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Phytocoenological analysis of grey alder (*Alnus incana* L.) forests in the Dinarides of Croatia and their relationship with affiliated communities

Phytozönologische Analyse von Grau-Erlenwäldern (*Alnus incana* L.) in den kroatischen Dinariden und ihrem Verhältnis zu verwandten Pflanzengesellschaften

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Abstract

This paper provides a comprehensive survey of the results of phytocoenological research into *Alnus incana* forests from the alliance *Alnion incanae* in the Dinarides. Stands from the south-eastern Dinarides (*Alnetum incanae* = *Oxali-Alnetum incanae*) were analyzed and compared with those from the north-western Dinarides (*Lamio orvalae-Alnetum incanae*). The comparison reveals significant differences in the floristic composition and in the degree of differentiation – and particularly in the presence of the species of the Illyrian floristic geoelement. Focus was placed on the area of western Croatia where a geographic variant of *Helleborus dumetorum* had previously been defined within the association *Lamio orvalae-Alnetum incanae*. Two of its subtypes, *Salix alba* and *Alnus glutinosa*, were determined in our research. The former subtype thrives on occasionally flooded, moist sites, where the floristic composition is dominated by hygrophytes. The latter subtype grows on elevated and drier terraces and is richer in mesophilous species from the surrounding zonal forests. A floristic-sociological comparison of the *Lamio orvalae-Alnetum incanae* with the related syntaxa indicates the presence of about fourty diagnostic species which accentuate its independence and the need to assess it at the level of an independent, regional association within the alliance *Alnion incanae*.

Keywords: *Alnion incanae*, *Alnus incana*, forest communities, *Lamio orvalae-Alnetum incanae*, the Dinarides

Erweiterte deutsche Zusammenfassung am Ende des Artikels

1. Introduction

Phytocoenological research into grey alder forests in the Dinarides began in the second half of the twentieth century. In the eastern and inner Dinarides in Montenegro, Serbia and Bosnia and Herzegovina research was conducted by BLEČIĆ (1960), STEFANOVIĆ (1964), JOVANOVIĆ et al. (1983), DINIĆ & KALINIĆ (1983), and more recently by RAKONJAC (2002), BARUDANOVIĆ (2007) and RAKONJAC et al. (2009). In their published works, the authors

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present 58 phytocoenological relevés which they classified into the syntaxa *Oxali-Alnetum incanae* Blečić 1960, *Alnetum incanae* Lüdi 1921 and *Alnetum glutinoso-incanae* Br.-Bl. 1915 within the alliance *Alnion incanae* Pawl. in Pawl. et al. 1928. Grey alder forests in the north-western Dinarides have been studied only recently. In Slovenia, DAKSKOBLER (2007, 2010) defined a new association *Lamio orvalae-Alnetum incanae* Dakskobler 2010, which was also confirmed in Croatia (VUKELIĆ et al. 2012). A total of 122 relevés have been presented in research to date, while this paper provides 16 new relevés. They are important because they allow new insights related to the floristic composition and variability of *Lamio orvalae-Alnetum incanae*.

The results of the cited studies have thus far not been compared, while a comparison of the association *Lamio orvalae-Alnetum incanae* with the neighbouring areas of Austria and Italy has partially been performed (SBURLINO et al. 2012, DAKSKOBLER & ROZMAN 2013). A new concept of European floodplain forests has recently been presented (DOUDA et al. 2016), in which all the listed syntaxa are classified into the association *Alnetum incanae*. For this reason, our research sets the following goals: (1) to provide phytocoenological relevés of grey alder forests in the Dinaric part of Croatia; (2) to compare them with other Dinaric syntaxa of grey alder which belong to the alliance *Alnion incanae*; and (3) to analyse and define them in the broader European context of recent phytocoenological surveys.

2. Study area

Phytocoenological relevés were made in the Croatian part of the western Dinarides (Fig. 1). The Dinaric Alps in this area are composed of Mesozoic carbonates with numerous karst landforms, which create a heterogeneous landscape. The dominant soil types are swampy gleyic mineral non-carbonate soils in combination with alluvial-colluvial gleyed soil (ŠKORIĆ et al. 2003). The occurrence and growth of grey alder forests is conditioned by occasional flooding of the River Kupa and its tributaries over a length of about thirty kilometres. The average fall of the River Kupa in the research area is 2 m/km. The river partly has a canyon form and partly extends along horizontally elongated terraces, on which the forests were cut down in the past. In the last 50 years land cultivation has gradually been abandoned, giving place to natural succession. The dominant tree species in the investigated forests is *Alnus incana*, while sites with long stagnating water are dominated by *Alnus glutinosa*. Other tree species, such as *Salix eleagnos*, *S. alba*, *Fraxinus excelsior*, *Acer pseudoplatanus*, *Carpinus betulus* and *A. campestre* also occur frequently.

These stands grow at elevations from 220 to 540 m. The average annual temperature in the study area is about 11 °C, and about 17 °C in the vegetation period (April - October). The average rainfall is 2200 mm, of which 43% falls in the vegetation period. These indicators suggest the prevalence of perhumid, temperate warm climate of mountain nature.

Grey alder stands represent permanent stages. The zonal vegetation in the lower parts of the surrounding mountains is made up of oak-hornbeam forests from the alliance *Erythronio-Carpinion* (Ht. 1938) Marinček in Mucina et al. 1993, while the higher parts are inhabited by Illyrian beech forests of the alliance *Aremonio-Fagion* (Ht. 1938) Borhidi in Török et al. 1989. Plant species of these zonal forests frequently penetrate to the banks of the River Kupa and even cross over to the river islands. About 70% of the western continental part of the Croatian Dinarides is covered by forests.

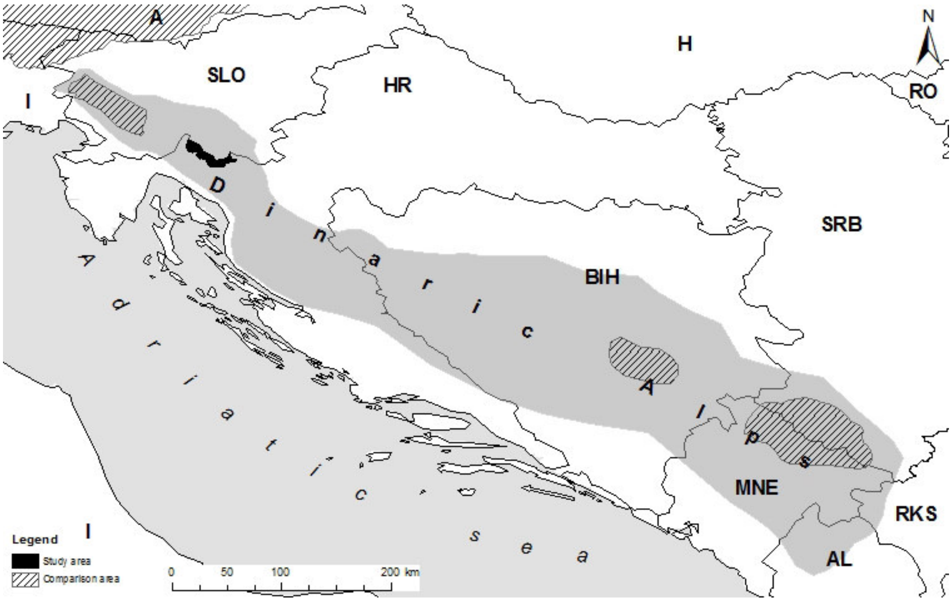

Fig. 1. Geographical position of the study area.

Abb. 1. Geographische Lage des untersuchten Gebiets.

3. Material and Methods

3.1 Methods and nomenclature

Research was conducted according to the principles of the standard Central European Phytocoenological School (BRAUN-BLANQUET 1964). Plant nomenclature was coordinated with the Flora Croatica Database (NIKOLIĆ 2004), and the mosses with ATHERTON et al. (2010). The syntaxonomic nomenclature of higher units follows the survey of DOUDA et al. (2016), and the regional syntaxa from previous studies are presented in their original form. A part of the syntaxa was described in accordance with ICPN (WEBER et al. 2000), and another part follows a multidimensional classification of vegetational units (MATUSZKIEWICZ & MATUSZKIEWICZ 1981).

The sociological species affiliation was determined according to our own understanding (VUKELIĆ 2012), but mostly follows the generally accepted and cited European phytocoenological literature (e.g., OBERDORFER 1994, AESCHIMANN et al. 2004).

3.2 Data collection and analysis

Literature sources of phytocoenological relevés are given in Table 1. The 16 new relevés were made in 2016, in fully canopied stands aged from 30 to 50 years and with a tree height of about 20 m.

All the 196 relevés of grey alder forests from the Dinarides were stored in the Turboveg Database (HENNEKENS & SCHAMINÉE 2001). The cluster analysis and Simprof test were made using PRIMER v6 software (CLARKE & GORLEY 2006). The UPGMA (Unweighted Pair-Group Method Using Arithmetic Averages) aglomerative hierarchical method with the Bray-Curtis similarity index was employed. The Simprof (Similarity Profile) test was used to test the structure of the *a priori* unstructured dataset. Combined with the UPGMA analysis, it shows specific substructures in the diagram which correspond to objective (non-random) groups. The test was conducted with 999 permutations and a 5% confidence interval. JUICE 7.0 (TICHÝ 2002) was used to determine the differential species.

Table 1. List of literature sources and phytocoenological relevés in the analysis.

Tabelle 1. Verzeichnis der Literaturquellen und phytozönologischen Aufnahmen in der durchgeführten Analyse.

