^{+}	.	.	.	.	I^{+}
	Viola reichenbachiana		V^{+}	2^{+}	IV	III	III^{+}	II^{+}
	Euphorbia amygdaloides		IV^{+-1}	.	.	.	.	V^{+-1}
	Melica nutans		IV^{+}	.	I	III	.	III^{+}
	Brachypodium sylvaticum		III^{+-1}	.	.	.	.	I^{+}
	Rosa arvensis	II	III+-1	.	.	.	.	.
	Actaea spicata	III	III^{+}	.	III	.	.	I^{+}
	Cephalanthera damasonium		III^{+}	.	.	.	.	.
	Geranium robertianum		III^{+}	.	III	III	.	.
	Gymnocarpium robertianum		III^{+}	.	.	.	.	I^{+}
	Lonicera alpigena	II	III^{+}	.	.	.	.	II^{+-1}
	Paris quadrifolia	III	III^{+}	3^{+}	V	II	.	II^{+}
	Campanula trachelium		II^{1}	.	.	II	.	.
	Asarum europaeum		II^{+}	.	.	.	.	I^{+}
	Fraxinus excelsior	II	II^{+}	.	.	.	.	I^{+}
•	Galium laevigatum	III	II^{+}	.	.	.	.	I^{+}
	Poa nemoralis		II^{+}	1^{+}	I	II	.	II^{+}
	Polystichum aculeatum		II^{+}	.	.	.	.	II^{+}
	Prenanthes purpurea		II^{+}	1^{+}	IV	IV	V^{+-1}	II^{+}
	Pulmonaria officinalis		II^{+}	.	.	.	.	I^{+}
	Ranunculus lanuginosus		II^{+}	.	.	.	.	I^{+}
	Scrophularia nodosa		II^{+}	.	.	.	I^{+}	.
	Symphytum tuberosum		II^{+}	.	.	.	.	II^{+}
	Galium odoratum		II^{+0}	.	I	I	II^{+}	.
	Epilobium montanum		.	.	III	III	III^{+}	II^{+}

Phyteuma spicatum		.	.	II	II	.	II^{+-1}
Petasites albus		.	.	II	I	I^{+}	II^{+}
Eurhynchium striatum	IV	.	.	I	II	.	.
Festuca altissima	III	.	.	I	.	II^{+-4}	.
Carex sylvatica		.	.	I	.	.	I^{+}
Galium sylvaticum		.	.	.	II	.	.
Lilium martagon		.	.	.	I	.	I^{+}

RP_2 QUERCETALIA ROBORIS-PETRAEAE R.-Tx. (1931) 1937 s. lat.

		1	2	3	4	5	6
Pteridium aquilinum	III	V^{+}	.	.	.	II^{+-2}	II^{+-1}
Veronica officinalis		V^{+}	.	III	III	II^{+-1}	III^{+}
Polypodium vulgare		III^{+}	.	.	.	II^{+}	I^{+}
Frangula alnus	II	II^{+}	.	.	.	.	I^{+}
Melampyrum pratense	III	.	1+	I	(I)	I^{+}	.
	I	.	.	.	.	II^{+-2}	
Castanea sativa	II	.	.	.	.	II^{+-2}	.
	III	.	.	.	.	II^{+-1}	.
Betula pendula	I	.	.	.	.	I^{+}	.
Carex montana	III	.	.	.	.	I^{+}	.
Hieracium lachenalii		.	.	.	.	I^{+}	.

Q_2 QUERCETALIA PUBESCENTIS Br.-Bl. 1931 s. lat.

		1	2	3	4	5	6
Digitalis grandiflora	III	IV^{+-1}	.	I	III	.	II^{+}
Campanula witasekiana		IV^{+}	.	.	.	.	.
Hypericum montanum		IV^{+}	.	.	.	.	.
Fraxinus ornus	I	II^{1}	.	.	.	.	.
	II	II^{2}	.	.	.	.	.
Ostrya carpinifolia		II^{+}	.	.	.	.	.
Sorbus aria		II^{+}	.	I	I	.	II^{+}

P PRUNETALIA SPINOSAE R. Tx. 1952 s. lat.

		1	2	3	4	5	6
Berberis vulgaris	II	II^{+}	.	.	.	.	I^{+}
Crataegus monogyna		II^{+}	.	.	.	.	.
Juniperus communis		II^{+}	.	.	.	.	.
Pyrus pyraster		II^{+}	.	.	.	.	.
Viburnum lantana		II^{+}	.	.	.	.	.

