

Classification of the relict forest communities of Palla's Black Pine (*Pinus nigra* subsp. *pallasiana*) in Bulgaria

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Ključne besede: Balkanski polotok, gozdovi iglavcev, vegetacija, sintaksonomija, klasterška analiza.

Abstract

New approach for the classification of the Black Pine forest communities in Bulgaria was made in the paper. The analysis of forest phytocoenoses from Vlahina, East and West Rhodopi and Balkan Range Mountains confirmed their separation into two classes – *Quercetetea pubescentis* (low-altitudinal) and *Erico-Pinetea* (high-altitudinal). The second class is represented from one polymorphic association *Seslerio latifoliae-Pinetum nigrae* whereas the other group is represented from two new associations. The association *Junipero deltoidi-Pineteum pallasianae* is more related to the surrounding thermophilous oak forests as well as the association *Lathyro laxiflori-Pinetum pallasianae* is more similar to the hornbeam and beech forests.

Izveček

V članku predstavljamo nov pristop k klasifikaciji gozdov črnega bora v Bolgariji. Z analizo gozdnih fitocenoz z območja Vlahina, vzhodnih in zahodnih Rodopov in gorovja Balkan, smo potrdili njihovo uvrstitev v dva razreda – *Quercetetea pubescentis* (na nižjih nadmorskih višinah) and *Erico-Pinetea* (na višjih nadmorskih višinah). Slednji je zastopan z eno polimorfno asociacijo *Seslerio latifoliae-Pinetum nigrae*, prvi razred pa predstavljata dve novi asociaciji. Asociacija *Junipero deltoidi-Pineteum pallasianae* je povezana s sosednjimi termofilnimi hrastovimi gozdovi, medtem ko je asociacija *Lathyro laxiflori-Pinetum pallasianae* bolj podobna gabrovim in bukovim gozdovom.

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Introduction

The Black pine (*Pinus nigra*) has wide range of distribution occupying territories from Central and South Europe to the South-West Asia and in this range it is strongly variable (Gaussen et al. 1993). Several subspecies are known from the different parts of Europe and Asia Minor but especially the subspecies *Pinus nigra* subsp. *pallasiana* occurs in Bulgaria (see Stoyanov 1963, Gaussen et al. 1993, Liber et al. 2003, etc.). Strong variability amongst the populations of Black Pine in Bulgaria also was recorded (Naydenov et al. 2006, 2015) which is a good evidence for their relict origin and the insular isolation within the surrounded forest types dominated from oak, beech or other coniferous species, mostly *Picea abies* and *Pinus sylvestris*.

According to Bondev (1991, 2002) and Roussakova & Valchev (2015) the communities of Black Pine belong to the Mediterranean vegetation forest type in Bulgaria. The species is xerothermic with large range of altitude, from 400 up to 1800 m alt. Presently, the main part of the Black pine forests in Bulgaria occur between (600) 800 and 1300–1500 m alt., mainly in steep slope areas. The forests occur in different vegetation belts, from the xerothermic oak belt, through the mesophilous hornbeam-beech forests up to the microthermic coniferous forests. Hence they fall within different climatic and phytogeographical territorial subdivisions which also reflect on their classification. These forest communities occur mostly in Rhodope, Vlahina and Pirin Mts. and to a more limited extent in Slavyanka, Rila, Osogovo Mts., the low mountains of West Bulgaria, the Balkan Range and Forebalkan (Roussakova & Valchev 2015). According to Panayotov & Yurukov (2016) the natural Black Pine forests in Bulgaria cover area about 37500 ha. This calculation is a little bit different from the area cited in the Red Data Book of Bulgaria, vol. 3 – 39940 ha (see Gussev & Tzonev 2015) on the basis of models produced from Bulgaria Forest Database.

These communities have conservation significance because the habitat of Black Pine is included in Annex № 1 of Habitat Directive and Bulgarian Biodiversity Act and is of conservation priority. Parts of the communities of *Pinus nigra* subsp. *pallasiana* are within protected areas and in sites from the European Ecological Network NATURA 2000. Some of the Bulgarian reserves like Chamdzhia, Kazanite, Kastrakli, Boraka, Gabra, Borovec, etc. were especially established to protect the genetic resources of natural Black Pine forests. The Black Pine communities also were assessed in the Red List Assessment of European Habitats (see Janssen et al. 2016) as “Least Concern” within the habitat G3.4b Temperate and submediterranean montane *Pinus sylvestris-nigra* woodland.

The natural and human-forested communities of Black Pine have significant importance in Bulgaria (Vlasev 1966). They are used as a construction material, for resin, and by the local people for the production of pine splinters. It has also ornamental features. But also thousands of hectares have been planted because of aesthetic and anti-erosion purposes in many areas in Bulgaria where the species is not native. According to Panayotov & Yurukov (2016) the Black Pine plantations in Bulgaria occupy one area of 272000 ha (7 times more than the natural forests) and near 80% of them are in the altitudinal belt between 0 and 700 m. But the origin of genetic material in many cases is not known and even is from different subspecies and also hybrids from France, Italy and other European countries.

The natural communities of Black Pine in Bulgaria have been object of numerous studies according to the dominant methodology (see Lavrenko 1959) most of them summarised by Apostolova & Slavova (1997). Mainly they were focused on these Black Pine forests in the protected areas and especially the reserves like Borovec (Bondev & Lyubenov 1985), Chamluka (Bondev & Lyubanova 1985), Gabra (Bondev & Lazarov 1995, Gussev et al. 2005), Boraka (Velchev et al. 1985), Kastrakli (Meshinev 1985), Chervenata Stena (Nikolov & Nikolov 1984) as well as some mountain areas in Bulgaria like the basin of Chepelarska river and south of Smolyan Town in Rhodope Mts. (Gorunova & Kochev 1992, Meshinev 1995), Osogovska Mts. (Zahariev 1934, Lazarov 1995), Plana Mts. (Penev 1938), Vitosha Mt. (Petkov 1921), Middle Rhodopi (Stranski 1921), Slavyanka Mt. (Stoyanov 1921) or specific communities like these ones with Black Pine and Bearberry (see Roussakova et al. 1991). Some data for the structure and the distribution of the Black Pine forests in Bulgaria also have in the works of Bondev & Yordanova (1973), Bondev (1991, 2002), Velchev (2002) and Roussakova et al. (1991). The habitat of Black Pine forests in Bulgaria (36G3 Forests of Black pine (*Pinus nigra* subsp. *pallasiana*)) was described by Roussakova & Valchev (2015). Only study according to the Braun-Blanquet methodology is the recent research of the flora and vegetation of Chamdzhia Reserve in Stara Planina Mts. (Vassilev & Gavrilova 2016), but because of insufficient phytocoenological materials the syntaxon was given only on a community level.

The studies on these communities on the Balkan and Western Anatolian Peninsula are more numerous but most of them are not very close to Bulgaria and therefore not provide sufficient information to conclude for the classification of such communities in this central part of Balkan Peninsula. More or less complete information for Black Pine forests from the surrounding countries of Bulgaria was given for Greece (Debazac 1970, Barbero

& Quezel 1976, Bergmeier 1990, 2002, Dimopoulos & Georgiadis 1995, etc.), Albania (Dring et al. 2002), the countries of former Yugoslavia (Em 1962, 1978, Domac 1965, Mišić 1981, Trinajstić 1986, 1998, Škorić & Vasić (eds.) 2006, Zupančič 2007, Popović et al. 1997, Milosavljević et al. 2008, Ostojić & Jovanović 2008, Sedlar et al. 2011, etc.), Turkey (Aksoy & Gemici 1980, Akman et al. 1979, Quézel et al. 1980, Ketenoglu et al. 2010, etc), as well as the whole Balkan Peninsula or some parts of the Mediterranean region (Horvat 1959, Horvat et al. 1974, Debazac 1971, Seibert 1992, Regato et al. 1995, Poldini & Vidali 1999, Brullo et al. 2001).

The aim of the present study is to make an attempt to establish classification scheme of the relict natural communities of Palla's Black Pine forests in Bulgaria. More detail descriptions of their ecological, floristic and dynamic peculiarities and their origin also were object of this research.

Material and methods

The plant communities of study sites were investigated during the period between years 1991–2014. The principles and methods of the Zürich-Montpellier School (Braun-Blanquet 1964, Mueller-Dombois & Ellenberg 1974, Westhoff & van der Maarel 1978) were applied.

The sample plot size varies between 200 to 600 sq. m because of the open structure of Black Pine forests. More than 100 relevés were used to cover some of the most important localities of Black Pine communities in Bulgaria like East and West Rhodope, Central Balkan Range, Vlachina Mountains, etc. (Figure 1). At each sampling plot a complete list of the present species (vascular plants) was recorded, together with their cover-abundance value according to the 7-degree Braun-Blanquet scale and transformed as proposed by van der Maarel (1979). The plant nomenclature follows Delipavlov et al. (2003).

All data analysis was performed with the SYN-TAX 2000 program package (Podani 2001). Average linkage method (UPGMA) and Principal Coordinate Analysis (PCoA) were used to evaluate floristic similarity between relevés or respectively established syntaxa according to the Horn's index (Horn 1966). UPGMA (Unweighted Pair Group Method with Arithmetic Mean) is a simple agglomerative or hierarchical clustering method used widespread in the phytocoenological studies (van der Maarel & Franklin 2013). UPGMA clustering is more robust and has a better goodness of fit to dissimilarities than complete and single linkage classifications (Podani & Schmera 2006). The Horn's index is an information theoretic index of community similarity (commu-



Figure 1: Map of studied communities in Bulgaria dominated from *Pinus nigra* subsp. *pallasiana*.

Slika 1: Zemljevid proučevanih združb z dominantno vrsto *Pinus nigra* subsp. *pallasiana* v Bolgariji.

nity overlap), which is recommended to such researches (Brower et al. 1998).

The synaxa were compared according their floristic structure and the constancy classes of the taxa. The synoptic similarity also was evaluated using also PCoA and average linkage method (UPGMA) using Horn's index. Principal Coordinates Analysis (PCoA = Multidimensional scaling, MDS) is a method to explore and visualize similarities or dissimilarities of data. It starts with a similarity matrix or dissimilarity matrix (= distance matrix) and assigns for each item a location in a low-dimensional space, e.g. as a 3D graphics. This analysis was pioneered by Gower (1966) as an alternative to PCA better suited to ecological datasets. This analysis was used in the study only on association level to establish the main gradient for differentiations amongst them.

The syntaxa names and the names of their authors are given according to ICPN (Weber et al. 2000). The leading for the determination of synoptic schema was the work of Mucina et al. (2016).

