

Forest vegetation of Plana Mountain, Bulgaria: a phytosociological approach

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Abstract

Plana Mountain, a water-poor and dry massif in Western Bulgaria, hosts a diverse mosaic of forest communities shaped by environmental gradients and long-term human activity. The objective of this study is to make a syntaxonomic analysis and to create a comprehensible classification. Vegetation surveys, comprising 15 forest communities, were analysed using Braun-Blanquet's approach. Nine associations and 6 plant communities have been identified, assigned to 5 classes, 8 orders and 9 alliances. Oak forests dominate on xeric, steep slopes with nutrient-poor soils and are represented by specific associations. Beech forests include mesophytic communities that grow on moderately rich soils with varying moisture. Scots pine forests occupy southern slopes on shallow, eroded soils. Ravine forests develop on steep canyon slopes with xerophilous composition. Riparian stands dominate on wet soils along streams and riverbanks. Historical data indicates that coniferous forests were more widespread prior to anthropogenic disturbance. Current successional trends include upward replacement of *Pinus sylvestris* L. forests and *Corylus avellana* L. shrublands by mesophytic beech forests on shady slopes and gradual progression of xerophilous oak forests on sunny slopes.

Key words: Braun-Blanquet's approach, succession, syntaxonomy.

Introduction

Plana Mountain is located near the largest city in Bulgaria, Sofia. The vicinity to the capital and the mountain's plain relief has led to intensive anthropogenic processes, thus resulting in a fragmented vegetation. Information on Plana's forests is given by the means of the Russian-Scandinavian approach (Penev 1938a, Bezlova 1989). Detailed analytical information on the origin and dynamics of forests and more

specifically on the coniferous forests of Plana Mountain and nearby areas, is provided by Penev (1938a,b). The coniferous vegetation is represented by Scots pine forests, which around 90 years ago were up to 50-year-old (mostly 30–40 years of age), primarily on eruptive rocks. In addition to Scots pine forests, Penev identified fragments of mixed beech-fir forests with a sporadic presence of *Picea abies* (L.) H. Karst. He also mentioned a community of *Pinus nigra* J.F. Arnold mixed with *P. syl-*

vestris, *Quercus cerris* L. and *Q. petraea* Liebl. Deciduous vegetation in the mountain is represented primarily by beech forests, mainly in the northern and southern parts (only in shady and moist valleys). The author also noted that a large part of the beech forests, similar to the *Q. petraea* forests, have been destroyed during the period 1910–1920. *Q. cerris* occurred in the area mainly represented by single, massive, old trees. In the northern parts, mainly in beech forests up to about 950 m a.s.l., the Common hornbeam (*Carpinus betulus* L.) was also recorded. Birch forests developed along the Porkolitsa River, with relatively high participation of beech and in the second layer, Common hazel (*Corylus avellana* L.) and Norway spruce (*Picea abies*). Riparian hydrophilous vegetation was dominated by *Alnus incana* (L.) Moench. and *Alnus glutinosa* (L.) Gaertn (Penev 1938a,b).

Therefore, the present study aims to provide the first comprehensive phytosociological classification of the forest vegetation of Plana Mountain, following the Braun-Blanquet approach (Braun-Blanquet 1964), based on original relevés and supported by an analysis of its successional patterns.

Study area and Methods

Study area

Plana Mt. is situated in the Plansko–Zaval-ska mountain range in southwestern Bulgaria, between the Vitosha and Lozenska mountains. The eastern boundary follows the dam wall of the Iskar Reservoir, while the Samokov Valley defines the southern boundary (Fig. 1). The total size is approximately 26,210 ha, of which roughly