F_3 QUERCO-FAGETEA Br.-Bl. & Vlieger in Vlieger 1937

		1	2	3	4	5	6
Ctenidium molluscum	IV	V^{1-2}	.	.	.	.	V^{+-2}
Carex digitata	III	V^{+}	.	.	II	II^{+-1}	IV^{+-1}
Hepatica nobilis		IV^{+-2}	.	.	.	.	IV^{+-1}
Corylus avellana	II	III^{+-1}	.	II	IV	II^{+-1}	I^{+}
Lonicera xylosteum		III^{+-1}	.	I	III	.	I^{+}
Anemone nemorosa	III	III^{+}	3^{+}	I	.	.	IV^{+-1}
Clematis vitalba	II	III^{+}	.	.	.	.	.
Isothecium myurum	IV	III^{+}	.	.	.	II^{+-2}	I^{+}
Platanthera bifolia	III	III^{+}	.	.	.	.	I^{+}
Moehringia muscosa		II^{+}	.	.	.	.	.
Acer campestre	II	II^{+}	.	.	.	.	.
Hedera helix		II^{+}	.	.	.	.	.
Listera ovata	III	II^{+}	.	.	.	.	I^{+}
Prunus avium	I	II^{+}	.	.	.	I^{+}	.
Moehringia trinervia	III	.	.	II	III	.	.
Convallaria majalis		.	.	I	II	.	.
	I	.	.	.	.	I^{+-1}	.
Quercus petraea	II	.	.	.	.	I^{+}	.
	III	.	.	.	.	I^{+}	
Carpinus betulus	I	.	.	.	.	I+	
Sambucus nigra	II	.	.	.	.	I+	

EP_3	ERICO-PINETEA Ht. 1959 s. lat.							
			1	2	3	4	5	6
	Carex alba	III	V^{+-2}	.	.	.	.	III^{+-1}
	Polygala chamaebuxus		V^{+-1}	.	.	.	.	.
	Buphthalmum salicifolium		IV^{+-1}	.	.	.	.	I^{+}
	Calamagrostis varia		IV^{+}	.	.	.	.	IV^{+-1}
	Rubus saxatilis	II	IV^{+}	.	.	I	.	II^{+-2}
	Pimpinella saxifraga	III	III^{+}	.	.	.	.	
	Gymnadenia odoratissima		II^{+}	.	.	.	.	
	Pinus sylvestris	I	.	.	.	.	II+-2	
A_3	BETULO-ADENOSTYLETEA Br.-Bl. & R. Tx. 1943 s. lat. (=MULGEDIO-ACONITETEA Hadač & Klika in Klika & Hadač 1944)							
			1	2	3	4	5	6
	Senecio fuchsii	III	V^{+}	.	IV	V	III^{+-2}	II^{+}
	Polygonatum verticillatum		IV^{+-1}	3^{+}	V	III	.	IV^{+-1}
	Dryopteris filix-mas		III^{+}	.	IV	III	II^{+-1}	II^{+}
	Athyrium filix-femina		II^{+}	2^{+}	V	III	V^{+-2}	IV^{+}
	Ranunculus platanifolius		II^{+}	.	.	.	.	II^{+}
	Milium effusum		.	1^{+}	III	II	.	I^{+}
	Rubus idaeus	II	.	1^{+}	II	II	IV^{+-1}	I^{+}
	Sambucus racemosa		.	.	III	III	I^{+}	.
	Vicia sylvatica	III	.	.	.	I	.	.
	Adenostyles alliariae		.	.	.	I	.	.
E	EPILOBIETEA ANGUSTIFOLII R. Tx. & Prsg. in R. Tx. 1950							
			1	2	3	4	5	6
	Fragaria vesca	III	V^{+-1}	.	II	III	II^{+}	III^{+}
	Gnaphalium sylvaticum		.	.	.	.	I^{+}	I^{+}
	Myosotis sylvatica		.	.	.	.	I^{+}	I^{+}
TG	TRIFOLIO-GERANIETEA SANGUINEI Th. Müller 1961 s. lat.							
			1	2	3	4	5	6
	Cruciata glabra	III	V^{+-1}	.	.	.	.	II^{+}
	Clinopodium vulgare		V^{+-1}	.	.	.	.	I^{+}
	Vincetoxicum hirundinaria		III^{+}	.	.	.	.	.
	Origanum vulgare		II^{+}	.	.	.	.	.
S	SESLERIETEA Br.-Bl. 1948 em. Oberd. 1978							
			1	2	3	4	5	6
	Campanula cochleariifolia	III	II^{+}	.	.	.	.	III^{+-1}
	Saxifraga incrustata		II^{+}	.	.	.	.	.
	Galium saxatile		.	1^{+}	I	.	.	.
MA	MOLINIO-ARRHENATHERETEA R. Tx. 1937 s. lat.							
			1	2	3	4	5	6
	Ajuga reptans	III	V^{+-1}	2^{+}	.	III	.	II^{+}
	Dactylis glomerata (s.lat.)		III^{+}	.	.	.	.	.
SC	Dactylorhiza maculata		III^{+}	.	.	.	.	I^{+}
	Leucanthemum ircutianum		III^{+}	.	.	.	.	.
	Angelica sylvestris		II^{+}	.	I	I	.	I^{+}
	Cirsium palustre		II^{+}	.	.	.	.	.
	Vicia sepium		.	.	II	IV	.	I^{+}
	Veronica chamaedrys		.	.	II	II	1^{+}	I^{+}
	Cardamine pratensis		.	.	I	III	.	.
AR	ARTEMISIETEA VULGARIS Lohm., Prsg. & R. Tx. in R. Tx. 1950							
			1	2	3	4	5	6
	Urtica dioica	III	III^{+}	.	.	.	.	.
	Aegopodium podagraria		II^{+}	.	.	.	.	.
	Galeopsis pubescens		.	.	.	.	II^{+-1}	.
AS	ASPLENIETEA TRICHOMANIS Br.-Bl. in Meier & Br.-Bl. 1934 corr. Oberd. 1977							
			1	2	3	4	5	6
	Asplenium trichomanes	III	IV^{+}	.	.	.	.	I^{+}