Area, Syntaxa	No. of relevés	Average area of relevés (m²)	Source
North-western Dinarides			
Slovenia			
Lamio orvalae-Alnetum incanae var. geogr. *Anemone trifolia*	29	280	DAKSKOBLER 2007, 2010, DAKSKOBLER & ROZMAN 2013
- *typicum*	22	340	DAKSKOBLER et al. 2004, DAKSKOBLER & ROZMAN 2013
- *caricetosum albae*	14	350	DAKSKOBLER et al. 2004
- *fraxinetosum excelsioris*	35	340	DAKSKOBLER 2007, DAKSKOBLER & ROZMAN 2013
- *rhamnetosum fallacies*	5	200	DAKSKOBLER & ROZMAN 2013
Lamio orvalae-Alnetum incanae var. geogr. *Scopolia carniolica*	9	310	DAKSKOBLER 2007
Croatia			
Lamio orvalae-Alnetum incanae var. geogr. *Helleborus dumetorum*			
- *Alnus glutinosa subtype*	15	450	VUKELIĆ et al. 2012, & this article
- *Salix alba subtype*	9	390	VUKELIĆ et al., this article
South-eastern and central Dinarides			
Montenegro			
Oxalido-Alnetum incanae			
- *lysimachietosum nummulariae*	14	350	BLEČIĆ 1960
Serbia			
Oxalido-Alnetum incanae			
- *athyrietosum*	7	3800	BLEČIĆ 1960
- *juniperetosum communis*	4	140	JOVANOVIĆ et al. 1993
Alnetum glutinoso-incanae	4	175	JOVANOVIĆ et al. 1983
Alnetum incanae	8	730	RAKONJAC 2002
Alnetum glutinoso-incanae	10	700	RAKONJAC et al. 2009
Bosnia and Herzegovina			
Alnetum incanae	4	150	STEFANOVIĆ 1964
Oxalido-Alnetum incanae	7	100	BARUDANOVIĆ 2007
Italy			
Primulo vulgaris-Alnetum incanae	39		SBURLINO et al. 2012
Aceri-Alnetum incanae	80		SBURLINO et al. 2012
Austria			
Aceri-Alnetum incanae	329		WILLNER & GRABHERR 2007
Europe			
Alnetum incanae	232		DOUDA et al. 2016

The abundance of the species which occur in several layers was merged into one layer in Turboveg (HENNEKENS & SCHAMINÉE 2001). Particular species and subspecies were unified within the species aggregate (e.g., *Asarum europaeum* and *A. europaeum* ssp. *caucasicum*, *Campanula patula* and *C. patula* ssp. *abietina*, *Phyteuma spicatum* and *P. spicatum* ssp. *coeruleum*, *Senecio nemorensis* and *S. ovatus*, *Stellaria nemorum* and *S. nemorum* ssp. *glochidisperma* (= *S. montana*), *Aconitum lycoctonum* and *A. lycoctonum* ssp. *vulparia*, *Lamium galeobdolon* and *L. galeobdolon* ssp. *flavidum*).

4. Results

A total of 615 species, of which 183 occur in only one relevé, were recorded in the 196 relevés of *Alnus incana* forests in the Dinaric Alps. There were 179 species common to the entire area.

The result of cluster analysis is presented in Figure 2. *Alnus incana* forests were classified into five groups, which largely follow its geographic distribution. Groups A–D represent all the relevés of the north-western Dinarides, while Group E contains relevés of the central and south-eastern Dinarides.

4.1 *Alnus incana* forests of the north-western Dinarides

According to research to date, these forests belong to the association *Lamio orvalae-Alnetum incanae*. In the ecological and sociological sense, it is characterized by two groups of species: the first group consists of species of floodplain and moist sites, which are frequent in similar vegetation types in Europe. Of these species, *Salix eleagnos*, *Rubus caesius* and *Cerastium sylvaticum* feature more frequently in relation to the affiliated *Alnus incana*

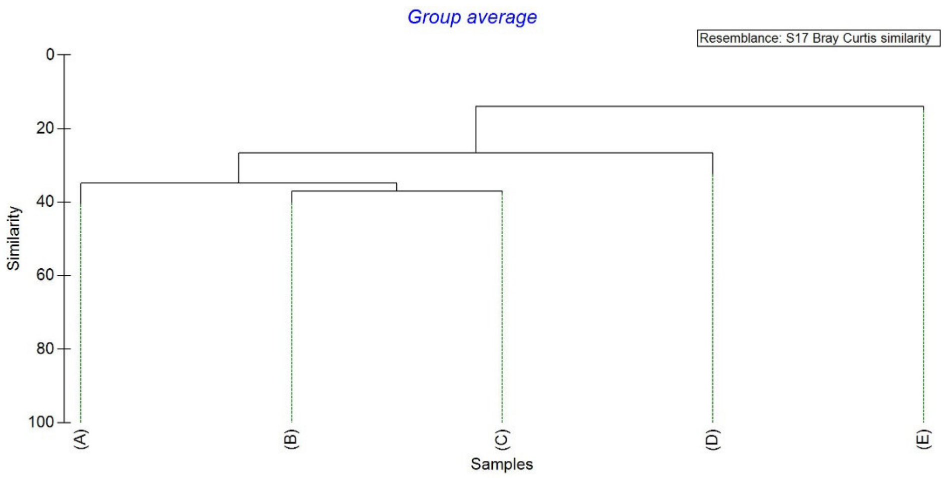

Fig. 2. Dendrogram of the 196 relevés of *Alnus incana* forests from the Dinaric Mountains.

A – *Lamio orvalae-Alnetum incanae* var. geogr. *Helleborus dumetorum*, subtype *Alnus glutinosa*, 15 relevés, Croatia; B, C – *Lamio orvalae-Alnetum incanae,* var. geogr. *Anemone trifolia* and var. geogr. *Scopolia carniolica*, 114 relevés, Slovenia; D – *Lamio orvalae-Alnetum incanae* var. geogr. *Helleborus dumetorum*, subtype *Salix alba*, 9 relevés, Croatia; E – *Alnetum incanae*, 58 relevés, south-eastern and central Dinarides.

Abb. 2. Dendrogramm der 196 Aufnahmen der *Alnus incana*-Wälder im Dinarischen Gebirge. Erläuterung s. o.

syntaxa. The second group includes mesophilous species of zonal sessile oak-hornbeam and beech forests, of which the following species of the Illyrian floristic geoelement are particularly prominent: *Lamium orvala*, *Scopolia carniolica*, *Cardamine trifolia*, *Knautia drymeia* ssp. *drymeia*, *Omphalodes verna*, *Galanthus nivalis*, *Hacquetia epipactis*, *Helleborus odorus*, *Cyclamen purpurascens*, *Cardamine enneaphyllos*, *Helleborus niger*, *Aposeris foetida* and *Primula vulgaris*. Stands from Croatia also feature *Epimedium alpinum* and *Helleborus dumetroum*, and those from Slovenia *Anemone trifolia*.

Statistical analysis indicates the chorological-floristic variability of the association *Lamio orvalae-Alnetum incanae* (Fig. 2). Groups A and D represent two types of the studied stands from western Croatia, and groups B and C represent stands from the Dinaric and south-eastern Alpine area of Slovenia. The Slovenian phytocoenologists described them in two geographic variants: var. geogr. *Anemone trifolia* Dakskobler 2010 and var. geogr. *Scopolia carniolica* Accetto 1996. The geographic variant *Anemone trifolia* is divided into the subassociations *typicum* Dakskobler, Šilc et Čušin 2004, *caricetosum albae* Dakskobler, Šilc et Čušin 2004, *fraxinetosum excelsioris* Dakskobler et Rozman 2013 and *rhamnetosum fallacis* Dakskobler et Rozman 2013. The justification for such classification was analyzed by DAKSKOBLER & ROZMAN (2013) and it is not the subject of our analysis.

We focus on stands from western Croatia, i.e., on groups A and D. In the floristic and ecological sense, they differ significantly from one another, but also from the mentioned lower syntaxa of *Alnus incana* forests in Slovenia. We compared them at the level of geographic variants and listed their differential species in Table 2. The geographic variant *Helleborus dumetorum* from western Croatia was divided into two subtypes – *Salix alba* and *Alnus glutinosa* – even though these are not ranked in the phytocoenological system. Their analytical relevés with diagnostic species are presented in Supplement S1. The differential species were determined using the JUICE programme, and the criterion used for determination was a frequency above 50% and a fidelity index above 40. Should future research show a broader distribution and a higher significance of these subtypes, it will be possible to rank them as independent subassociations within the association *Lamio orvalae-Alnetum incanae*, or its geographic variant *Helleborus dumetorum*.

4.1.1 *Lamio orvalae-Alnetum incanae* var. geogr. *Helleborus dumetorum* subtype *Salix alba* (Supplement S1, columns 1–9)

Mixed stands of grey alder and white willow were recorded in a larger, temporarily flooded field and in several places along the River Kupa itself and its tributaries. Stands along the River Kupa are 1–2 m above the average water level and are periodically flooded during higher waters. Stands in karst fields and depressions are found close to the watercourses, 0.5 to 2 m above the average level. They are under the strong impact of floodwater, and the lowest depressions with high groundwater are overgrown with common reed (*Phragmites australis*). In addition, the terrain is rich in temporary watercourses, which are activated during longer rainy periods and in early spring. Floods most frequently occur in April. In extremely humid years, floods may last up to three months (MAYER & BUŠIĆ 1993). The soils are alluvial-colluvial, gleyed. Sporadic afforestation with seedlings of black alder and with clones of black poplar and pedunculate oak undertaken in 1990 was not successful in this site.

In our research, 145 species of higher plants and 19 species of mosses were recorded in nine phytocoenological plots. The distinct differential species in Supplement S1 are the best indicators of moist terraces and of the riparian belt, but are rare in the other lower syntaxa of

Table 2. Differential species (marked grey) for the lower sintaxa in the association *Lamio orvalae-Alnetum incanae*: Croatia - 1. var. geogr. *Helleborus dumetorum*; Slovenia - 2. var. geogr. *Anemone trifolia*, 3. var. geogr. *Scopolia carniolica*.

Tabelle 2. Differentialarten (grau markiert) für niedrigere Syntaxa der Assoziation *Lamio orvalae-Alnetum incanae*. Erläuterung s. o.

Group No.	1	2	3
No. of relevés	24	105	9
	frequency (%)		
Differential species			
Brachythecium rutabulum	75	10	.
Circaea lutetiana	67	6	11
Lysimachia vulgaris	58	10	.
Helleborus dumetorum	58	.	.
Eupatorium cannabinum	54	2	.
Galeopsis speciosa	50	9	.
Alnus glutinosa	50	3	.
Hypnum cupressiforme	50	2	.
Poa trivialis	46	10	.
Carex brizoides	42	.	.
Carex remota	38	2	.
Ajuga reptans	33	10	.
Carex pendula	33	4	11
Lycopus europaeus	29	.	.
Lysimachia nummularia	29	1	.
Mentha longifolia	25	.	.
Scirpus sylvaticus	25	1	.
Rudbeckia laciniata	25	2	.
Juncus effusus	25	.	.
Anemone trifolia	.	75	.
Tilia cordata	.	69	.
Hepatica nobilis	17	61	.
Galanthus nivalis	12	54	.
Cyclamen purpurascens	12	43	11
Helleborus odorus	12	49	.
Carex alba	16	39	.
Veratrum nigrum	.	39	.
Tilia platyphyllos	4	37	11
Ostrya carpinifolia	.	35	.
Isophyrum thalictroides	4	25	.
Malus sylvestris	.	23	.

