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SUBALPINE BEECH FOREST WITH HAIRY ALPENROSE (*POLYSTICHO LONCHITIS-FAGETUM RHODODENDRETOSUM HIRSUTI* SUBASS. NOVA) ON MT. SNEŽNIK (LIBURNIAN KARST, DINARIC MTS)

Boštjan SURINA* & Marash RAKAJ**

Abstract

Subalpine beech stands with Hairy Alpenrose (*Rhododendron hirsutum*) were phytosociologically studied on Mt. Snežnik (Dinaric Mts). They thrived on stony and steep slopes of northern exposure. Comparisons with other subalpine Beech stands (*Polysticho lonchitis-Fagetum* s. lat.), Dinaric Fir-Beech stands with Hairy Alpenrose (*Omphalodo-Fagetum* s. lat. *rhododendretosum hirsuti*), and prealpine fir-beech stands with Hairy Alpenrose (*Homogyno sylvestris-Fagetum* s. lat. *rhododendretosum hirsuti*), stands of Hairy Alpenrose and Beech (*Rhododendro hirsuti-Fagetum* s. lat.), as well as Austrian subalpine beech stands (*Saxifrago rotundifoliae-Fagetum* s. lat.) showed their unique floristical composition due to ecological conditions, and thus distinct syntaxonomical position within the association *Polysticho-Fagetum.* Therefore, a new subassociation *Polysticho-Fagetum rhododendretosum hirsuti* subass. nova was described, and – as differential species for the subassociation – *Rhododendron hirsutum, Rubus saxatilis, Rosa pendulina*, and *Clematis alpina* were chosen.

Key words: **Dinaric Mts, Mt. Snežnik,** *Polysticho-Fagetum*, subalpine beech forest, *Rhododendron hirsutum*, vegetation

Izvleček

Prispevek podaja fitocenološko oznako subalpinskega bukovega gozda (*Polysticho lonchitis-Fagetum*) z dlakavim slečem (*Rhododendron hirsutum*) na Snežniku. Obravnavani sestoji uspevajo na kamnitih in/ali skalnatih ter strmih pobočjih severnih ekspozicij. Primerjave z ostalimi subalpinskimi bukovimi ter (jelovo-)bukovimi sestoji z dlakavim slečem (*Omphalodo-Fagetum rhododendretosum hirsuti, Homogyno sylvestris rhododendretosum hirsuti, Rhododendro-Fagetum*) ter subalpinskimi bukovji iz Avstrije (*Saxifrago rotundifolii-Fagetum*) so pokazale njihov poseben sintaksonomski položaj v okviru asociacije *Polysticho-Fagetum.* Zato smo te sestoje uvrstili v novo subasociacijo *Polysticho-Fagetum rhododendretosum hirsuti* subass. nova, za razlikovalnice pa izbrali vrste *Rhododendron hirsutum, Rubus saxatilis, Rosa pendulina* in *Clematis alpina.*

Ključne besede: Dinaridi, Snežnik, *Polysticho-Fagetum*, subalpinski bukov gozd, *Rhododendron hirsutum,* vegetacija

INTRODUCTION

Subalpine beech forests in Dinaric Mts: a brief synsystematic overview

Horvat (1938) classified beech forests in NW Dinaric Mts into three subassociations, namely: (a) montane beech forests *Fagetum sylvaticae croaticum australe montanum*, (b) montane and altimontane Dinaric fir-beech forests *Fagetum sylvaticae croaticum australe abietetosum*, and (c) subalpine beech forests *Fagetum sylvaticae croaticum australe subalpinum.* Subsequent studies clearly showed that Horvat's classification of beech forests from the alliance *Aremonio-Fagion* (= *Fagion illyricum*) was too broad; consequently, beech forest subassociations were ranked as associations and several new floristically and ecologically more or less well defined associations were described (e.g. Tregubov 1957, Košir 1979, Marinček 1983, 1996, Dakskobler 1997, Marinček 1998).

* University of Vienna, Faculty of Life Sciences, Department of Biogeography, Rennweg 14, A-1030 Vienna, Austria
Natural History Musem Rijeka, Lorenzov prolaz 1, 51000 Rijeka, Croatia. Bostjan.Surina@univie.ac.at
** Universiteti i Shkodrës »Luigj Gurakuqi«, Departimenti Biologji-Kimisë, Shkodër, Albania

After the nomenclature revision of the alliance *Aremonio-Fagion* (Marinček et al. 1993, but see also Poldini & Nardini 1993), the subalpine beech association (*Fagetum sylvaticae croaticum australe subalpinum* Horvat 1938) was split into two new associations: *Ranunculo platanifolii-Fagetum* (altimontane belt) and *Polysticho lonchitis-Fagetum* (extrazonally on exposed and/or northern slopes in altimontane belt, but commonly (zonally) in subalpine belt up to the forest line). There were attempts to further phytogeographically differentiate association *Polysticho-Fagetum* into geographical variants: (a) *Anemone trifolia* (Poldini & Nardini 1993) for NE Italy and W Slovenia, (b) *Salix waldsteiniana* (Marinček 1996) for the south-eastern foothills of the Julian Alps (namely Mts Blegoš and Ratitovec), and (c) *Allium victorialis* (Marinček 1996) for the Dinaric Mts, but according to our analyses they seemed to be of low synsystematic significance.

Subalpine beech forests on Mt. Snežnik

Tomažič was one of the first who studied subalpine beech stands on Mt. Snežnik but unfortunately the results (i.e. phytosociological tables) were never published (e.g. Zupančič 2001). Nevertheless, together with colleagues he successfully conducted extensive vegetation mappings throughout the study area and, as a result, detailed vegetation maps were provided (Tomažič & Tregubov 1958, 1959). He classified subalpine beech stands into the association *Allio victorialis-Fagetum* Tomažič nom. nud., and mapped them throughout the southern part of the Snežnik plateau. Afterwards, Tregubov (1957) provided three relevés (from Kujavič, Drče and NE slopes of the summit) and classified them within the association *Fagetum subalpinum* (sensu Horvat 1938). Only in 1996 Marinček published 29 relevés of subalpine beech stands from the plateaus of Trnovski gozd and Snežnik (NW Dinaric Mts), classifying them into the geographical variant *Polysticho-Fagetum* var. geogr. *Allium victorialis*, he recognised three subassociations: -*polystichetosum* (with variants *Gymnocarpium dryopteris* and *Adoxa moschatellina*), -*adenostyletosum alliariae*, and -*hacquetietosum*. Unfortunately, from the phytosociological table it is hardly possible to distinguish localities of relevés between the plateaus of Trnovski gozd and Snežnik.

One of the most distinctive characteristics of subalpine beech stands (beside the floristic composition) is their unique physiognomy. Specially on the upper limit of their altitudinal range (forest line), distorted, twisted stems and curved branches of beech trees make stands appear picturesque. Due to harsh environmental conditions (strong Bora, low winter temperature and heavy snowfalls) beech stands rarely exceed 3–5 m in height and 10–30 cm in trunk diameter.

