

ILLYRIAN PRE-ALPINE FIR AND BEECH FORESTS – THE ASSOCIATION *HOMOGYNO SYLVESTRIS-FAGETUM* MARINČEK ET AL. 1993

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Abstract

The work deals with the association *Homogyno sylvestris-Fagetum* in the pre-Alpine region of Slovenia. The communities were classified into a geographical race *typica* and divided into six subassociations: *typicum* subass. nova, *mercurialetosum perennis* subass. nova, *festucetosum altissimae* subass. nova, *calamagrostietosum variae* subass. nova, *luzuletosum sylvaticae* subass. nova and *vaccinietosum myrtilli* subass. nova. The results are shown in the analytical table, as well as in two diagrams.

Key words: *Fagus sylvatica*, *Abies alba*, forests, pre-Alpine region, forest community, vegetation, Slovenia.

Izvleček

V članku je predstavljena asociacija *Homogyno sylvestris-Fagetum* v predalpskem fitogeografskem območju. Združba je uvrščena v geografsko varianto *typica* in členjena v šest subasociacij: *typicum* subass. nova, *mercurialetosum perennis* subass. nova, *festucetosum altissimae* subass. nova, *calamagrostietosum variae* subass. nova, *luzuletosum sylvaticae* subass. nova in *vaccinietosum myrtilli* subass. nova. Rezultati so predstavljeni z analitsko tabelo in dvema diagramoma.

Glavne besede: *Fagus sylvatica*, *Abies alba*, gozdovi, predalpsko območje, gozdna združba, vegetacija, Slovenija.

1. INTRODUCTION

In comparison with Dinaric fir and beech stands of the association *Omphalodo-Fagetum*, thoroughly studied in terms of the phytosociology and ecology by a number of researchers (e.g. Horvat 1938, M. Wraber 1960, Tregubov et al. 1957, Puncer 1979, 1980, Puncer, Wojterski & Zupančič 1974, Horvat, et al. 1974, Marinček 1987, Kordiš 1993, Dakskobler et al. 2000, Franjič et al. 2001, Surina 2001, 2002) there exist only some elaborations of the pre-Alpine fir and beech forests (Marinček 1973a, 1973b, 1978, Dakskobler 2002, 2002a, 2002b, 2004). However, numerous detailed reports have been made for forest praxis including rele-

vant phytosociological maps in a scale of 1 : 10 000 with descriptions of different subassociations and also with detailed pedologic analyses, but they were not published. Besides, some additional studies were required which should have highlighted the floristic particularity of the pre-Alpine beech forests of the Illyrian floral province, either from the fir and beech forests of the utmost part of the Dinaric mountains showing a transitional character between Dinaric and pre-Alpine fir and beech forests, or from the association *Anemono-Fagetum*, frequently bordering on the forests of the association *Homogyno sylvestris-Fagetum*.

The long-term phytosociological research of the pre-Alpine beech forests is also reflected in

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their synsystematics. They were first named by M. Wraber (1960) as *Abieti-Fagetum austroalpinum* M. Wraber 1960. Robič renamed them as *Abieti-Fagetum praealpino-dinaricum* Robič 1965 (Košir et al. 1968). A few years later, when the designation of a zonal association according to phytogeographical territories won wide recognition, they were renamed as *Abieti-Fagetum praealpinum* Marinček 1973 (Marinček 1973b). Not earlier than in 1993 (Marinček, Mucina, Zupančič, Dakskobler et al. 1993), the binomial designation on a strictly floristic basis prevailed (see Barkman et al. 1986, but also Weber et al. 2000). At that time the pre-Alpine fir and beech forests acquired their present name *Homogyno sylvestris-Fagetum* Marinček et al. 1993.

In the area of Southeastern Alps three geographical races were described: *Homogyno sylvestris-Fagetum* var. geogr. *Luzula nivea* Marinček ex Dakskobler 2002 (Dakskobler 2002), *Homogyno sylvestris-Fagetum* var. geogr. *Sesleria autumnalis* Dakskobler 2002 (Dakskobler 2002a), *Homogyno sylvestris-Fagetum* var. geogr. *Scopolia carniolica* Dakskobler 2002 (Dakskobler 2002b). In the region of Savinjske Alpe and Kamniške Alpe appears a new geographical race *Homogyno sylvestris-Fagetum* var. geogr. *typica* var. geogr. nova presented in this paper.

METHODS

The vegetation was sampled in the pre-Alpine region of Slovenia and then processed by using the standard Central European method (Braun-Blanquet 1964). The numerical analysis has been made by SYN-TAX program, principal co-ordinate analysis, using similarity ratio as a measure of similarity (Podani 2001). The Braun-Blanquet scale was transformed as proposed by van der Maarel (1979). The nomenclature of plant species is according to Ehrendorfer (1973) for *Cormophyta*, Martinčič (2003) for *Bryopsida*, Frey et al. (1995) for *Hepaticae* and Wirth (1995) for *Lichenes*. The names of syntaxa are according to the Nomenclatural revision of *Aremonio-Fagion* (Marinček et al. 1993). As far as the floristic comparison is concerned, no moss species have been taken into consideration; these are, however, stated in the tables of the described subassociations of the association *Homogyno sylvestris-Fagetum*. Individual researchers do not record them, or else they are generally not familiar with them. Most of the moss species have a cosmopoli-

tan nature and their diagnostic value, particularly in zonal communities, is negligible. The synsystematic spectrum (Fig. 2) was made on the basis of a comparative synthetic table using the presence in percentage as ponder.

GENERAL ECOLOGICAL CONDITIONS

The association *Homogyno sylvestris-Fagetum* is a zonal association of the pre-Alpine phytogeographical territory of the Illyrian floral province (Marinček 1995). Its stands thrive at all aspects and are most frequently found in large continuous areas at an altitude of 800 to 1000 metres above sea level. In some sites, exposed to the sun, they reach up to 1400 metres, whereas on very shady slopes they thrive down to an altitude of 500 metres. In the area of the pre-Alpine phytogeographical territory, a humid climate with fresh summers and cold winters prevails. The most precipitation rich area is the western part of the region under consideration, where the average annual rainfall exceeds 2300 mm. The precipitation regime is favourable. The precipitation reduces progressively towards the east, however the average annual rainfall is still more than 1500 mm.

The data for the period 1961–1990 for the meteorological station Zgornje Jezersko, which is located in the middle of the area of distribution of the association *Homogyno-Fagetum*, show that the mean annual precipitations are 1976 mm and they are equally distributed through the year. The cold winter period lasting from December to February is characteristic of the thermal conditions of the pre-Alpine region, particularly in the mountain region (Zgornje Jezersko the minimal temperature ranges from -5.6 to -7.3 °C). The average monthly temperature in summer months is relatively high (ranging from 7.6 to 9.3 °C). The extreme temperatures are very pronounced, particularly in the valleys where temperature inversion occurs very frequently (for example the valley of Logarska dolina). The area is covered by snow for approx. 106 days. (Mekinda-Majaron 1995, Zupančič 1995, Ovsenik-Jeglič 2000).

More gentle relief in terms of smooth slopes which gradually proceed to rounded mountain ridges is developed on the mixed calcareous and noncalcareous bedrock. Deep ditches are cut into the slopes providing constant running water. By contrast, a diverse relief is developed on the

calcareous bedrock. There are fragments of karstic land configuration on limestones. Furthermore, the plain surfaces are combined with sinkholes and rock slopes and precipice walls in a mosaic form. The slopes are steep and smooth with pointed summits on dolomites, but also remnants of glacier moraines where water piles up calcareous loose rocks on the bottom of pre-Alpine valleys.