Results

The results of the analyses, demonstrated the existing of two main groups of Black Pine communities (Figure 2) that correspond to two vegetation classes. They could be presented in the following syntaxonomic scheme:

Class *Quercetea pubescentis* Doing-Kraft ex Scamoni et Passarge 1959

Order *Quercetalia pubescenti-petraeae* Klika 1933

Alliance *Fraxino orni-Ostryion* Tomažič 1940

Association *Lathyro laxiflori-Pinetum pallasianae* ass. nova hoc loco

Alliance *Carpinion orientalis* Horvat 1958

Association *Junipero deltoidi-Pinetum pallasianae* ass. nova hoc loco

Class *Erico-Pinetea* Horvat 1959

Order *Erico-Pinetalia* Horvat 1959

Alliance *Fraxino orni-Pinion nigrae* Em 1978

Association *Seslerio latifoliae-Pinetum nigrae* Em 1978 subass. *typicum*

Association *Seslerio latifoliae-Pinetum nigrae* Em 1978 subass. *haberletosum* subass. nova hoc loco

Pinus nigra subsp. *pallasiana* and *Brachypodium pinnatum* community

The first group of communities is on a lower altitude and on more xerophilous to xeromesophilous conditions. It could be related with the deciduous (oak, beech, hornbeam) forests. The species composition and ecological peculiarities of these communities are similar to the surrounding mostly oak forests. The deciduous trees like *Quercus frainetto*, *Q. pubescens*, *Carpinus orientalis*, *Acer campestre*, *Fraxinus ornus*, *Pyrus pyraeaster*, *Sorbus torminal-*

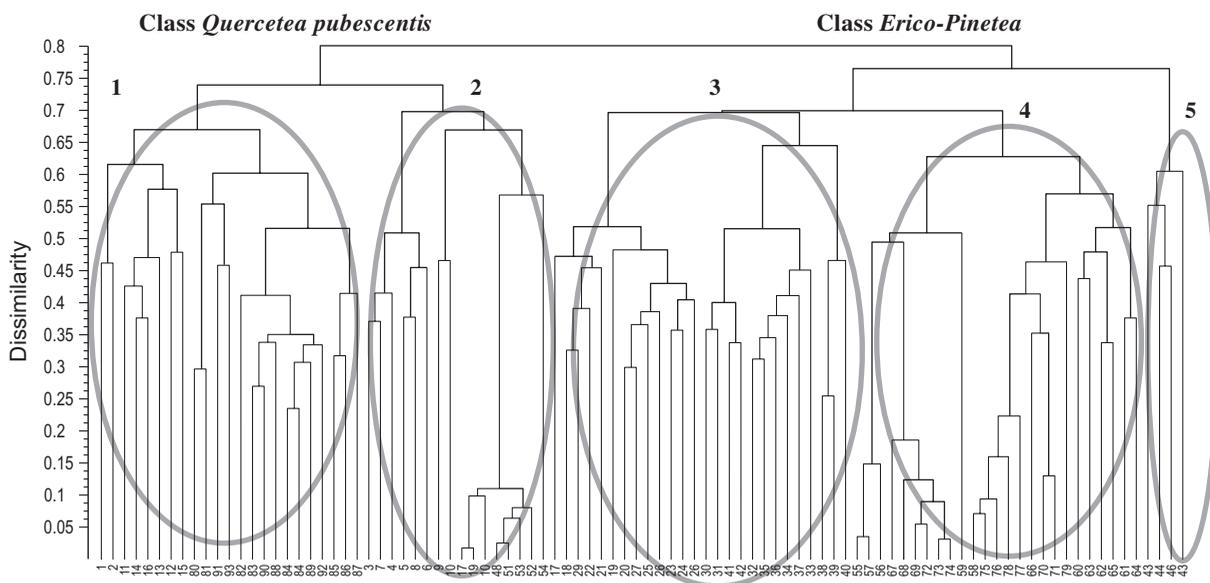


Figure 2: Cluster dendrogram of relevés with *Pinus nigra pallasiana*: 1. Ass. *Lathyro laxiflori-Pinetum pallasianae*; 2. Ass. *Junipero deltoidi-Pinetum pallasianae*; 3. Ass. *Seslerio latifoliae-Pinetum nigrae typicum*; 4. Ass. *Seslerio latifoliae-Pinetum nigrae haberletosum*; 5. *Pinus nigra pallasiana* and *Brachypodium pinnatum* community.

Slika 2: Dendrogram popisov z vrsto *Pinus nigra pallasiana*: 1. As. *Lathyro laxiflori-Pinetum pallasianae*; 2. As. *Junipero deltoidi-Pinetum pallasianae*; 3. As. *Seslerio latifoliae-Pinetum nigrae typicum*; 4. As. *Seslerio latifoliae-Pinetum nigrae haberletosum*; 5. Združba z vrstama *Pinus nigra pallasiana* in *Brachypodium pinnatum*.

is, etc. can be co-dominant. The shrub layer is also typical for this forest type and includes species like *Cornus mas*, *Corylus avellana*, *Cotinus coggygria*, and *Syringa vulgaris*. The participation of *Genista carinalis*, *Juniperus oxycedrus* subsp. *deltoides*, etc. provides the Mediterranean outlook of these forests. The herbaceous vegetation is dominated by *Brachypodium pinnatum*, *B. sylvaticum*, *Festuca heterophylla*, *Melica uniflora*, *Poa nemoralis*, etc. Most of the Black Pine forests from this type are not in good condition as a result of the anthropogenic pressure and natural forest succession and really the Black Pine forests have remained like only small islands among the broad-leaved vegetation. At the higher altitude (900–1200 m) more typical for montane forest belt of the Bulgarian mountains prevail more mesophilous species like *Quercus dalechampii*, *Fagus sylvatica*, *Carpinus betulus* which also have similar shrub and herbaceous layers with these forests.

The second main group is more related to coniferous forests. The coniferous species are represented mostly from *Abies alba* and *Picea abies*. The dominant role of *Sesleria latifolia* is typical for the herbaceous layer of these high-altitudinal Black Pine forests.

According to the analysis three main associations were described – one of them already described in Former Yugoslavia (Em 1978) presents the communities from *Erico-Pinetea*. Two new associations belong to low-altitudinal Black Pine forests from *Quercetea pubescentis*. All associations are described below with their ecological, phytocological and floristic features.

Especially PCoA (Figure 3) well illustrated the main gradients which differentiate the studied communities. The humidity and altitude are decreasing from left to right on Axis 1. The most xerophytic and low-altitudinal is the association *Junipero deltoidi-Pinetum pallasianae* (2) which is close to more mesophilous *Lathyro laxiflori-Pinetum pallasianae* (1) and they both belong to *Quercetea*. Whereas, the class *Erico-Pinetea* is presented from two subassociations (3 and 4) of one association and also from one community (5) but with a lower species richness.

Association *Lathyro laxiflori-Pinetum pallasianae* ass. nova hoc loco (Table 1), holotypus rel. 11

Diagnostic species for the association: *Pinus nigra* subsp. *pallasiana* (100%), *Aremonia agrimonoides* (57%), *Lathyrus laxiflorus* (48%), *Genista carinalis* (35%).

Constant species: *Pinus nigra* subsp. *pallasiana* (100%), *Quercus daleschampii* (78%), *Melica uniflora* (61%), *Fagus sylvatica* (57%), *Aremonia agrimonoides* (57%).

This new association (Figure 4) is described from two remote regions of Bulgaria – Vlachina Mt. (Gabra Reserve) on western border with FYR Macedonia and East Rhodope Mts. (Zhenda Reserve). These communities are

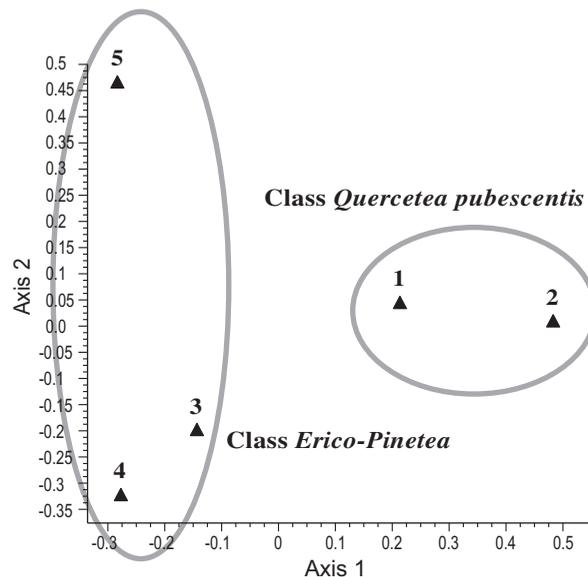


Figure 3: Ordination diagram of the established syntaxa: 1. Ass. *Lathyro laxiflori-Pinetum pallasianae*; 2. Ass. *Junipero deltoidi-Pinetum pallasianae*; 3. Ass. *Seslerio latifoliae-Pinetum nigrae typicum*; 4. Ass. *Seslerio latifoliae-Pinetum nigrae haberletosum*; 5. *Pinus nigra pallasiana* and *Brachypodium pinnatum* community.

Slika 3: Ordinacija ugotovljenih sintaksonov: 1. As. *Lathyro laxiflori-Pinetum pallasianae*; 2. As. *Junipero deltoidi-Pinetum pallasianae*; 3. As. *Seslerio latifoliae-Pinetum nigrae typicum*; 4. As. *Seslerio latifoliae-Pinetum nigrae haberletosum*; 5. Zdruzba z vrstama *Pinus nigra pallasiana* in *Brachypodium pinnatum*.



Figure 4: Stand of the association *Lathyro laxiflori-Pinetum pallasianae* in Borovec Reserve, East Rhodope Mts. Photo: Rossen Tzonev.

Slika 4: Sestoj asociacije *Lathyro axiflori-Pinetum pallasianae* v rezervatu Borovec, gorovje Vzhodni Rodopi. Foto: Rossen Tzonev.

more meso-xerophilous and represent the transitional type between typical low-altitudinal Black Pine communities from *Quercetea pubescentis* and the high-altitudinal mountain ones from *Erico-Pinetea*. They occupy the altitudinal

belt between 500-1300 m alt., mostly 800–1000 m. The exposition of the terrain is with northern component and the inclination varies between 8–45° (mostly 30–40°). The canopy of tree layer is about 60% (from 40 to 80%).

Besides with the dominant *Pinus nigra*, co-dominants are some mesophilous deciduous species (mostly belonging to *Fagion sylvaticae*) like *Quercus daleschampii*, *Fagus sylvatica*. The shrub layer is not well developed but the herbaceous species are typical also for the forests of Common Beech, Hornbeam or Sessile Oak. Such are *Aremonia agrimonoides*, *Melica uniflora*, *Poa nemoralis*, *Galium odoratum*, *Sanicula europaea*, *Galium pseudaristatum*, *Dactylis glomerata*, *Hieracium murorum* gr. The diagnostic species emphasize the relationships firstly with surrounding beech forests (*Aremonia agrimonoides*, *Lathyrus laxiflorus*) but also their relict and Balkan endemic origin (*Genista carinalis*).

Association *Junipero deltoidi-Pinetum pallasianae* ass. nova hoc loco (Table 1) holotypus rel. 47.

Diagnostic species: *Pinus nigra* subsp. *pallasiana* (100%), *Juniperus oxycedrus* subsp. *deltoides* (88%), *Dianthus petraeus* subsp. *petraeus* (44%), *Cotinus coggygria* (38%).

Constant species: *Pinus nigra* subsp. *pallasiana* (100%),

Juniperus oxycedrus subsp. *deltoides* (88%), *Fraxinus ornus* (88%), *Quercus pubescens* (88%), *Carpinus orientalis* (75%), *Quercus dalechampii* (69%), *Viola odorata* (56%).

This new association is the most xerophyllous and with the strongest sub-Mediterranean influence mainly from the surrounding oak forests. The Black Pine communities have relict origin and insular isolation amongst the deciduous forest vegetation. Such forests have been established in the lowest parts of distribution of Black Pine communities in Bulgaria – East Rhodope Mts. (Borovec and Boraka Reserves) (Figure 5) and part of southern slopes of Central Balkan Range (Chamdzha Reserve and Meden Dol Locality) (Figure 6). Their distribution varies in the altitudinal belt between 300–700 m alt. (mostly 500–600). They occupy slopes with inclination nearby 30–45° (between 12–45°) and with different expositions. It is mainly northern in East Rhodope Mts. but definitely south in the Balkan Range Mt.

The forests are open, dry and light. The canopy is mostly about 50–60%. *Pinus nigra* subsp. *pallasiana* is a dominant or co-dominant with deciduous tree species like *Quercus pubescens*, *Quercus dalechampii*, *Carpinus orienta-*



Figure 5: Stand of the association *Junipero deltoidi-Pinetum pallasianae* in Boraka Reserve, East Rhodope Mts. Photo: Rossen Tzonev.
Slika 5: Sestoj asociacije *Junipero deltoidi-Pinetum pallasianae*, rezervat Boraka, gorovje Vzhodni Rodopi. Foto: Rossen Tzonev.



Figure 6: Stand of the association *Junipero deltoidei-Pinetum pallasianae* in Chamdzha Reserve, Central Balkan Mts. Photo: Ivajlo Nikolov.

Slika 6: Sestoj asocijacije *Junipero deltoidei-Pinetum pallasianae*, rezervat Chamdzha, gorovje Srednji Balkan. Foto: Ivajlo Nikolov.

lis, and *Fraxinus ornus*. The shrub layer is better developed comparing with the previous association. *Juniperus oxycedrus* subsp. *deltoides* participates in both geographical areas whereas *Cotinus coggygria* is a dominant species in East Rhodope Mts. Other common species in shrub layer are *Cornus mas* and *Crataegus monogyna*. Widespread species like *Brachypodium sylvaticum*, *Veronica chamaedrys*, *Viola odorata*, etc. are typical for the herbaceous layer. Especially in Central Balkan Range, the forests are on calcareous rocky terrains where the hasmophytic Balkan endemics like *Dianthus petraeus* subsp. *petraeus* and *Moehringia pendula* could dominate in this layer. They are also diagnostic species together with South-East European subspecies of *Juniperus oxycedrus* – *Juniperus oxycedrus* subsp. *deltoides* and also *Cotinus coggygria* which represents the relationships with the open oak forests and forest-steppes of South-East Europe.

