VEGETATION OF THE PEČKA VIRGIN FOREST REMNANT

Lojze MARINČEK* & Aleksander MARINŠEK**

Abstract
In the region of Rog in south-eastern Slovenia we phytosociologically and pedologically studied the virgin forest remnant Pečka and mapped it in the scale of 1: 3.500. The virgin forest expands over 60.2 ha at the altitude of 795 to 910 metres above sea level. It is dominated by Dinaric fir-beech forests, namely by the geographical variant of the association *Omphalodo-Fagetum* (Tregubov 1957) Marinček et al. 1993 var. geogr. *Calamintha grandiflora* Surina 2002 with four subassociations; *-typicum* (M. Wraber 1955) Puncer 1980, *-galietosum odorati* (Tregubov 1957) Puncer 1980, *-festucetosum altissimae* Puncer, Wojterski, Zupančič 1974, and *-phyllitidetosum* (Puncer, Wojterski, Zupančič 1974) subass. nova. Two variants were described in the latter: the variant with *Corydalis cava* and the variant with *Lamium orvala*. A comparison with Rajhenau virgin forest was made.

Izvleček
Na Rogu v jugovzhodni Sloveniji smo fitocenološko in pedološko preučili pragozdni ostanek Pečka ter ga skartirali v merilu 1 : 3.500. Pragozd je velik 60,2 ha in se razprostira na nadmorski višini od 795 do 910 metrov. Povsem prevladujejo dinarski jelovo-bukovi gozdovi, in sicer geografska varianta asociacije *Omphalodo-Fagetum* (Tregubov 1957) Marinček et al. 1993 var. geogr. *Calamintha grandiflora* Surina 2002 s štirimi subasociacijami; *-typicum* (M. Wraber 1955) Puncer 1980, *-galietosum odorati* (Tregubov 1957) Puncer 1980, *-festucetosum altissimae* Puncer, Wojterski, Zupančič 1974, in *-phyllitidetosum* (Puncer, Wojterski, Zupančič 1974) subass. nova. V slednji smo izločili dve varianti: varianto z vrsto *Corydalis cava* in varianto z vrsto *Lamium orvala*. Narejena je bila primerjava s pragozdom Rajhenau.

Key words: south-eastern Slovenia, Pečka, phytosociology, virgin forest, *Omphalodo-Fagetum*, Rog, pedology
Ključne besede: jugovzhodna Slovenija, Pečka, fitocenologija, pragozd, *Omphalodo-Fagetum*, Rog, pedologija

1. INTRODUCTION

In a *sensu stricto* of the word virgin forest we consider a naturally formed forest which came into being without human intervention to be a virgin forest. In this strict sense it is not reasonable to expect a virgin forest to thrive in more or less densely populated spots. Even without human intervention there have been various indirect impacts such as air pollution, changes of climate provoked by man, over-population of game, seeds and pollen from neighbouring, artificially originated stands etc. Nevertheless, we can still talk of a virgin forest in a looser sense of the word if it remained untouched by axe for centuries, with the exception of felling of individual trees. Furthermore, there are no noticeable changes in the vegetation cover caused by forest pasture or forest litter removal. We can speak of a virgin forest in the wide sense of the word also when a forest has regained its natural balance after human intervention that occurred centuries ago (Zukrigl 2002).

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In the following article the term virgin forest will be used for our virgin forest remnants in the above mentioned sense.

The Pečka virgin forest is one of the remnants of mighty virgin forests in the region of Kočevsko, which were preserved until the end of the 19th century. As they were accessible only with difficulty, they were not managed in any way, with the exception of occasional charcoal burning.

First steps to commence a regulated forest management of the forest riches of the Rog region according to the principles of the then progressive forest management were taken by the principal of the princely forest office Leopold Hufnagl between the years of 1891 and 1893. At that time, 305.63 ha of virgin forest reservations composed of individual smaller sections were excluded from forest management. These virgin forest reservations were preserved almost entirely until the end of the second world war. As there were occasional fellings after the war, today only rather derogated parts have been preserved (Turk et al. 1985). From the originally separated surface of the Pečka virgin forest, which measured 113 ha, there is only about 60 ha left. The last considerable human interventions are noticeable mostly in the western and northern edge of the virgin forest. A certain negative impact on the virgin forest was caused by the battles between partisans and occupiers during the second world war, whose traces are still visible today on the highest peak of Pečka. There were felling interferences in the virgin forest also after the second world war.

Despite human interventions in the past, the forest preserved its virgin forest features, as well as the structure with all its characteristic life stages, in section 37.

Due to the relatively good state of preservation of the virgin forest, numerous studies have been conducted there (Anko 1965, Mlinšek 1967a, Mlinšek 1967b, Mlinšek et al. 1980, Turk, Kastelic & Hartman 1985, Debeljak 1997, 1999, Roženbergar 1999 and others), all with the intention to establish the developmental characteristics of the virgin forest stands and apply the results of the studies in close to nature silviculture. So far, there have been hardly any thorough investigations in the virgin forest. The only exception is a detailed report with a phytosociological map of Čampa (1971), in which, however, ecological conditions of forest communities are only cursorily described.

It is almost surprising that our virgin forests, with the exception of the Rajhenau virgin forest (Puncer, Wojterski & Zupančič 1974) and Ravna gora (Marinček & Marinšek 2003), have not been thoroughly phytosociologically and pedologically studied and that the results of the studies were not published accordingly. In part, the virgin forests of Šumik (Marinček 1995a), Krokar (Accetto 2002), Krakovski pragozd (Accetto 1973, 1974, 1975, 1995) and Donačka gora (Marinček et al. 2000) were phytosociologically studied and mapped. Unfortunately, however, biocoenological research of our virgin forests (Hočevar et al. 1985), which was very promising in the 1980s, was never finalised.

The purpose of this study is to supplement the now deficient ecological and vegetational image of the Pečka virgin forest and, based on floristic and vegetation research related to pedological studies and the making of a phytosociological map on a large scale, pave the way for further, detailed multilayered research.

Biocoenological research is highly important in this regard. A comparison of biocoenoses of habitats of virgin forests and biocoenoses of related habitats of managed forests would provide an opportunity to establish the level of preservation or alteration of a certain managed forest.

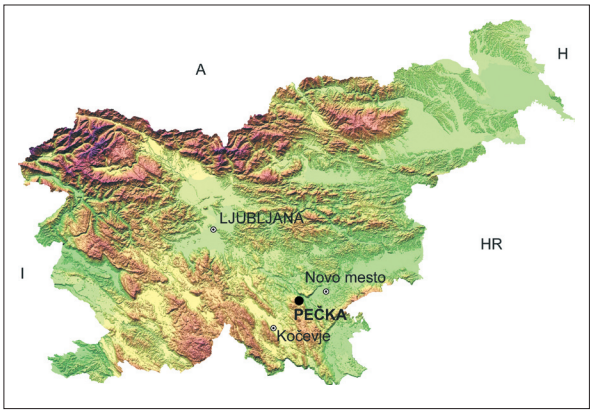

Figure 1: Location of the Pečka virgin forest in the territory of Slovenia
Slika 1: Lokacija pragozda Pečka v Sloveniji

The Pečka virgin forest has been protected as a virgin forest remnant since 1953 (Hočevar et al. 1985). It is situated on the northernmost rim of the Kočevski Rog, above the Krka valley, at an altitude of 795 to 910 metres above sea level. The highest peak is Pečka (911 m), which is situated in about the middle of the virgin forest. Eastward, as well as westward, it sweeps steeply into an extensive sinkhole. An explicit karst relief prevails throughout, in certain parts with extremely emphasised sur-

face stoniness. According to M. Wraber (1969) the virgin forest lies in the Dinaric phytogeographical region of Slovenia.

2. METHODS

The vegetation of the Pečka virgin forest was catalogued applying the standard Central-European Zürich-Montpellier method (Braun-Blanquet 1964, Westhoff & van der Maarel 1973). We catalogued during the entire vegetation period from the end of April to October, above all in the month of June when most of the vegetation in the lower part of the mountain belt is optimally developed.

The nomenclature of plant species follows Trpin & Vreš (1995), Martinčič et al. (1999), and syntaxonomy Marinček et al. (1993). Nomenclature sources for mosses are Frey et al. (1995) and Martinčič (2003).

Syntaxonomy is an important element in naming and classifying syntaxa into a hierarchical system, similarly as in taxonomy. However, there is a certain degree of subjectivity present in taxonomy within the field of plant communities, namely on account of elimination of more or less homogenous ecological complexes or habitats based on plant species. When applying the principle of multidimensional division of vegetation units (W. Matuszkiewicz & A. Matuszkiewicz 1981) this subjectivity and excessive eagerness to find something new, which sometimes leads to naming a syntaxon only on the basis of a single phytosociological relevé – although it is allowed by Code – results in extremely complicated technical terms of syntaxa. The consequence of such a manner of denomination is a diversion from using the results of phytosociological studies in practice.

Vegetation and ecological studies of virgin forests are doubtlessly very important and applicable for further research, so it is required to keep the traditional and already established syntaxon terminology to as high a degree as possible. Therefore we avoided using the principle of multidimensional division of vegetation units in classification of vegetation in the Pečka virgin forest into a hierarchical system, and to the highest degree considered the works of our acknowledged researchers of vegetation in Dinaric fir-beech forests, such as Tregubov (1957), Puncer (1980), Kordiš (1993) and sometimes also Surina (2002).

The authors of this study regret the failure of applying a three-name term for the syntaxa of geographical variants, such as *Calamintho grandiflorae-Omphalodo-Fagetum*. Above indicated problems regarding the terminology of syntaxa could only be solved with considerable revisions and supplements of the existing Code.

When cataloguing the vegetation we assessed coverage as well as sociability. On computer processing of the relevés we considered only the cover values.

On processing and analysis of phytosociological relevés we used also the ordination method of principle coordinates (PCoA) from the SYN-TAX 2000 (Podani 2001) computer package.

A phytosociological map of the syntaxa of the Pečka virgin forest (Figure 5) in the scale of 1 : 3.500 was made according to the principles of vegetation mapping (Puncer 1984).

Representative soil profiles were the basis for studying the soil conditions. The description of soil profiles was made by senior lecturer M.Sc. Tomaž Prus from the Centre for Soil and Environmental Science (Center za pedologijo in varstvo okolja CPVO) at the Biotechnical Faculty of Ljubljana – Agronomy Department (Prus 2003).

3. RESULTS

3.1 General ecological conditions

The region of Pečka is a part of the Dinaric high karst on the border of Dinaric and pre-Dinaric phytogeographical regions. The bedrock is composed of chemically easily soluble cretaceous limestone, on which there is diversified karst relief with sinkholes and in places also with very stony crests and stony slopes which sweep down in terraces into the bottom of sinkholes.