Subalpine beech stands of *Polysticho-Fagetum* are fairly widespread throughout the plateau, but they rarely (only above 1300–1400 m a.s.l. and mostly on the southern part of the Snežnik plateau) extend over larger areas. They usually thrive on mountain ridges, summits and northern slopes of mountains between 1300–1500 (1600) m a.s.l., forming a distinct forest line in direct contact with stands of Mountain pine (*Hyperico grisebachii-Pinetum mugo* var. geogr. *Arabis scopoliana*), as well as Dinaric subalpine tussock grasslands (alliance *Seslerion juncifoliae*). Probably, as a consequence of pasture activites in 19th century (according to Smerdel 1989), the upper altitudinal limit of stands (forest line!) might have been significantly lowered (e.g. Kindler 1957, Pogačnik & Prosen 1998). Subalpine beech stands may well occur also on lower altitudes of the plateau in freezing ravines as a result of extreme ecological conditions due to temperature inversion (Surina & Vreš 2004). On the other hand, the transition area on the lower altitudinal limit of stands might extend (mostly on northerly exposed and colder slopes) well into the altitudinal range of stands of other syntaxa (namely *Ranunculo-Fagetum* var. geogr. *Calamintha grandiflora*) and/or *Omphalodo-Fagetum* var. geogr. *Calamintha grandiflora*), and thus making sufficient delimitation of stands of different syntaxa (specialy *Ranunculo-Fagetum*) hardly possible.

During our research on flora and vegetation of the Liburnian karst we noticed on several occasions physiognomically, floristically and ecologically distinct subalpine beech stands with predominating Hairy Alpenrose (*Rhododendron hirsutum*) in shrub and/or herb layer thriving on steep, rocky and most frequently northerly exposed slopes. The aim of the present study was thus to determine their ecological and syntaxonomical position in comparison to other similar (fir-)beech stands with Hairy Alpenrose within the alliance *Aremonio-Fagion*.

Study area

The Snežnik plateau is a high-karst region in the northwesternmost part of the Liburnian karst (NW Dinaric Mts, SW Slovenia). The highest mountain of the plateau is Mt. Snežnik (1796 m), which creates a

distinctive orographic barrier between the northern and the southern part of the plateau. On average, the higher (and also with more diversified relief) southern part of the plateau received considerably higher amounts of precipitation (Gomance, 937 m, 3143 mm) than its northern part (Leskova dolina, 806 m, 2166 mm), while the entire region is among the wettest in Slovenia (Manohin 1957, Zupančič 1995). The precipitation regime of the southern part is strongy influenced by the Mediterranean. On account of the higher altitude of the plateau, karst relief, windness and abundant rainfall the climate is relatively cold. The mean temperature of Gomance was 6.7 °C (Mekinda-Majaron 1995), and the vegetation season lasts from May till September.

The geological bedrock consists of Jurassic and Cretaceous limestones, dolomitized limestones and their breccias (Pleničar 1956, Pavlovec & Pleničar 2000). At the time of the last glacial period the larger part of the study area was located above the perpetual snow line (Šifrer 1959).

For detailed microclimatic and general vegetation descriptions of the study area compare also Zupančič (1970, 1980), Wraber (1997) and Surina & Vreš (2004).

METHODS

Between 2002 and 2005 we made 11 relevés of subalpine beech stands on Mt. Snežnik applying the sigmatistic method (Braun-Blanquet 1964, Dierschke 1994). When arranging the relevés into a phytosociological table and comparing them with the stands of similar syntaxa we used the hierarchical classification (complete linkage method (farthest neighbour) – FNC, incremental sum of squares –ISSq, and unweighted average linkage method – UPGMA), and principal coordinates analysis (PCoA) within the SYN-TAX programme package (Podani 2001). For this purpose we transformed cover values with van der Maarel's numerical (1–9) scale (van der Maarel 1979). The measures of dissimilarity were a complement of the »similarity ratio« coefficient and »Euclidian distance«.

On the final arrangement of relevés (Tab. 1) we combined the results obtained by numerical methods with the arrangement based on diagnostic species. The phytosociological groups were generally in agreement with numerous authors but formed on our own criteria. The nomenclature source for the names of vascular plants was the Mala flora Slovenije (Martinčič et al. 1999), while names for mosses and lichens were in agreement with the Annotated check-list of the mosses of Slovenia (Martinčič 2003), and the Catalogue of the lichenised and lichenicolous fungi of Slovenia (Suppan et al. 2000). Only the most common taxa of mosses and lichens were determined and therefore excluded from the numerical analyses. For the names of syntaxa we followed Marinček et al. (1993) with some minor annotations, but the complete list is given in an appendix.

Subalpine beech stands with Hairy Alpenrose from Mt. Snežnik were compared with some similar beech communities in the Northeastern and Southeastern Alps, and in the Dinaric Mts:

1. *Polysticho lonchitis-Fagetum* s. lat.:
   Italy: Friuli (Poldini & Nardini 1993); Slovenia: Mts Blegoš and Ratitovec (Marinček 1980), Mt. Snežnik (Tregubov 1957), and Snežnik and Trnovski gozd plateaus (Marinček 1996); Croatia: Velebit Mts (Horvat 1938);
2. *Omphalodo-Fagetum* var. geogr. *Saxifraga cuneifolia rhododendretosum hirsuti*: Slovenia, Trnovski gozd plateau (Dakskobler et al. 2000);
3. *Homogyno sylvestris-Fagetum* var. geogr. *Anemone trifolia rhododendretosum hirsuti*, and *Homogyno sylvestris-Fagetum* var. geogr. *Luzula nivea rhododendretosum hirsuti*; Slovenia, Julian Alps (Dakskobler 2002, 2004);
4. *Rhododendro hirsuti-Fagetum* var. geogr. *Anemone trifolia* & var. geogr. *Phyteuma columnae*: Slovenia, NW Dinaric Mts and Julian Alps (Dakskobler 2003).
5. *Saxifrago rotundifoliae-Fagetum* Zukrigl 1989 s. lat.: Austria, NE and SE Alps (Willner 2007).

The synoptic table is available within electronic appendix.

RESULTS AND DISCUSSION

Floristic composition and physiognomic aspect of stands

In the tree layer *Fagus sylvatica*$^{4–5}$ completely prevailed, reaching up to 10–15 m in height and 10–30 cm of trunk diameter. Basal parts of beech-trunks, specially on slopes, were typically curved due to pressure of the heavy and long-lasting snow cover. *Sorbus aria*$^{+}$ occurred frequently in the studied stands, albeit with rather low coverage value. Less frequent and with low cover values were *Acer pseudoplatanus*$^{+}$, *Abies alba*$^{+}$, *Picea abies*$^{+}$, and *Sorbus aucuparia*$^{+}$.

Among the shrub species (occurring in shrub and/or herb layer) *Rhododendron hirsutum*$^{1–4}$ totaly

dominated in stands and together with *Fagus sylvatica* (in tree layer), *Lonicera alpigena*$^{+-2}$, *Rosa pendulina*$^{+-3}$, *Daphne mezereum*$^{+-1}$, *Salix appendiculata*$^{+-1}$, and *Rubus saxatilis*$^{+-2}$ most significantly contributed to the physiognomic aspect of stands.