Group No.	1	2	3
No. of relevés	24	105	9
	frequency (%)		
Carduus personata	.	8	100
Matteuccia struthiopteris	4	9	100
Scopolia carniolica	29	17	100
Cardamine pentaphyllos	.	30	100
Adoxa moschatellina	8	31	100
Omphalodes verna	21	17	89
Chrysosplenium alternifolium	.	14	78
Anthriscus sylvestris	12	10	78
Lathraea squamaria	.	13	56
Maianthemum bifolium	.	16	56
Corydalis solida	.	7	56
Myrrhis odorata	.	8	56
Cardaminopsis halleri	.	.	56
Diagnostic species for more syntax			
Ligustrum vulgare	46	56	.
Knautia drymeia	63	37	.
Helleborus niger	33	53	.
Salix alba	38	16	.
Hacquetia epipactis	16	36	.
Caltha palustris	29	14	.
Veratrum album	21	52	100
Oxalis acetosella	21	51	100
Anemone ranunculoides	.	50	78
Crocus vernus agg.	4	40	78
Aconitum lycoctonum	.	68	56
Carex digitata	21	56	56
Gagea lutea	.	20	56
Fagus sylvatica	29	69	67
Lonicera xylosteum	12	52	44
Myosotis sylvatica	.	33	44
Dactylorhiza fuchsii	.	20	11

this association. These are *Salix alba*, *Mentha longifolia*, *Scirpus sylvaticus*, *Stachys sylvatica* and *Lysimachia vulgaris*. Locally, *Impatiens noli tangere*, *Eupatorium cannabinum*, *Galeopsis speciosa*, *Urtica dioica*, *Petasites hybridus*, *Lamium maculatum* and *Glechoma hederacea* can also be singled out in relation to the subtype *Alnus glutinosa*.

Mixed grey alder and white willow stands have also been described in other European regions (e.g., OBERDORFER 1992, DAKSKOBLER et al. 2004, WILLNER & GRABHERR 2007, DAKSKOBLER 2016). However, they are primarily communities of the type *Salicetum albae* s.l. and are classified within the alliance *Salicion albae* Soó 1930. The presence of different species in these stands also reflects different biogeographic characteristics. Therefore, POLDINI et al. (2011) point out that these stands belong to the Central European vegetation type with different geographic variability.

4.1.2 *Lamio orvalae-Alnetum incanae* var. geogr. *Helleborus dumetorum*, subtype *Alnus glutinosa* (Supplement S1, columns 10–24)

This subtype is frequent in the study area, always occurring at higher positions than those of the previous. It inhabits a drier riparian part, on elongated terraces along the course of the River Kupa and its tributaries which are generally 2 to 6 m above the average water level. It sporadically rises for some fifteen metres above the river bed along wet slopes. The distance of the stands from the river course is generally up to 200 m. In the years with less rainfall this subtype is not flooded, but the soil is moist due to the runoff of water from the surrounding slopes. The soils are alluvial carbonate, gleyic and non-gleyed with inclusions of pseudogley, and are partially anthropogenic.

The tree layer is relatively heterogeneously composed, with grey alder frequently accompanied by black alder, common hornbeam and European ash, while the presence of other species is linked to the geomorphological features of the microsite, the distances from the water courses, anthropogenic impacts and the like. In relation to the other lower syntaxa within the association *Lamio orvalae-Alnetum incanae* the differential species are *Alnus glutinosa* and *Poa trivialis*. Locally, *Acer campestre*, *Carpinus betulus*, *Ligustrum vulgare*, *Crataegus monogyna*, *Primula vulgaris*, *Allium ursinum*, *Anemone nemorosa*, *Hedera helix*, *Knautia drymeia* and *Cirsium oleraceum* can also be singled out in relation to the subtype *Salix alba*.

4.1.3 Syndynamics

Syndynamic processes which lead to the formation of the association *Lamio orvalae-Alnetum incanae* were explained in detail by DAKSKOBLER (2010) along the course of the River Idrijca in western Slovenia. They are identical along the course of the River Kupa in Croatia as well. In simple terms, the development of vegetation starts from bare pebbly banks over different weedy, ruderal and other communities (most frequently the stage with the species *Petasites hybridus*) towards smaller shrubby groups of grey willow and purple osier (*Salicetum eleagno-purpureae petasitetosum hybridi* (Šilc et Čušin 2000) Oriolo et Poldini 2002). With a rise in the terrain, decreased wetness and the development of the humus-accumulative soil horizon, willows assume tree-like forms and the stands are penetrated by the more mesophilous elements of the surrounding zonal forests. This is how the association *Lamio orvalae-Salicetum eleagni* Dakskobler, Šilc et Čušin ex Dakskobler 2007 is formed, and it follows similar processes to develop into the community *Lamio orvalae-Alnetum incanae,* in which *Acer pseudoplatanus*, *Fraxinus excelsior*, *Alnus glutinosa* and

Carpinus betulus have a high degree of presence. Sometimes the tree layer also features *Fagus sylvatica* and *Picea abies*, but their vitality is significantly reduced. Stands developed in such a way remain as permanent stages, and their further development generally ends in the form of zonal communities of common hornbeam or beech.

One part of grey alder stands in western Croatia is characterized by a considerable presence of black alder, which is not typical of the association *Lamio orvalae-Alnetum incanae* in the rest of its distribution range. The higher presence of black alder is favoured by the longer retention and slower runoff of water on flat terraces and the formation of swampy gleyic soils.

4.2 *Alnus incana* forests of the south-eastern and central Dinarides

Grey alder forests in the central and south-western part of the Dinarides were investigated in the south-west of Serbia, in Montenegro along the rivers Tara and Lim, and in Central Bosnia in the mountains of Trebević and Vranica. Their distribution range is larger, but their composition is very similar. The stands extend from 900 to 1100 m and grow on mountain dystric pseudogley (with the presence of acidophilic species *Festuca heterophylla*, *Potentilla erecta*, *Deschampsia flexuosa*) with short periods of wet phases, because the water on the slopes with an inclination from 5 to 20° exhibits faster lateral drainage. The average annual temperature is about 7 °C, and rainfall is 670 mm in the eastern part (SW Serbia), and about 1100 mm in the inner part (Central Bosnia and Herzegovina).

The floristic composition of grey alder forests in this area features a very small number and low frequency of its diagnostic species in relation to other syntaxa. In the Supplement S2, nine (9) diagnostic species were recorded whose frequency is generally below 40 %. The classification of these forests in the association *Alnetum incanae* is justified (cf. columns 1 and 6 in Supplement S2). They display more floristic differences in relation to the north-western Dinarides than to the affiliated *Alnus incana* forests of the Romanian Carpathians (Sanda & Mihailescu 2003, Coldea & Ursu 2016) or Central Europe (e.g., Douda 2008, Chytrý 2013, Slezák et al. 2014, Pielech 2015).

5. Discussion and conclusions

In the synthetic table (Supplement S2), the association *Lamio orvalae-Alnetum incanae* was compared with neighbouring and related communities which were classified into the alliance *Alnion incanae.* There are 290 species of higher plants in the Table, but those represented in only one column below 15% were left out. Only those diagnostic species which relate to the association *Lamio orvalae-Alnetum incanae* were listed. They were determined subjectively, i.e., those represented only in this association or only those whose presence in the association is at least 30% higher than in other communities were considered. Species which are more frequently present in all the compared syntaxa have been omitted.

According to the comparison, with regard to the presence of basic species of temporarily flooded and moist sites (a total of about 100 species of the alliance *Alnion incanae* and classes *Alnetea glutinosae* Malcuit 1929, *Salicetea purpureae* Moor 1958, *Galio-Urticetea* Passarge ex Kopecký 1969*, Molinio-Arrhenetheretea* R. Tüxen 1937 em. R. Tüxen 1970, *Phragmiti-Caricetea elatae* Klika in Klika et Novak 1941), the studied communities show relatively few differences and a small number of diagnostic species.

As for other species, primarily those from the surrounding zonal forests, there are very significant differences. In this sense, the grey alder forests investigated in the north-western Dinarides are particularly distinct. Of the syntaxa compared in Supplement S2, they are floristically richest and show the highest degree of differentiation. Supplement S2 contains 39 species which differentiate them from other syntaxa.

The large number of diagnostic species of the association *Lamio orvalae-Alnetum incanae* is due to several factors. The presence of the species of the Illyrian distribution, as well as of some more thermophilous elements, is mainly the consequence of the biogeographic position and floristic-genetic development of the western Dinarides – one of the floristically richest forest areas in Europe. A higher number of species of the alliance *Tilio-Acerion* Klika 1955 is the consequence of deeper river canyons, a perhumid climate and high air humidity over the year. Mesophilous species from zonal oak-hornbeam and beech forests inhabit narrower slopes and belts along river courses where water is not retained for longer periods. These species penetrate from the surrounding slopes and mix with hygrophytes. Part of the year without much moisture in the soil is conducive to their growth. The geomorphology of the terrain is also important. In areas in which the stands along the watercourses in the Dinaric karst fields are spatially more distant from the slopes with zonal forests, the number of mesophilous species from these communities is much smaller. However, these localities are predominantly covered with forests dominated by black alder. Another important factor is also the anthropogenic factor, whose impact is reflected in the presence of anthropophytes.

The distinct diagnostic species and chorological characteristics are the main reason for which DAKSKOBLER (2010) placed stands of this type into an independent association, despite the fact that in 2007, during research along the River Soča, he had originally included them into the association *Alnetum incanae* and into syntaxonomic schemes that comprised several different biogeographic regions (e.g., MÜLLER & GÖRS 1958, SCHWABE 1985, partly WILLNER & GRABHERR 2007). DAKSKOBLER (2010, p. 12) concludes "that riparian grey alder forests and other broadleaf forests along mid-mountain and mountain water courses in the northern part of the Illyrian floristic province should be classified into the association *Lamio orvalae-Alnetum incanae*. Its diagnostic species are *Lamium orvala* and *Scopolia carniolica*, and indirectly some other diagnostic species of the alliances *Aremonio-Fagion* and *Erythronio-Carpinion*".