Due to the extremely diversified relief the prevailing Chromic Cambisols intertwine mosaically with rendzic Leptosols, chromic Luvisols of different depths and Chromic Cambisols partly colluvial.

On account of the borderline position of the Pečka virgin forest, the climate with abundant rainfall and distinctive rainfall peak in autumn, characteristic for the Dinaric region, is modified in terms of a more continental character, which is verified by the information provided by the meteorological station Kočevje (25-year-long period): mean annual temperature is 8.3 °C, absolute maximum 35.5 °C, absolute minimum –34.4 °C, extreme minimum in vegetation period: in May –6.9 °C, in June –0.6 °C, in July 3.7 °C, in August 2.1 °C and in Sep-

tember –2.9 °C (observation period between 1951 and 1960), continentality index is 21.5 (Puncer 1980).

Interesting is the comparison of the meteorological data for the period between 1961 and 1990 (Mekinda-Majaron 1995). Average temperature for this period is 8.4 °C. Considering only the period between 1980 and 1990, however, average yearly temperature is 8.6 °C, which proves that there has been a gradual warming of the atmosphere in the last few decades. Interestingly, also the rainfall in the 30-year-period between 1961 and 1990 increased to 1526 mm, which means on average by about 10 % (Zupančič 1995).

We can therefore conclude that the forest line partly extenuates the indicated climatic features (temperature extremes), although a certain climatic lability and unevenness is characteristic also for the Pečka virgin forest.

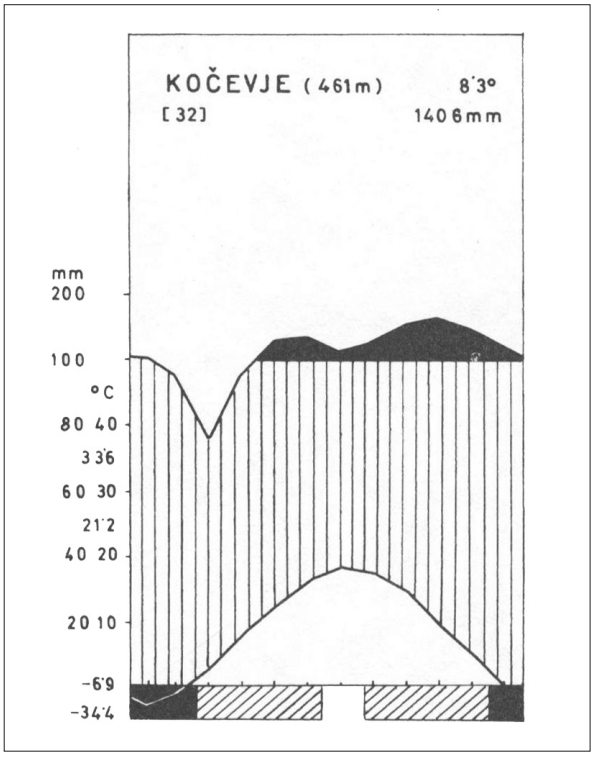

Figure 2: Climatic diagram of Kočevje (Puncer 1980)
Slika 2: Klimadiagram Kočevja (Puncer 1980)

Based on a comparison of temperature conditions and distribution area of Dinaric fir-beech forests Puncer (1980) established that within their distribution area mean annual temperatures oscillate between 6 and 8 °C, and between 10 and 14 °C during the vegetation period (Figure 2). Considering its position, the Pečka virgin forest has higher border values. More or less expected, very heterogeneous microclimatic values, for soil as well as for air, were proven by Puncer (1980) with his climatic measurements on small distances. His findings can doubtlessly be applied to the Pečka virgin forest as well.

3.2 FLORISTIC COMPOSITION

In the Pečka virgin forest those Central-European plant species prevail which can in terms of phytosociology and ecology be classified into the order *Fagetalia sylvaticae*: *Fagus sylvatica, Galium odoratum, Sanicula europaea, Festuca altissima, Carex sylvatica, Mercurialis perennis, Daphne mezereum, Euphorbia amygdaloides, Dryopteris filix-mas, Galeodbdolon flavidum, Geranium robertianum, Hordelymus europaeus, Paris quadrifolia, Polygonatum multiflorum, Polystichum aculeatum, Prenanthes purpurea, Senecio ovatus, Salvia glutinosa, Sambucus nigra, Viola reichenbachiana, Euonymus latifolia, Acer pseudoplatanus, Mycelis muralis, Brachypodium sylvaticum, Lonicera alpigena, Ulmus glabra, Arum maculatum, Dentaria bulbifera, Galeobdolon montanum, Petasites albus, Stellaria montana* as well as some others.

The so called Illyrian species, which optimally thrive in the western, and partly also in the central part of the Dinaric and pre-Dinaric phytogeographical region (M. Wraber1969, Marinček 1995), are syntaxonomically, and for their distribution area diagnostically, important for relatively extensive fir-beech forests of the western part of the Dinaric mountains. Those are the differential species of beech forests of the Illyrian floral province – *Aremonio-Fagion*: *Omphalodes verna, Aremonia agrimonoides, Dentaria enneaphyllos, Lamium orvala, Cardamine trifolia, Calamintha grandiflora, Daphne laureola, Cyclamen purpurascens, Scopolia carniolica*, more rarely also *Hacquetia epipactis, Dentaria trifolia* and *Isopyrum thalictroides*.

Also interesting is the group of explicitly mesophilous species, differential species of the suballiance of forests of noble deciduous trees of the Illyrian floral province *Polysticho setiferi-Acerenion pseudoplatani*, which thrive on moist stony slopes of larger sinkholes: *Phyllitis scolopendrium, Urtica dioica, Chrysosplenium alternifolium, Doronicum austriacum, Polystichum braunii, Circaea lutetiana, Adoxa moschatellina, Lunaria rediviva*.

Explicitly acidophilous species, differential species of the order *Vaccinio-Piceetalia* s. lat., with the

exception of the taxa *Dryopteris expansa* and *D. carthusiana,* were not found in the virgin forest. There are more species with a slightly acidophilous character, such as *Galium rotundifolium, Majanthemum bifolium, Oxalis acetosella, Valeriana tripteris.* However, a higher coverage is achieved only by the taxon *Oxalis acetosella.*

Most common among other taxa are the following: *Anemone nemorosa, Athyrium filix-femina,* and *Veratrum album.*

Mosses occur on sites with higher surface stoniness. The following species have the highest presence: *Ctenidium molluscum, Isothecium alopecuroides, Neckera crispa, Plagiomnium undulatum, Fissidens taxifolius* and *Plagiochila asplenioides.*

3.3 Syntaxa in the virgin forest remnant of Pečka

Forests in the virgin forest remnant of Pečka are part of the Dinaric fir-beech forests which are in terms of syntaxonomy classified into the association *Omphalodo-Fagetum* (Tregubov 1957) Marinček et al. 1993 (= *Abieti-Fagetum dinaricum* Tregubov 1957).

3.3.1 *Omphalodo-Fagetum* (Tregubov 1957) Marinček et al. 1993

Fir-beech forests of the Dinaric region were thoroughly researched mostly by Tregubov (1957) and Puncer (1980). Here is a short summary of their findings.

The association *Omphalodo-Fagetum* is a zonal community of the Dinaric phytogeographical region, which grows on altitudes of about 700 (400) to 1400 metres a.s.l., where fresh humid climate with abundant rainfall (from approximately 1400 to 2000 mm and more) and high air humidity (on average over 80 %) prevails. Humidity of the climate decreases towards the northern and eastern edge of the distribution area of the association as a result of increasing continental influence. On account of higher temperature oscillations and smaller quantities of rainfall the lability of climatic conditions increases, although not to such a degree that would endanger the growth of fir. Nevertheless, its vitality is weakened and fir often succumbs to secondary pests or reacts rapidly to (for silver fir) negative climatic changes related to the environment pollution.

Geological bedrock consists of limestones from different geological periods. Most of the limestones are Triassic and cretaceous, chemically easily soluble limestones where extremely diversified relief prevails with all its karstic features which to a large extent helps forming mesoclimatic and microclimatic conditions, favourable for the growth of fir-beech forests. Dolomites are subordinate to limestones.

In accordance with extremely diversified relief the soil is most often mosaically developed. On small surfaces Chromic Cambisols, which are the prevailing soil formation in fir-beech forests, intertwine with rendzic Leptosols of various developmental stages and in places also with chromic Luvisol.

Regarding their ecological features plant species of the association *Omphalodo-Fagetum* are of a mesophilous to subhygrophilous nature, basophilous to neutrobasophilous character. Most, over 40 %, belong to the order *Fagetalia sylvaticae*, and 10 % of these to the alliance of Illyrian beech forests *Aremonio-Fagion.* Slightly thermophilous species of the class *Querco-Fagetea* are not adapted to the mountain climate, so there are only 13 %, and even these only on account of extrazonal fir-beech forests which in special mesoclimatic conditions sweep deep down into the belt of submontane beech forests. Very interesting is the group of the class *Vaccinio-Piceetalia* s. lat., which reaches 18 % of the entire plant inventory. According to Puncer (1980), a relatively high presence of these acidophilous species is important for floristic differentiation of Dinaric fir-beech forests from less to more pure zonal beech forests – *Hacquetio-Fagetum* s. lat. and *Lamio orvalae-Fagetum* s. lat., which border the association *Omphalodo-Fagetum.* Partly differential in relation to the borderline zonal beech forests is the group of mosses and lichens with 11 %.

The tree layer of Dinaric fir-beech forests is composed of beech (*Fagus sylavtica*) and silver fir (*Abies alba*). In natural development conditions fir and beech are equal partners and in certain development stages and special ecological conditions fir even prevails. In general, however, beech in economic, especially in intensely managed forests, decisively dominates over fir. Sycamore (*Acer pseudoplatanus*) and wych elm (*Ulmus glabra*) are regularly present, but only as individuals in the mixture. Within the distribution area of Dinaric fir-beech forests the above mentioned noble deciduous trees more often occur mostly in forests of noble deciduous trees of the association *Omphalodo-Aceretum*

pseudoplatani P. Košir et Marinček 1999, which grows in the form of islands within the distribution area of fir-beech forests. Norway maple (*Acer platanoides*) is even rarer. Norway spruce (*Picea abies*), which occurs spontaneously only in specific ecological conditions on more acidic sites in Dinaric fir-beech forests, holds a special position within the association *Omphalodo-Fagetum*. In general, its higher frequency is influenced by human impact and game.

The shrub layer is more poorly developed and usually covers 10 to 30 % of the surface. It is composed mostly of moderately mesophilous species of the order *Fagetalia sylvaticae*, and more rarely of the class *Querco-Fagetea*.