Herb layer was well developed. *Clematis alpina*$^{1-2}$, *Anemone nemorosa*$^{1-2}$, *Valeriana tripteris*$^{+-2}$, *Homogyne sylvestris*$^{1-2}$, *Adenostyles glabra*$^{+-2}$, *Phyteuma ovatum*$^{+-2}$, and *Calamagrostis varia*$^{1-2}$ dominated with rather high coverage values, whereas *Polystichum lonchitis*$^{+-1}$, *Cardamine enneaphyllos*$^{+-1}$, *Euphorbia carniolica*$^{+}$, *Cardamine trifolia*$^{+-1}$, *Festuca altissima*$^{+-1}$, *Mercurialis perennis*$^{+-1}$, *Polygonatum verticillatum*$^{+-1}$, *Gentiana asclepiadea*$^{+-1}$, and *Solidago virgaurea*$^{+}$ occurred quite frequently but with smaller coverage values.

Moss layer covered 5–20 % of the relevé area and the most frequent species were *Ctenidium molluscum*$^{1-2}$, *Tortella tortuosa*$^{+-1}$, and *Schistidium apocarpum*$^{+-1}$.

The complete floristic composition of the studied stands is given in the phytosociological table (Tab. 1).

Characteristic and differential species of the association *Polysticho lonchitis-Fagetum* are fully represented, with *Polystichum lonchitis* being the most (100 %) and *Ribes alpinum* (36 %) the least frequent.

The number of seed plants per relevé varied between 35 and 56, with the median of 47, and the coefficient of variation of 16.14 %, indicating a quite uniform floristical composition of stands.

Ecology of stands

Most frequently stands thrived on northerly exposed slopes (Tab. 1). Slopes were moderately steep to very steep with inclination varying between 15 ° and 50 ° (Me=35 %). Stoniness made up a large proportion of relevé areas (10–70 %, Me=40 %). In comparison to other (fir-)beech and subalpine beech stands in the studied area, we noticed considerable delay in phenophases in subalpine stands with predominating *Rhododendron hirsutum*, most probably due to unfavourable ecological conditions. **Dolomitized limestones and limestone prevailed.**

Synsystematic position of studied stands

Firstly, in order to accurately determine the synsystematic position of the studied stands, we performed comparisons with stands of the subalpine beech association *Polysticho-Fagetum* in Slovenia and Croatia (Fig. 1).

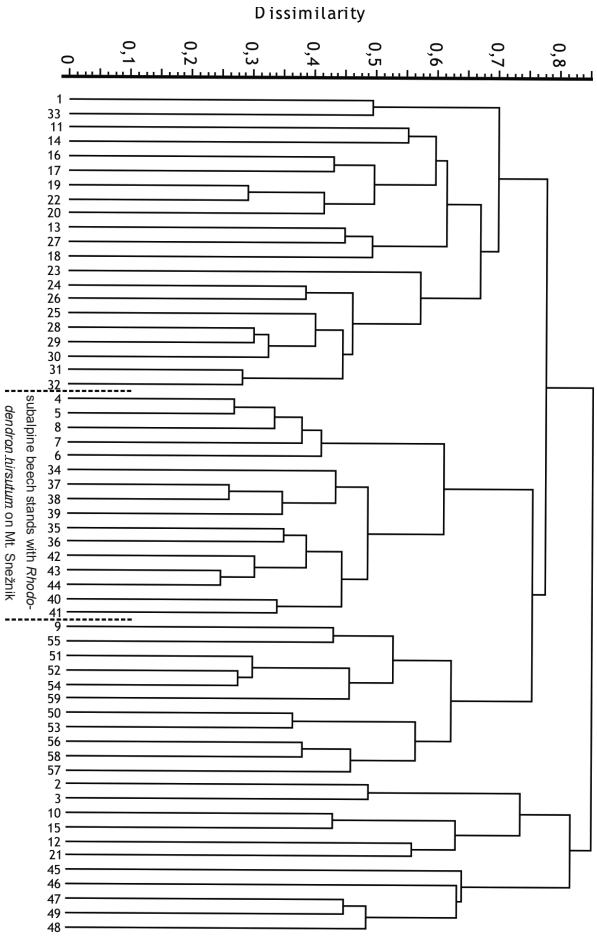

Figure 1: Dendrogram of the subalpine beech stands (*Polysticho-Fagetum* s. lat.) in the Julian Alps and Dinaric Mts (complete linkage, similarity ratio); 1–3: Mt. Snežnik (Tregubov 1957), 4–33: Snežnik and Trnovski gozd plateaus (Marinček 1996), 34–44: Mt. Snežnik (Surina, this work), 45–49: NE Italy (Poldini & Nardini 1993), 50–59: Mts Blegoš and Ratitovec (Marinček 1981).

Slika 1: Dendrogram subalpinskih bukovih sestojev (*Polysticho-Fagetum* s. lat.) v Julijskih Alpah in Dinaridih (complete linkage, similarity ratio); 1–3: Snežnik (Tregubov 1957), 4–33: Snežnik in Trnovski gozd (Marinček 1996), 34–44: Snežnik (Surina, to delo), 45–49: SV Italija (Poldini & Nardini 1993), 50–59: Blegoš in Ratitovec (Marinček 1981).

Stands from the Snežnik plateau with predominating *Rhododendron hirsutum* nested in a separate cluster, supporting their distinct synsystematic position, and were -somewhat surprisingly- most similar to stands from Mt. Blegoš. Some relevés from the phytosociological table of Marinček (1996; rel. 1–5; *-polystichetosum,* var. *Gymnocarpium dryopteris*) joined the cluster with the studied stands and therefore were treated separately in subsequent analyses.