The association *Lamio-orvalae-Alnetum incanae* also displays the majority of its floristic-diagnostic properties towards the community *Alnetum incanae* (sensu DOUDA et al. 2016) and does not fit in its Cocktail formula in several parameters. This example illustrates the following: defining one syntaxon over a large area may cause a number of problems, such as the loss of the biogeographic identity, biodiversity and evolutionary characteristics of regional forests, the levelling of ecologically diverse regions, and so on. This relates particularly to refugial areas such as the Dinarides, which are characterized by an unequal presence of species of the Illyrian floristic geoelement, and by rich but heterogeneous floristic compositions. DOUDA et al. (2016) point out: “Although many associations were not retained by our approach, some of them may still be kept in the national and regional vegetation surveys as they probably include region-specific species combinations that are not transferable to the European scale. Yet, they may remain meaningful within some regions”.

On the other hand, we should be aware that syntaxa which are defined too narrowly and locally are frequently needlessly described. The basic prerequisite for an objective solution of these problems is the systematic study of forests documented with a relevant number of phytocoenological relevés. This is not the case with the Dinarides and south-eastern Europe, to which DOUDA et al. (2016) draw attention.

Based on the performed analysis, we conclude that *Alnus incana* forests of the south-eastern Dinarides can be included in the association *Alnetum incanae*, whereas in the north-western part of the Dinarides they belong to the regional association *Lamio orvalae-Alnetum incanae*. This regional association differs from the stands which were described in the associations *Primulo vulgaris-Alnetum incanae* Sburlino, Poldini, Andreis, Giovagnoli et Tasinazzo 2012, *Equiseto-Alnetum incanae* Moor 1958 and *Aceri-Alnetum incanae* Beger 1922 in the neighbouring areas of northern Italy and Austria (cf. DAKSKOBLER & ROZMAN 2013).

In the syntaxonomic sense, the analyzed associations *Alnetum incanae* and *Lamio orvalae-Alnetum incanae* are classified in the suballiance *Alnenion glutinoso-incanae* Oberd. 1953, the alliance *Alnion incanae* Pawl. in Pawl. et al. 1928, of the order *Fagetalia sylvaticae* Pawl. in Pawl. et al. 1928 and class *Querco-Fagetea* Br.-Bl. et Vlieger 1937.

In the new synsystematic classification of vegetation of Europe (MUCINA et al. 2016), the alliance *Alnion incanae* was classified in the order *Alno-Fraxinetalia excelsioris* Passarge 1968 and class *Alno glutinosae-Populetea albae* P. Fukarek et Fabijanić 1968. Future analyses will show the justification of such an approach.

Erweiterte deutsche Zusammenfassung

Einleitung – Im Artikel werden phytozönologische Untersuchungen der Syntaxa der Grau-Erle aus dem Verband *Alnion incanae* Pawl. in Pawl. et al. 1928 in den Dinariden (Abb. 1) vorgestellt. Der nordwestliche Teil umfasst das Dinaridengebiet Sloweniens und Kroatiens, wo auf der kollin-submontanen Höhenstufe (200 bis 700 m) das *Lamio orvalae-Alnetum incanae* Dakskobler 2010 vorkommt. In den mittleren Dinariden in Bosnien und Herzegowina und den südöstlichen Dinariden im Südwesten Serbiens und in Montenegro dominiert das *Oxali-Alnetum incanae* Blečić 1960. Diese Syntaxa wurden bislang nicht miteinander verglichen, und in der Übersicht der Überschwemmungs- und Feuchtwälder in Europa (DOUDA et al. 2016) wurden sie als *Alnetum incanae* Lüdi 1921 aufgefasst. Das Ziel dieser Arbeit war daher, die Grau-Erlenwälder im dinarischen Gebiet Kroatiens phytozönologisch zu analysieren (1), und sie mit verwandten Wäldern in anderen dinaridischen und benachbarten Gebieten zu vergleichen (2).

Materialien und Methoden – Die Forschungen wurden nach den Prinzipien der standardisierten phytozönologischen Schule (BRAUN-BLANQUET 1964) durchgeführt. Von den 196 Vegetationsaufnahmen (Tab. 1) stammten 138 aus dem nordwestlichen (Tab. 2) und 58 aus dem südöstlichen Teil der Dinariden. Von den Vegetationsaufnahmen der nordwestlichen Dinariden sind 16 bisher noch nicht publiziert worden (Beilage S1).

Alle Vegetationsaufnahmen wurden in der Turboveg-Datenbank (HENNEKENS & SCHAMINÉE 2001) gespeichert. Die Cluster-Analyse, sowie der Simprof-Test wurden im PRIMER v6 (CLARKE & GORLEY 2006) durchgeführt. Als Clustering-Methode wurde die UPGMA (Unweighted Pair-Group Method Using Arithmetic Averages) angewendet, sowie der Bray-Curtis-Ähnlichkeitsindex. Die Differentialarten wurden mit dem Programm JUICE 7.0 (TICHÝ 2002) ermittelt.

Ergebnisse und Diskussion – Das Ergebnis der statistischen Analyse sind fünf getrennte Gruppen von Vegetationsaufnahmen (Abb. 2). Diese stimmen in hohem Maße mit der geographischen Verbreitung der dinaridischen Grau-Erlenwälder überein.

Die Gruppen A bis D präsentieren die Assoziation *Lamio orvalae-Alnetum incanae* in den nordwestlichen Dinariden. Die Gruppen A und D aus Westkroatien können als zwei neue Subtypen aufgefasst werden: Der Suptyp von *Salix alba* und der Subtyp von *Alnus glutinosa*. Der erste Subtyp umfasst 9 Aufnahmen aus sehr feuchten, zeitweilig überschwemmten und tiefer liegenden Standorten um das Ufer des Flusses Kupa und seinen Nebenflüssen (Spalten 1–9 in Beilage S1). Der zweite Subtyp umfasst Bestände auf höheren Flussterrassen, trockeneren Standorten und daher mit einer höheren Anzahl mesophiler Arten der umliegenden zonalen Wäldern (Spalten 10–24 in Beilage S1). Die Gruppen B und C stellen Grau-Erlenwälder Nordwestsloweniens dar, die in früheren Untersuchungen (DAKSKOBLER, 2007, 2010, DAKSKOBLER & ROZMAN 2013) in zwei geographische Varianten und vier Subassoziationen gegliedert wurden. Zur Gruppe E gehören Wälder der zentralen und sudöstlichen Dinariden. In deren Artenzusammensetzung treten Hygrophyten hervor, und die Gesamtzahl sowie die Frequenz der Differenzialarten sind sehr niedrig, sodass sie der Assoziation *Alnetum incanae* (vgl. Beilage S2, Spalten 1 und 6) angeschlossen werden können.

Die Ergebnisse unserer Untersuchung deuten auf eine Vielfalt der Grau-Erlenwälder in den Dinariden hin, auf eine reichhaltige und heterogene Atrenzusammensetzung und eine ungleichmäßige Präsenz des illyrischen Florenelements. Die Sonderstellung der Assoziation *Lamio orvalae-Alnetum incanae* (Beilage S2, Spalte 2) innerhalb der untersuchten Syntaxa kann als das Ergebnis der biogeographischen Lage an der nordwestlichen Grenze der Dinariden, der unterschiedlichen vegetationsgeschichtlichen Entwicklung, der vielfältigen Umweltbedingungen und, in einem geringeren Maße, der anthropogenen Einflüsse verstanden werden.

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Supplements

Supplement S1. *Lamio orvalae-Alnetum incanae* var. geogr. *Helleborus dumetorum* in the Croatian Dinarides.

Beilage S1. *Lamio orvalae-Alnetum incanae* var. geogr. *Helleborus dumetorum* in den kroatischen Dinariden.

Supplement S2. Comparison of the association *Lamio orvalae-Alnetum incanae* with affiliated communities of the Dinarides and neighbouring areas.

Beilage S2. Vergleich der Assoziation *Lamio orvalae-Alnetum incanae* mit verwandten Gesellschaften der Dinariden und benachbarter Gebiete.

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Supplement S1. *Lamio orvalae-Alnetum incanae* var. geogr. *Helleborus dumetorum* in the Croatian Dinarides.

Beilage S1. *Lamio orvalae-Alnetum incanae* var. geogr. *Helleborus dumetorum* in den kroatischen Dinariden.