The herb layer is best developed in late spring months when *Dentaria* sp. occur abundantly. It persists, however, until autumn and covers 40 to 60 % of the surface. There is a decisive predominance of the species of beech forests (*Fagetalia sylvaticae*). The group of acidophilous species of the class *Vaccinio-Piceetalia* is important, but only exceptionally reaches higher coverage.

Mosses cover 10 to 90 % of the surface, depending on surface stoniness. Mosses of basophilous neutrophilous nature prevail.

As character-species of the syntaxon *Omphalodo-Fagetum* Puncer (1980) mentions the following taxa: *Abies alba, Omphalodes verna, Aremonia agrimonoides, Cardamine trifolia, Rhamnus fallax*, and *Calamintha grandiflora*. The combination of character species indicates the explicitly Illyrian character of the community.

In the territory of the Pečka virgin forest we determined and mapped the following syntaxa:

Querco-Fagetea Br.-Bl. et Vlieger in Vlieger 1937
Fagetalia sylvaticae Pawlovski in Pawlovski et al. 1982
Aremonio-Fagion (I. Horvat 1938) Borhidi in Torok et al. 1989
Lamio orvalae-Fagenion Borhidi ex Marinček et al. 1993
Omphalodo-Fagetum (Tregubov 1957) Marinček et al. 1993 var. geogr. *Calamintha grandiflora* Surina 2002
– *typicum* (M. Wraber 1955) Puncer 1980
– *galietosum odorati* (Tregubov 1957) Puncer 1980
– *festucetosum altissimae* Puncer, Wojterski, Zupančič 1974
– *phyllitidetosum* (Puncer, Woyterski, Zupančič 1974) subass. nova
– var. *Corydalis cava* var. nova
– var. *Lamium orvala* var. nova

3.3.1.1 *Omphalodo-Fagetum* (Tregubov 1957) Marinček et al. 1993 var. geogr. *Calamintha grandiflora* Surina 2002 *typicum* (M. Wraber 1955) Puncer 1980

In the territory of the virgin forest the syntaxon – *typicum* does not occupy larger surfaces and is therefore presented with only four relevés. It occurs scattered in the southern half of the virgin forest. There are relatively larger surfaces in the vicinity of the highest peak Pečka and in the southernmost part where the relatively steep, very rocky slope sweeps down into the bottom of a big sinkhole. On very small surfaces it often mosaically intertwines with the subassociation *-festucetosum altissimae*, which caused many a problem when mapping the terrain. Slightly inclined slopes prevail with occasionally large surface stoniness, which can reach up to 60 %.

The bedrock consists of rudistic limestone. Within a small area a mosaic of rendzic Leptosols of different development stages and chromic Cambisols occurs.

Most stands of the syntaxon *-typicum* are presently in the younger optimum stage, in the period of strong predominance of beech, which almost entirely prevails in the dominant layer; fir is only individually admixed. In the lower layer, however, fir prevails over beech.

Other tree species are rarely admixed. Sycamore was recorded only in the shrub layer and Norway spruce only in the lower layer.

The shrub layer is badly developed and covers between 5 and 10 % of the surface; beech offspring prevails. Fir is rare. Most common among shrubs are: *Daphne mezereum, D. laureola* and S*ambucus nigra*.

On account of a large proportion of surface stoniness the herb layer reaches only about a 40 per cent coverage.

Character-species of the association are well represented, with the exception of *Calamintha grandiflora*. The species of the alliance *Aremonio-Fagion* are also constantly present. In general, the species of the order *Fagetalia sylvaticae* prevail: *Festuca altissima, Galium odoratum, Sanicula europaea, Mercurialis perennis, Galeobdolon flavidum, Polystichum aculeatum, Dryopteris filix-mas, Viola reichenbachiana, Euphorbia amygdaloides, Paris quadrifolia, Hordelymus europaeus, Senecio ovatus, Mycelis muralis* and others.

Most common among other species are: *Oxalis acetosella, Moehringia muscosa* and others.

The moss layer is well developed. The following taxa prevail: *Ctenidium molluscum, Neckera crispa, Dicranum scoparium, Isothecium alopecuroides, Hypnum cupressiforme, Plagiochila asplenioides.* Other moss species are only accidental.

3.3.1.2 *Omphalodo-Fagetum* (Tregubov 1957) Marinček et.al. 1993 var. geogr. *Calamintha grandiflora* Surina 2002 *galietosum odorati* (Tregubov 1957) Puncer 1980

Syntaxon *-galietosum odorati* is the predominant vegetation form in the Pečka virgin forest. Its basic ecological features, especially those regarding the relief, are almost identical to Puncer's (1980) findings: stands of subassociation *-galietosum odorati* grow on plateaus between sinkholes, in wide, shallow valleys, slight depressions and sinkholes, as well as on slightly inclined slopes. The inclinations are within 0 – 10°, only exceptionally a little more. The mostly levelled or slightly diversified surface is only occasionally interrupted by individual limestone rocks and stones.

Chromic Cambisols of different depths, which occasionally change into chromic Luvisols prevail on limestones.

Soil profile description with commentary (Prus 2003)[1]

Chromic cambisol, medium deep, with moder mull topsoil. Altitude 870 m, aspect WWS, slope gradient of 5 degrees, almost straight, 5 % surface stoniness, parent material is limestone.

Ol 4–0 cm, mostly beech foliage, beech mast left-over and bud scales

A 0–11 (15) cm, silty clay loam, subangular blocky structure, medium distinct peds, with medium stability in wet conditions. Humus content is very high. Consistence is loose and friable in moist conditions. The colour is 5YR 3/2,5 dark reddish brown. There are no rock fragments, abundant roots (Table 1).

ABrz 11(15) – 40 cm, silty clay loam of fine angular blocky structure, medium distinct peds with strong stability in wet conditions. The humus content is distinctly lower, and distributed in dead roots channels. Consistence is very firm in moist and hard in dry conditions. The colour is 5YR 5/6 yellowish red. There are no rock fragments, abundant roots.

Brz 40–60^{+} cm, clay to silty clay of angular blocky structure, strong durable peds are clearly evident. Humus is not visibly distributed, according to analytical data the content is low (Table 1). Consistence is firm and resistible to crushing in moist conditions. The colour is 5YR4/6 yellowish red. There are 30–40 % rock fragments of 20 cm and more in diameter, a few roots are present. The soil material fills a narrow crack between the rocks.

There are different developmental stages of the virgin forest within the distribution area of the subassociation *-galietosum odorati,* from the younger optimum stage, younger optimum stage with selective structure**,** optimum stage to rejuvenation stage. The common feature of all stands is that fir in the dominant layer dries. Most researchers of the developmental dynamics of the forest (Anko 1965, Mlinšek 1967a, Mlinšek 1967b, Mlinšek et al. 1980, Turk, Kastelic, Hartman 1985, Debeljak 1997, 1999, Roženbergar 1999 and others), believe that the

Table 1: Soil particle size distribution (texture) and chemical properties (Prus 2003)
Tabela 1: Mehanska sestava in kemijske lastnosti tal (Prus 2003)

HORIZON	DEPTH	pH CaCl2	P2O5 AL ---mg/100g---	K2O AL ---mg/100g---	org. matter %	C %	CN ratio	N %	sand %	silt %	clay %	text. class
A	0-11 cm	4.4	6.1	20.7	26.6	15.4	18.6	0.83	19.3	50.6	30.1	silty clay loam
AB	11-40 cm	4.2	<2.0	5.9	3.0	1.7	14.2	0.12	8.4	53.0	38.6	silty clay loam
Brz	40-60 cm	6.4	<2.0	<2.0	2.3	1.3	10.8	0.12	5.0	38.4	56.6	clay to silty clay

HORIZON	DEPTH	Ca	Mg	K	Na	H	S	T	V	Ca	Mg	K	Na	H
		---------- mmol C+ / 100g ----------							%	%	%	%	%	%
A	0-11 cm	18.56	1.75	0.54	0.09	33.10	20.9	54.0	38.7	34.4	3.2	1.0	0.2	61.3
AB	11-40 cm	4.84	0.34	0.12	0.06	16.90	5.4	22.3	24.2	21.7	1.5	0.5	0.3	75.8
Brz	40-60 cm	19.91	0.25	0.26	0.09	8.55	20.5	29.1	70.4	68.4	0.9	0.9	0.3	29.4

[1] Soil units according to WRB 98, description of profile according to the national coding system

drying of silver fir is a logical consequence of the alternation of beech and silver fir. Nevertheless, there is still a possibility that fir decays so quickly because of the borderline position of the virgin forest on the northern line of the distribution area of Dinaric fir-beech forests, which means that its a priori weakened vitality is susceptible to climatic changes conditioned by warming and increased air pollution. Certain studies in this direction would be more than welcome. Silver fir occurs mostly in the lower layer; it is rare in the shrub layer. Offspring is also scarce, so that beech almost entirely dominates all the layers of the stands. The upper tree layer reaches 70 to 100 % coverage and the lower layer 20 to 40 %. Other tree species are rare. Spruce was recorded only once in the upper layer and sycamore only in the shrub layer. Similarly to most virgin forests of extreme dimensions, trees reach a diameter at breast height of over one metre and a height of over 35 m.

Average coverage of the shrub layer, which is formed mostly by beech young growth, is 20 to 30 % and reaches even up to 60 % in certain places. Most common among shrubs are *Daphne laureola, D. mezereum, Rubus* sp. The species *Sambucus nigra, Lonicera alpigena, Hedera helix, Rosa arvensis, Clematis vitalba, Sorbus aucuparia, Rosa pendulina* occur only individually.

On average, herbs cover about 90 % of the surface. Character species of the association are very well represented. Among them *Omphalodes verna* stands out and gives the community its characteristic aspect in spring when it blossoms.

Differential species of the subassociation *-galietosum odorati* according to Puncer (1980) – *Galium odoratum, Sanicula europaea* and *Carex sylvatica* are well represented, especially the first two.

The great presence and in places abundant coverage of differential species of the alliance of Illyrian beech forests *Aremonio-Fagion*: *Omphalodes verna, Cardamine trifolia, Aremonia agrimonoides, Daphne laureola, Cyclamen purpurascens, Dentaria enneaphyllos,* give the syntaxon an explicit Dinaric-Illyrian characteristic. Other species of the alliance *Aremonio-Fagion*: *Dentaria trifolia, Isopyrum thalictroides, Hacquetia epipactis*, have the status of accidental species.

Favourable ecological conditions of the syntaxon are indicated by a large number of species of the order *Fagetalia sylvaticae*. Among them, the following have the highest presence and coverage: *Daphne mezereum, Viola reichenbachiana, Mycelis muralis, Dentaria bulbifera, Arum maculatum, Dryopteris filix-mas, Brachypodium sylvaticum, Galeobdolon flavidum, Paris quadrifolia* as well as some other species. Other syntaxonomical groups are subordinate to the species of the alliance *Aremonio-Fagion* and order *Fagetalia sylvaticae*.