The geologic bedrock is well diversified. Among the calcareous ground stones, there are predominantly triassic dolomites, dolomite limestones and dachstein limestones. Noncalcareous stones consist of clay schists and sandstones. (Seidl 1907–1908)

Due to the varied bedrock composition and diversified land configuration there are numerous types of soils which are mutually combined in a mosaic form. The most developed soils within the calcareous bedrock – such as Chromic Cambisol, deep Chromic Luvisol – are on Dachstein limestones and on the mixed calcareous and non-calcareous bedrock. More initial soil forms are particularly found on dolomites: Rendzina of different development stages from Protorendzina to Chromic Rendzina and shallow skeletal chromic soils. The soil is less developed also at higher altitudes, on lime loose rocks or on remnants of glacier moraines at the bottom of Alpine valleys.

Stands of the association thrive in the pre-Alpine phytogeographical territory of the Illyrian floral province. In the floristic and vegetational aspect of the syntaxa, the Illyrian pre-Alpine territory has a certain transitional feature among the clearly Illyrian syntaxa of the pre-Dinaric and Dinaric phytogeographical region and those from the south-Alpine region on the border with the Central European floral province. This results in a certain floristic impoverishment of zonal associations bordering the association *Homogyno sylvestris-Fagetum*: *Anemono-Fagetum* var. geogr. *Helleborus niger*, *Lamio orvalae-Fagetum* var. geogr. *Dentaria pentaphyllos*, *Ranunculo platanifolii-Fagetum* var. geogr. *Hepatica nobilis*, *Polysticho lonchitis-Fagetum* var. geogr. *Salix waldsteiniana* as well as azonal associations like *Ostryo-Fagetum*, particularly in the sense of scarce presence of certain character and differential species of the alliance *Aremonio-Fagion*. However, this is not indicated to such an extent that the authors of the revision of the nomenclature of the Illyrian beech forests (Marinček et al. 1993) would hesitate to classify these associations and the association *Homogyno-Fagetum* into the alliance of the Illyrian beech forests.

STRATIFICATION OF THE COMMUNITY, SOCIOLOGICAL STRUCTURE AND FLORISTIC COMPOSITION

In well preserved forests, *Fagus sylvatica*, *Abies alba* and *Picea abies* prevail in the tree layer. With regard to the very diverse site conditions of the stands, they rarely function as a biologically and ecologically equivalent edifier with regard to their nature. Therefore, beech and fir alternately prevail. More significant consequences for their proportion are caused by unsuitable human activities carried out by farmers, especially in the past. Intensive felling of fir trees accelerates the growth of beech and spruce trees which were planted on certain sites in larger areas. Selection forest management, which takes place rarely, is the most suitable way of cutting those forests.

In some places, pre-Alpine fir-beech stands are mixed with *Acer pseudoplatanus*. However, in comparison to Dinaric fir-beech stands (*Omphalodo-Fagetum*), they are not so frequently present. *Ulmus glabra* is found very scarcely. *Larix decidua* appears individually at higher altitudes. *Ostrya carpinifolia* is an expressively thermophilic and a lit-up tree appearing individually in the area of pre-Alpine fir and beech forests only on very sunny mountain ridges. *Fraxinus excelsior* is found only in Alpine valleys in special microclimatic conditions. The shrub layer is not well developed. Mainly, it is composed of the predominating tree species: beech, fir and spruce. In the shrub layer, the following species occur more or less regularly: *Daphne mezereum*, *Lonicera alpigena*, *Rubus idaeus*, *Lonicera nigra* and *Clematis alpina*. Shrubs with a moderately thermophilic character, like *Clematis vitalba*, are very seldom.

The herb layer is relatively well developed. With regard to the season, the herbs cover from 40 to 90 percent of the ground surface area. Among sociological and ecological groups, the species of beech forests predominate, particularly *Lamiastrum montanum* and *L. flavidum*, *Prenanthes purpurea*, *Mycelis muralis*, *Salvia glutinosa*, *Polystichum aculeatum*, *Euphorbia amygdaloides*, *Paris quadrifolia*, *Actaea spicata*, *Viola reichenbachiana* and some others.

Special diagnostic importance is given to differential species of the alliance *Aremonio-Fagion*. They occur more or less constantly. These are *Aposeris foetida*, *Aremonia agrimonoides*, *Cardamine trifolia*, *Cyclamen purpurascens*, *Dentaria enneaphyllos* (its somewhat smaller cover results from certain autumn samplings) and *Homogyne sylvestris*.

Other character species of the alliance *Aremonio-Fagion* are *Calamintha grandiflora*, *Omphalodes verna* and *Rhamnus fallax*. They appear rarely at the border of their distribution areas as accidental species. Moreover, *Vicia oroboides* and *Knautia drymeia* subsp. *drymeia* appear also very rarely, while *Lamium orvala* appears more frequently at lower altitudes.

The species of the order *Adenostyletalia* are present constantly and abundantly in compliance with the altimontane character of the association *Homogyno-Fagetum* like *Polygonatum verticillatum*, *Adenostyles glabra*, *Ranunculus platanifolius*, *Saxifraga rotundifolia*, *Dryopteris filix-mas*, *Athyrium filix-femina*, *Senecio fuchsii* and *Veratrum album*. Among them there are differential species of the suballiance *Saxifrago-Fagenion* that are well represented and give the association a typical altimontane character.

The character species of the class *Quercu-Fagetea* appear less frequently in compliance with the cold region where the association grows. The most frequent are *Anemone nemorosa* and *Carex digitata*. *Ajuga reptans* and *Galium laevigatum* are less frequent. The other species appear sporadically.

An important group is represented with slightly to moderately acidophilic species of the class *Vaccinio-Piceetea*, like: *Oxalis acetosella*, *Veronica urticifolia*, *Gentiana asclepiadea*, *Rosa pendulina*, *Luzula luzuloides*, *Hieracium sylvaticum*, *Vaccinium myrtillus*, *Maianthemum bifolium* and *Valeriana tripteris* which result from the colder and humid climate. Consequently, there is also predominantly well-rotted humus. Strong acidophilic species like *Lycopodium annotinum*, *Huperzia selago*, *Vaccinium vitis-idaea*, *Homogyne alpina*, *Luzula sylvatica* and some others thrive only in peculiar ecological conditions, at higher altitudes and in frost pockets. Other less frequent species have not been classified to the sociological units, such as *Calamagrostis varia*, *Carex alba*, *Sorbus aucuparia*, *Asplenium viride* and *Fragaria vesca*.

The moss layer is well developed only on certain sites. Sometimes it is even not present at all in the relevés. Among the moss species *Ctenidium molluscum*, *Isoetecium alopecuroides*, *Plagiochila asplenioides*, *Fissidens taxifolius* and *Neckera crispa* dominate.