Number of relevé		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Subtype		*Salix alba*									*Alnus glutinosa*														
Altitude in m		430	536	530	294	538	536	536	540	535	241	250	328	225	237	235	333	314	295	350	242	244	243	220	229
Aspect		-	-	-	-	-	-	-	-	-	-	-	N	-	-	-	-	-	-	-	-	-	-	-	-
Slope in degrees		0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	0	0	0	0	0	0	0
Releve area (00m²)		4	4	3	4	4	4	4	4	4	9	4	4	4	6	4	4	4	4	4	4	4	4	4	4
Cover in %: - tree layer (a)		90	50	50	90	80	60	50	50	50	75	60	70	70	75	70	75	90	85	90	95	90	85	80	80
- schrub layer (b)		30	25	50	30	40	40	40	40	60	20	80	35	35	50	25	50	60	35	25	35	60	30	60	50
- herb layer (c)		95	100	100	100	100	100	95	100	100	100	90	100	100	100	100	95	80	100	100	100	100	90	100	100
- moos layer (d)		5	2	3	0	1	5	3	30	1	1	25	30	5	20	10	10	15	10	5	50	5	5	3	1
Number of species		48	67	50	48	46	43	48	67	62	52	88	71	88	96	74	82	79	56	70	52	92	89	70	83
Ass. diff. species																									
Lamium orvala	c	+	+	.	1	1	+	+	1	+	+	+	2	2	+	1	2	2	+	2	.	.	+	+	+
Scopolia carniolica		.	.	.	.	+	.	+	+	.	+	.	.	.	+	.	.	.	+	1	.	.	.	.	.
Filipendula ulmaria		.	+	+	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Var. geogr. diff. species																									
Helleborus dumetorum		.	.	.	.	.	.	.	.	.	+	+	+	1	+	2	1	2	+	+	.	1	1	+	+
Subtype diff. species																									
Salix alba	a	.	3	3	+	+	4	+	1	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix alba	b	.	+	3	.	.	2	+	+	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Petasites hybridus	c	4	3	3	2	2	4	3	4	2	3	.	+	.	.	.	.	1	.	.	.	.	.	.	.
Urtica dioica		2	+	+	2	3	2	2	+	2	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Impatiens noli-tangere		.	+	+	1	.	+	+	+	+	+	.	.	.	.	+	.	+	.	.	.	.	.	.	+
Lysimachia vulgaris		.	+	+	+	+	+	.	+	+	.	.	.	+	+	.	.	.	+	.	+	+	1	.	+
Eupatorium cannabinum		+	1	+	+	.	1	.	1	+	.	+	.	.	.	.	+	.	.	.	+	1	+	.	+
Stachys sylvatica		1	.	+	2	+	+	1	1	+	.	.	+	.	.	.	.	+	.	.	.	.	+	.	+
Galeopsis speciosa		+	.	.	1	+	+	+	+	+	.	.	.	.	+	.	+	.	.	.	+	+	.	.	+
Lamium maculatum		+	+	.	.	1	1	2	+	1	+	.	+	.	.	.	.	.	.	1	.	.	.	.	+
Glechoma hederacea		2	+	.	+	.	+	+	+	.	1	.	.	.	+	.	.	.	.	.	.	.	.	.	+
Mentha longifolia		.	1	+	.	.	+	.	1	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Scirpus sylvaticus		.	+	1	+	.	.	.	1	2	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Alnus glutinosa	a	.	.	.	.	.	.	.	.	.	3	+	.	3	4	1	.	.	3	2	+	4	3	3	4
Carpinus betulus		.	.	.	.	+	.	.	.	.	.	1	1	2	2	3	3	2	1	1	+	.	2	+	.
Acer campestre		.	.	.	.	.	.	.	.	.	2	.	.	.	.	+	.	.	.	.	.	1	.	+	1
Acer campestre	b	.	.	.	.	.	.	.	.	.	1	+	+	+	+	+	+	+	+	+	.	+	+	1	2
Carpinus betulus		.	.	.	.	.	.	.	.	.	.	+	+	1	+	.	1	+	+	+	+	.	1	+	.
Crataegus monogyna		.	.	+	.	.	.	.	.	+	.	+	+	+	+	1	2	+	+	.	+	1	.	1	+
Ligustrum vulgare		.	.	+	.	.	.	.	.	.	.	.	.	1	+	+	1	1	+	.	+	1	1	+	.
Alnus glutinosa		.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	+	+	+	+	+
Hedera helix	c	.	.	.	.	.	.	.	.	.	+	2	+	1	1	1	1	.	2	1	+	+	1	+	+
Knautia drymeia		.	.	.	.	+	.	.	+	.	.	+	+	+	+	1	1	1	+	+	.	+	1	2	+
Allium ursinum		2	.	.	.	.	.	.	.	.	5	+	+	2	1	1	.	.	5	4	.	.	+	+	3
Ligustrum vulgare		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	+	.
Primula vulgaris		.	.	.	.	.	.	.	.	.	.	+	.	+	1	+	1	+	.	.	.	+	+	+	1
Anemone nemorosa			+	.	.	.	.	.	.	.	.	+	.	1	1	+	+	+	+	.	.	+	+	.	1
Cirsium oleraceum		.	.	.	.	.	.	.	.	.	+	+	+	.	1	.	+	+	+	.	.	+	+	.	1
Poa trivialis		.	+	+	.	.	.	.	.	.	+	+	+	.	.	+	.	.	.	.	+	+	+	+	+
Alnion incanae																									
Alnus incana	a	4	3	2	5	4	2	3	4	3	1	3	3	.	1	+	2	4	3	4	5	1	1	3	3
Alnus incana	b	+	+	1	1	1	1	+	3	2	.	.	+	+	+	.	+	3	+	+	+	+	+	+	.
Viburnum opulus		.	1	2	+	+	+	+	+	+	.	+	+	2	+	+	+	+	+	.	.	+	+	+	1
Festuca gigantea	c	+	+	+	1	+	+	1	+	1	+	+	+	.	.	.	.	+	.	.	+	.	.	+	+
Carex brizoides		.	+	.	1	.	.	.	3	+	.	.	.	1	.	.	3	+	.	+	.	.	+	+	.
Chaerophyllum hirsutum		.	1	+	.	.	+	.	2	+	+	+	.	.	+	.	.	.	.	.	.	.	.	.	1
Carex remota		.	+	.	+	.	.	.	+	+	.	.	.	.	1	+	.	+	.	.	.	.	.	+	+
Cardamine impatiens		+	+	.	.	.	.	+	+	.	.	+	.	.	.	+	.	+	.	.	.	.	.	.	+
Carex pendula		.	1	.	+	+	.	.	+	.	+	.	+	+	3	.	.	.	.	.	.	.	.	.	.
Listera ovata		.	.	.	.	.	.	.	.	.	.	.	+	1	+	+	.	.	.	+	.	+	.	.	+
Cerastium sylvaticum		.	.	.	1	.	.	.	.	.	.	+	1	.	.	1	.	+	.	.	.	.	.	.	+
Equisetum telmateia		.	2	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	.	.	.	.	1	.
Equisetum pratense		.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	.	.	.	.	.
Alnus incana		.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	.	.	.	.	.
Equisetum hyemale		.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Matteuccia struthiopteris		.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salicetea purpureae																									
Salix eleagnos	a	1	.	.	.	.	.	.	.	.	.	1	+	.	.	.	+	+	.	.	.	.	.	.	.
Populus nigra		.	+	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix purpurea	b	.	2	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Salix eleagnos		.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.
Alnetea glutinosae																									
Frangula alnus	b	.	+	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	.	.	.	+	.	+	.
Humulus lupulus		.	.	.	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Humulus lupulus	c	.	+	1	.	.	2	1	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Solanum dulcamara		.	.	+	.	.	.	.	1	.	.	.	+	.	.	.	.	.	.	.	.	+	.	+	+
Cardamine amara		.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Dryopteris carthusiana		.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Carex vesicaria		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+
Carpinion, Erythronio-Carpinion																									
Prunus avium	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Prunus avium		.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	+	.	.	.	.	.
Carpinus betulus	c	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	+	.	.
Vinca minor		1	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	1	.	.	.	.	.
Epimedium alpinum		.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	.	.	+	1	.	.
Erythronium dens-canis		.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1	.	.
Aremonio-Fagion																									
Rhamnus alpinus fallax	b	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Stellaria nemorum agg.		1	+	.	.	1	3	2	+	1	1	.	+	+	.	+	+	+	.	+	.	.	.	.	+
Helleborus niger		.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	+	.	.	+	.	+	+	+	.
Cardamine trifolia		+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	2	+	+	.	.	.	.	.
Vicia oroboides		.	.	.	.	+	+	.	.	.	.	.	.	+	.	.	.	.	+	+	.	.	.	.	.
Omphalodes verna		.	.	.	.	.	.	.	.	.	.	1	.	+	.	.	+	+	.	.	.	.	+	.	.
Hacquetia epipactis		.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	.	.	.	+	.	.	.
Cyclamen purpurascens		.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	+	.	.	.	.	.	.	.
Helleborus odorus		.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	+
Rhamnus alpinus fallax		.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.	.
Isopyrum thalictroides		.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Tilio-Acerion																									
Acer pseudoplatanus	a	1	.	.	+	1	.	+	.	+	+	.	.	.	.	.	.	.	.	.	+	1	1	.	.
Ulmus glabra		.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	+	.	.	.	.	.	.
Acer platanoides		.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
Acer pseudoplatanus	b	+	.	.	+	+	+	+	.	+	+	+	.	+	+	+	+	+	+	+	.	+	.	.	+
Ulmus glabra		.	+	.	.	.	+	.	.	.	.	+	.	1	+	+	+	+	.	.	+	+	+	.	.
Euonymus latifolius		.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.
Acer platanoides		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Lunaria rediviva	c	.	.	.	.	1	1	1	.	.	+	.	+	.	.	.	+	1	2	.	.	.	.	.	.
Arum maculatum		+	.	.	.	.	.	.	.	.	.	+	.	+	+	.	+	+	.	+	.	.	+	.	.
Geranium robertianum		+	.	.	.	.	.	.	+	.	.	.	+	.	.	.	+	+	+	.	+	.	.	.	.
Aruncus dioicus		+	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	+	.	+	.	.	.	.	+
Polystichum aculeatum		.	.	+	.	.	.	.	.	.	.	.	+	+	.	+	+	.	.	.	.	.	.	.	.
Aconitum lycoct. vulparia		.	.	.	.	+	.	.	.	.	.	.	.	+	.	1	+	+	.	.	.	.	.	.	.
Asplenium scolopendrium		.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	+	.	.	.	.	.	.	.
Glechoma hirsuta		.	.	.	.	.	.	.	.	.	.	.	1	.	.	2	.	+	.	+	.	.	.	.	.
Adoxa moschatellina		1	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Polystichum setiferum		+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
Euonymus latifolius		.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.
Aconitum variegatum		.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	.	.	.	.	.	.	.
Cardamine flexuosa		.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	+	.	.	.	.
Thalictrum aquilegiifolium		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.
Fagetalia																									
Fraxinus excelsior	a	1	.	.	.	.	+	.	.	.	+	+	2	2	+	+	+	1	1	.	+	+	1	1	+
Fagus sylvatica		.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	.	1	.	.	.	.	.	.
Fraxinus excelsior	b	+	.	.	+	+	+	.	.	.	+	1	+	1	+	+	+	2	1	+	2	+	+	3	+
Sambucus nigra		1	.	.	2	1	2	2	1	1	.	+	+	.	+	+	.	.	.	+	+	.	+	+	+
Fagus sylvatica		.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	.	+	.	+	.	.	.
Daphne mezereum		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.
Brachypodium sylvaticum	c	+	+	+	1	2	1	+	2	+	1	+	1	2	2	3	3	2	+	+	+	2	2	1	2
Lamium galeobdolon		+	+	.	+	+	+	.	+	.	1	+	1	1	+	+	+	+	1	1	.	2	2	.	+
Circaea lutetiana		.	+	+	1	+	.	+	+	+	1	.	.	.	+	.	+	+	1	+	.	+	.	+	1
Asarum europaeum		2	.	.	+	+	+	+	+	.	.	1	.	1	+	1	2	2	.	2	.	+	.	+	.
Carex sylvatica		.	+	.	+	.	+	+	.	.	.	+	+	+	+	.	.	+	.	.	+	+	+	+	+
Salvia glutinosa		1	+	.	.	.	.	.	+	.	.	1	.	+	+	1	1	1	+	1	.	1	+	.	+
Mercurialis perennis		+	.	.	.	+	+	+	.	.	.	+	.	+	+	+	1	1	1	1	.	.	.	.	.
Pulmonaria officinalis		+	.	.	.	+	+	+	.	.	.	+	.	+	+	+	.	+	.	+	.	.	.	.	+
Symphytum tuberosum agg.		.	+	.	.	.	+	.	.	.	+	+	+	1	+	+	.	.	+	+	.	.	.	+	.
Petasites albus		3	.	+	1	.	.	1	+	.	.	+	+	+	.	1	+	+	.	+	.	.	.	.	.
Ranunculus lanuginosus		.	+	+	.	.	+	.	.	.	+	+	+	.	+	.	.	.	.	+	.	.	.	.	+
Paris quadrifolia		.	.	.	.	.	+	+	+	.	.	.	.	+	+	.	.	.	+	.	.	+	+	.	+
Polygonatum multiflorum		.	.	+	.	.	.	.	+	.	.	+	.	+	+	.	+	+	.	+	.	.	.	.	.
Dryopteris filix-mas		.	.	+	.	.	.	.	+	.	.	.	+	.	.	.	.	+	+	1	+	.	.	+	.
Cardamine bulbifera		+	+	.	.	.	.	.	.	.	+	.	+	.	.	+	.	.	1	.	.	.	.	.	+
Viola reichenbachiana		.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	+	+	.	.	.	+	.	+	+
Scrophularia nodosa		.	.	.	+	.	.	.	+	+	.	+	+	+	.	.	.	.	+	.	.	.	.	.	.
Campanula trachelium		.	.	.	.	.	.	.	+	.	.	+	.	.	.	+	+	+	.	.	.	.	.	.	+
Mycelis muralis		+	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	+	.	+	.	.	.
Phyteuma spicatum		.	.	.	.	.	.	.	.	.	.	+	.	1	+	.	.	+	.	+	.	.	.	.	.
Melica nutans		.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	+	+	.	.
Heracleum sphondylium		.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	+
Ranunculus ficaria		.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	+	.	.	.	2
Sanicula europaea		.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.
Bromus benekenii		.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Fraxinus excelsior		.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	.	.	.	.	.	.	.
Euphorbia dulcis		.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.
Lilium martagon		.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.
Epipactis helleborine		.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	.	.
Lathyrus vernus		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.
Galium odoratum		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.
Quercetalia pubescentis																									
Fraxinus ornus	b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	1	.	.	.
Euonymus verrucosus		.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Acer obtusatum		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.
Carex flacca	c	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	1	1	+	.
Tamus communis		.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.
Acer obtusatum		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Fraxinus ornus		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Querco-Fagetea																									
Corylus avellana	a	.	.	+	.	+	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.
Corylus avellana	b	.	+	2	.	+	1	2	1	.	+	2	2	2	2	2	3	1	+	2	+	+	.	+	.
Lonicera xylosteum		.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	+	.	.	.
Pyrus pyraster		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.
Carex digitata	c	.	.	.	.	.	.	.	.	.	.	+	.	1	+	+	.	.	.	+	.	.	.	.	.
Galium sylvaticum		.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	+	+	.	.
Hepatica nobilis		.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	+	+	.	.
Cruciata glabra		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	+	.	.
Galanthus nivalis		.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+
Ranunculus auricomus		.	.	.	.	.	.	.	.	.	.	.	.	+	.	1	.	.	+	.	.	.	.	.	.
Scilla bifolia agg.		.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	+
Veronica montana		.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	+
Galium schultesii		.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.
Leucojum vernum		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+
Erico-Pinetea																									
Carex alba	c	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	+	+	.	.
Cirsium erisithales		.	.	.	.	.	.	.	.	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.
Vaccinio-Piceetea																									
Picea abies	a	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	+	+	.	.
Abies alba	b	.	.	.	.	+	.	+	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.
Picea abies		.	.	.	.	+	.	.	.	.	.	1	.	.	.	.	.	.	.	1	.	.	+	.	.
Rubus saxatilis		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Aposeris foetida	c	.	.	.	.	.	.	.	.	.	.	+	.	1	+	+	1	+	.	+	.	.	.	.	+
Oxalis acetosella		.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	+	.	1	.	.	.	.	.
Rubus saxatilis		.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	1	1	.	.	.	.	.	.
Abies alba		.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.
Veronica urticifolia		.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.
Streptopus amplexifolius		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.
Rhamno-Prunetea																									
Cornus sanguinea	b	+	+	.	.	+	.	.	.	+	+	2	1	+	+	1	+	+	2	+	+	1	1	+	1
Euonymus europaeus		.	.	+	.	.	.	.	+	.	+	.	+	1	+	.	.	.	+	.	1	+	+	1	1
Clematis vitalba		+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	1	.	1	+	1	+
Rhamnus cathartica		.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	+	+	+
Rubus plicatus		.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	3	+	.	+	.
Rosa arvensis		.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	+	+	.	.
Berberis vulgaris		.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	1	1	.	.
Prunus cerasifera		.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.
Viburnum lantana		.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.
Prunus spinosa		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	2	.
Cornus mas		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.
Euonymus europaeus	c	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	2	1	.	1	2
Clematis vitalba		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.
Cornus sanguinea		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.
Mulgedio-Aconitetea																									
Senecio ovatus	c	1	.	.	+	.	.	+	+	+	+	+	+	+	+	.	+	.	.	+	.	+	+	.	+
Athyrium filix-femina		+	+	+	+	.	.	+	.	+	+	.	.	.	.	.	.	.	+	1	+	.	.	+	.
Doronicum austriacum		.	.	.	+	.	.	.	.	.	.	.	.	+	+	+	+	.	.	+	.	.	.	.	.
Veratrum album		.	.	+	.	.	.	.	+	.	.	.	.	2	2	+	.	.	.	.	.	.	.	.	.
Silene dioica		+	+	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Adenostyles alliariae		.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Epilobietea angustifolii																									
Rubus idaeus	b	.	.	.	1	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Fragaria vesca		+	.	.	.	.	.	.	.	.	.	+	.	+	.	.	1	+	.	.	+	.	.	.	.
Arctium minus		.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	+	.	+
Molinio-Arrhenatheretea																									
Deschampsia cespitosa	c	+	.	.	.	.	+	+	+	+	.	.	.	+	+	+	1	+	.	+	.	.	+	.	+
Ajuga reptans		.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	+	.	+	1	+	+
Caltha palustris		.	+	+	+	.	.	.	1	1	.	.	.	.	3	.	.	.	.	.	.	.	.	.	+
Lysimachia nummularia		.	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	1	1	2	2
Angelica sylvestris		.	.	.	.	+	.	.	.	+	.	.	.	+	.	.	.	.	1	.	.	+	.	+	+
Valeriana dioica		.	+	.	.	.	.	.	.	.	.	.	.	1	+	1	.	.	.	.	.	2	+	.	.
Crepis paludosa		.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	+	+	.	+
Juncus effusus		.	+	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.
Myosotis scorpioides		.	+	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Valeriana officinalis		.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	.	.
Colchicum autumnale		.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	1
Anthriscus sylvestris		.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
Lythrum salicaria		.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Ranunculus acris		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.
Pimpinella major		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	+
Lychnis flos-cuculi		.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Glyceria striata		.	.	1	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Equisetum palustre		.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
Galium mollugo		.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Veronica chamaedrys		.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.
Dactylis glomerata		.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.
Prunella vulgaris		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	1	.	.
Holcus lanatus		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.
Juncus tenuis		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.
Phragmiti-Caricetea elatae																									
Lycopus europaeus	c	.	+	1	.	.	.	.	+	1	.	.	+	.	.	.	.	.	.	.	.	+	.	.	+
Mentha aquatica		.	+	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	+	+	+	.
Phragmites australis		.	3	1	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Glyceria fluitans		.	+	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Agrostietea																									
Equisetum arvense	c	+	.	.	2	+	+	+	+	+	+	+	+	.	1	.	+	.	.	+	+	+	+	+	2
Ranunculus repens		.	.	+	.	.	.	.	.	+	.	.	.	.	+	.	.	.	.	.	1	+	1	+	1
Galio-Urticetea																									
Aegopodium podagraria	c	2	2	2	2	2	2	1	1	1	1	+	2	+	1	1	1	1	2	1	+	+	1	+	1
Geum urbanum		.	+	+	1	+	+	+	+	.	+	.	+	.	+	1	+	+	+	.	2	+	+	+	+
Geranium phaeum		.	.	.	.	.	.	.	.	.	+	+	.	.	+	+	+	+	.	.	.	.	.	.	.
Alliaria petiolata		2	+	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Telekia speciosa		.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	.	.	.	.	.
Chaerophyllum temulum		.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
Lapsana communis		.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.
Impatiens glandulifera		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+
Myosoton aquaticum		.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Sambucus ebulus		.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Artemisietea																									
Galium aparine	c	.	+	.	.	.	+	+	.	+	+	.	.	.	.	.	.	.	.	.	+	.	.	+	+
Erigeron annuus		.	.	.	.	.	.	+	.	+	.	.	+	+	.	.	+	.	.	.	.	.	.	.	.
Solidago gigantea		.	.	.	+	.	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Chelidonium majus		+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Other species																									
Rubus caesius	b	+	1	3	.	3	3	3	+	2	1	2	3	+	1	2	.	.	2	+	2	3	2	3	3
Juglans regia		.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	+	.	+	.
Stellaria media	c	.	+	.	.	.	+	+	.	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.
Rudbeckia laciniata		.	.	.	.	.	.	.	.	.	.	+	1	.	.	+	.	.	.	.	+	.	.	1	2
Carex hirta		.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Viola hirta		.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.
Clinopodium vulgare		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.
Carex flava		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Rubus hirtus s.lat.		.	.	.	3	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Bryophyta	d																								
Brachythecium rutabulum		.	.	+	.	+	+	+	+	.	+	1	+	+	+	.	+	+	+	.	1	+	1	+	+
Plagiomnium undulatum		+	+	.	.	.	.	+	+	.	+	2	2	+	+	1	1	2	1	+	.	.	.	.	+
Hypnum cupressiforme		.	.	.	.	+	.	+	+	1	+	1	1	.	1	.	.	.	.	.	+	1	1	+	.
Isothecium alopecuroides		.	.	+	.	.	.	+	.	.	+	.	.	.	+	.	.	.	.	.	.	+	.	.	.
Atrichum undulatum		.	.	+	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	1	.	.	+	.
Anomodon attenuatus		.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.
Neckera complanata		.	.	.	.	.	.	.	.	.	.	+	+	.	1	.	.	.	.	.	.	+	+	.	.
Rhizomnium punctatum		.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	.	.	+	+	.	.
Anomodon viticulosus		.	.	+	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.
Conocephalum conicum		.	.	.	.	+	.	.	.	.	.	.	+	.	1	.	.	.	.	.	+	.	.	.	.
Ctenidium molluscum		.	.	.	.	.	.	.	.	.	.	+	.	.	1	.	.	.	.	.	.	+	+	.	.
Homalia trichomanoides		.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Fissidens bryoides		.	.	+	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.
Plagiomnium affine		.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Alleniella complanata		.	.	.	.	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.
Tortela tortuosa		.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	+	+	.	.
Neckera crispa		.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+	.	.
Plagiomnium medium		+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Brachythecium rivulare		+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Orthotrichum affine		.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Mnium marginatum		.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Homalothecium sericeum		.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Exsertotheca crispa		.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.
Climacium dendroides		.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Fissidens taxifolius		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
Plagiothecium nemorale		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.