Association *Seslerio latifoliae-Pinetum nigrae* Em 1978 (Table 2)

Diagnostic species for the association: *Pinus nigra* subsp. *pallasiana* (100%), *Sesleria latifolia* (63%), *Iberis sempervirens* (21%), *Daphne blagayana* (14%).

Constant species: *Pinus nigra* subsp. *pallasiana* (100%), *Fagus sylvatica* (79%), *Calamagrostis arundinacea* (74%), *Ostrya carpinifolia* (70%), *Abies alba* subsp. *alba* (70%), *Euphorbia amygdaloides* (70%), *Fragaria vesca* (60%), *Acer hyrcanum* subsp. *hyrcanum* (54%).

The group of communities in Bulgaria which belong to the class *Erico-Pinetea* (Figure 7) was included in the scope of described in Former Yugoslavia (FYR Macedonia) association *Seslerio latifoliae-Pinetum nigrae* Em 1978. Its range was expanded to all central Balkan Mountains and its floristic and ecological structure is accepted to be more polymorphic. This association is represented from different geographical synvicariant Black Pine communities distributed mostly inside the coniferous vegetation dominated from Scot Pine and/or Spruce. But these *Pinus nigra* communities, because of their lower competitive possibilities comparing with the dominant coniferous species, are isolated on not very large spots on some sometimes very steep and rocky slopes of mountain valleys or gorges. There is a clear dominant role of *Sesleria latifolia* in the herbaceous layer – Balkan endemic – ecological and geographical vicariant of some other similar species like *Sesleria robusta* in southern and western parts of the



Figure 7: Stand of the association *Sesleria latifoliae*-*Pinetum pallasianae* in West Rhodope Mts., Dobrostan. Photo: Rossen Tzonev.

Slika 7: Sestoja asociacije *Sesleria latifoliae*-*Pinetum pallasianae* v gorovju Zahodni Rodopi, Dobrostan. Foto: Rossen Tzonev.

Balkan Peninsula. This association is also synvicariant to the described in Kato Olimbos *Sesleria robustae*-*Pinetum pallasianae* Barbero et Quezel 1976 corr. Bergmeier 1990, which is similar but richer in endemic and oro-mediterranean species. Such species are *Sesleria robusta*, *Centaurea pindicola*, *Polygala nicaeensis* subsp. *mediterranea*, etc.

The association *Sesleria latifoliae*-*Pinetum nigrae* Em 1978 was described from the region of Baba Mountain (Pelister). The most of diagnostic species could be found also in the high-altitudinal Black Pine forests from West Rhodope and Central Balkan Range like *Sesleria latifolia* (dominant), *Iberis sempervirens*, *Daphne blagayana*. It could be summarized that the association described by Em (1978) is distributed in the Central Balkans and probably the distribution in Baba (Pelister) Mt. is on the periphery of its range, on the border with Dinaride Mountain System where *Pinus nigra* subsp. *dalmatica* occurs. Em (1978) did not give holotypus of the association according to the requirements of ICPN (Weber et al. 2000) but the association was validly described because it was described before 01.01.1979. Two cluster groups (see Figure 2) from *Erico*-*Pinetea* from Bulgaria could be accepted as a part of this association in a broad sense of

meaning. But the communities on the southern slopes of Central Balkan Range are closer to described from Em (1978) association than these ones from Rhodope Mts. which are geographically closer. It is the reason to describe the high-altitudinal Rhodopean Black Pine forests as a new sub-association while the Central Balkan group is accepted as belonging to the typical subassociation. This syntaxonomic decision will expand the range of described association from Em (1978) to the north and east direction.

Association *Sesleria latifoliae*-*Pinetum nigrae* Em 1978 subsp. *typicum* (Table 2)

Diagnostic species for the association: *Pinus nigra* subsp. *pallasiana* (100%), *Sesleria latifolia* (96%), *Iberis sempervirens* (40%), *Daphne blagayana* (24%).

Constant species: *Pinus nigra* subsp. *pallasiana* (100%), *Ostrya carpinifolia* (100%), *Sesleria latifolia* (96%), *Fagus sylvatica* (88%), *Fragaria vesca* (84%), *Abies alba* subsp. *alba* (76%), *Cotoneaster nebrodensis* (68%), *Acer pseudoplatanus* (64%), *Euphorbia amygdaloides* (60%), *Acer hyrcanum* subsp. *hyrcanum* (56%), *Galium schultesii* (52%), *Calamagrostis arundinacea* (52%).

These communities (Figure 8) are distributed on the southern macro-slopes of Central Balkan Range and geographically fall in the Tryoan part of Central Balkan National Park. They are distributed in the altitudinal belt between 1100 and 1500 m, on slopes mostly with west or east exposition. The inclination varies between 5 and 70°, but mostly the terrains are steep – 40–50°. The canopy varies between 50–80%, (mostly 60–70%).

The Black Pine (*Pinus nigra* subsp. *pallasiana*) is mostly co-dominant together with Common Beech (*Fagus sylvatica*), European Hop-Hornbeam (*Ostrya carpinifolia*) and European Silver Fir (*Abies alba* subsp. *alba*). The tree layer includes also species like *Acer hyrcanum*, *A. pseudo-platanus*, *Fraxinus ornus*. The shrub layer is typical for the terrains with rocky outcrops and includes species like *Genista rumelica*, *Cotoneaster nebrodensis*, *Daphne mezereum*, etc. The herbaceous layer is also rich and includes mostly species typical for coniferous and beech forests like *Calamagrostis arundinacea*, *Luzula sylvatica*, *Mycelis muralis*, *Doronicum columnae*, *Cephalanthera rubra*, *Galium schultesii*, *Laserpitium siler*. The diagnostic species like *Sesleria latifolia* is a dominant. Also the other diagnostic species for the association like *Iberis sempervirens*, *Daphne*

blagayana are also well represented in a part of communities. They also emphasized the relict origin of Black Pine communities survived on the steep and rocky places surrounded by the dominant Common Beech forests.

Association *Sesleria latifoliae*-*Pinetum nigrae* Em 1978 subass. *haberletosum rhodopensis* subass. *nova hoc loco* (Table 2) *holotypus* rel. 33.

Diagnostic species for the subassociation: *Pinus nigra* subsp. *pallasiana* (100%), *Haberlea rhodopensis* (24%), *Cotoneaster integerrimus* (38%).

Constant species: *Pinus nigra* subsp. *pallasiana* (100%), *Calamagrostis arundinacea* (92%), *Hieracium murorum* gr. (81%), *Euphorbia amygdaloides* (73%), *Abies alba* subsp. *alba* (65%), *Aremonia agrimonoides* (62%), *Acer hyrcanum* subsp. *hyrcanicum* (58%), *Primula veris* (58%), *Mycelis muralis* (58%), *Tanacetum corymbosum* (58%), *Picea abies* (62%), *Salvia glutinosa* (58%), *Phytospermum cornubiense* (54%).

This syntaxon was described from West Rhodope Mts., especially from Kazanite and Kastrakli Reserves, on the altitudinal belt between 1000–1300 m. Typical are the very steep slopes, mostly about 50°, with not very big tree



Figure 8: Stand of the association *Sesleria latifoliae*-*Pinetum pallasianae* in Central Balkan Mts., Ortaburun Locality. Photo: Ivajlo Nikolov.
Slika 8: Sestoj asocijacije *Sesleria latifoliae*-*Pinetum pallasianae* v gorovju Srednji Balkan, območje Ortaburun. Foto: Ivajlo Nikolov.

canopy (50–60%) because of the great calcareous rocky outcrops. The exposition varies from mostly northern in Kazanite Reserve to mostly southern in Kastrakli Reserve.

Black Pine forests unlike to these from Central Balkan are surrounded mainly from coniferous forests dominated by the Spruce (*Picea abies*). It affects also to their floristic composition and ecological structure. *Pinus nigra* is not a clear dominant but co-dominant with *Abies alba* and *Fagus sylvatica*. The last one increases in the understory. The species composition of heathland and herbaceous layers is determined from the dominants like *Vaccinium myrtillus*, *Calamagrostis arundinacea*, *Luzula luzuloides* and also *Sesleria latifolia*. The last species is not so common like to Central Balkan Range and dominates mostly in Kastrakli Reserve. Typical is that the ecological and floristic structure is a mixture between thermophilous species from the oak forests and more mesophilous typical for Beech and Spruce and Fir coniferous forests. The first group includes species like *Fraxinus ornus*, *Chamaecytisus hirsutus*, *Tanacetum corymbosum*, *Physospermum cornubiense*, *Festuca heterophylla*, etc. The second group includes species like *Aremonia agrimonoides*, *Luzula luzuloides*, *Dryopteris filix-mas*, *Oxalis acetosella*, and *Orthilia secunda*.

This group of communities was separated as the new subassociation *haberletosum*. Both differential species: *Haberlea rhodopensis* and *Cotoneaster integerrimus* are chasmophytes and emphasize the very steep and rocky substrates occupied from the Black Pine communities. *Haberlea rhodopensis* is also Tertiary relicts with a limited distribution in the mountains in the central part of Balkan Peninsula.

***Pinus nigra* subsp. *pallasiana* and *Brachypodium pinnatum* community (Table 2)**

Constant and dominant species: *Pinus nigra* subsp. *pallasiana* (100%), *Pinus sylvestris* (50%), *Brachypodium pinnatum* (75%).

Four relevés of Black Pine communities from West Rhodope Mts. are determined only as communities because lack of sufficient material to be classified. They are dominated from *Pinus nigra* subsp. *pallasiana*, and in three of them *Brachypodium pinnatum* is a dominant in the herbaceous layers. But their floristic composition is too heterogeneous and allows only to being included in *Fraxino orni-Pinion nigrae* Em 1978 and *Erico-Pineteta*. The common species in all communities are widespread in different forest types – such are *Primula veris*, *Dactylis glomerata*, *Euphorbia amygdaloides*, *Cruciata glabra*. The community from Chervenata Stena Reserve includes also the Balkan endemic *Pulsatilla halleri* subsp. *rhodopaea* which is part of species complex diagnostic to the class *Erico-Pineteta*. Future investigations will decide where is

the place of these or similar to them forest communities which are widespread in many places in the Bulgarian mountains.

Discussion

As a conclusion we can summarise some common feature in all described Black Pine communities in Bulgaria. Everywhere they are fragments of older (relict) vegetation. Well-preserved parts of the relict forests that are with preserved composition and structure of the autochthonous vegetation are very rare. Apart from the autochthonous communities also secondary ones exist. They occur in the three climatic zones in Bulgaria: moderate continental, transitional and continental-Mediterranean. They inhabit steep slopes mainly with southern aspect. The Black Pine forests prefer alkaline rocks but in Rhodope Mts. they can occur also on other types of bedrock. The Black Pine is rarely clear dominant but often forms mixed communities with various coniferous and deciduous tree species that have xerothermic or meso-xerothermic characteristics. But the natural habitats of the species have been strongly reduced. The forests have been destroyed as a result of various economic activities (including unregulated logging) or have been replaced by *Quercus dalechampii*, *Fagus sylvatica*, etc. as a result of natural successions. Parts of the communities have been turned into open (sparse) forests (Roussakova & Valchev 2015).

Everywhere in its natural range, the Black Pine communities are usually small, relict and isolated inside the dominant forest types. The last ones could be coniferous forests from *Vaccinio-Piceetea* in the mountains, or deciduous forests from *Quercetea pubescentis*, *Quercetea robori-petraeae* or *Carpino-Fageteta* (depending from the altitude and latitude), or even evergreen from *Quercetea ilicis* in the southernmost parts of this range. It is the main reason for describing of many Black Pine associations usually with small areas everywhere in the species range. This situation is repeating in all neighbouring of Bulgaria countries where this subspecies occurs. But it is also the same with the communities of other subspecies like *Pinus nigra* subsp. *dalmatica*, *Pinus nigra* subsp. *banatica*, *Pinus nigra* subsp. *calabrica*, *Pinus nigra* subsp. *salzmanii*, etc. (see Trinajstić 1986, 1998, 1999, Regato et al. 1995, Dring et al. 2002, Brullo et al. 2001, Zupančič 2007, Sedlar et al. 2011, Coldea 2015, etc.).