CHARACTER SPECIES AND DIFFERENTIAL SPECIES OF THE COMMUNITY

The only, but weak, character species of the association *Homogyno-Fagetum* is *Homogyne sylvestris*. According to Praprotnik (1987), the Alpine-Illyrian floral element is spread in the South-eastern Calcareous

Alps and their bordering areas, and in the area of the Illyrian floral province. Borhidi (1963) considers it as the first quality character species of the alliance *Aremonio-Fagion*. Although various authors have made slightly different diagnoses of the area of distribution, they have an opinion similar to that of Borhidi, who considers it to be a typical Illyrian species of the montane belt. Although the species *Homogyne sylvestris* builds special subassociations in the Dinaric fir and beech forests (*Omphalodo-Fagetum homogynetosum*) as well as in altimontane beech forests (*Anemono-Fagetum* var. geogr. *Helleborus niger homogynetosum*, *Ranunculo platanifolii-Fagetum* var. geogr. *Hepatica nobilis homogynetosum*), it defines very well the association *Homogyno sylvestris-Fagetum* as the Illyrian fir and beech community. It clearly distinguishes the latter from similar communities of the alliance *Eu-Fagion* (particularly *Helleboro nigri-Fagetum* Zukrigl 1974) (Zukrigl 1989).

The differential species of the association *Homogyno sylvestris-Fagetum* are composed of two ecological and sociological groups.

The first one comprises the species of the suballiance of altimontane beech forests of the Illyrian floral province *Saxifrago-Fagenion*: *Polygonatum verticillatum*, *Adenostyles glabra*, *Ranunculus platanifolius*, *Saxifraga rotundifolia* and *Luzula sylvatica* appear more abundantly. The others, such as *Cicerbita alpina*, *Geranium sylvaticum*, *Polystichum lonchitis* appear more rarely. Within this group, there are species which are not considered by the authors as differential species of the suballiance *Saxifrago-Fagenion* like *Clematis alpina*, *Calamagrostis villosa* and *Homogyne alpina*.

The second differential species group consists of moderately acidophilic species which generally reach a very high constancy: *Veronica urticifolia*, *Luzula luzuloides*, *Gentiana asclepiadea*, *Vaccinium myrtillus* and some others. A diagnostically very important differential species is also *Larix decidua*, although it is found only at upper altitudes and gives the association a dealpine character.

Dakskobler (2002a) enumerates among differential species also the species *Asplenium viride* and *Saxifraga cuneifolia* and in a wider sense also *Laburnum alpinum* and *Anemone trifolia*.

SYNSYSTEMATICS OF THE ASSOCIATION

This paper deals with a new geographical race *Homogyno sylvestris-Fagetum* var. geogr. *typica* that is divided into six subassociations and several variants.

***Homogyno sylvestris-Fagetum* var. geogr. typica typicum subass. nova hoc loco** represents an ecological and floristical average of the association. It thrives in all expositions on gently inclined slopes and plateaus. The bedrock is composed of limestones, particularly Dachstein limestone, Dolomite limestones and more seldom dolomites.

In some places these stands also thrive on mixed calcareous and noncalcareous bedrock. In such cases the noncalcareous bedrock, which consists mainly of schists and sandstones of different geological ages, is filled with lime and calcareous loose rocks.

A well diversified bedrock in connection with very diverse relief results in many soil forms. There are shallow Chromic Cambisol and Rendzina of various development stages on dolomite limestones, particularly on steeper slopes and mountain ridges. On limestones, there is most frequently medium deep to deep Chromic Cambisol with very pronounced surface ground rock cover in some places. There is also Chromic Cambisol which is very fertile due to a favourable mixture of chemical and physical properties on the mixed calcareous and noncalcareous bedrock. The subassociation – *typicum* has no pronounced differential species. Favourable growing conditions are indicated by the presence of ecologically more demanding plants, particularly of the species of beech forests.

The *holotypus* of the subassociation is relevé no. 4, Table no. 1, *holotypus hoc loco*.

Two variants were defined within the framework of the subassociation.

***Homogyno sylvestris-Fagetum* var. geogr. typica typicum var. *Hacquetia epipactis* var. nova hoc loco**

It encompasses small areas at the lower edge of the area of distribution of the association *Homogyno sylvestris-Fagetum*. It appears below 1000 metres above sea level on gently inclined sunny slopes above limestone in medium deep Chromic Cambisol. In addition to the species *Hacquetia epipactis* which appears abundantly, there are differential species of the class *Quercus-Fagetum*: *Rosa arvensis*, *Crataegus monogyna*, *Helleborus odoratus* and *Primula vulgaris*, the species of the alliance *Erythronio-Carpinion*. All the above mentioned species show a certain similarity to the association *Hacquetio-Fagetum*.

The *holotypus* of the variant is relevé no. 1, Table no. 1.

***Homogyno sylvestris-Fagetum* var. geogr. typica typicum var. *Gymnocarpium dryopteris* var. nova hoc loco**

The variant depends on edaphic factors. It grows on the mixed calcareous and noncalcareous bedrock in deep calcareous Chromic Luvisol, which is very fertile due to a favourable mixture of chemical and physical properties. The differential species of the variant are *Gymnocarpium dryopteris*, *Dryopteris carthusiana* agg. and *Lonicera nigra* indicating more acid soil.

The *holotypus* of the variant is relevé no. 16, Table no. 1.

***Homogyno sylvestris-Fagetum* var. geogr. typica calamagrostietosum variae subass. nova hoc loco**

This appears on sunny, deep and very stony slopes. It is often found in narrow strips along steep mountain ridges. On limestones, Dolomite limestones and dolomites, predominantly of Triassic age, there is Rendzina of different development stages from very shallow to medium deep, passing over to shallow Chromic Cambisol.

The differential species of the subassociation are *Calamagrostis varia* and *Carex alba*. The first one grows abundantly in lit-through forests on steep rock slopes, whereas *Carex alba* reaches its optimal site conditions on skeletal shallow soils prevailing in the subassociation described below. The subassociation is in a certain sense similar to the vicariant subassociation *mercurialetosum*. Both dispose of very similar ecological conditions, i.e. deep stony sunny slopes, less developed soils. The difference is in the fact that the subassociation *calamagrostietosum variae* grows at higher altitudes at the edge of the area of distribution of the Illyrian floral province. Its floristic composition differs sufficiently from the subassociation *mercurialetosum*.

The *holotypus* of the subassociation is relevé no. 19, Table no. 1, *holotypus hoc loco*.

***Homogyno sylvestris-Fagetum* var. geogr. typica mercurialetosum perennis subass. nova hoc loco**

It grows at relatively lower elevations above sea level ranging from 750 to around 1050 metres, on steep to very steep shady slopes and frequently on rocky mountain ridges. There is a complex of different Rendzina and very skeletal Chromic Cambisol on limestones and dolomite limestones and dolomites. In the upper layers there is well-rotted and raw humus as a consequence of very shady sites.

The differential species of the subassociation is *Mercurialis perennis* which grows optimally on skeletal soils with good drainage.

The character species *Homogyno sylvestris* is well represented with a considerable cover in places.

The *holotypus* of the subassociation is relevé no. 29, Table no. 1, *holotypus hoc loco*.

The subassociation has been divided into two variants.

***Homogyno sylvestris-Fagetum* var. geogr. typica
mercurialetosum perennis var. *Cephalanthera damasonium*
var. nova hoc loco**

It grows mainly on the limestone bedrock in medium deep skeletal Chromic Cambisol where well-rotted humus predominates. The differential species of the variant are *Cephalanthera damasonium*, *Salvia glutinosa* and *Polygonatum multiflorum*. This variant is differentiated by the almost complete absence of acidophilic species.

The *holotypus* of the variant is relevé no. 24, Table no. 1.

***Homogyno sylvestris-Fagetum* var. geogr. typica
mercurialetosum perennis var. *Homogyne sylvestris* var.
nova hoc loco**

It is limited to expressively shady steep stone slopes where there is horizontal well-rotted and raw humus in the upper soil layers.