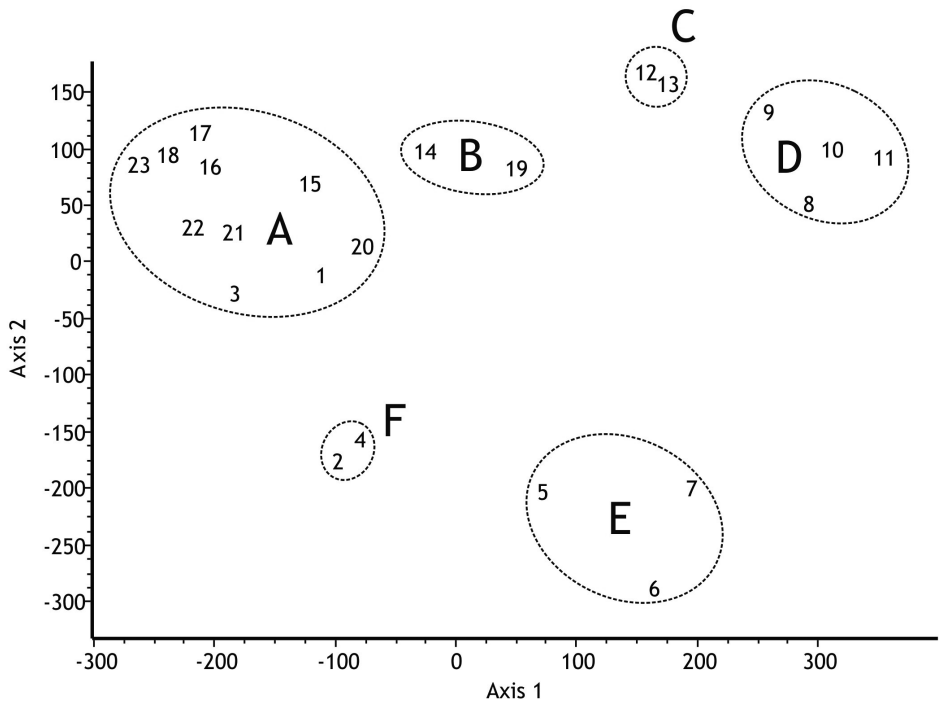

Figure 2: Two-dimensional scatter-diagram of subalpine (fir-) beech stands with Hairy Alpenrose (*Rhododendron hirsutum*) in the Julian Alps, NE and SE Alps in Austria, and Dinaric Mts (PCoA, Euclidian distance); *Polysticho-Fagetum* s. lat.: **1** – NE Italy (Poldini & Nardini 1993), **2** – Mts. Blegoš and Ratitovec (Marinček 1981), **3** – Velebit Mts (Horvat 1938), **4** – Trnovski gozd and Snežnik plateaus (Marinček 1996, rel. 6–29), **5** – Trnovski gozd and Snežnik plateus (Marinček 1996, rel. 1–5), **6** – Mt. Snežnik (Surina, this work); *Omphalodo-Fagetum* var. geogr. *Saxifraga cuneifolia rhododendretosum*: **7** – Trnovski gozd plateau (Dakskobler et al. 2000); **8–11** – *Rhododendro-Fagetum* var. geogr. *Anemone trifolia* & var. geogr. *Phyteuma columnae* (Dakskobler 2003, Tabs. 8, 5, 6 & 7); *Homogyno-Fagetum rhododendretosum*: **12–13** – Trnovski gozd plateau and the Julian Alps (Dakskobler 2002, 2004); *Saxifrago rotundifoliae-Fagetum* s. lat. **14–23** (SE and NE austrian Alps): **14 & 19** – *Saxifrago-Fagetum calamagrostietosum variae*, **15 & 20** – *Saxifrago-Fagetum typicum*, **16–21** – *Saxifrago-Fagetum adenostyletosum alliariae*, **17–22** – *Saxifrago-Fagetum petasitetosum*, **18–23** – *Saxifrago-Fagetum stellarietosum nemorum* (Willner & Grabherr 2007, Tab. 26).

Slika 2: Dvorazsežni ordinacijski diagram subalpinskih (jelovo-) bukovih z dlakavim slečem (*Rhododendron hirsutum*) v Julijskih Alpah in Dinaridih (PCoA, Euclidian distances); *Polysticho-Fagetum* s. lat.: **1** – SV Italija (Poldini & Nardini 1993), **2** – Blegoš in Ratitovec (Marinček 1981), **3** – Velebit (Horvat 1938), **4** – Trnovski gozd in Snežnik (Marinček 1996, rel. 6–29), **5** – Trnovski gozd in Snežnik (Marinček 1996, rel. 1–5), **6** – Snežnik (Surina, to delo); *Omphalodo-Fagetum* var. geogr. *Saxifraga cuneifolia rhododendretosum*: **7** – Trnovski gozd in Julijske Alpe (Dakskobler et al. 2000); *Rhododendro-Fagetum* var. geogr. *Anemone trifolia* & var. geogr. *Phyteuma columnae*: **8–11** – (Dakskobler 2003, Tabs. 8, 5, 6 & 7); *Homogyno-Fagetum rhododendretosum*: 12–13 – Julijske Alpe (Dakskobler 2002, 2004); *Saxifrago rotundifoliae-Fagetum* s. lat. **14–23** (SE and NE austrian Alps): **14 & 19** – *Saxifrago-Fagetum calamagrostietosum variae*, **15 & 20** – *Saxifrago-Fagetum typicum*, **16–21** – *Saxifrago-Fagetum adenostyletosum alliariae*, **17–22** – *Saxifrago-Fagetum petasitetosum*, **18–23** – *Saxifrago-Fagetum stellarietosum nemorum* (Willner & Grabherr 2007, Tab. 26).

Secondly, comparisons with other (fir-)beech stands with *Rhododendron hirsutum* in Slovenia and Austria (*Saxifrago-Fagetum*) were conducted (Figs. 2 & 3, Tab. 2). Again, the results showed the rather unique syntaxonomic position of the studied stands.

Results from the Principal Coordinates Analysis (Fig. 2) generally indicated 6 distinct groups of syntaxa: group A is composed mainly of stands of *Saxifrago-Fagetum* s. lat., but (somewhat surprisingly) also with stands of *Polysticho-Fagetum* s. lat. from NE Italy (1) and Velebit Mts – Croatia (3); group B presents stands of *Saxifrago-Fagetum calamagrostietosum*; group C is composed of fir-beech stands *Homogyno-Fagetum* s. lat. from Trnovski gozd plateau and Julian Alps, while group D of stands of *Rhododendro-Fagetum*. Groups E and F are composed of stands of *Polysticho-Fagetum*, where group

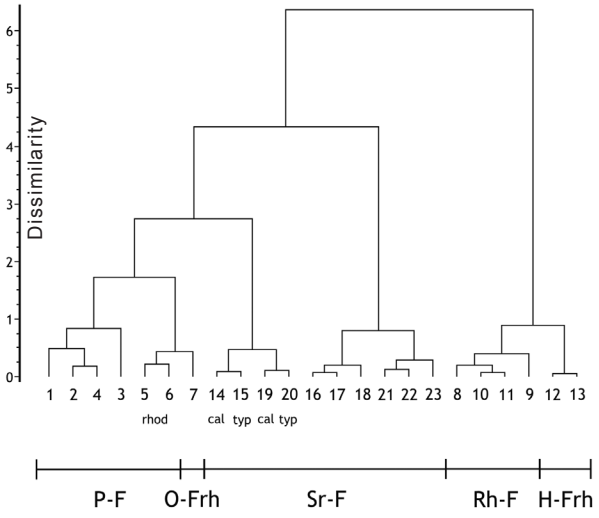

Figure 3: Dendrogram of (fir-)beech syntaxa with Hairy Alpenrose (*Rhododendron hirsutum*) in the Julian Alps, Austrian NE and SE Alps, and Dinaric Mts (MISSQ, similarity ratio; numbers correspond with Fig. 2).

Slika 3: Dendrogram subalpinskih bukovih gozdov, subalpinskih bukovih gozdov z dlakavim slečem, bukovih gozdov z dlakavim slečem in jelovo-bukovih sestojev z dlakavim slečem v Julijskih Alpah, SZ in JV avstrijskih Alpah in Dinaridih (MISSQ, similarity ratio; številke se ujemajo s številkami v sl. 2).