In former Yugoslavia the subspecies *Pinus nigra* subsp. *pallasiana* appear in communities in the southern and eastern parts of FYR Macedonia and Eastern Serbia (Horvat 1959, Em 1962, Horvat et al. 1974, Škorić & Vasić 2006, etc.). Besides the association *Seslerio latifoliae-Pinetum nigrae*, Em (1978) has described also

the associations *Lathyro versicoloris-Pinetum nigrae* and *Pulsatillo macedonicae-Pinetum nigrae*. But they are with limited geographical distribution.

In Serbia, the subspecies is located only in the eastern part of the country – the valleys of Resava, Jerma and Lazareva Rivers, Suva, Ducat and Crnook Mts. (Avramović et al. 2006). In the last one is located the single reserve (Jarešnik) of Palla's Black Pine forests in the country (see Ostoić & Jovanović 2008). But there are not really validly published associations from the country, which can be compared with the neighbouring similar in Bulgaria. The associations *Seslerio-Pinetum pallasianae* N. Rand et al. 2006, *Vaccinio-Pinetum pallasianae* N. Rand et al. 2006, published and cited also by Milosavljević et al. (2008), are “nomen nudum”. Not valid is also the association *Taxo-Pinetum nigrae* Mišić 1981 and it was correctly cited as a community from Ostoić & Jovanović (2008). The indirectly cited floristic structure of these communities indicated their closer similarity to *Erico-Pinetea*, than to *Quercetea pubescentis*, but for more precise comparison relevés are necessary to be available. The syntaxa described in East Serbia also include two associations with very limited distribution: *Humileto-Pinetum nigrae* Jovanović 1956 and *Colurno-Pinetum nigrae* Jovanović 1951. According to Tatić & Tomović (2006) both last mentioned syntaxa belong to one association - *Carici humilis-Pinetum nigrae* B. Jovanović 1956 from Suva Mt. and Sukovska Reka locality. The diagnostic species of the association were not indicated, but the floristic structure and ecological and geographical peculiarities have proved that it is another and different syntaxon with many diagnostic for class *Festuco-Brometea* species like *Carex humilis*, *Sesleria filifolia*, *Galium purpureum*, *Achillea clypeolata*, *Melica ciliata*, etc.

The presence of *Pinus nigra* subsp. *pallasiana* in Romania according to Boşcaiu & Boşcaiu, (1999) is located only in south-westernmost part of the country. The single described association *Genisto radiatae-Pinetum pallasianae* (Fekete 1959) Resmerița 1972 has the diagnostic species *Genista radiata*, *G. januensis*, *Festuca xanthina*, *Linum uninerve* and *Campanula kladniana*. According to Coldea (2015) it is included in the alliance *Seslerio rigidae-Pinion sylvestris* Coldea 1991 together with the surrounding forests dominated from *Pinus sylvestris*. This alliance and communities does not occur in the geographical region of Bulgaria.

The forests of *Pinus nigra* subsp. *pallasiana* are represented from one association in Ukraine only in south-eastern part and the Crimean Peninsula (Didukh 2003). But it is very specific and separated in different alliance and even order *Pinetalia pallasianae-kochianae* Korzhenevsky 1998 (see Mucina et al. 2016) also enough different from the Balkan communities.

The ecology and classification of the forests of *Pinus nigra* subsp. *pallasiana* in Greece is discussed in several publications (see Barbero & Quezel 1976, Bergmeier 1990, 2002, Dimopoulos & Georgiadis 1995, Dimopolous et al. 1996, Brullo et al. 2001, etc.). For example, Bergmeier (1990) has corrected some of syntaxa described by Barbero & Quezel (1976) which were not described in accordance of the Code of phytocoenological nomenclature like the associations *Pinus nigra* subsp. *pallasiana* and *Campanula stenosphon* community, *Pinus nigra* subsp. *pallasiana* and *Crataegus pycnoloba* (both from Pelopones), *Pinus nigra* subsp. *pallasiana* and *Stachelina uniflosculosa*, *Pinus nigra* subsp. *pallasiana* and *Daphne blagayna* (both from Pelagonia) and *Pinus nigra* subsp. *pallasiana* and *Sorbus torminalis* (from Pindus Mt.). The most of them were assigned to *Abieto-Pinion*, now *Abietion cephalonicae* Hovat et al. 1974 – determined by Mucina et al. (2016) as relict supramediterranean Hellenic fir and Black Pine forests. In spite of sometime similar ecological and floristic structure of these communities to the Bulgarian Black Pine forests they belong to the typical oro-mediterranean forest vegetation.

The last conception is especially the association *Seslerio robustae-Pinetum pallasianae* from Kato Olimbos to be included in the alliance *Chamaecytiso hirsuti-Pinion pallasianae* Barbero et Quézel 1976 (Mucina et al. 2016). Such communities from Peloponissos (South Greece) are represented from two associations (see Dimopoulos et al. 1996). The associations *Cicero graeci-Pinetum pallasianae* Dimopolous et al. 1996 is a part of evergreen vegetation from *Quercetea ilicis*, while the association *Crataego pycnolobae-Pinetum pallasianae* Barbero & Quezel 1976 represents xerophilous deciduous forests from *Quercetea pubescentis* but the relict supramediterranean alliance *Abietion cephalonicae* Horvat et al. 1974. The association *Pyrolo chlorantae-Pinetum nigrae* from Mt. Parnon (Peloponissos) also is within *Abietion cephalonicae* (Bergmeier 2002) which alliance does not occur in Bulgaria.

Very complicated is the situation in Turkey, where the subspecies *Pinus nigra* subsp. *pallasiana* is widespread and participates in many different syntaxa, which have been summarized mainly in the work of Ketenöglü et al. (2010). More than 33 associations have been described there and all of them represent the xerophilous deciduous vegetation of *Quercetea pubescentis* (see Akman et al. 1979, Quézel et al. 1980, etc) but within special for Asia Minor alliances and even orders. The taxon *Pinus nigra* subsp. *pallasiana* is mostly distributed in Northern (Pontic Mountains, the provinces of Kastamonu, Samsun, Sinop, Bolu and Cankiri), Western (the provinces of Kutahya, Ankara, Afyon, Eskisehir, etc.) and sporadic in the Central Part (Konya, Aksaray). The as-

sociations from Pontic Mountains belong to the specific order *Quercus cerridis-Carpinetalia orientalis* Quézel et al. 1980 and the alliances *Carpino betuli-Acerion hyrcani* Quézel et al. 1978, *Cisto laurifolii-Pinion pallasianae* Akman et al. 1978, *Quercion anatolicae* Akman et al. 1979. These ones from the western and central parts belong to another order *Quercus pseudocerridis-Cedretalia libani* Barbéro et al. 1974 and its alliances *Abieto cilicicae-Cedron libani* Quézel et al. 1978, *Lonicero nummulariaefoliae-Cedron libani* Quézel et al. 1978, *Ostryo carpiniifoliae-Quercion pseudocerridis* Quézel et al. 1978 and *Adenocarpus complicati-Pinion pallasianae* Quézel et al. 1978. Additional fact which limits any comparisons of these communities of Black Pine to those of the central Balkans is that many of these associations have not been described according to the rules of the ICPN (Weber et al. 2000) (for example Art. 3 (d, h), Art. 5, etc.), therefore they are not valid. Such associations for example are *Pinus nigra* subsp. *pallasiana-Quercus petraea* subsp. *iberica* Akman et al. 1983, *Tanacetum-Pinetum nigrae* Ozen & Kilinc 1995, *Pinus nigra* subsp. *pallasiana-Astragalus listonia* Kilinc 1985, *Cephalanthero-Pinetum nigrae* Ocakverdi & Cetik 1987, *Pinus nigra* subsp. *pallasiana-Ligustrum vulgare* Akman et al. 1983, *Pinus nigra* subsp. *pallasiana-Anthyllis vulneraria* Akman & Aydogdu 1986, etc. Some of them also are only on the level of community. But it is undeniable that their syntaxonomical position based on the floristic structure and ecological peculiarities is very different comparing with the Black Pine communities in Bulgaria and the Balkans, in general.

The main conclusion from the analysis is that the Black Pine forests in Bulgaria are enough specific to be new syntaxa or to expand the range of distribution of some already described associations, endemic to parts of the Balkans. It emphasizes their significance not only as relict communities with limited distribution but also as important part of the natural vegetation. According to Roussakova & Valchev (2015) the Black pine forests are also an important edaphic and hydrological factor and also some rare and protected plants occur in them. Such species are *Anthemis rumelica*, *Carduus thracicus*, *Fritillaria pontica*, *Pulsatilla halleri* subsp. *rhodopaea*, *Scabiosa rhodopensis*, *Verbascum roripifolium*, *V. rupestris*, *Centaurea achtarovii*, *Kernera saxatilis*, etc.

The natural communities of Black Pine in Bulgaria also have conservation significance because as a part of the habitat 9530 *(Sub-) Mediterranean pine forests with endemic black pines, they are target object of NATURA 2000 network in Bulgaria. Therefore, their preservation is not only from national Bulgarian but also from European interest.

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Table 1: Diagnostic table of the syntaxa from *Quercetea pubescentis*.

Tabela 1: Diagnostična tabela sintaksonov razreda *Quercetea pubescentis*.

Number of releves	1	2	11	14	16	13	12	15	80	81	91	93	82	83
Locality	Chamluka Rezerve	Chamluka Rezerve	Zhenda Reserve	Gabra Reserve										
Author	RTz, ChG	RTz, ChG	RTz, ChG	MD	MD	RTz, ChG	RTz, ChG	MD	VV, ChG	VV, ChG	VV, ChG	VV, ChG	VV, ChG	VV, ChG
Data	7/30/2014	7/30/2014	7/31/2014	6/16/2006	6/16/2006	7/31/2014	7/31/2014	6/16/2006	18.05.2001	18.05.2001	20.05.2001	20.05.2001	18.05.2001	18.05.2001
Latitude	41 29 33.4	41 29 32.0	41 47 04.2	41 47 08.0	41 46 57.0	41 47 25.1	41 47 12.0	41 47 13.4	42 01 30.8	42 01 37.4	42 01 39.0	42 01 51.2	42 01 45.8	42 01 33.1
Longitude	25 16 07.1	25 16 10.4	25 10 50.4	25 10 48.0	25 10 49.0	25 10 38.4	25 10 43.6	25 11 00.8	22 50 13.9	22 50 11.3	22 50 02.7	22 49 59.4	22 50 12.7	22 50 06.1
Altitude	468	468	819	900	690	828	828	764	1010	980	960	910	960	1000
Exposition	E	E	N	N	S	SE	N	N	W	NW	NW	NE	E	N
Inclination	8	8	22	45	25	40	8	20	40°-45°	40°-45°	30°-35°	10°-15°	10°-15°	35°-40°
Coverage (%)	60	60	80	70	70	80	80	70	50	50	60	60	60	80
Sample plot (sq. m)	400	400	400	400	400	400	400	400	200	200	200	200	200	200
Association <i>Lathyro laxiflori-Pinetum pallasianae</i> ass. nova, holotypus rel. 11 hoc loco														
<i>Pinus nigra</i> J.F. Arnold subsp. <i>pallasiana</i> (Lamb.) Holmboe	4	4	4	4	4	3	4	4	5	5	5	5	5	5
<i>Aremonia agrimonoides</i> (L.) DC	2b	.	+	+	.	.	+	.	.	.	+	.	+	+
<i>Lathyrus laxiflorus</i> (Deaf.) Kuntze	.	.	+	+	1	.	.	+	.	+	+	+	.	.
<i>Genista carinalis</i> Griseb.	+	+	2b	2b	2b	+	.	.	+	+	.	.	.	.
Association <i>Junipero deltoidi-Pinetum pallasianae</i> ass. nova, holotypus rel. 47 hoc loco														
<i>Juniperus oxycedrus</i> L. subsp. <i>deltoides</i> (R. P. Adams) N. G. Passal.	1	.	2b	.	2b	+	.	.	.	.	.	.	.	.
<i>Dianthus petraeus</i> Waldst. et Kit. subsp. <i>petraeus</i>	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Moebria pendula</i> (Waldst. et Kit.) Fenzl.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Cotinus coggygria</i> Scop.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alliance <i>Fraxino orni-Ostryion</i> Tomazic 1940														
<i>Fraxinus ornus</i> L.	3	3	2b	+	.	.	2b	.	.	.	.	.	.	.
<i>Ostrya carpinifolia</i> Scop.	+	.	.	.	.	.	+	.	.	.	.	.	.	.
<i>Primula veris</i> L.	.	.	2b	+	.	.	+	+	.	.	.	.	.	.
<i>Campanula persicifolia</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alliance <i>Carpinion orientalis</i> Horvat 1958														
<i>Carpinus orientalis</i> Mill.	.	.	.	+	+	.	.	.	.	.	.	.	.	.
Order <i>Quercetalia pubescenti-petraeae</i> Klika 1933 and class <i>Quercetea pubescentis</i> Doing-Kraft ex Scamoni et Passarge 1959														
<i>Quercus pubescens</i> Willd.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