There are *Ostrya carpinifolia* and *Larix decidua* in the tree layer. The appearance of two ecologically different species on the same site can be explained by rocky ridges where the light conditions facilitate the growth of both heliophilic species.

The differential species of the variant are *Homogyne sylvestris* and *Neckera crispa*. The variant is distinguished by the permanent presence of moderately acidophilic species *Valeriana tripteris*, *Gentiana asclepiadea* and some others.

The *holotypus* of the variant is relevé no. 29, Table no. 1.

***Homogyno sylvestris-Fagetum* var. geogr. typica
festucetosum altissimae subass. nova hoc loco**

It grows on rather steep and rocky, often shady slopes in a step-resembling form, with rounded summits and ridges. The bedrock consists mainly of Dachstein limestone, on which there is a soil complex of well-rotted and decayed humus. At higher elevations, well-rotted humus and Chromic Luvisol predominate. On rocks and stones under the turf of the grass *Festuca altissima* there is well-rotted Rendzina, whereas in crevasses and pockets between stones there is Chromic Luvisol.

The differential species of the subassociation is *Festuca altissima*, which grows optimally on medium deep rocky and moderately acidic soils with well-rotted humus, principally on cold sites, reflects very well the site conditions.

The differential species of the suballiance *Saxifrago-Fagenion* are well represented by *Polygonatum verticillatum*, *Adenostyles glabra*, *Luzula sylvatica* and *Ranunculus platanifolius*. The remaining ones are only accidental species.

The presence of the species of the alliance *Aremonio-Fagion* is rather poor. More common are only *Dentaria enneaphyllos*, *Cyclamen purpurascens*, *Aremonia agrimonoides* and *Helleborus niger* subsp. *niger*. Species of the order *Fagetalia sylvaticae*, which are well represented with high coverage value, in some sites show favourable site conditions of the described subassociation.

The share of acidophilic species rises considerably with increasing altitude. The species with high coverage value are *Picea abies*, *Oxalis acetosella*, *Luzula sylvatica* and some others.

The *holotypus* of the subassociation is relevé no. 40, Table no. 1, *holotypus hoc loco*.

The subassociation is divided into one variant and two forms.

***Homogyno sylvestris-Fagetum* var. geogr. typica
festucetosum altissimae var. typica**

It grows on sites with average ecological conditions of the subassociation *festucetosum altissimae*. These sites are gently steep to steep stony slopes overgrown abundantly with grass *Festuca altissima*. The plant combination has been rather impoverished, particularly on account of the differential species of the suballiance *Saxifrago-Fagenion* and the alliance *Aremonio-Fagion* as well as the class *Quercu-Fagetea*.

The holotype is the same as for the subassociation.

***Homogyno sylvestris-Fagetum* var. geogr. typica
festucetosum altissimae f. *Galium odoratum* f. nova hoc loco**

It grows on more gentle slopes and plateaus at lower elevations below 1000 metres on medium deep to deep Chromic Cambisol with less pronounced surface ground rock cover. The differential species of the form are *Galium odoratum*, *Hordelymus europaeus*, *Ranunculus lanuginosus* and *Sambucus nigra*. With the species of the class *Quercu-Fagetea*: *Clematis vitalba*, *Corylus avellana*, *Lonicera xylosteum*, they indicate favourable soil and humid conditions and lower altitudes.

The *holotypus* of the form is relevé no. 35, Table no. 1.

***Homogyno sylvestris-Fagetum* var. geogr. typica
festucetosum altissimae f. *Luzula sylvatica* f. nova hoc loco**

It thrives on higher elevations above sea level ranging from 1000 to 1300 metres. Very shady slopes and ridges with very pronounced surface stones predominate. The soil composition does not differ notably from the described soils of the subassociation, only that raw humus is more abundantly represented in the upper layers.

The differential species of the form is *Luzula sylvatica*, which grows very well on fresh soils, mostly poor in bases or on the calcareous bedrock where the raw humus eliminates to a certain extent the influence of the calcareous bedrock. Other differential species *Rubus hirtus*, *Veronica urticifolia*, *Rosa pendulina* show a moderately acidophilic character of the described form.

The *holotypus* of the form is relevé no. 46, Table no. 1.

Homogyno sylvestris-Fagetum* var. *geogr. typica luzuletosum sylvaticae* subass. *nova hoc loco

It thrives on higher elevations above sea level ranging from 1300 to 1450 metres and passes over directly to the association *Adenostyles glabrae-Piceetum*.

The subassociation grows on the remnants of the calcareous glacier loose rocks. Gently inclined slopes, plateaus and wide ditches predominate. There are skeletal Rendzina and shallow Chromic Cambisol, covered with well-rotted and partially raw humus on Dachstein limestones and triassic dolomites. The differential species of the subassociation are *Calamagrostis villosa*, *Homogyne alpina*, *Huperzia selago*, *Luzula sylvatica*, *Lycopodium annotinum*, *Melampyrum sylvaticum* and *Vaccinium vitis-idaea*. *Rosa pendulina*, which has a high constancy and has also a partial differential character.

The species of the suballiance *Saxifrago-Fagenion* are very well represented regarding the number and cover of the species complying with the strong altimontane character of the community.

The species of the alliance *Aremonio-Fagenion* are represented to a smaller extent. Particularly the species *Hacquetia epipactis*, *Lamium orvala*, *Vicia oroboides*, *Primula vulgaris*, *Knautia drymeia* subsp. *drymeia*, the species of the alliance *Aremonio-Fagenion* growing particularly in the submontane and montane belt and *Omphalodes verna* and *Calamintha grandiflora*, and the species with Dinaric distribution pattern, are completely missing. Special site conditions result also in a smaller cover of the species of beech forests. The facies of the species of *Carex alba* can be found on smaller surfaces.

The *holotypus* of the subassociation is relevé no. 50, Table no.1, *holotypus hoc loco*.

Homogyno sylvestris-Fagetum* var. *geogr. typica vaccinietosum myrtilli* subass. *nova hoc loco

It grows on the bottom of broad pre-Alpine valleys. It is particularly well developed in the valley of Logarska dolina, having a partial frost pocket character. Cold climatic conditions and abundant precipitation result in the predominance of raw humus and thus in the partially acidophilic character of the subassociation in the differential species combination, namely *Vaccinium myrtillus*, *Rubus saxatilis*, *Bazzania trilobata*. The partially acidophilic character of the subassociation is confirmed by the great cover value of the species *Oxalis acetosella* and the constant presence of the species *Maianthemum bifolium*, *Hieracium sylvaticum* and *Phegopteris connectilis*. Furthermore, the species *Carex alba*, which frequently grows luxuriantly on young soils over the deposited limestone gravel, is mentioned as the differential species. The sites of the subassociation are, in fact, periodically inundated by torrents. With regard to the lower altitudes of the subassociation (approx. 800 metres), it is clear that the species of the suballiance *Saxifrago-Fagenion* are less represented. The species *Saxifraga rotundifolia* was noted only once. Moreover, the species of the order *Adenostyletalia* are less represented.

The nomenclature type of the subassociation is relevé no. 59, Table no.1, *holotypus hoc loco*.