The species of the class *Querco-Fagetea*, with the exception of the species *Anemone nemorosa*, occur only randomly. Just as rare are the species of the order *Vaccinio-Piceetalia* s. lat., with the exception of the taxon *Oxalis acetosella*. Among other herbs, only *Moehringia muscosa* has a higher presence.

The moss layer is poor. Only two mosses are worth mentioning here: *Ctenidium molluscum* and *Isopyrum alopecuroides*.

3.3.1.3 *Omphalodo-Fagetum* (Tregubov 1957) Marinček et al. 1993 var. geogr. *Calamintha grandiflora* Surina 2002 *festucetosum altissimae* (M. Wraber 1955) Puncer, Wojterski, Zupančič 1974

Stands of syntaxon *-festucetosum altissimae* cover smaller surfaces in the Pečka virgin forest, mostly on the edge of its distribution area. It grows on flat crests as well as on slightly inclined and very stony plateaus. Stones can cover even up to 80 % of the ground surface. Extremely diversified microrelief conditions the intertwining of different soil types on a small surface: from moder to moder mull, to Chromic Cambisols of different depths.

Soil profile description with commentary (Prus 2003)

Chromic Cambisol, shallow to medium deep with moder mull top soil. Altitude 860 m, aspect SE, slope gradient of 15 degrees, gently undulated, 60 % surface stoniness, parent material is limestone.

Ol 2–0 cm, mostly beech foliage, mast remnants and twigs.

A 0–12 cm, silty clay loam of fine subangular blocky structure, medium distinct peds with strong stability in wet conditions. Humus content is high. Consistence is loose and friable in moist. The colour is 5YR 3/2 dark reddish brown. Rock fragments are few, up to 5 cm in diameter, abundant roots (Table 2).

ABrz 12–35 cm, silty clay loam to silty clay of fine angular blocky structure, medium distinct peds with strong stability in wet conditions. The humus content is lower and distributed in dead roots

Table 2: Soil particle size distribution (texture) and chemical properties (Prus 2003)
Tabela 2: Mehanska sestava in kemijske lastnosti tal (Prus 2003)

HORIZON	DEPTH	pH CaCl2	P2O5 AL mg/100g	K2O AL mg/100g	org matter %	C %	CN ratio	N %	sand %	silt %	clay %	text. class
A	0-12 cm	5.4	<2.0	14.5	20.6	11.9	18.0	0.66	11.8	55.3	32.9	silty clay loam
ABrz	12-35 cm	5.9	<2.0	7.5	8.0	4.6	15.9	0.29	1.1	58.7	40.2	silty clay loam
Brz	35-53 cm	6.7	<2.0	<2.0	4.9	2.8	13.3	0.21	2.4	45.8	51.8	silty clay

HORIZON	DEPTH	Ca	Mg	K	Na	H	S	T	V	Ca	Mg	K	Na	H
		mmol C+ / 100g							%	%	%	%	%	%
A	0-12 cm	33.93	1.25	0.38	0.11	21.75	35.7	57.5	62.1	59.0	2.2	0.7	0.2	37.8
ABrz	12-35 cm	31.23	0.36	0.17	0.11	14.10	31.9	46.0	69.3	67.9	0.8	0.4	0.2	30.7
Brz	35-53 cm	31.64	0.25	0.24	0.10	8.90	32.2	41.1	78.3	77.0	0.6	0.6	0.2	21.7

channels and cracks. Consistence is firm in moist. The colour is 7,5YR 4/4 brown to dark brown. Rock fragments are few, of 20 cm and more in diameter, abundant roots.

Brz 35–53 cm, silty clay of angular blocky structure, strong durable peds are clearly evident. Humus is not visibly distributed, according to analytical data the content is low (Table 2). Consistence is firm and very stable to crushing in moist but sligthly plastic in wet. The color is 7,5YR 4/4 brown to dark brown. There are 40 % rock fragments of 40 cm and more in diameter, few roots.

A younger optimal stage prevails within the distribution area, in some regions with only indicated selective structure, with a badly developed medium layer**.** On average, the tree layer covers about 90 % of the ground surface.

Similarly to other syntaxa in the virgin forest, the upper layer in the stands of subassociation *-festucetosum altissimae* is also formed by fir, which, however, is decaying rapidly. More or less vital silver fir grows in the lower layer where it prevails over beech. The other two tree species, sycamore and Norway spruce, grow only in the shrub layer, with a very low presence.

The shrub layer is only occasionally better defined (up to 40 %). It consists of silver fir and beech, with beech dominating over silver fir. The most common species among shrubs are *Daphne mezereum* and *D. laureola,* and partly also *Lonicera alpigena.* Others, such as *Sambucus nigra, Rosa pendulina*, *Sorbus aucuparia* occur only individually.

On account of extensive surface stoniness the herb layer is badly developed, so the herbs cover only about 50 % of the soil surface. The only true differential species of the syntaxon is *Festuca altissima*, which gives these habitats their special appearance with its clusterous growth. The differential species *Dicranum scoparium*, which Puncer (1980) additionally classifies into the differential combination of the syntaxon *-festucetosum altissimae*, has a medium presence.

Puncer et al. (1974) and Puncer (1980) mention as the differential species of the syntaxon *festucetosum altissimae* also the taxon *Orthilia secunda*, which, however, was not recorded in the Pečka virgin forest. According to them, this syntaxon is well differentiated also by a group of moderately acidophilous and acidophilous species, such as *Lonicera nigra, Rosa pendulina, Dryopteris dilatata, Homogyne sylvestris, Rhytidiadelphus loreus, R. triquetrus, Goodyera repens, Huperzia selago, Lycopodium annotinum* and others. Two of the above mentioned taxa were found in the Pečka virgin forest: *Rosa pendulina* and *Dryopteris dilata,* but only as accidental species.

Differential species of the alliance *Aremonio-Fagion* are constantly present with a slightly lowered coverage.

Even in this subassociation the basis of the herb layer is composed of the species of the order *Fagetalia sylvaticae*, above all of *Festuca altissima, Galium odoratum, Sanicula europaea, Dentaria bulbifera, Mercurialis perennis, Galeobdolon montanum, G. flavidum, Hordelymus europaeus, Dryopteris filix-mas, Polystichum aculeatum, Mycelis muralis, Brachypodium sylvaticum, Arum maculatum, Viola reichenbachiana* as well as some others. The differential species of other syntaxonomical units are *Querco-Fagetea* and *Vaccinio-Piceetalia*, which have very low presence, with the exception of the taxa *Oxalis acetosella* and partly *Galium rotundifolium.* Among other herbs only the taxon *Moehringia muscosa* has a higher coverage.

The moss layer is well developed, which is consistent with the large surface stoniness.

Neutrophilous-basophilous taxa, such as *Ctenidium molluscum, Isothecium alopecuroides* and *Neckera crispa* have the highest coverage.

3.3.1.4 *Omphalodo-Fagetum* (Tregubov 1957) Marinček et al. 1993 var. geogr. *Calamintha grandiflora* Surina 2002 *phyllitidetosum* (Puncer, Woyterski, Zupančič 1974) subass. nova

Stands of subassociation *-phyllitidetosum* grow on specific sites, on steeper rocks, shady slopes, which sweep down into the bottom of larger sinkholes. The inclinations are 20 to 30°, surface stoniness is 60 to 80 %. On rudistic limestones there is a mosaic of rendzic Leptosols, and Chromic Cambisols, partly colluvial at the bottom of sinkholes.

Within the distribution area of the subassociation we excavated two representative pedological profiles. The results of chemical and mechanical analyses are presented within the variants of the syntaxon.

The stands of subassociation *-phyllitidetosum* grow mostly in the lower part of the virgin forest, to the south-east of the peak of Pečka. Within the distribution area of the syntaxon described the younger optimum phase prevails, in places also the regeneration phase.

Trees cover 70 to 100 % of the surface. Regarding other virgin forest syntaxa which have been described there are no considerable differences between the proportion of quantity of beech and fir. In the tree layer there are only beech and fir. Fir builds the dominating layer and is accompanied by individual beech trees. In the lower layer beech heavily dominates over fir, which only occasionally gets an equal share to that of the beech.

The shrub layer is badly developed, about 10 %. Beech young growth prevails over individual silver fir trees. Sycamore seedlings are very rare. The dominating shrubs are *Daphne mezereum* and *D. laureola.*

Herbs cover about 70 % of the soil surface. In early spring, geophytes blossom in the lower part of the virgin forest, at the bottom of the sinkhole.

The subassociation *-phyllitidetosum* has a large differential group of plant species: *Phyllitis scolopendrium, Scopolia carniolica, Stellaria montana, Urtica dioica, Chrysosplenium alternifolium, Polystichum braunii, Circaea lutetiana, Adoxa moschatellina, Lunaria rediviva.* Most of them are the differential species of the alliance *Polysticho setiferi-Acerenion* (Marinček 1993) Borhidi & Kevey 1996. They indicate specific site conditions, higher humidity of the site and partial colluviality of the soil. The freshness of the sites is indicated also by a higher coverage of the taxa *Dryopteris filix-mas, Sambucus nigra, Polystichum aculeatum, Dentaria bulbifera*, as well as by the presence of mesophilous species: *Petasites albus, Actaea spicata.*

The subassociation *-phyllitidetosum* was named after the taxon *Phyllitis scolopendrium*, which prefers moist, rocky, more or less steep slopes where moist colluvial soil or Chromic Cambisols, which are partly colluvial, prevail. The listed ecological features of the taxon *Phyllitis scolopendrium* clearly indicate the site conditions of the subassociation and together with the rest of the differential combination also the relationship with the syntaxon *Omphalodo-Aceretum.*

The species of the alliance *Aremonio-Fagion* have a lower presence than in other subassociations described in the Pečka virgin forest. This is especially true for the taxon *Omphalodes verna*, while *Calamintha grandiflora* is completely absent.

Species of the order *Fagetalia sylvaticae* prevail in the herb layer, above all *Galium odoratum, Sanicula europaea, Paris quadrifolia, Viola reichenbachiana, Mycelis muralis, Brachypodium sylvaticum* and others.

Among other taxa, the following have higher presence and coverage *Athyrium filix-femina, Anemone nemorosa* and *Oxalis acetosella.*

The moss layer is well developed and reaches a coverage of up to 40 %. The prevailing species are: *Ctenidium molluscum, Plagiomnium undulatum, Isopyrum alopecuroides, Fissidens taxifolus, Neckera crispa,…*

Nomenclature type (*holotype*) of the *Omphalodo Fagetum* var. geogr. *Calamintha grandiflora phyllitidetosum* is the relevé 6 in the Phytosociological Table 5.