F represents somewhat typical stands, and group E stands of *Polysticho-Fagetum* (5 & 6) and *Omphalodo-Fagetum* var. geogr. *Saxifraga cuneifolia* (7) with predominating *Rhododendron hirsutum* in herb or shrub layer. Cluster analysis (Fig. 3) showed slightly different but still similar results. Syntaxa were split into three groups: the first cluster (P-F, O-Frh, and Sr-F cal & typ) was rather homogeneous and composed mostly from subalpine beech stands (*Polysticho-Fagetum* s. lat. – 1–6, *Saxifrago-Fagetum calamagrostietosum* – 14 & 19 and *typicum* – 15 & 20) and dinaric fir-beech forest with *Rhododendron hirsutum* (*Omphalodo-Fagetum* var. geor. *Saxifraga cuneifolia rhododendretosum hirsuti* – 7); the second cluster (Sr-F) comprehended syntaxa entirely of *Saxifrago-Fagetum* – 16–23, while the third cluster (Rh-F and H-Frh) gathered syntaxa of *Rhododendro-Fagetum* (8–11) and *Homogyno-Fagetum* (12–13). The studied subalpine beech stands with *Rhododendron hirsutum* from Mt. Snežnik nested well within subalpine beech stands (*Polysticho lonchitis-Fagetum* s. lat.), but in a separate cluster (rhod). Not quite unexpectedly, fir-beech stands with *Rhododendron hirsutum* from the Trnovski gozd plateau (O-Frh) were clustered together with our studied stands (and not separately or even together with pre-alpine fir-beech stands with *Rhododendron hirsutum* –

Table 2: Phytosociological groups (in %) in (fir-)beech syntaxa with Hairy Alpenrose (*Rhododendron hirsutum*) in the Julian Alps and Dinaric Mts (successive numbers from 1–13 correspond to Figs. 2 & 3).

Tabela 2: Fitocenološke skupine (v %) v (jelovo-) bukovih sintaksonih z dlakavim slečem (*Rhododendron hirsutum*) v Julijskih Alpah in Dinaridih (številke od 1 do 13 se ujemajo s sl. 2 in 3).

Syntaxon	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Number of relevés	5	10	15	25	5	11	15	11	23	26	18	25	19
Number of seed plants	64	102	100	150	64	96	104	119	169	172	127	114	151
Vaccinio-Piceetea	30	24	17	19	33	26	28	27	15	19	17	26	23
Fagetalia sylvaticae	25	23	24	17	16	16	13	13	14	14	15	9	7
Mulgedio-Aconitetea	16	19	15	19	11	13	14	10	6	7	9	9	9
Erico-Pinetea	6	7	8	9	8	9	9	10	11	9	12	14	13
Aremonio-Fagion	6	9	11	10	8	9	6	7	8	6	7	4	6
Asplenietea trichomanis	3	2	.	3	6	8	11	10	8	10	11	10	10
Other species	8	13	7	11	5	3	4	6	7	9	5	4	5
Querco-Fagetea	2	2	13	7	6	5	7	3	13	5	6	4	3
Elyno-Seslerietea	2	1	1	3	3	4	3	7	4	8	5	8	10
Thlaspietea rotundifolii	3	2	3	2	3	5	5	6	3	5	5	5	8
Quercetalia pubescentis	.	.	1	1	2	1	1	2	8	4	5	3	2
Quercetalia roboris-petraeae	.	.	.	.	.	.	.	.	3	2	2	2	2
Festuco-Brometea	.	.	.	.	.	.	.	.	2	2	2	3	2

H-Frh) since they thrive on their upper elevational limit, in close contact with subalpine beech stands and in very similar ecological conditions (compare also Dakskobler et al. 2000). The reason why stands of pre-alpine fir-beech forests with *R. hirsutum* (*Homogyno-Fagetum* s. lat. *rhododendretosum*) clustered so separately from other subalpine beech stands might be explained by their close proximity to the Julian Alps and thus by the large proportion of SE-Alpine taxa. Comparison of phytosociological groups in (fir-)beech syntaxa with Hairy Alpenrose (*Rhododendron hirsutum*) in the Julian Alps and Dinaric Mts showed several distinctions and significantly explained the cluster topology: species of the *Erico-Pinetea, Asplenietea* and *Elyno-Seslerietea* were most frequently represented in *Rhododendro-Fagetum* and *Homogyno-Fagetum rhododendretosum*. Furthermore, species of the *Festuco-Brometea* and the *Quercetalia roboris-petraeae* were present only in stands of *Homogyno-Fagetum* and *Rhododendro-Fagetum*, while species of the *Quercetalia pubescentis* were most frequent in stands of *Rhododendro-Fagetum*. These stands, although physiognomically resembling *Polysticho-Fagetum rhododendretosum*, are characterised by the presence of thermophilous taxa and floristic richness, indicating more moderate ecological conditions as a consequence of thriving at lower altitudes. Typically among beech forests, species of the *Vaccinio-Piceetea* are most frequent in fir-beech forests (*Omphalodo-Fagetum* s. lat., *Homogyno-Fagetum* s. lat.). Generaly, tall herbs (*Mulgedio-Aconitetea*) were more frequent in subalpine beech stands (*Polysticho lonchitis-Fagetum*).

In terms of phytosociological groups, subalpine beech stands with Hairy Alpenrose differ from other subalpine beech stands in hosting a smaller number of the *Fagetalia sylvaticae* (*Aremonio-Fagion*) and the *Mulgedio-Aconitetea* species, but a higher number of *Asplenietea trichomanis* species, the latter due to the higher proportion of stoniness.

Interestingly, certain subalpine beech stands from Austria (*Saxifrago-Fagetum calamagrostietosum* and *typicum*) clustered together with stands of *Polysticho-Fagetum* from the SE Alps and Dinaric Mts, while other, more mesophilic stands, formed a distinct cluster (Figs. 2 & 3).

According to Willner (2002, 2007), subalpine (*Polysticho lonchitis-Fagetum*) and altimontane (*Ranunculo platanifolii-Fagetum*) beech stands from the SE Alps and Dinaric Mts from the alliance *Aremonio-Fagion* show no significant floristical differences from the Central-European subalpine and altimontane beech stands (alliance *Fagion sylvaticae*). Therefore, according to the nomenclature code (Weber et al. 2000) and principle of priority, they should be treated as *Saxifrago rotundifoliae-Fagetum* Zukrigl 1989. However - our analysis, although not comprehensive enough – does not fully support this statement. Only thorough and extensive analysis covering Central European and SE European beech stands could solve the problem of the syntaxonomic position of alliances (*Fagion sylvaticae* vs. *Aremonio-Fagion*).

Nevertheless, we classified subalpine beech stands with Hairy Alpenrose into a new subassociation *Polysticho lonchitis-Fagetum rhododendretosum hirsuti*, and as differential species for the subassociation we chose *Rhododendron hirsutum, Rubus saxatilis, Rosa pendulina*, and *Clematis alpina* (Tab. 1). As inferred from Figs. 1–3, relevés 1–5 from the phytosociological table of *Polysticho-Fagetum* var. geogr. *Allium victorialis* (Marinček 1996, cluster Ib – 5) were included into the new subassociation *–rhododendretosum hirsuti*, since the differential species (*Polystichum lonchitis* for the subassociation and *Gymnocarpium dryopteris, Solidago virgaurea, Vaccinium vitis-idaea* for the variant) of the previously described subassociation and variant (*-polystichetosum* var. *Gymnocarpium robertianum*) were not most accurately chosen, and do not fully indicate specific ecological conditions of the selective stands. As inferred from our synoptic table and numerical analyses (but also field diagnostics) those relevés do not represent a "typicum" but rather distinct stands with a particular floristic combination, frequency and coverage of differential species, indicating unfavourable ecological conditions.