Numerical analysis and synsystematic spectrum

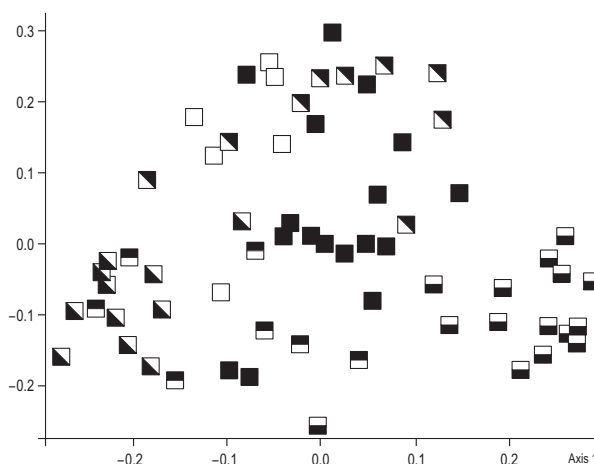


Figure 1: Numerical analysis of the *Homogyno-Fagetum*.
Slika 1: Numerična analiza asociacije *Homogyno-Fagetum*.

■ *typicum*, ■ *mercurialetosum*, ▴ *festucetosum altissimae*, □ *calamagrostietosum variaae*, ▣ *luzuletosum sylvaticae*, ▤ *vaccinietosum myrtilli*.

The numerical analysis (Fig. 1) shows the gradient of the most acidophilic subassociation *vaccinietosum* over *luzuletosum sylvaticae*, *calamagrostietosum variae*, *mercurialetosum*, *typicum* to the most basiphilic subassociation *festucetosum altissimae*. Axis 2 reflects the thermicity. The most frigidiphilic subassociation *festucetosum altissimae*, *vaccinietosum* and *luzuletosum sylvaticae* over *typicum* to the most thermophilic *calamagrostietosum* and *mercurialetosum*.

The synsystematic spectrum (Fig. 2) shows that the classes *Erico-Pinetea* and *Vaccinio-Piceetea* are better represented in the pre-Alpine and Alpine zone, whereas more species of the beech forest (*Fagetalia*) are revealed in the Dinaric Alps.

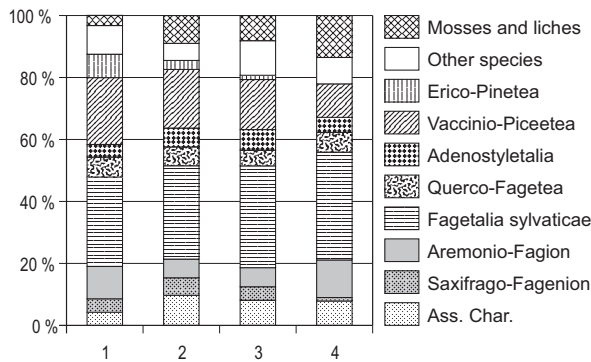


Figure 2: Synsystematic spectrum.
Slika 2: Sinsistematski spekter.

1 – *Anemono trifoliae-Fagetum* Tregubov 1962 (Marinček, Poldini & Zupančič 1989); 2 – *Homogyno sylvestris-Fagetum* Marinček et al. 1993 (Marinček & Čarni, Table 1) 3 – *Omphalodo-Fagetum* (Tregubov 1957) Marinček et al. 1993 var. geogr. *Saxifraga cuneifolia* (Surina 2001), 4 – *Omphalodo-Fagetum* (Tregubov 1957) Marinček et al. 1993 (Puncer 1980).

DISCUSSION

At the beginning of the discussion, it could already be confirmed that the study of the pre-Alpine fir and beech forests by Marinček & Dakskobler (1988) has been neglected, or else the results of the studies of the pre-Alpin fir and beech forests were not published properly in comparison with the studies of the Dinaric forests of the association *Omphalodo-Fagetum*.

Since 1965, the basis for divulging the contents of the phytosociology of the pre-Alpine fir and beech forests was provided by a synthetic table of Robič (Košir et al. 1968), in which was presented the phytosociological composition of the pre-Al-

pine fir and beech forests on the calcareous (*Abieti-Fagetum praealpino-dinaricum*) as well as on the noncalcareous bedrock (*Abieti-Fagetum praealpino-dinaricum luzuletosum albidae*).

This was used for the first time for comparisons with the pre-Alpine fir and beech forests in the above mentioned discussion by Marinček and Dakskobler. Taking into consideration the opinion of Robič, the authors mentioned for the pre-Alpine fir and beech forests as character species and differential species (*Abieti-Fagetum praealpinum=Homogyno sylvestris-Fagetum*): *Adenostyles glabra*, *Polygonatum verticillatum*, *Ranunculus platanifolius*, *Veronica urticifolia*, *Anemone trifolia* and *Festuca altissima*. The revision of the nomenclature of the Illyrian beech forests of the alliance *Aremonio-Fagion* (Marinček et al. 1993) introduced the binomial designation of forest communities on the floristic basis.

A constant, but more or less abundant presence of fir in a tree layer results in certain ecological contents of these forests. Fir and beech forests thrive in special ecological conditions, as mentioned in the introduction. Its constant mixture differentiates the association *Homogyno sylvestris-Fagetum* from more or less pure beech forests bordering the described association, either from the Alpine beech forests *Anemono-Fagetum* or from altimontane beech forests of the pre-Alpine region of the Illyrian floral province *Ranunculo platanifolii-Fagetum* var. geogr. *Hepatica nobilis* or the sub-Alpine beech forests of type *Polysticho lonchitis-Fagetum* var. geogr. *Salix waldsteiniana*.

With regard to the relatively weak character species of the association, the differential species are rather more significant. Marinček & Dakskobler (1988) stated *Adenostyles glabra*, *Polygonatum verticillatum*, *Ranunculus platanifolius*, *Veronica urticifolia*, *Anemone trifolia* as differential species of the pre-Alpine fir and beech forests. The association *Homogyno sylvestris-Fagetum* has only recently been attached to the suballiance *Saxifrago-Fagenion* (Marinček et al. 1993). The differential species of the suballiance *Adenostyles glabra*, *Polygonatum verticillatum* and *Ranunculus platanifolius*, however, indicate very well the altimontane site conditions of stands of the association *Homogyno sylvestris-Fagetum*, although they cannot function as their differential species at the same time.

The differential species of the association is a whole series of moderately acidophilic to acidophilic species such as *Veronica urticifolia*, *Valeriana tripteris*, *Vaccinium myrtillus*, *Rubus saxatilis*, *Hieracium sylvaticum*, *Vaccinium vitis-idaea* and *Larix*

decidua. The species listed indicate a more acidic form of humus as the consequence of a colder Alpine climate and higher elevations above sea level (according to Marinček & Dakskobler 1988, see also Marinček 1983).

As indicated in the introduction, the association *Homogyno sylvestris-Fagetum* belongs to the alliance of Illyrian beech forests *Aremonio-Fagion*. The floristic composition, ecological and synecological conditions of the associations *Lamiastro flavidi-(Abieti)-Fagetum* Zukrigl 1987 (= *Lamiastro flavidi-Fagetum*) and *Savensi-Fagetum* var. *Abies alba* Košir 1962 (= *Cardamino savensi-Fagetum*) and the comparison with the pre-Alpine fir and beech forests on the calcareous bedrock have already been dealt with by Marinček & Dakskobler (1988). This discussion will be limited to the ecological and floristic comparison with the Alpine beech forests *Anemono-trifoliae-Fagetum* Tregubov 1962, and with the Dinaric fir and beech forests *Omphalodo-Fagetum* (Tregubov 1957 corr. Puncer 1980) Marinček et al. 1993.