Within the subassociation *-phyllitidetosum* two variants were described**.**

***Omphalodo-Fagetum* (Tregubov 1957) Marinček et al. 1993 var. geogr. *Calamintha grandiflora* Surina 2002 – *phyllitidetosum* (Puncer, Woyterski, Zupančič 1974) subass. nova var. *Corydalis cava* var. nova**

The variant with the species *Corydalis cava* is at the bottom of the largest sinkhole in the virgin forest, where snow preserves long into spring.

Nomenclature type (*holotype*) of the *Omphalodo-Fagetum* var. geogr. *Calamintha grandiflora phyllitidetosum* var. *Corydalis cava* is the relevé 6 in the Phytosociological Table 5.

Soil profile description with commentary (Prus 2003)

Chromic Cambisol, shallow with moder mull topsoil. Altitude 800 m, aspect NE, singhole's slope with gradient of 10 degrees, almost straight, 5 % surface stoniness, parent material is limestone.

Ol 2–0 cm, mostly beech foliage, mast remnants and twigs, remnants of fir needles.

A 0–10 cm, silty loam of subangular to angular blocky structure where strong durable peds are clearly evident. Humus content is high. Consistance is firm to friable with a slight resistance to crushing in moist conditions. The colour is 10YR 3/3 dark brown. There are no rock fragments, roots abundance is common. Charcoal fragments are present (Table 3).

Brz 10–33 cm, silty clay loam of angular blocky structure. Peds are clearly evident, structure grade is moderate to strong. The humus content is distinctly lower and distributed in dead roots channels and cracks. Consistence is firm to friable in moist. The colour is 10YR 4/4 dark yellowish brown. There are no rock fragments, roots abundance is common.

CBrz 35–55^{+} cm, silty clay loam of angular blocky structure. Peds are clearly evident, structure grade is moderate to strong. There are no visible signs of humus presence. Consistence is firm to friable in moist. The colour is 10YR 4/4 dark yellowish brown. There are 70 % rock fragments of 40 cm and more in diameter, a few roots are visible. The soil material of this horizon fills narrow crevices between rocks and is identical to upper Brz (except for the humus distribution), so no sample was taken.

On deep Chromic Cambisols, especially in spring when geophytes, differential species of the variant *Corydalis cava, Isopyrum thalictroides, Dentaria trifolia* blossom, the vegetation is abundantly developed.

***Omphalodo-Fagetum* (Tregubov 1957) Marinček et al. 1993 var. geogr. *Calamintha grandiflora* Surina 2002 -*phyllitidetosum* (Puncer, Woyterski, Zupančič 1974) subass. nova var. *Lamium orvala* var. nova**

The variant with the species *Lamium orvala* grows on the shady slope of a large sinkhole in the lower part of the virgin forest. It extends almost from the top of the peak of Pečka and goes almost to the bottom of the sinkhole in a belt about 150 metres wide. The shady slope is rocky, the stones cover 30–50 % of the soil surface and the inclinations range from 15 to 25 %.

Nomenclature type (*holotype*) of the *Omphalodo-Fagetum* var. geogr. *Calamintha grandiflora phyllitidetosum* var. *Lamium orvala* is relevé 3 in the Table 5.

Soil profile description with commentary (Prus 2003)

Rendzic Leptosol with moder top soil transitional to Cromic Cambisols. Altitude 850 m, aspect SSE, slope gradient of 15 degrees, gently undulated, 60 % of surface stoniness, parent material is limestone.

Ol 4–0 cm, mostly beech foliage, scarce fir needles, mast remnants and twigs.

Oh 0–10 cm, accumulation of humus, fine subangular blocky structure, where strong durable peds are clearly evident and stable in wet conditions. Consistence is loose and friable in moist. The colour is 5YR 2,5/2 dark reddish brown. There are very few rock fragments up to 15 cm in diameter and many roots.

A 10–36 cm, silty clay loam of subangular to angular blocky structure with strong durable peds and good stability in wet. Humus content is high. Consistence is firm to friable in moist. The colour is 7,5YR 3/2 dark brown. Rock fragments are many (20 – 30 %), the size is up to 20 cm in diameter. There are many roots.

BrzC 36–50^{+} cm, silty clay loam of fine angular blocky structure of strong durable peds that are clearly evident. Humus content is still high. Consitence is firm and resistible to crushing in moist. The colour is 7,5YR 4/4 dark brown to brown. Abundant rock fragments (40 %) up to 20 cm in diameter, roots abundance is common.

Table 3: Soil particle size distribution (texture) and chemical properties (Prus 2003)
Tabela 3: Mehanska sestava in kemijske lastnosti tal (Prus 2003)

		pH	P2O5 AL	K2O AL	org matter	C	CN ratio	N	sand	silt	clay	text. class
HORIZON	DEPTH	CaCl2	mg/100g		%	%		%	%	%	%	
A	0-10 cm	5.1	6.5	21.9	15.2	8.8	15.7	0.56	12.3	66.2	21.5	silt loam
Brz	10-33 cm	5.0	<2.0	9.6	2.3	1.3	9.3	0.14	4.1	64.4	31.5	silty clay loam

		Ca	Mg	K	Na	H	S	T	V	Ca	Mg	K	Na	H
HORIZON	DEPTH	mmol C+ / 100g							%	%	%	%	%	%
A	0-10 cm	22.75	1.76	0.54	0.07	20.30	25.1	45.4	55.3	50.1	3.9	1.2	0.2	44.7
Brz	10-33 cm	8.81	0.77	0.23	0.04	13.60	9.9	23.5	42.1	37.5	3.3	1.0	0.2	57.9

Table 4: Mechanical structure and chemical properties of soil (Prus 2003)
Tabela 4: Mehanska sestava in kemijske lastnosti tal (Prus 2003)

HORIZON	DEPTH	pH CaCl2	P2O5 AL mg/100g	K2O AL mg/100g	org. matter %	C %	CN ratio	N %	sand %	silt %	clay %	text. class
Oh	0-10 cm	5.2	8.9	21.8	39.0	22.6	21.1	1.07				
A	10-36 cm	5.9	2.2	9.8	15.1	8.7	17.1	0.51	4.3	59.1	36.6	silty clay loam
BrzC	36-50 cm	6.0	<2.0	7.8	8.8	5.1	16.5	0.31	2.0	61.1	36.9	silty clay loam

HORIZON	DEPTH	Ca	Mg	K	Na	H	S	T	V %	Ca %	Mg %	K %	Na %	H %
		mmol C+ / 100g												
Oh	0-10 cm	47.50	3.32	0.54	0.14	29.85	51.5	81.4	63.3	58.4	4.1	0.7	0.2	36.7
A	10-36 cm	34.48	0.82	0.23	0.11	17.50	35.6	53.1	67.0	64.9	1.5	0.4	0.2	33.0
BrzC	36-50 cm	34.43	0.50	0.19	0.10	14.65	35.2	49.9	70.5	69.0	1.0	0.4	0.2	29.4

Only *Scopolia carniolica* and *Phyllitis scolopendrium* are present from the differential combination of the subassociation *-phyllitidetosum*. Regarding its floristic composition it is very similar to the subassociation *-galietosum odorati* and has a transitional character between the subassociations.

The only true differential species of the variant is *Lamium orvala*, which gives the herb layer its specific appearance. Partially differential is also the species *Polystichum aculeatum*.

4. DISCUSSION AND CONCLUSIONS

The Pečka virgin forest lies entirely within the domain of Dinaric fir-beech forests, which are in terms of syntaxonomy classified into the association *Omphalodo-Fagetum*.

Phytosociological studies have proven that the stands of three previously described (Tregubov 1957, Puncer 1980) subassociations of the mentioned syntaxon: *-typicum*, *-festucetosum altissimae* and *-galietosum odorati* grow within the region of the virgin forest. The subassociation *-phyllitidetosum scolopendrii* and its two variants var. *Corydalis cava* and var. *Lamium orvala* are newly described.

Figure 3 indicates synecological relationships among the syntaxa in the Pečka virgin forest: a very similar ecology between the subassociations *-typicum* and *-festucetosum,* a specific position of the subassociation *-galietosum odorati* on account of well developed soil, as well as a wide ecological amplitude of the subassociation *-phyllitidetosum*. Furthermore, Figure 3 clearly indicates that var. *Corydalis cava* has a special position within the subassociation *-phyllitidetosum*, and also shows a certain similarity of var. *Lamium orvala* with the subassociation *-galietosum odorati*.

The floristic composition of the syntaxon *Omphalodo-Fagetum* var. geogr. *Calamintha grandiflora*

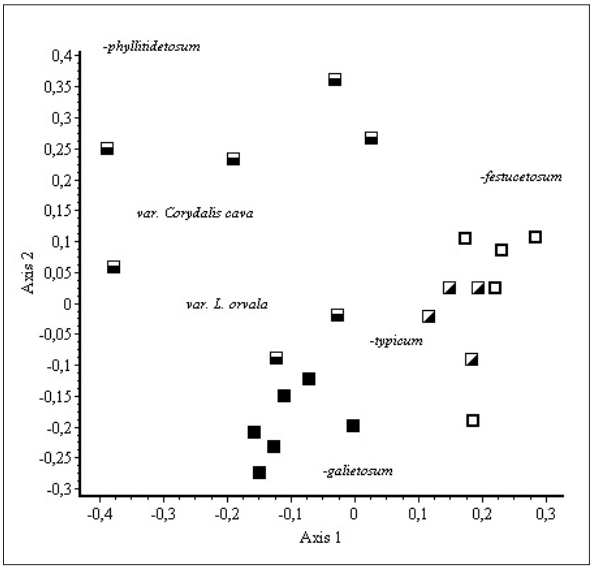

Figure 3: Ordination diagram of relevés of analytic table (Table 5). ⬓ – *phyllitidetosum*, □ – *festucetosum*, ◪ – *typicum*, ■ – *galietosum*.
Slika 3: Ordinacija popisov analitske tabele (tabela 5)

in the Pečka virgin forest (Table 5) is very similar to the vegetation composition of previously described syntaxa in the Rajhenau virgin forest (Puncer, Wojterski, Zupančič 1974) as well as in managed forests (Puncer 1980). Provided, of course, that we take into consideration the findings of vegetational and floristic investigations (Trinajstič 1972, Marinček, Puncer & Zupančič 1980, Marinček 1995a, Bončina 2000, Marinček & Marinšek 2003) which proved that there is a higher number of syntaxa in managed forests.