	Asplenium viride		III^{+}	.	.	.	.	III^{+}
	Asplenium ruta-muraria		III^{+}	.	.	.	.	I^{+}
	Moehringia muscosa		II^{+}	.	.	.	.	II^{+}
O	OTHER SPECIES (Ostale vrste)							
			1	2	3	4	5	6
	Euphorbia cyparissias	III	IV^{+}	.	.	.	.	I^{+}
	Phyteuma sp.		III^{+}	.	.	.	.	.
	Juglans regia	II	II^{+}	.	.	.	.	.
NC	Potentilla erecta	III	II^{+}	.	.	.	I^{+}	II^{+}
	Rubus fruticosus	II	II^{+}	.	.	.	.	I^{+}
	Sorbus aucuparia		II^{+}	2+-1	IV	III	II^{+-1}	III^{+}
	Knautia sylvatica	III	.	.	II	V	.	.
ML	MOSSES AND LICHENS (Mahovi in lišaji)							
			1	2	3	4	5	6
	Cladonia pyxidata	IV	IV^{+}	.	.	.	I^{+}	III^{+}
	Plagiochila asplenioides		III^{+-1}	.	I	.	III^{+-1}	IV^{+-1}
	Tortella tortuosa		III^{+-1}	.	.	.	.	IV^{+-1}
	Neckera crispa		II^{1}	.	.	.	.	.
	Anomodon viticulosus		II^{+}	.	.	.	.	.
	Cladonia rangiferina		II^{+}	.	.	.	.	III^{+}
	Cladonia squamosa		II^{+}	.	.	.	.	.
	Metzgeria furcata		II^{+}	.	.	.	.	I^{+}
	Mnium affine		.	3^{+-1}	.	.	I^{+-1}	I^{+}
	Pogonatum aloides		.	.	.	.	I^{+}	.

LEGEND (Legenda)

Analytical tables (Analitične tabele)

1 - Aposerido-Piceetum Zupančič (1978) 1999 galietosum rotundifolii Zupančič & Žagar 2010
2 - Picea–Galium rotundifolium ass. J. et M. Bartsch 1940
3 - Galio rotundifolii-Piceetum J. et M. Bartsch 1940 typicum Oberd. 1957
4 - Galio rotundifolii-Piceetum J. et M. Bartsch 1940 calamagrostidetosum arundinaceae Oberd. 1957
5 - Galio rotundifolii-Abietetum M. Wraber (1955) 1959
6 - Aposerido-Piceetum Zupančič 1999 var. geogr. Helleborus niger (comparison selected species in column one)

Sinsistematical characteristic (Sinsistematska pripadnost)

EP Erico-Pinion mugi Leibundgut 1948 nom. inv.
NC Nardo-Callunetea Preising 1949
SC Scheuchzerio-Caricetea fuscae (Nordh. 1936) R. Tx. 1937
• Southeast European species (Jugovzhodno evropske vrste)

Bedrock (Geološka podlaga)

apn limestone (apnenec)
ble micashist (blestniki)
bsa variable sandstones /buntsandstein/ (pisani peščenjak)
gna gneiss (gnájs)
gra granite (granit)
grd granodiorite (granodiorit)
mor moraine (morena)