Species noted in one relevé with + : b - Populus tremula (22), Tilia platyphyllos (23), Daphne laureola (16), Juglans nigra (21), Quercus petraea (20), c - Veronica serpyllifolia (20), Campanula patula (20), Carex buekii (24), Alisma plantago-aquatica (22), Brachypodium pinnatum (22), Convallaria majalis (22), Asplenium trichomanes (11), Myosotis arvensis (11), Carex elata (2), Galium palustre (2), Carex pallescens (23), Crocus vernus agg. (23), Senecio sarracenicus (18), Vicia sepium (5), Cardamine waldsteinii (10), Orchis militaris (16), Poa palustris (16), Cardamine enneaphyllos (13), Tordilis japonica (13), Aquilegia vulgaris (13), Allium carinatum (16), Calamintha grandiflora (16), Calamagrostis epigejos (9), Equisetum fluviatile (9), Luzula luzuloides (9), Molinia caerulea (9), Phalaris arundinacea (9), Laserpitium siler (8), Agrostis stolonifera (8), Cirsium palustre (8), Epilobium montanum (8), Equisetum sylvaticum (8), Hypericum perforatum (8), Hypericum tetrapterum (8), Arctium nemorosum (3), Cardaminopsis arenosa (15), Crepis biennis (15), Vicia sylvatica (15), Silene vulgaris (17), Gentiana asclepiadea (17), Myosotis species (4), Pteridium aquilinum (4), Actaea spicata (19), Galium rotundifolium (19), Melica uniflora (19), Polypodium vulgare (19), d - Plagiomnium elatum (2), Leucodon sciuroides (11), Porella platyphylla (11), Calliergonella cuspidata (14), Polytrichum formosum (21), Fissidens adianthoides (22)