90	88	84	94	89	92	85	86	87	%	3	7	4	5	8	6	9	10	47	49	50	48	51	53	52	54	%	
Gabra Reserve		Borovec Reserve	Boraka Reserve	Boraka Reserve	Chamdza - Central Balkan	Meden dol - Central Balkan																					
VV, ChG		RIz, ChG	MD	RIz, ChG	MD	MD	MD	RIz, ChG	MD	IvNik																	
20.05.2001	19.05.2001	18.05.2001	20.05.2001	19.05.2001	20.05.2001	19.05.2001	19.05.2001	19.05.2001		7/30/2014	6/12/2006	7/30/2014	6/12/2006	6/12/2006	6/12/2006	7/30/2014	6/12/2006	4/20/2012	4/20/2012	4/20/2012	4/20/2012	4/20/2012	4/20/2012	4/20/2012	5/17/2013		
42 01 36.9	42 01 29.5	42 01 29.8	42 01 55.0	42 01 32.1	42 01 32.2	42 01 46.1	42 01 41.4	42 01 34.3		41 33 35.8	41 33 35.0	41 33 29.1	41 33 39.0	41 33 28.0	41 33 36.4	41 50 55.7	41 50 83.5	42 43 52.9	42 43 40.1	42 43 52.9	42 43 48.3	42 43 47.1	42 43 50.5	42 43 44.2	42 39 02.2		
22 50 03.1	22 50 34.3	22 50 07.4	22 49 58.2	22 50 21.3	22 50 22.9	22 50 20.4	22 50 24.8	22 50 26.8		25 31 08.5	25 30 44.0	25 30 47.1	25 31 10.0	25 30 44.0	25 30 65.9	25 16 47.3	25 16 80.4	24 35 22.2	24 35 30.5	24 35 22.2	24 35 37.7	24 35 36.6	24 35 36.2	24 35 29.8	24 50 10.7		
980	1035	1015	900	1010	1010	955	1000	990		350	375	409	340	410	309	409	356	600	548	625	620	582	631	622	700		
NW	Z	Z	Z	NW	NE	W	W	W		NW	NE	Z	Z	Z	W	S	SW	SE	S	Z	Z	E	NE	E	S		
35°-40°	35°-40°	35°-40°	30°-35°	20°-25°	40°-45°	35°-45°	35°-40°	35°-40°		12	12	12	15	5	10	22	30	45	45	45	45	45	45	45	35		
70	80	80	40	50	60	60	60	60		60	60	60	80	80	70	50	50	50	40	60	60	40	60	60	60	50	
200	200	200	200	200	200	200	200	200		400	400	400	400	400	400	400	400	600	600	600	600	600	600	600	600	600	
5	4	5	5	5	5	5	5	5	100	4	3	4	4	5	4	4	2b	2b	2b	3	3	2b	2b	2b	2b	2b	100
+	+	.	+	.	+	+	+	.	57	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	.	+	+	.	.	+	+	.	48	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	.	.	.	35	.	.	.	.	.	2m	+	1	.	.	.	.	.	.	.	.	19
.	.	.	.	.	.	.	.	1	22	.	+	+	+	.	+	+	2b	2b	1	1	1	1	1	2b	2b	88
.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	3	2b	2b	2b	2b	1	2b	.	44
.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	2b	2b	3	3	2b	3	3	.	44
.	.	.	.	.	.	.	.	.	0	2b	2b	3	2b	2b	3	.	.	.	.	.	.	.	.	.	.	38
.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	.	.	.	22	2b	2b	+	+	+	.	.	.	+	1	+	1	1	1	1	2b	88
.	.	.	.	.	.	.	.	.	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	.	.	.	22	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
.	1	.	.	.	.	.	+	.	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	.	.	.	.	.	.	.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	.	.	+	.	.	.	.	.	13	+	+	.	+	.	.	.	+	2b	1	1	1	1	2b	2b	2b	75
.	.	.	.	.	.	.	.	.	0	.	4	.	2b	+	2b	2b	2b	+	1	+	+	1	+	2b	2b	88

Number of relevés	1	2	11	14	16	13	12	15	80	81	91	93	82	83
<i>Sorbus torminalis</i> (L.) Crantz.	.	.	+	.	.	.	.	.	.	+	+	.	.	.
<i>Galium pseudaristatum</i> Schur.	+	.	.	+	.	.	.	.	.	.	+	+	2b	.
<i>Quercus frainetto</i> Ten.	2b	+	.	.	.	.	.	.	.	.	3	3	.	.
<i>Cornus mas</i> L.	2b	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Crataegus monogyna</i> Jacq.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
<i>Tamus communis</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Quercus cerris</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Physospermum cornubiense</i> (L.) DC	.	.	.	.	.	.	.	.	.	+	.	.	.	.
<i>Trifolium medium</i> L. subsp. <i>balkanicum</i> Velen.	.	+	.	.	.	.	.	.	+	+	.	.	.	+
<i>Tanacetum corymbosum</i> (L.) Sch.Bip.	.	.	.	.	.	.	.	.	.	+	.	+	.	.
<i>Clinopodium vulgare</i> L.	.	.	+	.	+	.	.	.	+	.	.	.	.	.
<i>Lathyrus niger</i> (L.) Bernh.	+	.	.	.	.	+	.	.	.	.	.	.	.	+
<i>Buglossoides purpureoerulea</i> (L.) I.M.Johnst.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Sorbus domestica</i> L.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Potentilla micrantha</i> Ramond ex DC	.	.	.	+	.	.	+	.	.	.	.	.	.	.
<i>Festuca heterophylla</i> Lam.	.	.	.	.	.	.	+	1	.	.	+	.	.	.
<i>Acer tataricum</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Limodorum abortivum</i> (L.) Schwartz.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
<i>Pyrus pyraster</i> Burgst.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
<i>Helleborus odoratus</i> Waldst. et Kit.	.	.	.	.	.	.	.	.	.	.	+	.	+	.
<i>Luzula forsteri</i> (Sm.) DC.	.	.	.	+	.	.	.	+	.	.	.	.	.	.
<i>Doronicum orientale</i> Hoffm.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Iris sintenisii</i> Janka	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Lonicera etrusca</i> Santi.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Pulmonaria mollis</i> Wulfen ex Hornem.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Lathyrus venetus</i> (Mill.) Wohlff.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
<i>Silene italica</i> (L.) Pers.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Class <i>Quercetea robori-petraeae</i> Br.-Bl. et Tx. ex Oberd. 1957														
<i>Quercus dalechampii</i> Ten.	2b	2b	+	+	2b	3	+	2b	1	1	+	.	.	+
<i>Euphorbia amygdaloides</i> L.	+	.	.	.	+	.	.	+	.	.	+	.	+	.
<i>Chamaecytisus hirsutus</i> (L.) Link.	.	.	.	+	.	+	.	.	+	+	+	+	.	.
<i>Quercus petraea</i> (Mattuschka) Liebl.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Pteridium aquilinum</i> (L.) Kuhn.	.	+	+	.	.	.	2b	2b	.	.	.	.	.	.
<i>Lerchenfeldia flexuosa</i> (L.) Schur.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Class <i>Carpino-Fagetea sylvaticae</i> Jakuch ex Passarge 1968														
<i>Melica uniflora</i> Retz.	.	.	.	1	.	.	3	1	.	.	.	.	+	3
<i>Poa nemoralis</i> L.	+	.	+	+	2m	+	.	2m	+	+	.	+	.	+
<i>Fagus sylvatica</i> L.	.	.	.	.	.	.	2b	.	+	+	+	.	2b	2b
<i>Dactylis glomerata</i> L.	.	.	+	+	+	+	+	+	+	+	+	.	.	.
<i>Hieracium gentile</i> Jord. ex Boreau	.	+	+	.	.	.	.	+	+	+	+	+	.	+
<i>Sanicula europaea</i> L.	.	.	+	.	+	.	+	2b	.	.	.	.	+	.
<i>Scilla bifolia</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Viola reichenbachiana</i> Jord. ex Boreau	1	+	+	.	.	.	+	.	.	.	.	.	.	.
<i>Galium odoratum</i> (L.) Scop.	.	.	.	.	.	.	.	.	.	.	.	.	2b	1
<i>Cephalanthera damasonium</i> (Mill.) Druce	.	.	.	.	+	.	.	.	.	.	.	.	.	.
<i>Hedera helix</i> L.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
<i>Cephalanthera rubra</i> (L.) Rich.	.	.	.	+	+	.	.	.	.	.	.	.	.	.
<i>Acer campestre</i> L.	.	.	.	.	.	.	.	.	+	.	.	.	+	.
<i>Melittis melissophyllum</i> L.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
<i>Luzula luzuloides</i> (Lam.) Dandy	.	.	.	.	.	.	.	.	+	+	.	+	.	.

90	88	84	94	89	92	85	86	87	%	3	7	4	5	8	6	9	10	47	49	50	48	51	53	52	54	%
+	1	+	+	30	+	2b	+	+	.	2b	.	.	.	.	.	.	.	.	.	.	31
.	+	+	+	+	39	.	.	.	+	.	+	.	+	.	.	.	.	.	.	.	.	19
.	1	.	.	.	+	.	+	+	35	2b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
.	+	.	.	9	2b	2b	.	+	+	2b	.	.	.	.	.	.	.	.	.	.	31
.	+	.	9	.	.	.	.	.	.	.	.	.	.	1	1	1	1	+	-	31
.	0	+	+	+	1	+	.	.	.	.	.	.	1	1	1	2b	.	31
.	+	.	.	4	.	.	.	.	.	.	.	.	.	.	.	+	+	1	2b	.	25
+	.	.	.	+	13	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	13
.	+	22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	9	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	13
.	13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	6
.	13	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
.	0	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	19
.	4	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	13
.	9	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
.	13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	0	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	13
.	4	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	6
.	4	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	6
.	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	6
.	0	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
.	0	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	6
.	0	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
+	+	.	.	+	.	+	+	+	78	2b	+	2b	.	.	.	.	.	+	+	2b	+	1	+	2b	1	69
.	+	+	.	30	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	13
.	26	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	6
.	0	.	.	.	.	.	.	.	.	.	2b	1	.	2b	2b	2b	1	38
+	22	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
1	2b	1	+	1	+	3	2b	1	61	.	+	.	.	.	1	.	.	.	.	.	.	.	.	.	.	13
.	+	48	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	13
3	2b	2b	4	2b	3	.	+	.	57	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	35	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	1	19
+	+	.	.	.	43	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	6
+	.	.	+	.	.	+	.	.	35	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	0	.	.	.	.	.	.	.	.	.	+	+	+	+	+	1	+	44
.	17	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	19
+	2b	+	.	+	.	.	.	.	26	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	4	+	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	25
.	4	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	19
.	9	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	13
.	+	+	17	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0
.	4	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	13
.	13	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0