While classification of the studied stands within subalpine beech stands was not questionable, delimitation of stands of syntaxa *Polysticho-Fagetum* s. lat. and *Ranunculo platanifolii-Fagetum* s. lat., specially in terms of good characteristic and differential species, is less conspicuous and in many cases (according to our personal observations and while comparing available phytosociological data, partly also following judgments of Horvat (1938) and Tomažič (1958, 1959) – see the introduction) the distinction between stands of the two syntaxa was based till now most frequently on their physiognomy rather than floristic principles, since appropriate characteristic and differential species are hard to define. Therefore only a thorough synoptic approach taking into account all (fir-)beech stands of the Illyrian floral province would properly challenge the current syntaxonomy. Although much beyond the scope of the present treatise, we sug-

gest reconsidering the present synsystematics of subalpine-altimontane beech stands of the alliance *Aremonio-Fagion* and possibly trying to define them with the help of altitudinal variants. Additionally, and as already pointed out, the geographical delimitation of subalpine beech syntaxa in terms of different geographical variants proved to be of no significant synsystematic value (e.g. figs. 1–3). We classified the studied stands as follows:

Querco-Fagetea Br.-Bl. et Vlieg. 1937
Fagetalia sylvaticae Pawl. 1928
Aremonio-Fagion (Horvat 1938) Borhidi in Török, Podani et Borhidi 1989
Polysticho lonchitis-Fagetum (Horvat 1938) Marinček in Poldini & Nardini 1993
rhododendretosum hirsuti Surina subass. nova

Nomenclatural type for the subassociation *Polysticho lonchitis-Fagetum rhododendretosum hirsuti* subass. nova: relevé no. 4 in table 1, *holotypus* hoc loco.

Generally, stands of the *Polysticho-Fagetum rhododendretosum* on the Snežnik plateau are neither frequent nor do they extend over larger areas. Although subalpine beech stands are quite widespread throughout the plateau, we found stands with prevailing *Rhododendron hirsutum* in the undergrowth only on extreme sites, namely: western and north-western slopes of the dolina of Stanišče, northerly exposed slopes between Lom and Kapetanova bajta (above the dolinas of Grda draga and Pekel), in the area of forest reserves of Planinc-Zatrep and Ždrocle, on ridges above dolinas of Grdobe and Medvedje doline, in the vicinity of Herbade above the dolina of Ilovca, and on the ridge west from Mt. Žaknovec. As a rule, stands of subalpine beech forest (*Polysticho-Fagetum* s. lat.) do not have a significant role in wood exploitation, although till the middle of the 20th century these stands were (mostly due to suitable trunk diameter) abundantly used for charcoal-burning. Nevertheless, their indispensable forest protective function has been recognized for a long time.

CONCLUSIONS

(a) Subalpine beech stands with Hairy Alpenrose (*Rhododenron hirsutum*) are floristically and ecologically quite distinct from other subalpine beech stands of the association *Polysticho lonchitis-Fagetum* s. lat. (b) Therefore, on the basis of the synoptic table, numerical analyses, and according to the current synsystematics of subalpine beech syntaxa of the Illyrian floral province, we classified them into the new subassociation *Polysticho-Fagetum rhododendretosum hirsuti* subass. nova (alliance *Aremonio-Fagion*). Differential species of the subassociation (*Rhododendron hirsutum, Rubus saxatilis, Rosa pendulina*, and *Clematis alpina*) sufficiently illustrate the ecological peculiarities of their sites. (c) Stands thrive on ecologically unfavourable growth sites, e.g. steep, rocky and northerly exposed slopes with heavy and long-lasting snow cover, and ridges exposed to strong Bora. (d) Stands of the *Polysticho-Fagetum rhododendretosum* subass. nova on the Snežnik plateau are neither frequent nor do they extend over larger areas. Till now they were observed only on the southern part of the plateau.

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APPENDIX

1. *Localities of relevés*:
Slovenia, Dinaric Mts, Liburnian karst, Snežnik plateau:
1–3, 9 – Stanišče, 24. 7. 2002, leg. B. Surina.
4, 5, 7, 8, 10, 11 – Kapetanova bajta, 26. 7. 2005, leg. B. Surina.
6 – Ilovca (SW from Herbade), 29. 7. 2005, leg. B. Surina.

2. *List of syntaxa*
– *Adenostyletalia* G. Br.-Bl. & J. Br.-Bl. 1931
– *Allio victorialis-Fagetum* (Tomažič 1958) Accetto 2002 nom. inval.
– *Aremonio-Fagion* (Horvat 1938) Borhidi in Török, Podani & Borhidi 1989
– *Asplenietea trichomanis* Br.-Bl. in Meier & Br.-Bl. 1934
– *Elyno-Seslerietea* Br.-Bl. 1948
– *Erico-Pinetea* Horvat 1959
– *Fagetalia sylvaticae* Pawl. 1928
– *Fagion sylvaticae* Luquet 1926
– *Homogyno sylvestris-Fagetum* Marinček et al. 1993 *rhododendretosum hirsuti* Dakskobler 2004
– *Hyperico grisebachii-Pinetum mugo* Zupančič et al. 2004 var. geogr. *Arabis scopoliana* Zupančič et al. 2004

– *Mulgedio-Aconitetea* Hadač & Klika in Klika & Hadač 1944
– *Omphalodo-Fagetum* (Tregubov 1957 corr. Puncer 1980) Marinček et al. 1993 var. geogr. *Saxifraga cuneifolia* Surina 2002 *rhododendretosum hirsuti* Dakskobler et al. 2000
– *Polysticho lonchitis-Fagetum* (Horvat 1938) Marinček in Poldini & Nardini 1993 *rhododendretosum hirsuti* Surina 2007
– *Quercetalia pubscentis* Klika 1933
– *Querco-Fagetea* Br.-Bl. & Vlieg. 1937
– *Ranunculo platanifolii-Fagetum* Marinček et al. 1993
– *Rhododendro hirsuti-Fagetum* Accetto ex Dakskobler 1998 var. geogr. *Anemone trifolia* Dakskobler 1998
– *Rhododendro hirsuti-Fagetum* Accetto ex Dakskobler 1998 var. geogr. *Phyteuma columnae* Dakskobler nom. prov.
– *Saxifrago rotundifoliae-Fagetum* Zukrigl 1989 s. lat.
– *Seslerion juncifoliae* Horvat 1962
– *Thlaspietea rotundifolii* Br.-Bl. in Br.-Bl. & Jenny 1926
– *Vaccinio-Piceetea* Br.-Bl. 1939 emend. Zupančič (1976) 2000

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Table 1: Phytosociological table of the subalpine beech stands with Hairy Alpenrose (*Rhododendron hirsutum*) on Mt. Snežnik.

Tabela 1: Analizna tabela subalpinskih bukovih sestojev z dlakavim slečem (*Rhododendron hirsutum*) na Snežniku.