This study will avoid floristic comparison between the same taxa in the Pečka virgin forest and managed forests. Above all, we shall concentrate on the vegetational and floristic – in part also ecological – comparison between the virgin forests of

Pečka and Rajhenau. Apart from that we shall determine the newly described subassociation *-phyllitidetosum scolopendrii.*

Comparison of floristic composition and vegetation structure showed a high similarity between the two virgin forests. There are, however, still certain differences conditioned by the different situation of virgin forests within Kočevski Rog and with rather different relief conditions.

Figure 4: Detail of terminal phase from the Pečka virgin forest remnant (Photo by A. Marinšek)
Slika 4: Terminalna faza v pragozdnem ostanku Pečka (foto A. Marinšek)

What is above all surprising is the almost complete absence of the taxon *Rhamnus fallax* in the Pečka virgin forest and its abundant presence in the Rajhenau virgin forest. Furthermore, in Rajhenau, where the optimal stage prevails, there is a higher presence of fir in all of the layers of the forest. A smaller presence of fir in the Pečka virgin forest, conditioned by its general decay – which, according to most researchers of the virgin forest, is the consequence of alternation of beech and fir (Anko 1965, Mlinšek 1967a, Turk et al. 1985, Debeljak 1997, 1999, Roženbergar 1999 and others) – is likely to be the result of the borderline position of the virgin forest on the border of the Dinaric and pre-Dinaric regions as well as of a general warming of the climate in the past few decades.

It can be established that the Pečka virgin forest has a rather beech forest like composition, while in the Rajhenau virgin forest some explicitly acidophilous taxa stand out: *Goodyera repens, Rhytidiadelphus loreus, R. triquetrus, Hylocomium splendens, Lonicera nigra, Lycopodium annotinum*, partly also *Thuidium tamariscinum*, which are completely absent from the Pečka virgin forest. According to Puncer (1980), this acidophilous group well differentiates Dinaric fir-beech forests from its borderline beech forests (above all from the association *Lamio orvalae-Fagetum*).

Colder mesoclimatic and microclimatic conditions which dominate in the Rajhenau virgin forest are the consequence of slightly higher altitudes (from 850 to 960m) than are those in the Pečka virgin forest (between 795 and 910 m), as well as of a very diversified relief which allows the formation of a cold microclimate and related growth of acidophilous species.

The subassociation *Omphalodo-Fagetum* var. geogr. *Calamintha grandiflora phyllitidetosum* is very similar to the subassociation *Abieti-Fagetum dinaricum aceretosum* Puncer, Wojterski, Zupančič 1974. The computer comparison was hindered, as there is only a synoptic table for the syntaxon described in the Rajhenau virgin forest, so we were forced to compare the newly described subassociation also with the subassociation described in managed forests. Comparison with phytosociological relevés which were made in managed forests was further hindered by the ignorance of the then unknown community *Omphalodo-Aceretum* P. Košir et Marinček 1999 in that time. The stands of this syntaxon grow in lower parts of shady steeper slopes of sinkholes and at the bottom of sinkholes as a sort of a lens in the distribution area of the Dinaric fir-beech forest. Therefore both communities – *Omphalodo-Fagetum* and *Omphalodo-Aceretum* are included in the relevés of the subassociation *-aceretosum* Puncer (1980). This is partly evident from the rearranged table of the subassociation *–aceretosum* (Puncer 1980, tab. No. 4). The right part of the table from relevé No. 8 to relevé No. 15, where *Acer pseudoplatanus* prevails, and is in all of the layers accompanied by the differential species of the alliance *Polysticho setiferi-Acerenion*: *Phyllitis scolopendrium, Chrysosplenium alternifolium, Circaea lutetiana, Myosotis sylvatica, Impatiens noli-tangere, Adoxa moschatellina, Lunaria rediviva* as well as *Polystichum braunii,* is very similar to the relevés within the distribution area of the association *Omphalodo-Aceretum.* It should

be added that the relevés from managed forests were made above all in the summer, so it is very likely that some of the geophytes were not detected or were found in a much smaller coverage.

Despite these deficiencies we decided to rename the subassociation *-aceretosum pseudoplatani* with the syntaxon *-phyllitidetosum.*

Character species of the association *Omphalodo-Fagetum* are well represented in the subassociation *-aceretosum* in the Rajhenau virgin forest. However, two character species: *Calamintha grandiflora* and *Rhamnus fallax,* which are very important, are completely absent in the Pečka virgin forest.

Furthermore, in the Rajhenau virgin forest there are the above mentioned acidophilous species present even in this, very mesophilous syntaxon. There is a big difference in the presence or absence of noble deciduous trees. *Acer pseudoplatanus,* which gave the name for the subassociation, occurs very rarely in virgin forest form, as does the species *Ulmus glabra.* On account of mesoheliophilous nature of noble deciduous trees, above all of sycamore maple (*Acer pseudoplatanus)* and lime tree (*Tilia platyphyllos*), these two species occur much more frequently in managed forests, which due to frequent interventions have much more heliophilous conditions, than in the virgin forest. Sycamore maple is therefore frequently, and in places abundantly, present in managed forests. Comparison between variously managed forests of the subassociation *-aceretosum* showed that the presence and coverage of sycamore maple depends on the manner of forest management to such a degree that the name *-aceretosum* for these, very specific sites, whose floristic composition includes many taxa of the suballiance *Polysticho setiferi-Acerenion* – is very problematic. The name originated in the 1950s. At that time, transitional syntaxa were often named after tree species, e.g. *carpinetosum, fagetosum, piceetosum, pinetosum* (M. Wraber 1960), which was due to insufficient research. With the advance of phytosociological research these names were gradually forsaken. The only one left is the subassociation *-aceretosum*, whose name won recognition in practice.

Taking into consideration the inappropriate naming of subassociations after tree species whose proportion of quantity depends heavily on human impact, and the results of the investigations in the recent time (P. Košir & Marinček 1999), we decided to rename the subassociation *Omphalodo-Fagetum* var. geogr. *Calamintha grandiflora aceretosum* into the subassociation *Omphalodo-Fagetum* var. geogr. *Calamintha grandiflora phyllitidetosum.*

5. POVZETEK

Vegetacija pragozdnega ostanka Pečka

Na Rogu v jugovzhodni Sloveniji smo fitocenološko in pedološko preučili pragozdni ostanek Pečka ter ga skartirali v merilu 1 : 3.500. Nahaja se na skrajnem severnem obrobju Kočevskega Roga, nad dolino reke Krke na meji dinarskega in preddinarskega fitogeografskega območja ilirske florne province. Pragozd je eden od ostankov mogočnih pragozdov na Kočevskem, ki so se ohranili vse do zadnjega desetletja 19. stoletja. Pragozd je velik 60,2 ha in leži v nadmorski višini od 795 do 910 metrov. Geološka matična podlaga so kemično lahko topljivi rudistni kredni apnenci, na katerih je zelo razgiban kraški relief z vrtačami in kamnitimi grebenčki in pobočji, ki se terasasto spuščajo v dno vrtač.

Skladno z izredno razgibanim reliefom se mozaično prepletajo rjava pokarbonarna tla, ki prevladujejo, z rjavimi rendzinami, izpranimi pokarbonatnimi tlemi različnih globin in pokarbonatnimi, delno koluvijalnimi tlemi. Podnebje z obilnimi padavinami in izrazitim padavinskim viškom v jeseni, ki je značilno za dinarsko območje, je zaradi robnega položaja pragozda Pečka na meji med dinarskim in preddinarskim območjem modificirano v smislu večje kontinentalnosti, kar ima za posledico nekoliko manj padavin in večja temperaturna nihanja.

Vegetacijo pragozda smo popisali po standardni srednjeevropski züriško-montpelierski metodi (Braun-Blanquet 1964, Westhoff & van der Maarel 1973). Podlaga za preučitev talnih razmer so bili reprezentančni talni profili.

Prevladujejo vrste reda *Fagetalia sylvaticae* Pawl. 1928, zveze ilirskih bukovih gozdov *Aremonio-Fagion* (I. Horvat 1938) Borhidi in Torok, Podani et Borhidi 1989. Celotno območje pragozda Pečka poraščajo dinarski jelovo-bukovi gozdovi, in sicer geografska varianta asociacije *Omphalodo-Fagetum* (Tregubov 1957) Marinček et al. 1993 var. geogr. *Calamintha grandiflora* Surina 2002 s štirimi subasociacijami: *-typicum* (M. Wraber 1955) Puncer 1980, *-galietosum odorati* (Tregubov 1957) Puncer 1980, *-festucetosum altissimae* Puncer, Wojterski, Zupančič 1974 in *-phyllitidetosum* (Puncer, Wojterski, Zupančič 1974) subas. nova. Največje površine zavzema subasociacja *-galietosum odorati*; subasociaciji *–typicum* in *-festucetosum altissimae* sta ji površinsko podrejeni.

Opisana je bila nova subasociacija *Omphalodo-Fagetum* (Tregubov 1957) Marinček et al. 1993 var. geogr. *Calamintha grandiflora* Surina 2002 *phyllitide-*

tosum (Puncer, Wojterski, Zupančič 1974) subas. nova. V slednji smo izločili dve varianti: varianto z vrsto *Corydalis cava* in varianto z vrsto *Lamium orvala*. Razlikovalnice subasociacije, pretežno vrste zveze *Polysticho setiferi-Acerenion* s. lat.: *Phylittis scolopendrium, Chrysosplenium alternifolium, Circaea lutetiana, Doronicum austriacum, Urtica dioica, Adoxa moschatellina, Lunaria rediviva, Polystichum braunii, Scopolia carniolica* in *Stellaria montana,* nakazujejo vlažnost rastišča in sorodnost subasociacije s sintaksonom *Omphalodo-Aceretum pseudoplatani* (P. Košir & Marinček 1999).

Varianta z vrsto *Coydalis cava* je na spodnjih delih reliefnih depresij. Razlikovalnice variante so: *Corydalis cava, Isopyrum thalictroides* in *Dentaria trifolia*. Varianta z vrsto *Lamium orvala* ima samo eno diferencialno vrsto (*Lamium orvala)* in leži na osrednjem delu vrtač.

Primerjava floristične sestave in vegetacijske zgradbe pragozda Pečka in Rajhenau je pokazala veliko podobnost med obema pragozdoma. Vendar so opazne tudi določene razlike, pogojene z različnim položajem pragozdov v okviru Kočevskega Roga in precej različnimi reliefnimi razmerami.