Number of relevés	1	2	11	14	16	13	12	15	80	81	91	93	82	83
<i>Mycelis muralis</i> (L.) Dumort.	.	.	.	.	.	.	.	+	.	.	.	+	.	.
<i>Prunus avium</i> L.	+	.	.	.	.	.	+	.	.	.	.	.	.	.
<i>Carex digitata</i> L.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
<i>Campanula rapunculoides</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Cardamine bulbifera</i> (L.) Crantz.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Epipactis helleborine</i> (L.) Crantz.	+	.	.	.	.	.	.	.	.	.	.	+	.	.
<i>Vicia cracca</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Crataegus pentagyna</i> Waldst. et Kit.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Lilium martagon</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Lonicera xylosteum</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Abies alba</i> Mill. subsp. <i>alba</i>	.	.	.	.	.	.	+	.	.	.	.	.	.	.
<i>Arum maculatum</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Carpinus betulus</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Fraxinus excelsior</i> L.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Neotia nidus-avis</i> (L.) Rich.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Class Vaccinio-Piceetea Br.-Bl. in Br.-Bl. et al. 1939														
<i>Juniperus communis</i> L. subsp. <i>communis</i>	.	+	.	+	.	.	.	+	.	+	.	.	.	.
<i>Dicranum scoparium</i> Hedw.	+	+	+	.	.	.	.	.	.	.	.	.	.	.
Other species														
<i>Veronica chamaedrys</i> L.	.	.	.	.	.	.	.	.	+	+	+	+	.	.
<i>Viola odorata</i> L.	.	.	.	+	+	.	.	.	.	.	.	.	.	.
<i>Brachypodium sylvaticum</i> (Huds.) P. Beauv.	.	+	2b	2b	2b	.	.	2b	.	.	.	.	.	.
<i>Stellaria media</i> (L.) Vill.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Rosa canina</i> L.	1	.	.	+	+	.	.	.	.	.	+	.	.	+
<i>Peucedanum cervaria</i> (L.) Lapeyr.	.	.	.	.	.	.	.	.	.	.	+	.	.	+
<i>Veronica hederifolia</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Dorycnium herbaceum</i> Vill.	+	.	+	+	.	.	.	.	.	.	.	.	.	.
<i>Laser trilobum</i> (L.) Borkh.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Hieracium cymosum</i> L.	.	.	+	+	+	+	.	+	.	.	.	.	.	.
<i>Viola tricolor</i> L.	.	.	.	.	.	.	.	.	.	.	+	.	+	+
<i>Trifolium alpestre</i> L.	.	.	+	+	2b	.	.	.	.	+	.	.	.	.
<i>Euphorbia helioscopia</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Brachythecium velutinum</i> (Hedw.) Schimp.	+	+	.	.	.	+	.	.	.	.	.	.	.	.
<i>Hypericum cerastioides</i> (Spach) N. Robson	.	+	.	.	.	.	.	.	.	.	.	.	.	.
<i>Micropyrum tenellum</i> Link.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
<i>Chamaecytisus absinthioides</i> (Janka) Kuzmanov	+	+	.	.	.	.	.	.	.	.	.	.	.	.
<i>Corylus avellana</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	r	+
<i>Cruciata glabra</i> (L.) Ehrend.	.	.	.	.	.	.	+	.	.	.	.	+	.	.
<i>Fragaria vesca</i> L.	.	.	.	.	+	.	.	.	.	.	.	.	.	+
<i>Rosa pimpineifolia</i> L.	+	+	+	.	.	.	.	.	.	.	.	.	.	.
<i>Trifolium angustifolium</i> L.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
<i>Vicia angustifolia</i> Grufberg	.	.	.	+	2b	+	.	.	.	.	.	.	.	.
<i>Astragalus depressus</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Geranium lucidum</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Lapsana communis</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Bituminaria bituminosa</i> (L.) Stirt.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Carlina vulgaris</i> L.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
<i>Genista tinctoria</i> L.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Geranium sanguineum</i> L.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
<i>Poa bulbosa</i> L.	.	.	.	.	.	.	.	.	.	.	.	+	.	.

Number of relevés	1	2	11	14	16	13	12	15	80	81	91	93	82	83
<i>Prunus cerasifera</i> Ehrh.	.	+
<i>Teucrium chamaedrys</i> L.	+
<i>Thymus</i> sp.	.	.	.	+
<i>Brachypodium pinnatum</i> (L.) P. Beauv.	3	.	.	.	.	.	.	.	.	.	1	.	.	.
<i>Clematis vitalba</i> L.	+	.
<i>Galium verum</i> L.	+	+
<i>Genista ovata</i> Waldst. et Kit.	+	+	.	.
<i>Juglans regia</i> L.	+	+
<i>Agrimonia eupatoria</i> L.
<i>Ajuga genevensis</i> L.
<i>Anthemis tinctoria</i> L.
<i>Campanula lingulata</i> Waldst. et Kit.
<i>Cardamine hirsuta</i> L.
<i>Clematis viticella</i> L.
<i>Cornus sanguinea</i> L.
<i>Evonymus europaeus</i> L.
<i>Galium aparine</i> L.
<i>Geranium columbinum</i> L.
<i>Geum urbanum</i> L.
<i>Koeleria simonkaii</i> Adamovic
<i>Lamium purpureum</i> L.
<i>Ligustrum vulgare</i> L.
<i>Linara pelisseriana</i> (L.) Mill.
<i>Ophrys cornuta</i> Steven
<i>Parentucellia latifolia</i> (L.) Caruel
<i>Prunus spinosa</i> L.
<i>Ranunculus arvensis</i> L.
<i>Rubus caesius</i> L.
<i>Silene noctiflora</i> L.
<i>Aegopodium podagraria</i> L.
<i>Ajuga reptans</i> L.	.	.	.	+
<i>Asperula cynanchica</i> L. subsp. <i>cynanchica</i>	+
<i>Astragalus glycyhylloides</i> DC.	+
<i>Calamagrostis arundinacea</i> (L.) Roth.	+	.	.
<i>Chrysopogon gryllus</i> (L.) Trin.	+
<i>Cladonia foliacea</i> (Huds.) Willd.	+
<i>Danthonia alpina</i> Vest.	.	+
<i>Ferulago sylvatica</i> (Besser) Rchb.
<i>Festuca valesiaca</i> Schleich. ex Gaudin	.	.	.	2b	.	.	.	.	.	.	.	.	.	.
<i>Filago vulgaris</i> Lam.	+
<i>Helianthemum nummularium</i> (L.) Mill.	+	.	.	.
<i>Hieracium hoppeanum</i> Schult.	.	+
<i>Hypericum perforatum</i> L.	+	.	.
<i>Hypochaeris maculata</i> L.	+
<i>Myrrhoides nodosa</i> (L.) Cannon	+	.
<i>Populus tremula</i> L.
<i>Silene vulgaris</i> (Moench.) Garcke
<i>Trifolium repens</i> L.	+	.	.

Table 2: Diagnostic table of the syntaxa from *Erico-Pinetea*.
Tabela 2: Diagnostična tabela sintaksonov razreda *Erico-Pinetea*.

Number of releve	55	57	56	67	68	69	72	73	74	59	58	75	76	78	77	66	70	71	79	60	63	61	62	
Locality	Ortaburun- Central Balkan	Ortaburun- Central Balkan	Ortaburun- Central Balkan	Korfia- Central Balkan	Ortaburun- Central Balkan	Korfia- Central Balkan	Korfia- Central Balkan	Ortaburun- Central Balkan	Ortaburun- Central Balkan	Ortaburun- Central Balkan	Kuntepe- Central Balkan	Kravite- Central Balkan	Kravite- Central Balkan	Kravite- Central Balkan	Kurthisar- Central Balkan	Kravite- Central Balkan	Kravite- Central Balkan	Kravite- Central Balkan	Kravite- Central Balkan					
Author	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	IvNik	
Data	6/29/2012	6/29/2012	6/29/2012	6/29/2012	6/29/2012	6/29/2012	6/29/2012	6/29/2012	6/29/2012	6/29/2012	4/11/2013	4/11/2013	4/11/2013	4/11/2013	4/11/2013	6/4/2011	6/4/2011	6/4/2011	6/16/2013	6/4/2011	5/29/2011	5/29/2011	5/29/2011	
Latitude	42 45 07.9	42 45 10.9	42 45 14.7	42 45 46.4	42 45 37.4	42 45 38.0	42 45 41.5	42 45 19.1	42 45 18.9	42 45 07.4	42 45 19.9	42 45 20.8	42 45 13.3	42 45 13.3	42 45 23.4	42 45 12.5	42 44 49.7	42 45 07.9	42 45 16.5	42 45 07.9	42 45 27.4	42 45 01.4	42 45 02.6	
Longitude	24 35 48.3	24 35 54.9	24 35 59.4	24 35 39.8	24 35 44.0	24 35 43.8	24 35 42.8	24 35 46.0	24 35 46.0	24 35 49.1	24 36 20.0	24 36 21.7	24 36 28.4	24 36 28.4	24 36 21.5	24 36 51.4	24 37 26.9	24 36 42.5	24 36 50.6	24 36 36.9	24 36 48.7	24 36 55.0	24 36 51.0	
Altitude	1117	1110	1127	1233	1230	1255	1251	1210	1200	1130	1053	1031	1100	1250	1012	1237	1212	1220	1315	1238	1470	1397	1315	
Exposition	E	E	E	E	NW	E	E	W	W	NW	W	W	W	W	W	W	S	NW	SW	W	SW	NWQ	NW	
Inclination	70	65	50	50	50	50	45	60	60	45	55	40	55	45	45	40	50	50	55	60	30	10	20	
Coverage (%)	50	50	70	50	70	70	60	50	50	70	60	60	70	80	50	60	70	70	80	60	60	80	80	
Sample plot (sq. m)	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	
Diagnostic species for association <i>Seslerio latifoliae-Pinetum nigrae</i> Em 1978 subass. <i>typicum</i>																								
<i>Pinus nigra</i> J.F. Arnold subsp. <i>pallasiana</i> (Lamb.) Holmboe	2b	2b	3	3	3	2b	2b	3	3	2b	2b	2b	3	3	2b	3	3	3	2b	3	3	3	3	
<i>Sesleria latifolia</i> (Adamovic) Degen	2b	1	3	3	3	+	+	1	1	.	3	2b	4	4	1	3	2b	2b	3	1	2b	2b	2b	
<i>Iberis sempervirens</i> L.	2b	2b	+	.	2b	+	+	1	1	.	.	.	.	.	.	.	.	.	1	2b	.	.	.
<i>Daphne blagayana</i> Freyer	.	.	.	2b	+	2b	2b	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Differential species for the subassociation <i>haberletosum</i> subass. <i>nova</i>, holotypus rel. <i>hoc loco</i> 33																								
<i>Haberlea rhodopensis</i> Friv.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Cotoneaster integerrimus</i> Medicus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Pinus nigra</i> subsp. <i>pallasiana</i> and <i>Brachypodium pinnatum</i> community																								
<i>Brachypodium pinnatum</i> (L.) P. Beauv.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Alliance <i>Fraxino orni-Pinion nigrae</i> Em 1978, order <i>Erico-Pinetalia</i> Horvat 1959 and class <i>Erico-Pinetea</i> Horvat 1959																								
<i>Ostrya carpinifolia</i> Scorp.	2b	+	2b	2b	1	2b	1	+	+	2b	2b	2b	2b	2b	1	2b	2b	2b	2b	1	1	1	1	
<i>Fraxinus ornus</i> L.	1	1	1	.	1	.	.	.	.	1	1	2b	1	.	1	+	.	.	.	.	.	.	.
<i>Pinus sylvestris</i> L.	2b	2b
<i>Laserpitium siler</i> L.	.	.	.	+	1	+	+	2b	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Galium lucidum</i> All.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Chamaecytisus hirsutus</i> (L.) Link.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Pulsatilla halleri</i> (All.) Willd. subsp. <i>rhodopaea</i> (Stoj. & Stefanov) K. Krause	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Genista rumelica</i> Velen.	1	1	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Carex humilis</i> Leyss.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Hieracium pannosum</i> Boiss.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Number of releve	55	57	56	67	68	69	72	73	74	59	58	75	76	78	77	66	70	71	79	60	63	61	62	
Class <i>Carpino-Fagetea sylvaticae</i> Jakuch ex Passarge 1968																								
<i>Fagus sylvatica</i> L.	.	.	2b	2b	1	2b	3	+	+	2b	1	2b	2b	2b	2b	1	2b	2b	2b	+	.	1	1	
<i>Abies alba</i> Mill. subsp. <i>alba</i>	.	.	.	2b	+	2b	2b	+	+	2b	1	1	+	.	+	2b	1	2b	2b	+	.	.	2b	
<i>Hieracium gentile</i> Jord. ex Boreau	1	.	.	.	.	.	+	.	.	2b	+	1	.	.	
<i>Aremonia agrimonoides</i> (L.) DC	1	1	1	+	.	1	.	.	
<i>Mycelis muralis</i> (L.) Dumort.	.	.	.	+	+	+	+	+	+	+	.	1	1	+	.	.	.	
<i>Acer pseudoplatanus</i> L.	.	.	.	1	+	+	+	+	+	.	.	.	.	.	.	.	2b	2b	1	+	.	1	1	1
<i>Prenanthes purpurea</i> L.	.	.	.	+	+	+	2b	+	+	+	.	.	.	.	.	.	.	.	.	1	.	1	.	.
<i>Lilium martagon</i> L.	+	+	1	.	+	+	1	+	+	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.
<i>Luzula luzuloides</i> (Lam.) Dandy	3	.	.	.	.	.	.	.	.	.	+	.	2b	.	2b
<i>Cotoneaster nebrodensis</i> (Guss.) C. Koch	.	.	.	1	2b	1	+	+	+	.	1	+	1	1	r	1	.	1	2b	1	.	.	1	
<i>Salvia glutinosa</i> L.
<i>Campanula rapunculoides</i> L.	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.
<i>Galium schultesii</i> Vest.	+	+	1	+	+	2b	1	+	+	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.
<i>Hepatica nobilis</i> Mill.	+	1	1	1	1	+	1	.	+	.	.	.	.
<i>Luzula sylvatica</i> (Hudson) Gaudin	.	.	.	1	+	2b	2b	+	+	.	.	2b	.	.	2b	.	2b	2b	.	.	.	.	.	.
<i>Cephalanthera damasonium</i> (Mill.) Druce
<i>Doronicum columnae</i> Ten.	+	1	1	+	2b	+	1	+	+	.	.	.	1
<i>Poa nemoralis</i> L.	+	+	+	2b	.	.	.	.	.	.	.	.	.	.	.	r	+	.
<i>Populus tremula</i> L.	1	.	.	.	.	.	.
<i>Dryopteris filix-mas</i> (L.) Schott.	1	.	.	.	.	.	.	.	1
<i>Lonicera xylosteum</i> L.	1	.	.	.	.
<i>Viola reichenbachiana</i> Jord. ex Boreau
<i>Cephalanthera rubra</i> (L.) Rich.	1	1	1	1	1	1	1	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Symphytum tuberosum</i> L.	1	+	1	r	.	.	.	.	.
<i>Dactylis glomerata</i> L.	+
<i>Geranium robertianum</i> L.	+	1
<i>Sorbus aucuparia</i> L. x <i>Sorbus aria</i> (L.) Crantz.	2b	.	.	.	.	.	.	.	.	.	.	.	1	1	+	1	.	.	1	1
<i>Daphne mezereum</i> L.	1	1	.	1	.	.	1
<i>Knautia drymeja</i> Heuff.
<i>Acer platanoides</i> L.	.	.	.	1	+	2b	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.
<i>Aquilegia nigricans</i> Baumg.
<i>Hedera helix</i> L.	+	+	+	.	2b	.	.	.	.	.	.	.	.
<i>Lathyrus vernus</i> Bernh.
<i>Campanula trachelium</i> L. subsp. <i>trachelium</i>	+	.	.	.	r	1	.
<i>Epilobium montanum</i> L.
<i>Galium odoratum</i> (L.) Scop.	+	1	.	+	.	.	2b	.
<i>Melica nutans</i> L.
<i>Mercurialis perennis</i> L.	+	+	1	.	.	1	.	.	.	+	.	.	.	.	.
<i>Sanicula europaea</i> L.
<i>Sorbus austriaca</i> (Beck) Hedl.
<i>Veronica urticifolia</i> Jacq.
<i>Carpinus betulus</i> L.
<i>Anemone ranunculoides</i> L.
<i>Cardamine bulbifera</i> (L.) Crantz.	1	.	.	.	+	r	.	.	.
<i>Lamium galeobdolon</i> (L.) L.
<i>Prunus avium</i> L.	r	.	1
<i>Athyrium filix-femina</i> (L.) Rothm.
<i>Convallaria majalis</i> L.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Epipactis helleborine</i> (L.) Crantz.	1	+	.	.	.	.	.
<i>Fraxinus excelsior</i> L.	1	+	.	.	.	.	.
<i>Pulmonaria officinalis</i> L.
<i>Tilia cordata</i> Mill.