	Succesive number			**1**	**2**	**3**	**4***	**5**	**6**	**7**	**8**	**9**	**10**	**11**		
	Altitude (m)			1310	1330	1310	1420	1420	1340	1440	1430	1340	1390	1390		
	Exposition			N	N	NE	NNW	N	N	N	N	N	N	N		
	Inclination (°)			35	35	35	30	40	30	25	15	45	40	50		
	Relevé area (m^2)			400	400	400	400	400	400	400	400	400	400	400		
	Stoniness (%)			10	40	25	40	40	50	20	50	40	20	70		
	Cover (%)	Tree layer	A	90	90	95	95	90	90	80	80	80	95	80		
		Shrub layer	B	10	10	10	10	5	5	1	5	30	40	60		
		Herb layer	C	80	80	70	60	50	40	70	50	60	70	30		
		Moss layer	D	5	20	5	10	5	5	5	5	20	5	10		
	No. of seed plants			54	49	41	56	55	45	57	47	35	40	40	Fr.	%
	Character and differential species of the association															
VP	*Polystichum lonchitis*		C	+	+	+	1	+	1	+	+	+	+	1	11	**100**
MA	*Salix appendiculata*		B	.	.	.	+	+	+	.	+	.	+	1	8	**73**
			C	.	.	.	+	.	.	+	.	+	.	+		
ES	*Carex ferruginea*		C	+	.	.	+	+	.	1	+	.	.	.	5	**45**
VP	*Lonicera caerulea*		C	.	+	.	.	+	.	+	+	.	.	.	4	**36**
EP	*Ribes alpinum*		B	.	+	.	+	.	.	.	.	.	.	.	4	**36**
			C	.	.	+	.	.	.	.	.	.	.	+	2	**18**
	Differential species of the subassociation *rhododendretosum hirsuti*															
EP	*Rhododendron hirsutum*		C	1	3	3	3	2	3	3	3	4	3	3	11	**100**
EP	*Rubus saxatilis*		C	2	1	+	1	1	1	1	2	1	2	1	11	**100**
VP	*Clematis alpina*		C	1	2	2	2	2	2	2	2	2	2	2	11	**100**
VP	*Rosa pendulina*		B	.	1	.	+	1	+	.	.	.	1	1	11	**100**
			C	2	2	2	2	2	2	2	2	1	3	2		
AF	***Aremonio-Fagion***															
	Cardamine enneaphyllos		C	+	+	+	+	+	1	+	+	+	+	+	11	**100**
	Euphorbia carniolica		C	+	+	.	+	+	+	+	+	+	+	+	10	**91**
	Cardamine trifolia		C	1	.	.	+	+	1	+	+	.	+	+	8	**73**
	Hacquetia epipactis		C	.	+	1	.	.	.	+	+	.	.	.	4	**36**
	Cyclamen purpurascens		C	.	.	.	.	.	.	.	+	1	.	.	2	**18**
	Vicia oroboides		C	+	.	.	.	.	.	+	.	.	.	.	2	**18**
	Rhamnus fallax		B	.	.	+	.	.	.	.	.	.	.	.	1	**9**
	Omphalodes verna		C	+	.	.	.	.	.	.	.	.	.	.	1	**9**
FS	***Fagetalia sylvaticae***															
			A	5	5	5	5	5	5	5	5	4	5	5		
	Fagus sylvatica		B	+	+	1	1	+	+	+	1	3	2	2	11	**100**
			C	+	+	+	1	+	+	+	+	+	.	+		
	Lonicera alpigena		B	+	+	.	1	+	.	.	1	.	1	.	11	**100**
			C	+	+	+	.	+	+	1	1	1	2	2		
	Dahpne mezereum		B	+	+	1	+	+	.	+	.	+	1	.	10	**91**
			C	.	+	1	+	+	+	.	+	+	+	.		
	Festuca altissima		C	+	+	+	1	1	.	1	.	1	+	1	9	**82**
	Mercurialis perennis		C	1	1	+	+	1	+	1	+	.	1	.	9	**82**
	Prenanthes purpurea		C	+	+	.	+	+	+	+	.	+	+	+	9	**82**

	Succesive number		1	2	3	4*	5	6	7	8	9	10	11		
	Acer pseudoplatanus	A	.	+	+	.	.	.	.	.	+	.	.	7	**64**
		C	+	+	+	+	+	+	.	.	+	.	.		**0**
	Epilobium montanum	C	.	+	.	+	+	.	+	.	.	.	+	5	**45**
	Symphytum tuberosum	C	1	.	.	.	+	+	+	.	.	.	+	5	**45**
	Ranunculus platanifolius	C	+	.	+	+	.	+	+	.	.	.	.	5	**45**
	Helleborus niger	C	.	.	1	.	.	.	+	+	.	.	.	3	**27**
	Actaea spicata	C	+	+	.	+	.	+	.	.	.	.	.	4	**36**
	Dryopteris filix-mas	C	+	+	.	.	.	.	+	.	.	.	.	3	**27**
	Geranium robertianum	C	+	.	.	.	.	.	.	+	.	+	.	3	**27**
	Mycelis muralis	C	.	.	.	.	+	.	+	.	.	.	.	2	**18**
	Adoxa moschatelina	C	+	.	.	+	.	.	.	.				2	**18**
	Lilium martagon	C	.	.	.	.	.	.	+	.	.	+	.	2	**18**
	Aruncus dioicus	C	.	.	.	+	.	.	.	.	.	.	.	1	**9**
	Galium sylvaticum	C	.	.	+	.	.	.	.	.	.	.	.	1	**9**
	Lathyrus vernus	C	.	.	.	.	.	.	+	.	.	.	.	1	**9**
QP	***Quercetalia pubescentis***														
		A	.	+	+	+	.	.	+	.	+	+	.		
	Sorbus aria	B	+	.	.	+	.	.	.	+	+	+	+	9	**82**
		C	.	.	+	+	.	.	+	.	.	.	.		
QF	***Querco-Fagetea***														
	Anemone nemorosa	C	1	2	1	1	1	1	2	2	1	2	2	11	**100**
	Carex digitata	C	+	+	.	+	.	+	+	.	.	.	.	5	**45**
	Convalaria majalis	C	.	.	.	.	.	+	+	1	+	.	.	4	**36**
	Hepatica nobilis	C	.	.	+	.	.	.	.	+	+	.	.	3	**27**
	Dactylorhiza maculata	C	+	.	.	.	.	.	.	+	.	.	.	2	**18**
	Poa nemoralis	C	.	.	.	+	.	.	.	.	.	.	.	1	**9**
MA	***Mulgedio-Aconitetea***														
	Veratrum album subsp. *album*	C	1	+	+	+	+	+	+	+	+	+	+	11	**100**
	Phyteuma ovatum	C	1	1	1	2	1	+	+	.	1	1	1	10	**91**
	Polygonatum verticillatum	C	+	+	+	+	+	+	1	1	.	.	.	8	**73**
	Pleurospermum austriacum	C	.	.	.	.	.	.	+	+	.	+	.	3	**27**
	Athyrium filix-femina	C	.	.	.	.	+	.	.	.	.	+	.	2	**18**
	Viola biflora	C	.	.	.	.	+	+	.	.	.	.	.	2	**18**
	Aconitum ranunculifolium	C	.	.	.	.	.	.	.	+	.	.	.	1	**9**
	Allium victorialis	C	.	.	.	.	.	.	.	+	.	.	.	1	**9**
	Saxifraga rotundifolia	C	.	+	.	.	.	.	.	.	.	.	.	1	**9**
	Cirsium waldsteinii	C	+	.	.	.	.	.	.	.	.	.	.	1	**9**
VP	***Vaccinio-Piceetea***														
	Valeriana tripteris	C	1	1	1	2	1	+	1	1	1	2	2	11	**100**
	Homogyne sylvestris	C	1	1	1	2	1	1	1	1	1	1	1	11	**100**
	Gentiana asclepiadea	C	1	+	+	+	+	+	+	1	+	+	+	11	**100**
	Solidago virgaurea	C	+	+	.	+	+	+	+	+	+	+	+	10	**91**
		A	.	+	.	.	.	.	.	.	+	.	.		
	Abies alba	B	+	1	+	.	+	.	.	.	1	+	1	8	**73**
		C	.	1	.	+	+	.	.	.	.	.	+		
	Vaccinium myrtillus	C	.	1	.	.	+	1	1	2	2	2	1	8	**73**
	Maianthemum bifolium	C	+	+	+	+	+	+	1	+	.	.	.	8	**73**
	Huperzia selago	C	+	+	.	+	+	+	+	+	.	.	.	7	**64**
	Aposeris foetida	C	2	1	+	.	.	.	.	+	+	.	.	5	**45**
	Veronica urticifolia	C	+	.	+	1	1	.	.	.	.	.	+	5	**45**
	Hieracium murorum agg.	C	.	.	+	+	+	+	.	.	.	.	+	5	**45**