Preseneča popolna odsotnost taksona *Rhamnus fallax* v pragozdu Pečka. Nasprotno je v Rajhenavskem pragozdu obilno prisoten. Dalje je v pragozdu Rajhenau, kjer prevladuje optimalna faza, v vseh plasteh gozda močneje prisotna jelka. Manjša prisotnost jelke v pragozdu Pečka, pogojena z njenim splošnim propadanjem po mnenju večine raziskovalcev pragozda kot posledica cikličnih izmenjav med bukvijo in jelko, je verjetno tudi posledica robnega položaja pragozda na meji dinarskega in preddinarskega območja ter spremembe klime v preteklih desetletjih. Prav tako ugotavljamo, da ima pragozd Pečka bolj »fagetalno« sestavo; v Rajhenavskem pragozdu pa izstopajo nekateri izrazito acidofilni taksoni: *Goodyera repens, Rhytidiadelphus loreus, R. triquetrus, Hylocomium splendens, Lonicera nigra, Lycopodium annotinum*, delno tudi *Thuidium tamariscinum*, ki v pragozdu Pečka popolnoma manjkajo.

Primerjava med različnimi gospodarskimi gozdovi subasociacije -*aceretosum* je pokazala, da je pogostost in pokrovnost gorskega javora v tako veliki meri odvisna od načina gospodarjenja, da je poimenovanje -*aceretosum* teh sicer zelo posebnih rastišč, katerih floristična sestava vsebuje veliko taksonov podzveze *Polysticho setiferi-Acerenion*, zelo problematična. Poimenovanje je nastalo v petdesetih letih prejšnjega stoletja. V tem času so prehodne sintaksone zaradi njihove nezadostne preučenosti pogosto poimenovali po drevesnih vrstah: *carpinetosum, fagetosum, piceetosum, pinetosum* (M. Wraber 1960). Z napredkom fitocenoloških raziskav so se ta poimenovanja sčasoma opustila. Ostala je samo subasociacija -*aceretosum*, katere ime se je uveljavilo v praksi.

Upoštevaje neustreznost poimenovanja subasociacij po drevesnih vrstah, katerih količinsko razmerje je zelo odvisno od človekovega vpliva, ter posebno ekologijo subasociacije, ki je precej sorodna ekologiji mejne združbe plemenitih listavcev *Omphalodo-Aceretum*, smo se odločili, da subasociacijo *Omphalodo-Fagetum* var. geogr. *Calamintha grandiflora aceretosum* preimenujemo v subasociacijo *Omphalodo-Fagetum* var. geogr. *Calamintha grandiflora phyllitidetosum*.

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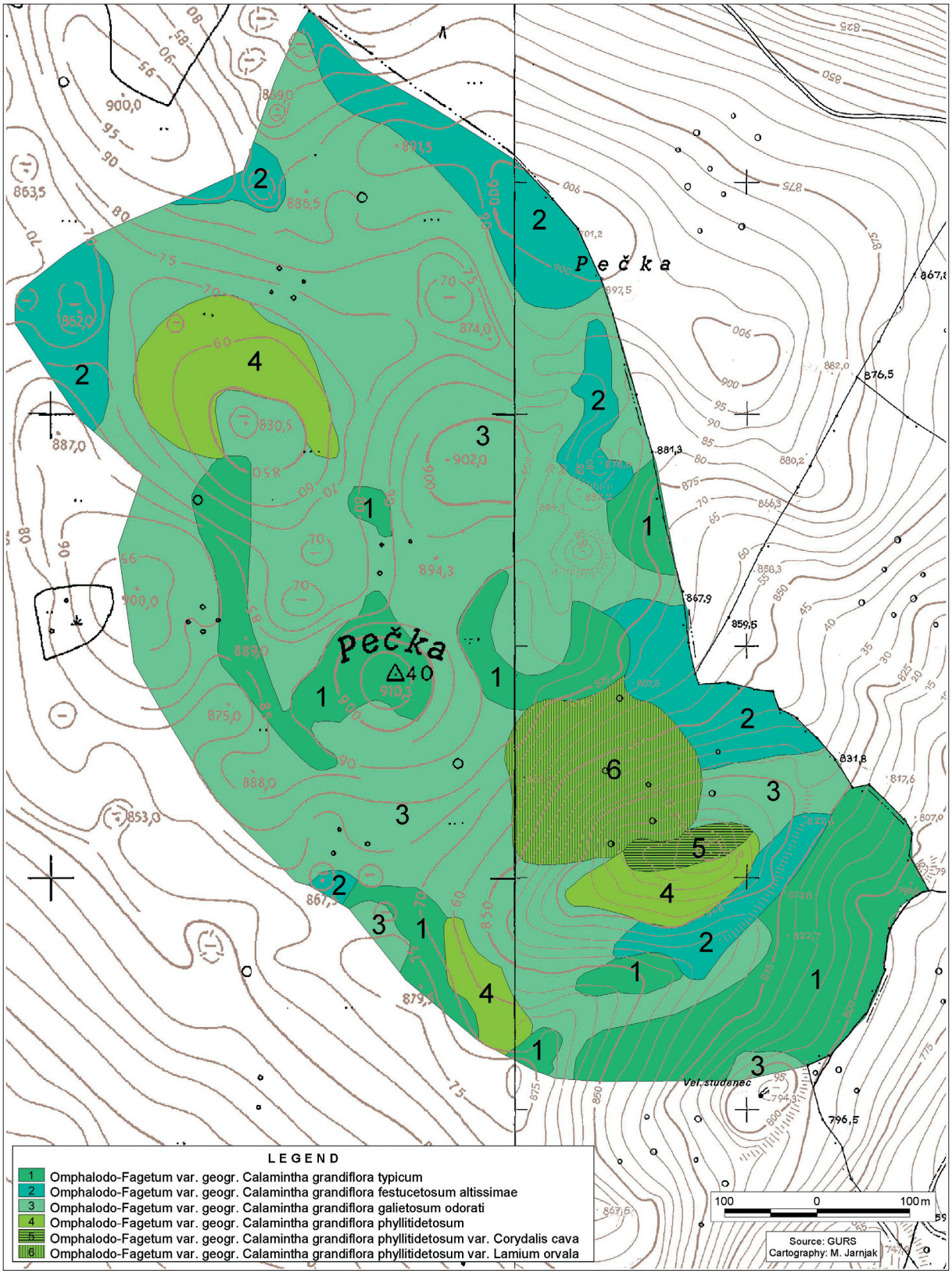

Figure 5: Phytosociological map of the Pečka virgin forest remnant
Slika 5: Fitocenološka karta pragozdnega ostanka Pečka

Table 5: Analytic table of the association *Omphalodo-Fagetum* (Tregubov 1957) Marinček et al. 1993 var. geogr. *Calamintha grandiflora* Surina 2002
Tabela 5: Analitska tabela asociacije *Omphalodo-Fagetum* (Tregubov 1957) Marinček et al. 1993 var. geogr. *Calamintha grandiflora* Surina 2002

Relevé number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22					
Relevé area (m^2)		400	400	400	400	400	400	300	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400					
Altitude (m)		810	885	865	865	840	790	810	875	880	818	880	885	870	870	890	880	825	830	830	830	820	910					
Aspect (degrees)		SE	SE	E	NE	NW	0	SW	0	SW	S	SW	SW	0	E	SE	E	S	N	SW	SE	SE	NE					
Slope (degrees)		20	15	15	15	25	0	10	0	5	5	2	5	0	20	10	15	15	20	15	10	15	15					
Cover tree layer (%)		80	90	100	90	60	90	100	100	80	40	90	90	70	90	70	100	90	20	80	90	80	100					
Cover shrub layer (%)		10	15	20	10	10	10	40	40	30	10	20	20	60	10	20	20	5	90	10	5	10	20					
Cover herb layer (%)		40	40	40	50	50	80	20	60	40	40	70	40	70	40	60	70	30	40	50	50	40	50					
Cover moss layer (%)		20	40	20	40	40	2	0	5	0	5	2	5	2	30	40	5	40	50	20	20	30	15					
Cover bare rock (%)		40	50	30	80	60	2	5	10	5	5	10	5	10	60	70	15	80	40	20	40	60	30					
Number of species		35	42	37	41	40	31	31	30	41	33	33	28	27	38	36	35	26	60	40	35	33	35					
		phyllitidetosum							***galietosum***						***festucetosum***					***typicum***				%				
CHARACTER SPECIES OF THE ASSOCIATION																												
Značilnice asociacije		***Lamium orvala***					***Corydalis cava***																	*phyllitidetosum*	*galietosum*	*festucetosum*	*typicum*	TOGETHER / SKUPAJ
Abies alba	A1	2	2	1	+	1	2	1	.	2	1	1	2	1	1	2	+	2	+	+	+	+	1	100	83	100	100	95
Abies alba	A2	1	2	2	.	+	.	.	2	2	2	2	+	2	2	+	2	1	1	2	2	2	1	57	100	100	100	86
Abies alba	B	.	+	+	.	.	.	+	.	+	.	+	.	.	+	.	.	.	+	.	+	+	.	42	33	40	50	41
Abies alba	C	+	+	+	+	+	+	+	+	.	.	+	+	+	.	+	+	+	.	.	+	+	+	100	66	60	75	77
Cardamine trifolia		+	+	+	.	1	+	+	1	1	+	1	1	1	+	1	+	+	1	1	1	1	+	85	100	100	100	95
Daphne laureola	B	+	+	+	+	+	+	+	1	+	+	+	+	.	+	+	.	.	+	+	+	+	+	100	83	60	100	86
Aremonia agrimonoides	C	.	+	+	+	.	+	.	+	+	+	+	+	.	+	+	1	+	+	+	1	1	+	57	83	100	100	82
Omphalodes verna		.	1	2	.	.	+	.	+	1	2	2	+	2	+	1	1	+	+	.	+	1	.	42	100	100	50	73
Calamintha grandiflora		.	.	.	.	.	.	.	.	+	+	+	.	+	+	.	+	+	.	.	.	+	.	.	66	60	25	36
DIFFERENTIAL SPECIES OF SUBASS. AND VAR.																												
Razlikovalnice subas. in variant																												
Phyllitis scolopendrium	C	+	+	.	2	2	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	85	.	.	.	27
Scopolia carniolica		1	1	1	+	+	1	+	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	100	.	20	.	36
Stellaria montana		+	.	+	1	1	2	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	71	16	.	.	27
Urtica dioica		.	.	.	1	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	42	.	.	.	14