65	64	%	17	18	22	21	19	29	20	27	28	25	23	24	26	30	31	41	42	32	35	36	37	33	34	38	39	40	%	43	44	46	45					
2b	2b	88	2b	1	2b	2b	+	3	+	.	.	.	+	+	.	2b	2b	3	3	3	2b	2b	2b	+	1	.	.	1	77	.	.	1	.					
1	2b	76	2b	3	3	4	4	3	4	4	2b	3	3	3	3	+	+	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	65	+	.	.	+
.	.	20	+	+	+	+	1	.	+	1	+	+	+	+	+	+	+	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	1	28	+	r	.	+	+	.	1	+	+	+	+	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	40	.	+	.	.	+	+	+	+	.	+	+	+	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	1	64	.	.	.	.	+	+	+	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2b	.	40	r	+	.	.	.	.	.	r	+	.	+	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	40	+	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2b	.	20	2b	2b	1	2m	.	1	2m	2b	2b	2b	2b	2b	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2b	.	68	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	0	.	+	.	+	+	+	+	+	+	+	+	.	.	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	12	.	.	.	.	2m	.	+	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	2b	52	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	32	.	+	.	.	.	.	.	r	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	40	.	r	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	0	.	.	.	.	.	.	.	+	r	.	.	.	.	r	+	+	+	+	+	.	.	.	.	.	+	+	r	+	.	.	.	.	.	.
.	.	40	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	24	2b	2m	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	4	.	2b	+	1	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	1	12	.	+	.	.	+	+	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	4	+	+	.	.	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	0	.	+	.	r	+	.	+	1	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	40
.	.	16	..	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	4	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	1	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
2b	1	36	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1	.	20	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	0	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	24	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	0	.	.	.	.	r	.	+	r	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	16	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	0	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	1	16	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	1	4	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	1	20	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	0	.	.	.	r	.	.	.	.	.	.	.	.	.	2b	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	20	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	0	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	2b	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	0	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	1	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	0	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

Number of releve	55	57	56	67	68	69	72	73	74	59	58	75	76	78	77	66	70	71	79	60	63	61	62	
<i>Acer campestre</i> L.
<i>Actaea spicata</i> L.
<i>Anemone nemorosa</i> L.
<i>Arabis procurrens</i> Waldst. et Kit.	+	1	.	+	.	.	.
<i>Asarum europaeum</i> L.
<i>Festuca drymeja</i> Mert. & Koch.
<i>Dryopteris carthusiana</i> (Vill.) H. P. Fuchs.
<i>Evonymus latifolius</i> (L.) Mill.
<i>Galium rotundifolium</i> L.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Moehringia trinervia</i> (L.) Clairv.
<i>Myosotis sylvatica</i> Ehrh. ex Hoffm.	1	.
<i>Polygonatum latifolium</i> (Jacq.) Desf.
<i>Primula elatior</i> (L.) Hill.
<i>Ranunculus ficaria</i> L. subsp. <i>caltifolius</i> (Rchb.) Arcang.	1	.	.
<i>Symphytum bulbosum</i> Schim.	1	.	.	.	.	.	.
<i>Viscum album</i> L.
Class <i>Quercetea robori-petraeae</i> Br.-Bl. et Tx. ex Oberd. 1957																								
<i>Euphorbia amygdaloides</i> L.	+	+	1	.	.	.	.	.	.	+	1	1	1	1	1	.	1	1	+	+	+	.	.	
<i>Brachypodium sylvaticum</i> (Huds.) P. Beauv.
<i>Campanula persicifolia</i> L.	1	1	1	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Cephalanthera longifolia</i> (L.) Fritsch.
<i>Quercus dalechampii</i> Ten.	2b	.	.	.	.	.	.	.	.	.	.	r	+	.	.
<i>Preridium aquilinum</i> (L.) Kuhn.
<i>Veronica officinalis</i> L.
<i>Lerchenfeldia flexuosa</i> (L.) Schur.
<i>Viburnum lantana</i> L.
Class <i>Vaccinio-Piceetea</i> Br.-Bl. in Br.-Bl. et al. 1939																								
<i>Picea abies</i> (L.) Carst.
<i>Orthilia secunda</i> (L.) House	1	1	1	+	+	.	.	.	.	.	+	.	.	.
<i>Vaccinium myrtillus</i> L.	1	2b	
<i>Rosa pendulina</i> L.	1	.	
<i>Juniperus communis</i> L. subsp. <i>communis</i>	1	.	.	1	.	.	.	1	
<i>Oxalis acetosella</i> L.
<i>Lonicera caerulea</i> L.
<i>Moneses uniflora</i> (L.) A.Gray
<i>Corallorhiza trifida</i> Chatel	+	1	.	.	.	.	.	.
<i>Goodiera repens</i> (L.) R.Br.
<i>Melampyrum sylvaticum</i> L.
Class <i>Quercetea pubescentis</i> Doing-Kraft ex Scamoni et Passarge 1959																								
<i>Acer hyrcanum</i> Fish. C. A. Mey. subsp. <i>hyrcanicum</i>	1	1	.	1	.	1	+	+	+	1	1	+	1	.	+	+	.	.	.	r	.	.	.	
<i>Primula veris</i> L.	.	.	.	+	+	1	1	+	+	+	.	.	.	.	.	.	.	.	.	.	r	.	.	.
<i>Clinopodium vulgare</i> L.	+	+	1	+	+	+	+	+	+	.	.	.	.	.	.	.	+	.	.	.	r	.	.	.
<i>Potentilla micrantha</i> Ramond ex DC	1	1	1	1	1	.	.	.	.	.	.	.	.	.
<i>Tanacetum corymbosum</i> (L.) Sch. Bip.	1	r	.	.	.	.	.	.	.	.	.	.	.	.
<i>Physospermum cornubiense</i> (L.) DC
<i>Sorbus torminalis</i> (L.) Crantz.
<i>Evonymus verrucosus</i> Scop.
<i>Festuca heterophylla</i> Lam.	2b	1	.
<i>Cornus mas</i> L.
<i>Digitalis lanata</i> Ehrh.	1	+	1	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
<i>Sorbus aria</i> (L.) Crantz.	1	1	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	.	.	.	1
<i>Digitalis viridiflora</i> Lindt.

Number of releve	55	57	56	67	68	69	72	73	74	59	58	75	76	78	77	66	70	71	79	60	63	61	62	
<i>Campanula sparsa</i> Friv.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Crataegus monogyna</i> Jacq.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
<i>Carpinus orientalis</i> Mill.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Juniperus oxycedrus</i> L. subsp. <i>deltoides</i> (R.P.Adams) N.G.Passal.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Syringa vulgaris</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Trifolium medium</i> L. subsp. <i>balcanicum</i> Velen.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Cotinus coggygria</i> Scop.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Galium pseudaristatum</i> Schur.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Vincetoxicum hyrundinaria</i> Medicus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Acer byrcanum</i> Fish. C. A. Mey. subsp. <i>intermedium</i> (Pančić) Palam.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2b	.	.	.	.
<i>Chamaecytisus frivaldskyanus</i> (Degen) Kuzmanov	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Coronilla emerus</i> L. subsp. <i>emeroides</i> (Boiss. & Spruner) Holmboe	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Quercus pubescens</i> Willd.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Other species	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Calamagrostis arundinacea</i> (L.) Roth.	.	.	.	1	+	+	2b	+	+	.	.	.	.	.	.	.	.	.	1	3	2b	2b	3	
<i>Fragaria vesca</i> L.	.	.	.	1	+	+	+	+	+	1	+	+	+	1	1	1	1	.	+	1	1	2b	.	
<i>Cruciata glabra</i> (L.) Ehrend.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	1	.	.
<i>Sorbus aucuparia</i> L.	.	.	.	2b	+	+	+	+	+	1	.	.	.	.	.	.	1	+	+	.	.	.	.	.
<i>Teucrium chamaedrys</i> L.	1	1	+	.	.	.	.	.	.	+	1	+	.	.	.	+	.	.	.	2b	.	.	.	.
<i>Corylus avellana</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2b	.	.	.	.
<i>Geranium sanguineum</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Ajuga reptans</i> L.	.	.	.	+	+	+	+	+	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
<i>Thesium bavarum</i> Schrank	+	+	1	1	1	+	+	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Dianthus petraeus</i> Waldst. et Kit. subsp. <i>petraeus</i>	1	2b	+	.	1	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Origanum vulgare</i> L.	1	1	1	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Chamaecytisus austriacus</i> (L.) Link.	1	1	+	.	+	+	+	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Rubus saxatilis</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3	.
<i>Campanula glomerata</i> L. subsp. <i>glomerata</i>	1	1	1	.	1	+	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Jurinea mollis</i> (L.) Rchb. subsp. <i>anatolica</i> (Boiss.) Stoj.	1	1	+	+	1	+	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Laser trilobum</i> (L.) Borkh.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Seseli rigidum</i> Waldst. et Kit. var. <i>rigidum</i>	2b	2b	+	+	1	+	+	1	2b	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Solidago virgaurea</i> L.	.	.	.	+	+	+	1	+	+	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
<i>Coronilla varia</i> L.	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Dorycnium herbaceum</i> Vill.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Galium verum</i> L.	.	.	.	+	1	+	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Polygonatum odoratum</i> (Mill.) Druce	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Polypodium vulgare</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Campanula rotundifolia</i> L.	+	+	1	.	1	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Bryophyta</i> sp. indent.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Rubus idaeus</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Tussilago farfara</i> L.	.	.	.	.	+	+	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Asplenium trichomanes</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Astragalus monspessulanum</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Chamaecytisus ciliatus</i> (Wahlenb.) Rothm.	1	1	1	.	.	.	1	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Gentiana asclepiadea</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Geranium macrorrhizum</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Sedum ochroleucum</i> Chaix	.	.	.	+	1	+	+	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Vicia sepium</i> L.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