	Succesive number		1	2	3	4*	5	6	7	8	9	10	11		
	Vaccinium vitis-idaea	C	.	.	+	+	+	.	.	2	.	.	.	4	**36**
	Dryopteris dilatata	C	+	+	.	+	+	.	.	.	.	.	.	4	**36**
	Luzula sylvatica	C	+	.	.	+	+	.	+	.	.	.	.	4	**36**
		A	.	.	.	.	.	+	.	.	.	.	.		
	Picea abies	B	.	.	.	+	.	+	.	.	.	.	.	4	**36**
		C	+	+	.	.	.	.	+	.	.	.	.		
	Gymnocarpium dryopteris	C	+	1	.	.	.	.	.	.	1	.	.	3	**27**
	Oxalis acetosella	C	1	+	.	.	+	+	.	.	.	.	.	4	**36**
	Laserpitium krapfii	C	.	.	.	.	.	.	.	+	.	+	.	2	**18**
	Thelypteris phegopteris	C	.	.	.	.	+	.	.	.	.	.	+	2	**18**
EP	***Erico-Pinetea***														
	Calamagrostis varia	C	2	1	1	1	1	.	2	2	1	2	1	10	**91**
	Cirsium erisithales	C	+	+	+	+	.	+	+	.	1	+	.	8	**73**
	Aquillegia nigricans	C	+	+	+	.	.	.	+	+	.	.	.	5	**45**
	Erica herbacea	C	.	.	.	.	.	.	.	+	.	+	.	2	**18**
	Juniperus sibirica	C	.	.	.	.	.	.	.	+	.	+	.	2	**18**
ES	***Elyno-Seslerietea***														
	Aster bellidiastrum	C	1	.	+	.	+	1	.	.	1	+	+	7	**64**
	Erigeron glabratus	C	.	.	.	.	.	.	+	.	.	.	.	1	**9**
	Heliosperma alpestre	C	.	.	.	+	.	.	.	.	.	.	.	1	**9**
AT	***Asplenietea trichomanis***														
	Asplenium viride	C	+	+	+	+	1	1	+	+	+	+	+	11	**100**
	Campanula justiniana	C	.	+	+	.	.	1	.	+	1	+	+	7	**64**
	Carex brachystachys	C	.	.	.	1	1	+	+	.	.	+	.	5	**45**
	Moehringia muscosa	C	.	.	.	.	+	+	+	.	.	.	+	4	**36**
	Cystopteris fragilis	C	.	+	.	+	+	+	.	.	.	.	.	4	**36**
	Cystopteris regia	C	.	.	.	.	+	.	+	.	.	.	+	3	**27**
	Asplenium ruta-muraria	C	.	.	.	.	+	+	.	.	.	.	+	3	**27**
	Asplenium trichomanes	C	.	.	.	.	.	.	.	.	.	.	+	1	**9**
	Festuca stenantha	C	.	.	.	+	.	.	.	.	.	.	.	1	**9**
TR	***Thlaspietea rotundifolii***														
	Adenostyles glabra	C	.	.	1	2	2	1	+	+	1	1	1	9	**82**
	Campanula cochleariifolia	C	.	.	.	1	+	.	+	+	.	.	.	4	**36**
	Gymnocarpium robertianum	C	.	.	.	+	+	+	+	.	.	.	+	5	**45**
	Dryopteris montana	C	.	.	.	+	.	.	.	.	.	.	.	1	**9**
OS	**Other species**														
		A	.	+	.	.	.	.	.	.	.	.	.		
	Sorbus aucuparia	B	.	+	.	.	.	.	.	.	.	+	+	7	**64**
		C	+	.	.	+	+	.	+	.	.	.	.		
	Thalictrum aquilegiifolium	C	+	+	+	+	.	.	1	.	.	.	.		**45**
	Rubus idaeus	C	+	+	.	.	.	.	.	.	.	.	.	2	**18**
	Parnassia palustris	C	.	.	.	.	+	.	.	.	.	.	.	1	**9**
	Mosses and lichens														
	Ctenidium molluscum	D	2	1	1	2	2	2	2	2	2	2	2	11	**100**
	Tortella tortuosa	D	1	+	1	1	1	1	1	1	1	1	1	11	**100**
	Schistidium apocarpum	D	+	+	+	1	1	1	+	1	+	.	1	10	**91**
	Fissidens cristatus	D	1	+	1	1	1	.	+	1	+	.	.	8	**73**
	Cladonia pyxidata	D	+	+	+	+	+	.	+	+	.	+	.	8	**73**
	Dicranum scoparium	D	.	1	+	.	+	.	+	+	+	.	+	7	**64**
	Plagiochila asplenioides	D	.	.	+	+	.	1	.	1	.	+	1	6	**55**
	Conocephalum conicum	D	+	+	+	.	.	.	+	.	.	.	.	4	**36**

Succesive number		**1**	**2**	**3**	**4***	**5**	**6**	**7**	**8**	**9**	**10**	**11**		
Peltigera leucophlebia	D	.	.	.	.	+	.	.	.	+	+	+	4	**36**
Hypnum cupressiforme	D	1	+	+	.	.	.	.	.	.	.	.	3	**27**
Brachythecium sp.	D	.	.	.	.	+	.	.	.	.	+	+	3	**27**
Distichium capillaceum	D	.	.	.	+	+	1	.	.	.	.	.	3	**27**
Pleurozium schreibersi	D	.	.	.	+	.	+	.	.	.	+	.	3	**27**
Leptogium saturninum	D	.	.	.	+	+	.	.	.	.	.	.	2	**18**
Rhytidiadelphus triquetrus	D	.	.	.	.	.	+	.	.	.	.	+	2	**18**
Solorina saccata	D	.	.	+	.	.	.	.	.	.	.	+	2	**18**
Bryum sp.	D	.	.	.	.	.	.	.	+	.	.	.	1	**9**
Peltigera sp.	D	.	.	.	.	+	.	.	.	.	.	.	1	**9**
Pohlia elongata/elongata	D	.	.	.	.	.	.	+	.	.	.	.	1	**9**
Polytrichum alpinum	D	.	.	.	.	.	.	.	.	.	+	.	1	**9**
Polytrichum commune	D	.	.	.	.	.	.	.	.	+	.	.	1	**9**