The ecological and floristic comparison between Dinaric (*Omphalodo-Fagetum*) and pre-Alpine fir and beech forests (*Homogyno sylvestris-Fagetum*) arouses great interest. The Dinaric fir and beech forests are a prototype of the Illyrian fir and beech forests. Favourable edaphic conditions result from the predominant limestone bedrock, on which the karstic relief is completely developed. It produces constantly high air humidity and predominantly well developed Chromic Cambisol as a result of abundant precipitation. In this way optimal conditions for the growth of fir and beech forests within the European region are provided. Favourable site edaphic conditions, particularly the well developed Chromic Cambisol in comparison with the pre-Alpine fir and beech forests are indicated by mezophilic and neutrophilic species such as *Galium odoratum*, *Carex sylvatica*, *Myosotis sylvatica*, *Solanum dulcamara*, *Chrysosplenium alternifolium*, *Urtica dioica* which do not appear, or appear only seldom in the association *Homogyno sylvestris-Fagetum*. In particular, they differ among themselves floristically with regard to the presence and cover the size of character species and differential species of the alliance *Aremonio-Fagion*. The Dinaric fir and beech forests grow in the centre of the Illyrian floral province, and the species as *Omphalodes verna*, *Calamintha grandiflora*, *Primula vulgaris*,

Hacquetia epipactis, *Euphorbia carniolica* and *Rhamnus fallax* are well represented. Hence, they appear more or less as accidental species in stands of the association *Homogyno sylvestris-Fagetum*. Moreover, they reach a high constancy and coverage value in the association *Omphalodo-Fagetum* and give a characteristic feature to Dinaric fir and beech forests. Additionally, species like *Dentaria trifolia*, *Scopolia carniolia*, *Dentaria polyphylla* and *Daphne laureola* are diagnostically very significant for the fir and beech forests. They do not appear at all in the syntaxon *Homogyno sylvestris-Fagetum* var. *geogr. typica*.

The pre-Alpine fir and beech forests grow in more rough ecological conditions compared to the Dinaric forests. The climate of the pre-Alpine and Alpine region is colder, edaphic conditions are more initial because of the predominant dolomite bedrock. Furthermore, higher altitudes cause the formation of well-rotted and raw humus.

The bordering location of the site of the association *Homogyno sylvestris-Fagetum* at the edge of the Illyrian floral province is also of great importance. Particularly, ecologically more demanding species of beech forests and differential species of the alliance *Aremonio-Fagion* have a lower vitality and are less frequently encountered. On the other hand, there is a whole series of acidophilic elements in the association *Homogyno sylvestris-Fagetum* like *Veronica urticifolia*, *Valeriana tripteris*, *Vaccinium myrtillus*, *Rubus saxatilis*, *Hieracium sylvaticum*, *Vaccinium vitis-idaea* and *Larix decidua* which clearly differentiate the pre-Alpine fir and beech forests from the Dinaric forests. Mention should be made of the species *Larix decidua* which appears mainly at the highest altitudes. However, its presence indicates the partially Alpine character of the association.

Differential species of the association *Anemono trifoliae-Fagetum* are also a group of species of the order *Erico-Pinetalia*: *Pinus sylvestris*, *Buphthalmum salicifolium*, *Erica carnea*, *Polygala chamaebuxus* and some other species. They reach an optimal development in the Alpine beech forests, particularly at lower altitudes (*Anemono trifoliae-Fagetum* var. *geogr. Helleborus niger cephalantheretosum*) and in more extreme sites in relation to the land configuration. However, their appearance in the distribution area of the association indicates their specific syngeneses and relationship with the association *Orno-Pinetum nigrae*.

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Table 1: Illyrian pre-alpine fir and beech forest – the association *Homogyne sylvestris-Fagetum* Marinček et al. 1993
Tabela 1: Ilirski predalpski jelovo-bukovi gozdovi – asociacija *Homogyne sylvestris-Fagetum* Marinček et al. 1993