Positions of new relevés in the WGS84 Coordinate Reference System (Nr. relevé - Latitude - Longitude): 2 - N45°31'53,3'' - E14°38'44,5''; 3 - N45°31'48,3'' - E14°38'52,0''; 5 - N45°32'05,0'' - E14°38'42,1''; 6 - N45°32'52,1'' - E14°38'40,8''; 7 - N45°31'55,6'' - E14°38'01,3; 9 - N45°30'01,9'' - E14°39'11,2''; 10 - N45°26'17,0'' - E14°50'50,6''; 11 - N45°30'17,6'' - E14°47'16,4''; 12 - N45°29'03,7'' - E14°48'19,7''; 14 - N45°26'28,5'' - E14°52'12,9''; 20 - N45°26'52,5'' - E14°52'12,9''; 21 - N45°27'51,7'' - E14°48'24,2''; 22 - N45°27'53,4'' - E14°48'26,8''; 23 - N45°28'29,7'' - E14°53'18,5''; 24 - N45°27'38,3'' - E14°49'43,0''

Supplement S2. Comparison of the association *Lamio orvalae-Alnetum incanae* with affiliated communities of the Dinarides and neighbouring areas.

Beilage S2. Vergleich der Assoziation *Lamio orvalae-Alnetum incanae* mit verwandten Gesellschaften der Dinariden und benachbarter Gebiete.

1. *Oxalido-Alnetum incanae, Alnetum glutinoso-incanae, Alnetum incanae*, south-eastern Dinarides
2. *Lamio orvalae-Alnetum incanae,* north-western Dinarides
3. *Primulo vulgaris-Alnetum incanae,* Italy
4. *Aceri-Alnetum incanae,* Italy
5. *Aceri-Alnetum incanae,* Austria
6. *Alnetum incanae,* Europe