65	64	%	17	18	22	21	19	29	20	27	28	25	23	24	26	30	31	41	42	32	35	36	37	33	34	38	39	40	%	43	44	46	45	
.	.	0	.	.	.	.	.	.	.	+	+	+	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	15	1	.	.	.
1	.	8	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	12	.	.	.	.
.	.	0	+	+	+	+	15
.	.	0	r	.	.	+	.	8	.	1	1	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	1	.	.	1
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	8	.	.	.	.
.	.	0	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	1
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.
.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	+	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	4	.	.	.	.
3	2b	52	2b	2b	1	1	1	1	2b	1	2b	+	+	1	+	1	2b	1	+	2b	1	2b	.	.	2b	2b	2b	3	92	2b	1	.	1	
1	1	84	.	+	.	.	.	+	+	1	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	31	.	1	2b	1
		16	.	.	.	.	.	.	+	2m	+	.	+	2m	2m	2m	.	+	2m	+	.	.	.	.	+	1	.	.	50	2b	1	1	1
2b	1	48	+	+	+	.	.	+	.	+	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	35	.	.	.	.
.	.	32	1	+	27	1	.	.	.
.	.	4	+	1	.	.	.	.	+	2b	2b	.	+	.	+	+	.	2b	+	+	.	.	.	.	.	.	.	.	50	+	.	.	.
.	.	0	.	.	.	.	r	.	.	.	r	.	.	.	.	r	.	.	.	+	+	+	+	+	+	+	+	+	46	1	.	.	.
.	1	32	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	15	.	.	.	.
.	.	36	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12	.	.	.	.
.	.	36	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.
.	.	20	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	19	.	.	.	1
.	.	36	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.
.	.	4	.	.	.	.	.	+	+	+	+	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	1	31	.	.	1
.	.	36	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.
.	.	36	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	+	+	+	+	+	+	.	.	r	35	.	.	.	
.	.	36	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.
.	.	28	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.
.	.	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	+	.	19	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	31	.	.	.	.
.	.	24	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	2b	.	1	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	+	+	+	+	+	+	+	.	.	31	.	.	.	.
.	.	0	+	+	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	31	.	.	.	.
.	.	32	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.
.	.	0	.	+	2m	2m	.	2b	.	+	.	.	.	2m	+	.	.	.	.	.	.	.	.	.	.	.	.	.	27	.	.	.	.
.	.	0	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	19	.	1	.	1
.	.	24	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.
.	.	0	+	+	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	23	.	.	.	.
.	.	0	+	+	+	.	23	.	.	.
.	.	24	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.
.	.	0	.	.	.	.	.	+	+	r	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	23	.	.	.	.
.	.	0	+	2b	+	.	.	2b	+	r	.	.	23
.	.	24	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.
.	.	0	.	.	.	.	.	+	+	r	+	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	23	.	.	.	.

Number of releve	55	57	56	67	68	69	72	73	74	59	58	75	76	78	77	66	70	71	79	60	63	61	62	
<i>Viola odorata</i> L.	1
<i>Campanula cervicaria</i> L.	1	+	1	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Campanula moesiaca</i> Velen.
<i>Carlina vulgaris</i> L.	1	1	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Clematis vitalba</i> L.
<i>Euphorbia cyparissias</i> L.
<i>Galium</i> sp.
<i>Lapsana communis</i> L.	r	+	1	1	.
<i>Silene alba</i> (Mill.) E. Krause
<i>Festuca dalmatica</i> (Hack.) K. Rich.
<i>Rhamnus catharticus</i> L.
<i>Saxifraga rotundifolia</i> L.
<i>Scabiosa trinifolia</i> Friv.
<i>Thymus callieri</i> Borbas ex Velen.
<i>Asperula cynanchica</i> L. subsp. <i>cynanchica</i>
<i>Aster amellus</i> L.
<i>Carex divulsa</i> Stokes	1	1	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Hypericum perforatum</i> L.
<i>Juniperus sibirica</i> Burgsd.	1	1	.
<i>Peucedanum austriacum</i> (Jacq.) Koch.
<i>Scorzonera hispanica</i> L.
<i>Senecio doria</i> L. subsp. <i>umbrosus</i> (Waldst. & Kit.) Soó	+	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Tanacetum vulgare</i> L.
<i>Teucrium montanum</i> L.
<i>Veronica chamaedrys</i> L.
<i>Achillea ageratifolia</i> (Sm.) Boiss.	2b	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Asplenium adiantum-nigrum</i> L.
<i>Asplenium viride</i> Huds.	1	.	.	.	.	.	.	.	.	.
<i>Carlina acanthifolia</i> All.
<i>Carum graecum</i> Boiss.& Heldr.
<i>Chondrilla urumoffii</i> Degen
<i>Dicranum scoparium</i> Hedw.
<i>Evonymus europaeus</i> L.	+
<i>Geum urbanum</i> L.	+	1	.
<i>Helianthemum nummularium</i> (L.) Mill.
<i>Heracleum ternatum</i> Velen.
<i>Hieracium villosum</i> L.
<i>Hypericum maculatum</i> Crantz.
<i>Inula britannica</i> L.
<i>Laserpitium latifolium</i> L. var. <i>latifolia</i>	.	.	.	+	1	.	.	.	.
<i>Linum hirsutum</i> L.
<i>Orobanche</i> sp.
<i>Ranunculus montanus</i> Willd.
<i>Rosa obtusifolia</i> Desv. (<i>R. dumetorum</i>)	1
<i>Sedum hispanicum</i> L.
<i>Sesleria coerulans</i> Friv.
<i>Stachys recta</i> L.
<i>Thalictrum minus</i> L.
<i>Trachelium rumelianum</i> Hampe
<i>Trifolium alpestre</i> L.
<i>Achillea clypeolata</i> Sm.
<i>Achillea grandifolia</i> Friv.	1	.	.	.	.

65	64	%	17	18	22	21	19	29	20	27	28	25	23	24	26	30	31	41	42	32	35	36	37	33	34	38	39	40	%	43	44	46	45	
.	.	4	.	.	.	.	.	.	.	.	+	+	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	19	.	.	.	.
.	.	20	0
.	.	0	+	r	.	.	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	19	.	.	.	.
.	.	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	8	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	r	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	19	.	.	.	.
.	.	0	+	+	+	+	19
.	.	0	+	.	.	.	.	.	+	+	+	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	19	.	.	.	.
1	.	20	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.
.	.	0	+	.	.	.	+	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	19	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	2b	.	.	.	.	.	+	+	1	15	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	15	.	.	.	.
.	.	0	+	+	.	.	.	+	.	.	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	15	.	.	.	.
.	.	0	r	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	15	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	.	.	+	+	+	15	.	.	.	.
.	.	0	+	+	+	12
.	.	0	+	2b	+	12
.	.	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.
.	.	0	.	.	.	.	r	.	.	r	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	12	.	.	.	.
.	1	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.
.	.	0	2b	2b	+	12
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	12	.	.	.	.
.	.	12	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	12	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	12	.	.	.	.
.	.	0	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.
.	.	8	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	8	.	.	.	.
.	.	4	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	8	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	1	1	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	8	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	1	1
.	.	4	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	4	.	.	.	.
.	.	0	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	.	8	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	1	1	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	8	.	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	1	1
.	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	r	.	.	4	1	.	.	.
.	.	4	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	0	.	.	.	.

Number of releve	55	57	56	67	68	69	72	73	74	59	58	75	76	78	77	66	70	71	79	60	63	61	62	
<i>Acinos</i> sp.
<i>Aegopodium podagraria</i> L.
<i>Allium flavum</i> L.
<i>Anthemis tinctoria</i> L.
<i>Anthericum liliago</i> L.
<i>Astragalus</i> sp.	1	.	.
<i>Briza maxima</i> L.
<i>Briza media</i> L.
<i>Bromus tectorum</i> L.
<i>Centaurea stoebe</i> L. gr.
<i>Cystopteris fragilis</i> (L.) Bernh.	1	.	.	.	.	.	.	.
<i>Dianthus armeria</i> L.
<i>Epilobium angustifolium</i> L.
<i>Erophylla verna</i> (L.) Chevall.
<i>Euphorbia myrsinites</i> L.
<i>Euphrasia rostkoviana</i> Hayne
<i>Festuca nigrescens</i> Lam.
<i>Festuca valesiaca</i> Schleich. ex Gaudin
<i>Filipendula vulgaris</i> Moench.
<i>Fragaria viridis</i> Duchense
<i>Galium album</i> Mill.
<i>Galium aparine</i> L.	1	.
<i>Genista tinctoria</i> L.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Gentiana cruciata</i> L.
<i>Geranium sylvaticum</i> L.
<i>Hieracium hoppeanum</i> Schult.
<i>Hieracium lachenalli</i> Suter
<i>Inula aschersoniana</i> Janka
<i>Lathyrus sylvestris</i> L.
<i>Linum uninerve</i> (Rochel) Borbas
<i>Lobaria pulmonaria</i> L.
<i>Lotus corniculatus</i> L.
<i>Lysimachia punctata</i> L.
<i>Melica ciliata</i> L.
<i>Micromeria frivaldszkiana</i> (Degen) Velen.
<i>Micromeria cristata</i> (Hampe) Griseb.
<i>Minuartia rhodopaea</i> (Degen) Kozuharov et Kuzmanov
<i>Moehringia pendula</i> (Waldst. et Kit.) Fenzl.
<i>Morus alba</i> L.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Pastinaca sativa</i> L.
<i>Pimpinella peregrina</i> L.
<i>Pimpinella saxifraga</i> L.
<i>Plantago lanceolata</i> L.
<i>Platanthera bifolia</i> (L.) Rich.
<i>Pleurozium shreberi</i> (Michx.) Trevis.
<i>Poa pratensis</i> L.
<i>Polygala major</i> Jacq.
<i>Potentilla erecta</i> (L.) Raesch.
<i>Prunella vulgaris</i> L.
<i>Ranunculus sprunerianum</i> Boiss.
<i>Rhytidadelphus triquetrus</i> (Brid.) Mitt.
<i>Ribes alpinum</i> L.

Number of releve	55	57	56	67	68	69	72	73	74	59	58	75	76	78	77	66	70	71	79	60	63	61	62	
<i>Rosa pimpinifolia</i> L.
<i>Rubus caesius</i> L.
<i>Rubus serpens</i> Weihe ex Lej. et Court	2b
<i>Sagina procumbens</i> L.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<i>Salix caprea</i> L.
<i>Sanguisorba minor</i> Scop.
<i>Saxifraga strybnyi</i> (Velen.) Podp.
<i>Sedum maximum</i> (L.) Suter
<i>Selaginella helvetica</i> (L.) Spring
<i>Senecio sylvaticus</i> L.
<i>Seseli rhodopaeum</i> Velen.
<i>Silene vulgaris</i> (Moench.) Garke
<i>Stellaria graminea</i> L.
<i>Thalictrum simplex</i> L.
<i>Thymus jankae</i> Celak
<i>Thymus striatus</i> Vahl.
<i>Trifolium montanum</i> L.
<i>Urtica dioica</i> L.	2b
<i>Valleriana officinalis</i> L.
<i>Veronica hederifolia</i> L.
<i>Viburnum opulus</i> L.
<i>Vicia cassubica</i> L.
<i>Vicia hirsuta</i> (L.) Gray
<i>Viola dacica</i> Borbas