Relevé number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22					
Chrysosplenium alternifolium		.	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	42	.	.	.	14
Doronicum austriacum		.	.	.	.	1	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	42	.	.	.	14
Polystichum braunii		.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	28	.	.	.	9
Circaea lutetiana		.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	28	.	.	.	9
Adoxa moschatellina		.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	28	.	.	.	9
Lunaria rediviva		.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	.	5
Corydalis cava		.	.	.	.	.	4	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	28	.	.	.	9
Isopyrum thalictroides		.	.	.	.	+	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	42	.	.	.	14
Dentaria trifolia		.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	.	5
Lamium orvala		2	2	2	.	.	.	+	.	.	.	.	.	.	1	.	.	+	.	1	.	+	+	57	.	40	75	41
Galium odoratum		1	2	2	1	1	1	1	2	2	2	2	1	2	1	.	1	1	1	1	1	1	1	100	100	80	100	95
Sanicula europaea		.	+	+	.	+	.	+	1	1	2	1	+	1	.	1	1	+	+	+	1	1	+	57	100	80	100	82
Carex sylvatica		.	+	.	.	+	+	.	+	+	.	+	.	+	.	.	.	.	.	.	.	+	.	42	66	.	25	36
Festuca altissima		+	.	.	+	.	.	.	+	.	+	.	.	.	1	3	4	2	3	+	+	+	.	28	33	.	75	55
Dicranum scoparium	D	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	1	+	+	.	.	.	.	.	50	23
Aremonio-Fagion																												
Dentaria enneaphyllos	C	1	+	1	+	1	.	1	1	+	.	1	1	+	1	.	+	+	+	+	.	.	1	85	83	80	50	77
Cyclamen purpurascens		.	+	+	.	.	.	.	+	+	+	+	+	+	.	+	+	+	+	+	+	+	1	28	100	80	100	73
Hacquetia epipactis		.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	16	.	.	5
Fagetalia sylvaticae																												
Fagus sylvatica	A1	3	4	5	4	3	2	5	5	4	5	4	4	4	4	3	5	4	5	5	4	5	4	100	100	100	100	100
Fagus sylvatica	A2	3	1	3	3	3	4	4	+	2	2	3	3	+	+	2	+	1	1	1	1	1	+	100	100	100	100	100
Fagus sylvatica	B	+	3	2	+	1	2	3	3	3	2	2	1	4	1	2	1	.	3	1	+	+	1	100	100	80	100	95
Fagus sylvatica	C	+	+	+	.	+	+	2	1	+	+	1	1	1	+	.	+	.	.	+	.	.	+	85	100	40	50	73
Daphne mezereum	B	+	+	+	+	1	.	+	+	+	1	+	+	1	.	+	+	+	+	+	+	1	+	85	100	80	100	91
Dryopteris filix-mas	C	1	1	+	2	1	2	+	+	+	1	+	.	+	+	+	.	.	1	+	+	+	+	100	83	60	100	86
Mycelis muralis		.	+	+	+	+	.	.	1	+	+	+	+	+	+	+	+	+	+	.	+	+	+	57	100	100	75	82
Viola reichenbachiana		+	1	+	.	+	.	+	+	+	+	+	+	+	+	.	+	.	.	+	+	+	.	71	100	40	75	73
Mercurialis perennis		.	+	+	.	.	.	.	+	+	+	.	+	.	+	1	1	+	1	+	+	+	3	28	66	100	100	68
Paris quadrifolia		+	+	+	+	+	.	+	+	+	+	.	+	.	.	+	.	.	+	+	+	.	1	85	66	40	75	68
Senecio ovatus		+	+	1	1	.	.	.	.	+	+	+	+	+	.	+	.	.	+	1	+	+	.	57	83	40	75	64
Dentaria bulbifera		+	+	+	+	+	1	1	.	+	.	1	.	1	+	.	.	+	.	.	.	.	+	100	50	40	25	59
Galeobdolon montanum		+	.	.	.	+	.	+	.	.	.	1	1	1	1	1	1	1	+	.	.	.	1	42	50	100	25	55
Galeobdolon flavidum		.	+	1	.	.	.	.	+	.	.	1	+	1	.	1	1	.	.	1	1	1	.	28	66	40	75	50
Salvia glutinosa		.	.	.	1	.	+	+	+	+	+	+	.	+	.	+	.	.	+	+	.	.	.	42	83	40	25	50

Polystichum aculeatum		1	.	1	+	.	+	.	.	.	.	.	.	.	+	.	.	+	1	+	+	+	.	57	.	60	75	45
Sambucus nigra	B	+	+	1	+	.	+	+	.	.	.	.	.	.	+	+	.	.	.	+	.	+	.	85	.	40	50	45
Acer pseudoplatanus		.	+	+	.	.	.	+	+	+	.	.	.	+	.	+	+	.	+	.	+	.	.	42	50	60	25	45
Brachypodium sylvaticum	C	.	2	1	+	.	+	+	+	1	+	.	.	.	.	.	.	.	.	.	.	+	+	71	50	.	50	45
Hordelymus europaeus		.	.	.	.	.	.	.	.	.	.	+	+	1	.	+	+	.	+	+	+	.	+	.	50	60	75	41
Euphorbia amygdaloides		.	.	+	.	.	.	.	.	+	1	.	+	1	.	.	1	.	.	+	+	.	.	14	66	20	50	36
Acer pseudoplatanus		+	.	.	.	.	.	.	.	.	+	+	+	.	.	+	.	.	.	.	.	+	+	14	50	20	50	32
Arum maculatum		+	+	+	.	.	.	.	.	+	.	+	+	.	+	.	.	.	.	.	.	.	.	42	50	20	.	32
Prenanthes purpurea		.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	1	.	+	+	.	.	.	.	33	40	25	23
Lonicera alpigena	B	.	.	.	.	.	.	.	.	.	.	+	.	.	.	1	+	.	+	.	.	+	.	.	16	60	25	23
Veronica montana	C	.	.	.	.	+	+	.	.	.	+	.	.	+	.	.	+	.	.	.	.	.	.	28	33	20	.	23
Geranium robertianum		.	+	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	28	.	20	25	18
Polygonatum multiflorum		.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	16	20	50	18
Actaea spicata		.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	42	.	.	25	18
Euonymus latifolius	B	.	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	28	.	20	.	14
Ulmus glabra		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	20	25	9
Gymnocarpium robertianum	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	20	25	9
Petasites albus		+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	28	.	.	.	9
Polystichum x illyricum		.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	.	5
Polystichum setiferum		.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	.	5
Campanula trachelium		.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	.	5
Prunus avium	B	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	16	.	.	5
Lilium martagon	C	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	16	.	.	5
Melica nutans		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	20	.	5
Querco-Fagetea																											
Anemone nemorosa	C	+	+	+	+	+	+	+	+	+	1	2	1	1	.	+	1	.	.	.	+	+	.	100	100	40	50	77
Clematis vitalba	B	.	.	+	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	14	33	.	.	14
Hedera helix		.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	14	16	.	.	9
Cruciata glabra	C	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	.	5
Carex digitata		.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	20	.	5
Platanthera bifolia		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	20	.	5
Vaccinio-Piceetalia																											
Oxalis acetosella	C	+	+	+	1	1	2	+	+	1	1	1	+	2	+	1	+	+	+	+	+	+	1	100	100	100	100	100
Dryopteris expansa		+	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	+	.	28	.	40	50	27
Dryopteris carthusiana		.	.	+	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	28	33	.	.	18
Galium rotundifolium		.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	1	.	.	.	+	.	.	.	16	40	25	18

Relevé number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22					
Picea abies	B	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	14	.	20	25	14
Dryopteris dilatata	C	.	.	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	28	16	.	.	14
Maianthemum bifolium		.	.	.	.	.	.	+	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	14	16	20	.	14
Rosa pendulina	B	.	+	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	14	16	20	.	14
Picea abies	A1	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	16	.	25	9
Picea abies	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	20	.	5
Dryopteris affinis		.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	16	.	.	5
Valeriana tripteris		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	20	.	5
Other species / Ostale																												
Rubus sp.	B	+	1	+	+	+	+	+	+	+	+	+	+	.	+	.	+	.	+	+	+	.	+	100	83	60	75	82
Moehringia muscosa	C	.	+	.	.	.	.	.	.	+	.	.	.	.	+	+	.	+	+	+	+	+	+	14	16	80	100	45
Athyrium filix-femina		+	.	.	+	+	+	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	71	33	.	.	32
Asplenium trichomanes		+	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	+	.	42	.	20	50	27
Sorbus aucuparia	B	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.	+	.	.	14	16	40	25	23
Polypodium vulgare	C	.	+	.	.	+	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	+	.	28	16	20	25	23
Veratrum album		.	.	.	.	+	+	1	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	42	16	.	.	18
Rubus idaeus	B	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	28	.	20	.	14
Fragaria sp.	C	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	14	16	.	.	9
Fragaria vesca		.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	16	20	.	9
Gentiana asclepiadea		.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	14	16	.	.	9
Listera ovata		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	25	5
Cystopteris fragilis		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	25	5
Salix glabra	B	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	.	5
Fragaria moschata	C	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	20	.	5
Polygala vulgaris		.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	20	.	5
Mosses and lichens / Mahovi in lišaji																												
Ctenidium molluscum	D	3	2	+	3	2	1	.	+	.	.	+	+	.	3	3	1	3	3	2	2	3	2	85	50	100	100	82
Isotechyum myurum		2	1	.	2	1	.	.	+	.	.	+	.	.	1	3	1	2	2	+	1	1	1	57	33	100	100	68
Neckera crispa		1	.	.	+	.	.	.	.	.	.	.	.	.	1	2	.	1	1	1	+	1	.	28	.	80	75	41
Tortella tortuosa		.	+	.	.	+	.	.	+	.	.	.	.	.	+	1	.	+	.	.	.	+	+	28	.	60	50	36
Hypnum cupressiforme		.	+	.	1	.	.	.	+	.	.	.	+	.	.	3	.	.	.	+	+	1	.	28	33	20	75	36
Mnium undulatum		1	+	.	+	.	+	.	.	.	.	.	.	.	+	.	.	.	.	1	.	+	.	57	.	20	50	32
Fissidens taxifolius		.	.	.	1	+	+	.	.	.	.	.	.	.	.	+	.	.	.	+	.	+	.	42	.	20	50	27
Plagiomnium undulatum		.	.	.	1	2	+	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	.	42	.	.	50	23
Plagiochila asplenioides		.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	28	.	.	50	18

Polytrichum formosum	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	+	.	.	.	16	20	25	14
Plagiothecium undulatum	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	14	.	20	.	9
Mnium punctatum	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	14	.	20	.	9
Eurinchium striatum ssp. *zetterstedtii*	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	14	.	20	.	9
Plagiothecium sylvaticum	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	28	.	.	.	9
Fissidens cristatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	25	5
Bryum sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	25	5
Racomitrium canescens	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	20	.	5
Cladonia rangiferina	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	20	.	5
Tortula muralis	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	20	.	5
Tortella fragilis	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	.	5
Cirriphyllum tenuinerve	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	.	5
Cirriphyllum piliferum	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	.	5
Mnium stellare	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	.	5
Brachythecium populeum	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	.	5
Brachythecium rutabulum	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	14	.	.	.	5