Syntaxon /column	1	2	3	4	5	6
Number of relevés	58	138	39	80	329	232
			frequency (%)			
Differential species						
Alchemilla vulgaris	36	.	.	.	.	12
Potentilla reptans	34	.	.	.	.	3
Euphorbia amygdaloides	33	17	.	.	.	10
Festuca heterophylla	31	.	.	.	.	.
Glechoma hirsuta	29	3	.	.	.	.
Aremonia agrimonoides	24	.	.	.	.	.
Potentilla erecta	21	.	.	.	.	.
Deschampsia flexuosa	19	.	.	.	.	.
Prunella vulgaris	52	3	.	.	21	7
Arum maculatum	16	38	.	1	.	.
Rhamnus fallax	21	9	.	.	.	.
Myosotis sylvatica	10	28	.	.	.	.
Abies alba	12	21	.	.	.	.
Viburnum opulus	26	61	10	4	3	13
Lamium orvala		92	.	.	.	7
Ulmus glabra	7	76	.	3	4	8
Lunaria rediviva	9	60	.	1	.	.
Aconitum lycoctonum agg.	.	59	5	15	.	11
Anemone trifolia	.	58	.	.	.	1
Euonymus europaeus	10	57	15	3	4	4
Cardamine trifolia	.	52	5	1	13	.
Ranunculus ficaria	5	51	5	.	2	3
Veratrum album	12	50	.	10	.	.
Allium ursinum	12	47	13	.	1	.
Cerastium sylvaticum	.	46	3	1	.	.
Helleborus niger	.	46	.	.	.	3
Hepatica nobilis	.	46	13	16	.	3
Cardamine enneaphyllos	.	45	3	3	.	2
Symphytum tuberosum	2	43	8	3	6	.
Galanthus nivalis	.	43	.	.	.	.
Anemone ranunculoides	2	43	.	.	.	7
Knautia drymeia agg.	.	39	.	.	.	.
Cyclamen purpurascens	.	36	.	.	.	1
Adoxa moschatellina	2	36	.	.	9	.
Acer platanoides	.	35	.	.	.	5
Carex alba	.	33	.	.	.	3
Cardamine pentaphyllos	.	30	8	9	.	.
Veratrum nigrum	2	30	.	.	.	.
Aposeris foetida	.	30	.	.	.	6
Tilia platyphyllos	.	30	.	.	.	.
Hacquetia epipactis	.	30	.	.	.	.
Crocus vernus ssp. vernus		26	.	.	.	.
Scopolia carniolica	.	25	.	.	.	.
Solidago gigantea	.	23	3	1	1	2
Omphalodes verna	.	22	.	.	.	.
Isopyrum thalictroides	2	20	.	.	.	.
Gagea lutea	.	19	.	.	1	.
Asplenium scolopendrium	.	18	.	.	.	.
Polystichum aculeatum	2	17	.	.	.	.
Convallaria majalis	.	17	.	.	.	1
Dryopteris affinis	.	17	.	.	.	1
Matteuccia struthiopteris	.	15	.	.	1	6
Helleborus dumetorum	.	10	.	.	.	.
Rubus caesius	3	83	92	34	16	19
Primula vulgaris	.	61	51	4	.	3
Polygonatum multiflorum	.	55	23	6	2	6
Hedera helix	2	47	54	1	.	2
Acer campestre	.	68	31	3	.	3
Cornus sanguinea	.	74	77	3	3	11
Ligustrum vulgare	.	51	56	.	1	.
Salix eleagnos	7	56	26	15	.	13
Vinca minor	.	43	51	.	.	3
Helleborus odorus	5	39	31	1	.	.
Carpinus betulus	3	54	15	.	1	2
Ostrya carpinifolia	.	27	23	.	.	.
Listera ovata	5	53	23	9	.	10
Leucojum vernum	.	38	13	.	1	.
Salix alba	.	19	28	3	.	.
Crataegus monogyna	38	58	36	3	3	.
Prunus padus	.	1	.	26	19	27
Primula elatior	.	1	.	6	17	37
Polygonatum verticillatum	3	5	3	24	12	.
Viola biflora	2	1	13	28	44	29
Rubus idaeus	16	9	3	69	43	63
Solidago virgaurea	2	11	.	25	22	13
Sorbus aucuparia	13	7	3	38	19	31
Alnion incanae						
Alnus incana	98	94	100	100	96	100
Stellaria nemorum agg.	12	46	56	44	39	57
Chaerophyllum hirsutum	5	53	23	60	61	73
Impatiens noli-tangere	21	22	38	46	44	53
Chrysosplenium alternifolium	10	16	3	10	23	30
Carex remota	10	8	5	4	4	11
Cardamine impatiens	10	29	28	16	.	.
Festuca gigantea	.	33	5	14	10	28
Equisetum hyemale	.	4	13	8	1	1
Phalaris arundinacea	.	1	8	3	3	7
Carex pendula	2	9	.	.	1	1
Cardamine amara	.	5	.	1	15	19
Dryopteris carthusiana	.	17	.	.	1	9
Carex brizoides	.	7	.	.	1	6
Equisetum telmateia	.	4	.	.	1	.
Ranunculus cassubicus	3	.	.	.	.	2
Alnetea glutinosae						
Solanum dulcamara	14	8	5	20	10	13
Humulus lupulus	10	33	33	10	3	7
Lycopus europaeus	5	5	8	1	2	5
Alnus glutinosa	26	11	15	.	1	4
Frangula alnus	22	19	13	5	.	5
Carex vesicaria	2	1	.	.	.	.
Salix cinerea	2	.	.	.	.	3
Salicetea purpureae						
Salix purpurea	7	6	3	13	5	17
Populus nigra	.	12	13	.	.	2
Salix fragilis	9	3	.	.	.	.
Tilio-Acerion						
Acer pseudoplatanus	26	88	36	44	37	50
Geranium robertianum	36	30	38	59	36	47
Aruncus dioicus	2	41	26	28	6	20
Aconitum variegatum	.	25	3	14	.	10
Euonymus latifolia	10	10	.	.	.	1
Corydalis solida	.	9	.	.	1	.
Polystichum setiferum	.	1	.	.	.	3
Erythronio-Carpinion						
Prunus avium	2	25	13	3	.	.
Lonicera caprifolium	5	2	.	.	.	.
Aremonio-Fagion						
Saxifraga rotundifolia	2	4	.	.	1	.
Calamintha grandiflora	16	1	.	.	.	.
Fagetalia sylvaticae						
Fraxinus excelsior	19	95	46	46	31	38
Brachypodium sylvaticum	36	87	74	38	23	32
Mercurialis perennis	12	80	13	15	16	23
Paris quadrifolia	19	78	28	29	19	27
Lamium galeobdolon agg	31	76	59	68	43	51
Carex sylvatica	14	26	23	11	20	28
Dryopteris filix-mas	28	49	28	44	37	28
Viola reichenbachiana	36	57	21	16	14	21
Pulmonaria officinalis	2	70	10	33	7	26
Circaea lutetiana	19	17	8	6	6	10
Daphne mezereum	7	64	5	26	14	30
Ranunculus lanuginosus	10	66	3	28	14	33
Salvia glutinosa	3	66	67	35	23	22
Sambucus nigra	5	64	56	26	20	18
Scrophularia nodosa	5	11	3	10	8	16
Petasites albus	7	35	18	49	42	58
Fagus sylvatica	5	62	3	9	6	9
Galium odoratum	17	2	10	3	3	11
Asarum europaeum agg.	7	82	36	.	6	29
Heracleum sphondylium	2	23	5	19	12	.
Cardamine bulbifera	2	31	13	5	1	.
Mycelis muralis	28	19	21	31	.	32
Melica nutans	2	33	10	19	.	18
Campanula trachelium	2	21	8	21	.	18
Euphorbia dulcis	.	35	10	18	2	8
Tilia cordata	.	32	13	10	1	4
Poa nemoralis	28	5	3	29	12	27
Phyteuma spicatum agg.	3	10	.	1	11	.
Epilobium montanum	26	2	.	15	25	.
Veronica montana	3	2	.	.	1	3
Prenanthes purpurea	.	1	3	5	6	.
Actaea spicata	5	18	.	11	.	.
Corydalis bulbosa	.	17	5	.	.	1
Galium sylvaticum agg	9	4	.	.	.	.
Lilium martagon	2	17	.	.	.	.
Sanicula europaea	3	6	.	.	.	.
Galium schultesii	16	1	.	.	.	.
Bromus benekenii	.	4	.	.	.	1
Sambucus racemosa	2	.	.	.	1	.
Anthriscus nitidus	.	10	.	.	.	.
Quercetalia pubescentis						
Euonymus verrucosus	3	4	.	.	.	1
Sorbus aria	.	4	.	.	.	2
Quercetalia roboris-petraeae						
Betula pendula	2	.	1	5	6	.
Luzula luzuloides	7	1	.	.	.	.
Pteridium aquilinum	7	1	.	.	.	1
Viola riviniana	.	13	3	3	.	.
Querco-Fagetea						
Corylus avellana	41	93	69	28	26	22
Lonicera xylosteum	5	45	44	35	14	27
Moehringia trinervia	9	4	3	5	4	9
Anemone nemorosa	9	64	.	5	17	14
Carex digitata	.	45	31	11	.	6
Cruciata glabra	9	7	.	.	1	.
Malus sylvestris	3	18	.	.	.	.
Rosa arvensis	2	5	.	.	.	.
Pyrus pyraster	7	3	.	.	.	.
Dactylorhiza fuchsii	5	17	.	21	16	.
Melica uniflora	2	1	.	.	.	.
Rhamno-Prunetea						
Clematis vitalba	5	46	23	10	6	6
Rubus plicatus	9	4	8	9	9	8
Berberis vulgaris	.	24	3	8	8	4
Viburnum lantana	.	17	10	13	.	6
Prunus spinosa	22	4	.	.	.	.
Vaccinio-Piceetea						
Picea abies	19	61	44	70	46	71
Oxalis acetosella	74	49	31	51	59	57
Maianthemum bifolium	5	16	.	24	10	18
Equisetum sylvaticum	3	1	.	1	9	15
Lonicera nigra	2	3	.	14	1	12
Veronica urticifolia	7	12	.	.	.	11
Dryopteris dilatata	2	5	.	.	.	8
Luzula pilosa	2	1	.	.	.	3
Hieracium murorum	3	1	3	11	.	.
Calamagrostis arundinacea	.	.	3	8	2	.
Gentiana asclepiadea	9	3	.	.	.	.
Luzula sylvatica	2	.	.	.	1	.
Vaccinium myrtillus	5	.	.	.	.	2
Calamagrostis villosa	.	.	.	.	1	3
Mulgedio-Aconitetea						
Senecio ovatus agg.	17	49	3	45	53	51
Athyrium filix-femina	33	23	15	34	42	46
Thalictrum aquilegiifolium	5	28	10	21	10	48
Carduus personata	5	12	3	23	21	33
Valeriana officinalis	3	4	21	10	7	.
Milium effusum	.	4	3	3	6	14
Doronicum austriacum	12	7	.	.	1	.
Silene dioica	.	9	.	15	19	.
Geranium sylvaticum	.	.	3	11	.	13
Chaerophyllum aureum	5	8	.	.	.	.
Adenostylles alliariae	2	4	.	.	.	.
Rudbeckia lacinata	.	6	.	.	1	.
Rumex alpestris	.	.	.	.	1	15
Myrrhis odorata	.	9	.	.	.	.
Epilobietea angustifolii						
Stachys sylvatica	19	25	33	45	33	58
Galeopsis speciosa	9	15	3	20	9	11
Fragaria vesca	55	29	18	55	50	.
Eupatorium cannabinum	.	11	13	8	9	11
Galio-Urticetea						
Aegopodium podagraria	22	92	77	44	30	63
Geum urbanum	50	45	23	40	20	32
Urtica dioica	36	31	26	54	53	64
Petasites hybridus	10	41	15	39	14	55
Glechoma hederacea	7	23	28	35	17	29
Elymus caninus	7	1	8	45	9	40
Anthriscus sylvestris	12	14	.	5	2	9
Stellaria media	2	7	10	1	.	.
Lamium maculatum	5	21	.	.	21	27
Geranium phaeum	9	17	.	.	1	17
Alliaria petiolata	.	14	8	4	.	4
Galeopsis pubescens	2	.	3	9	7	.
Impatiens parviflora	.	4	15	8	3	4
Torilis japonica	5	1	.	.	.	1
Myosoton aquaticum	.	1	3	1	.	.
Viola odorata	7	5	.	.	.	.
Lapsana communis	14	1	.	.	.	.
Impatiens glandulifera	.	12	.	.	1	.
Chaerophyllum temulum	.	1	.	.	.	1
Phragmiti-Magnocaricetea						
Lysimachia vulgaris	7	18	3	1	3	6
Galium palustre	3	1	.	.	.	8
Mentha aquatica	5	2	.	.	.	.
Glyceria fluitans	.	2	.	.	.	3
Carex paniculata	7	.	.	.	.	3
Calthion						
Angelica sylvestris	10	57	13	38	29	39
Caltha palustris	14	16	5	19	28	37
Crepis paludosa	2	9	3	16	26	40
Cirsium oleraceum	.	35	36	10	35	38
Scirpus sylvaticus	5	5	.	.	1	8
Juncus effusus	2	4	.	.	.	5
Molinio-Arrhenatheretea						
Dactylis glomerata	33	12	3	13	22	22
Ranunculus repens	50	13	3	28	26	41
Deschampsia caespitosa	17	64	54	49	51	62
Filipendula ulmaria	28	33	10	15	15	46
Poa trivialis	9	16	3	9	9	8
Myosotis scorpioides	3	3	5	3	33	31
Galium mollugo	9	9	41	31	18	.
Equisetum palustre	2	1	5	3	9	.
Cirsium palustre	9	1	.	5	17	7
Geum rivale	7	1	13	19	13	41
Lysimachia nummularia	43	6	.	.	1	14
Ajuga reptans	52	13	3	.	20	34
Ranunculus acris	2	2	.	.	.	5
Vicia sepium	.	1	.	5	.	5
Symphytum officinale	.	.	.	1	1	3
Taraxacum officinale	7	10	.	.	.	.
Veronica chamaedrys	5	4	.	.	.	.
Crepis biennis	3	1	.	.	.	.
Molinia caerulea	2	1	.	.	.	.
Valeriana dioica	.	6	.	.	6	.
Pimpinella major	.	6	.	.	.	3
Galium album	2	.	.	.	.	22
Plantago major	9	.	.	.	.	3
Belis perennis	7	.	.	.	.	1
Vicia cracca	2	.	.	.	.	1
Trifolio-Geranietea						
Clinopodium vulgare	14	3	.	.	.	3
Hypericum perforatum	21	1	.	.	.	.
Other species						
Equisetum arvense	21	44	31	34	17	27
Salix caprea	5	6	3	8	6	16
Tussilago farfara	19	5	3	9	.	13
Galium aparine	.	11	10	5	4	9
Rumex obtusifolius	7	1	.	1	6	.
Agrostis stolonifera	7	1	.	4	14	.
Mentha longifolia	21	4	.	.	.	10
Polypodium vulgare	2	9	.	.	.	4
Robinia pseudacacia	.	17	28	3	.	.
Aconitum napellus	.	2	.	3	6	30
Campanula patula	17	1	.	.	.	.
Populus tremula	3	1	.	.	.	.
Asplenium trichomanes	3	10	.	.	.	.
Rubus saxatillis	.	7	.	.	.	3
Petasites paradoxus	.	8	.	.	.	2
Brachypodium pinnatum	.	1	.	.	.	3
Ribes nigrum	.	4	.	.	.	1
Carex pallescens	.	1	.	.	.	1
Lysimachia nemorum	3	.	.	.	36	.
Galeopsis tetrahit	3	.	.	.	14	.
Astrantia major	2	2	.	.	.	14
Knautia dipsacifolia	.	.	.	.	16	13
Juniperus communis	16	.	.	.	.	.
Dactylorhiza incarnata	17	.	.	.	.	.
Geum montanum	16	.	.	.	.	.
Bryophyta	x		x	x		
Plagiomnium undulatum		85	.	.	2	64
Brachythecium rutabulum		20	.	.	1	15
Atrychum undulatum		4	.	.	1	29
Rhizomnium punctatum		4	.	.	1	21
Eurhynchium striatum		16	.	.	1	6
Plagiomnium affine		2	.	.	1	38
Calliorgonella cuspidata		1	.	.	1	9
Climacium dendroides		13	.	.	1	.
Ctenidium molluscum		26	.	.	.	2
Polytrichum formosum		4	.	.	.	6
Eurhynchium striatum		15				
Isothecium alopecuroides		12	.	.	.	.
Hypnum cupressiforme		10	.	.	.	.
Eurhynchium hianis	.	.	.	.	.	27

x - Bryophytes not listed