Relevé no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32				
Altitude (in 10 m)	97	101	102	78	98	96	107	76	141	145	105	106	119	105	70	110	101	125	101	125	120	130	108	96	100	103	107	73	75	106	100	129				
Aspect	W	NE	NW	N	N	S	NE	EN	S	W	E	NE	NW	N	pl	N	NE	S	S	W	W	S	SW	SE	NW	NE	N	SE	N	NW	N	S				
Slope (in degrees)	15	35	30	35	30	20	25	10	15	20	5	30	15	20		10	15	35	15	30	40	25	30	30	30	30	35	40	35	35	45	20				
Rock coverage (in %)	15		10	1	20	5		60	30	20	40	20		15	1	10	40	70	30		5	40	5		10		30	10		40	35	20				
Surface (in m ²)	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400				
Coverage (in %)																																				
– tree layer	A	90	95	90	90	80	90	80	80	80	90	90	90	80	95	90	90	90	70	90	85	90	80	80	90	95	90	90	90	95	95	80	80			
– shrub layer	B	30	2	2	15	30	30	30	70	2	10	5	5	20	5	20	5	10	10	20	5	15	10	30	5	5	5	2	25	20	10	20	5			
– herb layer	C	80	30	30	30	50	50	40	60	30	90	70	40	40	20	70	30	50	50	60	70	60	80	60	40	50	40	40	70	80	50	50	80			
– moos layer	D	10	1	2	5	5	5		30	2	5	40	20		10		5	20	10	10		5	5				5	10		20	20	20				
Subassociations		typicum														calamagrostietosum variae							mercurialetosum													
																var. <i>Gymnocarpium dryopteris</i>							var. <i>Cephalanthera</i>							var. <i>Homogyne sylvestris</i>						
Lower units	layer	var. <i>Hacquetia</i>																																		
Char. species of ass.																																				
<i>Homogyne sylvestris</i>	C	1	+	+	1	.	+	.	+	.	.	+	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Diff. species of subass.																																				
<i>Hacquetia epipactis</i>	C	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Gymnocarpium dryopteris</i>																																				
<i>Lonicera nigra</i>	B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Dryopteris carthusiana</i> agg.	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Calamagrostis varia</i>																																				
<i>Carex alba</i>	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Mercurialis perennis</i>	.	1	1	1	+	1	1	2	.	.	2	1	.	+	1	+	1	.	1	+	.	2	1	.	2	2	2	2	3	3	2	3	2	1	.	
<i>Salvia glutinosa</i>	1	.	.	+	.	+	.	+	.	+	+	.	+	.	+	.	+	.	+	.	+	.	+	.	+	.	+	.	+	.	+	.	+	.	+	
<i>Cephalanthera damasonium</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Polygonatum multiflorum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Homogyne sylvestris</i>	1	+	+	1	.	+	.	+	.	+	.	+	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Neckera crispa</i>	D	+	.	.	+	+	.	1	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Festuca altissima</i>	C	.	.	.	+	2	.	2	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Galium odoratum</i>	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Hordeleymus europaeus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Ranunculus lanuginosus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Sambucus nigra</i>	B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Luzula sylvatica</i>	C	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Huperzia selago</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Melampyrum sylvaticum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Vaccinium vitis-idaea</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Homogyne alpina</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Lycopodium annotinum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Calamagrostis villosa</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Vaccinium myrtillus</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Rubus saxatilis</i>	B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Bazzania trilobata</i>	D	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Saxifraga-Fagenion																																				
<i>Polygonatum verticillatum</i>	C	+	.	.	.	+	+	+	.	+	+	+	+	+	+	.	1	1	+	.	+	+	+	1	+	+	+	+	+	+	+	+	+	+		
<i>Adenostyles glabra</i>	.	1	1	.	1	+	1	.	+	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Relevé no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32					
<i>Ranunculus platanifolius</i>	.	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
<i>Clematis alpina</i>	B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1	+	+			
<i>Saxifraga rotundifolia</i>	C	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
<i>Polystichum lonchitis</i>	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
<i>Adenostyles alliariae</i>	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Aremonio - Fagion																																					
<i>Cardamine trifolia</i>	2	.	+	1	2	+	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	.	.	+	.	+	1	+	+	+				
<i>Dentaria enneaphyllos</i>	.	+	.	+	.	+	.	1	+	1	1	+	+	1	+	1	1	.	.	+	+	+	.	2	1	1	+	.	+	1	+	+	+	+			
<i>Cyclamen purpurascens</i>	+	1	1	.	1	1	.	.	.	.	.	+	.	+	+	1	+	1	.	1	.	1	+	1	1	1	+	1	1	+	1	+	+	+		
<i>Aposeris foetida</i>	+	+	+	.	.	+	.	.	.	.	+	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
<i>Helleborus niger</i>	.	1	1	.	.	1	.	.	.	1	+	.	.	.	.	.	+	+	.	.	1	+	.	.	.	1	1	.	.	.	.	.	.	.	+
<i>Aremonia agrimonoides</i>	1	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
<i>Lamium orvala</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fagetalia sylvaticae																																					
<i>Fagus sylvatica</i>	A	+	4	5	3	4	5	3	4	3	4	4	2	2	4	1	4	1	2	2	2	3	3	4	4	5	4	5	4	4	3	3	2				
<i>Fagus sylvatica</i>	B	3	+	+	1	.	1	+	2	+	.	+	+	1	+	3	1	+	.	1	+	1	+	2	+	.	1	+	+	+	+	1	1				
<i>Fagus sylvatica</i>	C	.	.	.	.	1	1	.	.	.	.	.	.	.	.	.	1	.	+	+	.	+	.	+	1	.	.	1	.	.	.	.	.	.	.
<i>Lamium montanum et flavidum</i>	.	.	+	.	.	1	.	+	+	+	1	+	+	+	1	+	1	+	+	+	.	+	+	1	.	+	1	.	+	+	.	.	.	.	+
<i>Prenanthes purpurea</i>	.	+	+	+	.	.	+	.	.	.	.	1	1	+	.	1	.	+	1	+	+	+	1	1	+	+	+	+	+	+	+	1	+			
<i>Daphne mezereum</i>	B	+	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Mycelis muralis</i>	C	.	.	+	.	+	+	+	1	+	+	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.
<i>Acer pseudoplatanus</i>	A	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Acer pseudoplatanus</i>	B	.	+	+	.	+	+	.	1	.	+	1	+	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Acer pseudoplatanus</i>	C	.	.	.	+	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Euphorbia amygdaloides</i>	+	+	+	+	.	.	+	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Paris quadrifolia</i>	.	.	+	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Polystichum aculeatum</i>	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Viola reichenbachiana</i>	+	.	.	.	+	+	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Actaea spicata</i>	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Phyteuma sp.</i>	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Lonicera alpigena</i>	B	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Petasites albus</i>	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Sanicula europaea</i>	+	.	.	.	.	+	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Fraxinus excelsior</i>	B
<i>Melica nutans</i>	C	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Epilobium montanum</i>
<i>Lilium martagon</i>	+	+	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Symphytum tuberosum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Scrophularia nodosa</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Pulmonaria officinalis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Acer platanoides</i>	B	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Brachypodium sylvaticum</i>	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Carex sylvatica</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Dentaria bulbifera</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Neottia nidus-avis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Geranium robertianum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Adoxa moschatellina</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Aruncus dioicus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Epipactis helleborine</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Fragaria moschata</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Quercu - Fagetea																																					
<i>Anemone nemorosa</i>	1	+	+	.	1	1	.	.	.	.	+	+	1	.	+	1	2	1	.	+	.	+	+	+	+	+	+	.	.	.	.	.	.	1	+	
<i>Carex digitata</i>	1	+	+	.	1	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Relevé no.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32					
<i>Hepatica nobilis</i>		1	+	.	.	.	+	.	.	.	+	.	.	.	.	1	1	.	.	.	.	1	.	.	.	.	.	.	+	.	.	.	2	+			
<i>Galium laevigatum</i>		+	.	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	1	.	+	+	+				
<i>Ajuga reptans</i>		.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Corylus avellana</i>	B	+	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.
<i>Laburnum alpinum</i>		.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	.	.
<i>Lonicera xylosteum</i>		+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
<i>Fraxinus ornus</i>		+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Clematis vitalba</i>		.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Platanthera bifolia</i>	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
<i>Ostrya carpinifolia</i>	A	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
<i>Helleborus odorus</i>	C	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Adenostyletalia																																						
<i>Dryopteris filix-mas</i>	C	.	+	+	.	+	+	+	+	+	+	1	+	+	+	+	1	+	+	+	+	.	+	+	.	+	+	+	+	+	.	+	+	+				
<i>Senecio ovatus</i>	1	+	.	+	+	+	+	+	+	+	1	1	.	.	.	+	+	+	+	1	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.
<i>Athyrium filix-femina</i>		.	.	+	+	.	.	+	+	.	.	.	.	+	+	1	1	.	.	.	.	+	+	+	.	.	.	.	.	.	.	+	.	.	+
<i>Veratrum album</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Ribes alpinum</i>	B	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
<i>Doronicum austriacum</i>	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Vaccinio - Piceetea																																						
<i>Abies alba</i>	A	4	3	2	4	+	.	3	3	2	1	3	4	2	2	1	2	3	2	4	2	3	2	1	3	3	3	+	2	4	2	3	2					
<i>Abies alba</i>	B	1	.	+	1	3	1	1	1	.	+	+	+	1	1	+	1	1	+	+	+	+	1	1	.	.	.	+	+	+	1	1	+	1	1			
<i>Abies alba</i>	C	+	+	.	+	.	+	+	.	.	+	+	1	+	+	+	1	+	+	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.
<i>Picea abies</i>	A	1	.	.	.	+	+	+	+	+	+	3	2	1	1	3	1	3	+	.	3	+	+	.	.	.	.	.	+	+	+	3	+	1			
<i>Picea abies</i>	B	+	.	+	.	1	.	.	1	+	.	.	.	1	1	.	+	+	1	.	+	+	1	+	.	.	.	.	.	.	+	1	1	.	+		
<i>Picea abies</i>	C	+	.	.	.	.	.	+	.	+	.	.	.	.	.	.	1	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Oxalis acetosella</i>	1	.	.	1	1	+	+	1	1	2	1	1	2	1	2	+	2	1	+	2	1	.	1	+	.	.	.	.	.	.	.	1	1	.			
<i>Veronica urticifolia</i>	+	+	+	.	+	.	+	.	.	.	.	+	+	+	.	.	.	.	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	+	1	+	
<i>Gentiana asclepiadea</i>	1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	1	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
<i>Valeriana tripteris</i>	.	+	1	.	+	+
<i>Hieracium sylvaticum</i>	+	.	.	.	.	+	+	.	.	.	.	.	1	.	.	.	.	.	.	.	+	1	1	+	.	.	.	.	.	.	.	.	.	+	1	+	
<i>Maianthemum bifolium</i>	2	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	1	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Rosa pendulina</i>	B	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
<i>Solidago virgaurea</i>	C	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+
<i>Luzula luzuloides</i>	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Thelypteris phegopteris</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Dryopteris assimilis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Saxifraga cuneifolia</i>	C	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
<i>Larix decidua</i>	A	.	.	.	+	+	.	.	.	.	.	.	.	.	.	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
<i>Calamagrostis arundinacea</i>	C	.	.	.	+	+	.
<i>Luzula luzulina</i>	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Luzula pilosa</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Other species																																						
<i>Sorbus aucuparia</i>	B	+	.	+	.	.	+	.	.	.	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
<i>Rubus idaeus</i>	.	+	+	+	.	.	+
<i>Fragaria vesca</i>	C	+	+	+	+	+	+	.
<i>Asplenium viride</i>	+	.	+	.	.	.	+	+	.
<i>Sorbus aria</i>	B	+	+	.
<i>Digitalis grandiflora</i>	C	+	+	.
<i>Veronica officinalis</i>
<i>Cirsium erisithales</i>	+	+	.
<i>Aquilegia vulgaris</i> agg.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Rubus hirtus</i>	B	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Hypericum montanum</i>	C	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Eupatorium cannabinum</i>	+

Relevé no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32								
<i>Dactylorhiza maculata</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Asplenium trichomanes</i>	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Cystopteris fragilis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Moehringia muscosa</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mooses and lichenes																																								
<i>Ctenidium molluscum</i>	D	1	.	+	+	2	+	+	2	1	1	2	2	2	1	.	1	2	2	+	+	.	.	+	+	+	+	+	1	.	1	2	2	.	.					
<i>Isoetecium alopecuroides</i>	+	.	.	+	+	.	.	1	.	1	1	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	1	1				
<i>Plagiochila asplenioides</i>	.	.	.	+	1	.	+	1	.	+	1	.	+	1	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Polytrichum formosum</i>	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Fissidens taxifolius</i>	+	.	+	+	1	+	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	1	1	.	.			
<i>Tortella tortuosa</i>	.	.	.	.	.	+	.	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	1				
<i>Dicranum scoparium</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
<i>Hypnum cupressiforme</i>	+	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Thuidium tamariscinum</i>	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Rhytidiadelphus triquetrus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
<i>Eurhynchium angustirete</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Cladonia pyxidata</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
<i>Grimmia pulvinata</i>	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
<i>Plagiothecium denticulatum</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Bartramia pomiformis</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
<i>Rhytidiadelphus loreus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
<i>Metzgeria furcata</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
<i>Racomitrium canescens</i>	+	1	.

Appendix to Table 1:

Less frequent species: 1. *Primula vulgaris* C +, *Crataegus monogyna* B +, *Rosa arvensis* +, *Rubus* sp. +, *Bromus ramosus* C +, 3. *Betonica officinalis* C +, 4. *Asarum europaeum* C +, 6. *Calamintha grandiflora* C +, 7. *Omphalodes verna* C +, 8. *Rhamnus fallax* B +, *Gymnocarpium robertianum* C +, *Ostrya carpinifolia* B +, *Cladonia rangiferina* D +, 9. *Astrantia carniolica* C +, 10. *Cicerbita alpina* +, *Vicia oroboides* +, *Poa nemoralis* +, 13. *Orthilia secunda* C +, 15. *Lathyrus vernus* C +, *Milium effusum* +, *Anomodon attenuatus* D +, *Sambucus racemosa* C +, *Dicranella heteromalla* D +, 18. *Polypodium vulgare* C +, 19. *Solanum dulcamara* C +, 20. *Orthilia secunda* C +, *Carex flacca* +, 21. *Sambucus racemosa* B +, *Deschampsia cespitosa* C +, 23. *Primula vulgaris* C +, *Omphalodes verna* +, 25. *Polypodium vulgare* C +, *Thalictrum aquilegifolium* C +, 26. *Euphorbia carniolica* C +, 27. *Anomodon attenuatus* D +, 28. *Convallaria majalis* C +, 29. *Hedera helix* B +, 31. *Leucobryum glaucum* D +, 32. *Erica carnea* C +, 33. *Phyllitis scolopendrium* C +, *Aegopodium podagraria* +, 34. *Ulmus glabra* A +, 36. *Rhamnus fallax* B +, *Cladonia rangiferina* D +, *Campanula trachelium* C +, 37. *Ulmus glabra* A +, 38. *Stellaria montana* C +, 39. *Stellaria montana* C +, *Galium rotundifolium* C 1, *Atrichum undulatum* D +, 40. *Clematis alpina* C +, 43. *Veronica montana* C +, 46. *Adenostyles alliariae* 1, *Deschampsia cespitosa* +, *Poa nemoralis* +, *Crepis paludosa* +, 47. *Leucobryum glaucum* D +, 48. *Astrantia carniolica* C +, 49. *Ribes grossularia* B +, 50. *Verbascum nigrum* C +, 51. *Gymnocarpium robertianum* C +, *Geranium sylvaticum* +, *Aconitum degenii* subsp. *paniculatum* +, *Anthriscus nitidus* +, *Neckera complanata* D +, *Rhizomnium punctatum* +, 55. *Calamintha grandiflora* C +, *Knautia drymeia* subsp. *drymeia* +, *Viburnum lantana* B +, *Melittis melissophyllum* +, *Astrantia carniolica* +, *Pteridium aquilinum* +, 56. *Berberis vulgaris* B +, 58. *Veronica montana* C +, *Crepis paludosa* +, 60. *Hypnum cupressiforme* D +, *Polystichum braunii* C +, *Lunaria rediviva* +.

Localities of relevés: 1. Jezersko, between Roblek and Vršnik; 2. Lučka Bela; 3. Petrovo Brdo; 4. Kamniška Bistrica, under Žagana peč; 5. Petrovo Brdo, on the border of GG Kranj and GG Tolmin; 6. Zali Log, Plestenjak; 7. Zali Log; 8. Jezersko, between Kopašča and Ovča koča; 9. Jezersko, at the station of cabel railway upon Češka koča; 10. Matkov kot, dep. 139a; 11. Kamniška Bistrica; 12. Jezersko, under Turni; 13. under Uršlja gora; 14. Železniki, Vancovec; 15. Petrovo Brdo, under Porezen; 16. Jelovica, 300 m western of Kališnik; 17. Jezersko, below the road under Mali vrh; 18. Zali Log, above Zadnja molža; 19. 20. Menina planina, Kerjavska peč; 21. Zali Log, border to GG Bled; 22. Jezersko, below the station of the cable railway to Češka koča; 23. Davča, Plestenjak; 24, 25, 26. Kamniška Bistrica, below Kuharjev vrh; 27. Menina planina; 28, 29. Menina planina, Kerjavska peč; 30. Zali Log, Črni vrh above Soriška planina; 31. Lučka Bela, Žegnani studenec; 32. Vancovec, below the hill 1000; 33. Jelendol; 34. Dobrovlje, below Tolsti vrh; 35. Jelendol; 36. Vancovec, Železniki; 37. Menina planina, above Pesek towards hut; 38, 39. Menina planina, besides the road to the hut; 40. Dobrovlje, between Tolsti vrh and Šentjoški vrh; 41. Dražgoše, below Mili pogled; 42. Menina planina; 43 – 46. Menina planina; 47 Kamniška Bistica, below Žagana peč; 48 – 53. Jelendol; 54. Jelovica, below Jarčji vrh; 55 - 65. Logarska dolina.