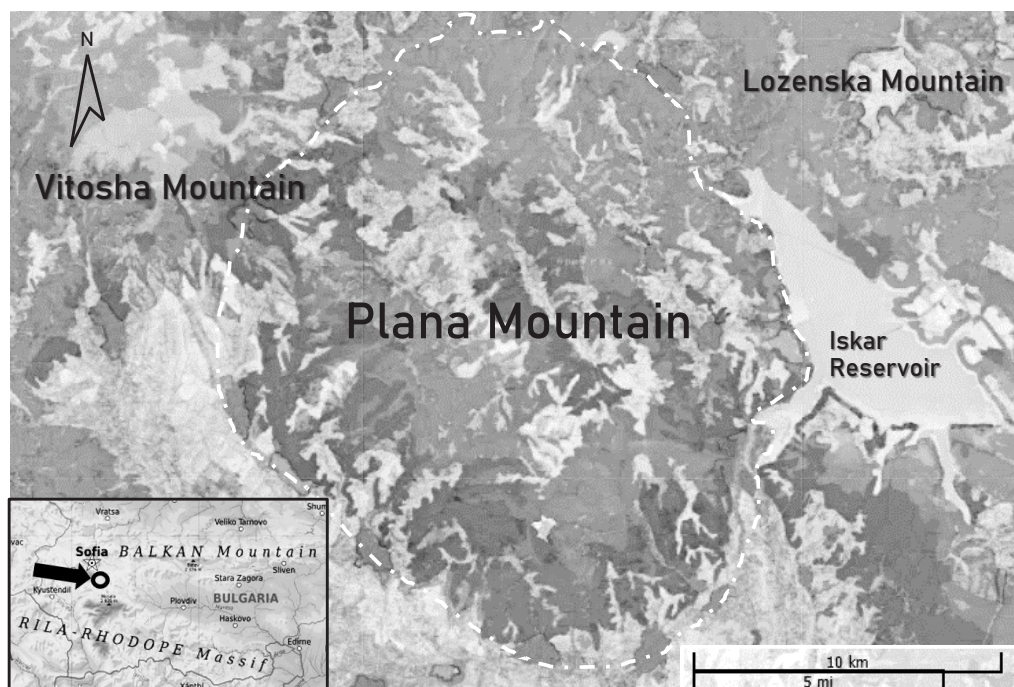


Fig. 1. Location of Plana Mountain.

60 % are woodland. Plana is a relatively flat massif ranging from 636 m a.s.l. (Devil's bridge) to 1338 m a.s.l. (Manastirishte peak). In the central and southern parts the altitude mostly varies between 1000 and 1200 m a.s.l., whereas in the northern region it is lower and the terrain is enmeshed in the Iskar River. Plana's climate is characterised as typically continental, with a cold winter and mild warm summer. In the period 1979–2014, the average annual temperature for the summer months was reported 16–18 °C, with a spring (7–8 °C) colder than autumn (8–10 °C) (Todorov 2017). Winds that dominated in this period were western and northwestern, occurring mainly in winter. The average annual rainfall can vary from 650 to 800 mm with a summer maximum in May and June and a winter minimum in February and March. The average relative humidity from April to July ranges between 50 and 80 %. The geological substrate is dominated by Precambrian crystalline rocks, including metamorphic formations, such as gneisses, muscovite gneisses, and amphibolites, as well as plutonic igneous rocks, primarily quartz diorites, diorites, and granodiorites. Most bedrock types are acidic and rich in siliceous material (Bezlova 1989). The prevailing soil types are Dystric Cambisols and Lithic and Umbric Leptosols (Ninov 2002). Data on soil conditions were obtained from forest management plans covering the study area (EFA 2016, 2019).

Methods

During the period 2022–2025, a total of 187 phytocoenological relevés were recorded; following a detailed analysis, 173 relevés

were retained based on floristic similarity. The size of the sampling plots was determined according to commonly accepted standards for such surveys: 200 m² for coniferous communities, 300 m² for broad-leaved communities, 100 m² for secondary shrub communities, and 200 m² for gallery alder forests (Chytrý and Otýpková 2003). Taxon presence and cover were estimated using the Braun–Blanquet combined scale (van der Maarel 1979).

The cluster dendrogram was produced using the SYN-TAXA (Podani 2001), following the UPGMA method. The Horn index was applied to calculate floristic similarity (Krebs 1999).

The determination of diagnostic, constant, and dominant species was performed using the specialized software JUICE 7.1 (Tichý et al. 2011). The following threshold values were applied: Fidelity threshold – $\Phi \geq 30$ (Lower), ≥ 60 (Higher); Frequency threshold – ≥ 40 (Lower), ≥ 75 (Higher); Cover threshold – ≥ 50 (Lower), ≥ 60 (Higher).

The assignment of the groups obtained through cluster analysis to specific syntaxa was carried out by comparing them with known units and evaluating the degree of correspondence in ecological conditions, diagnostic species, and complete floristic composition. For this purpose, the referenced literature was used (Tzonev et al. 2006, 2019a; Douda et al. 2016; Mucina et al. 2016; Alexandrova et al. 2020; Petrova and Tzonev 2020; Vassilev et al. 2025). The classification scheme also includes 'communities' – syntaxa of undefined rank, equivalent to associations but not formally designated as such due to the regional character of the study. The nomenclature of plant species follows Delipavlov et al. (2011).

Results and Discussion

The analysis of the cluster dendrogram shows the differentiation of 15 groups of plant communities (Fig. 2).

The syntaxonomic analysis has result-

ed in recognizing the clusters as associations already mentioned for Bulgaria. Other clusters are included in rankless communities. The syntaxa are classified in the following scheme:

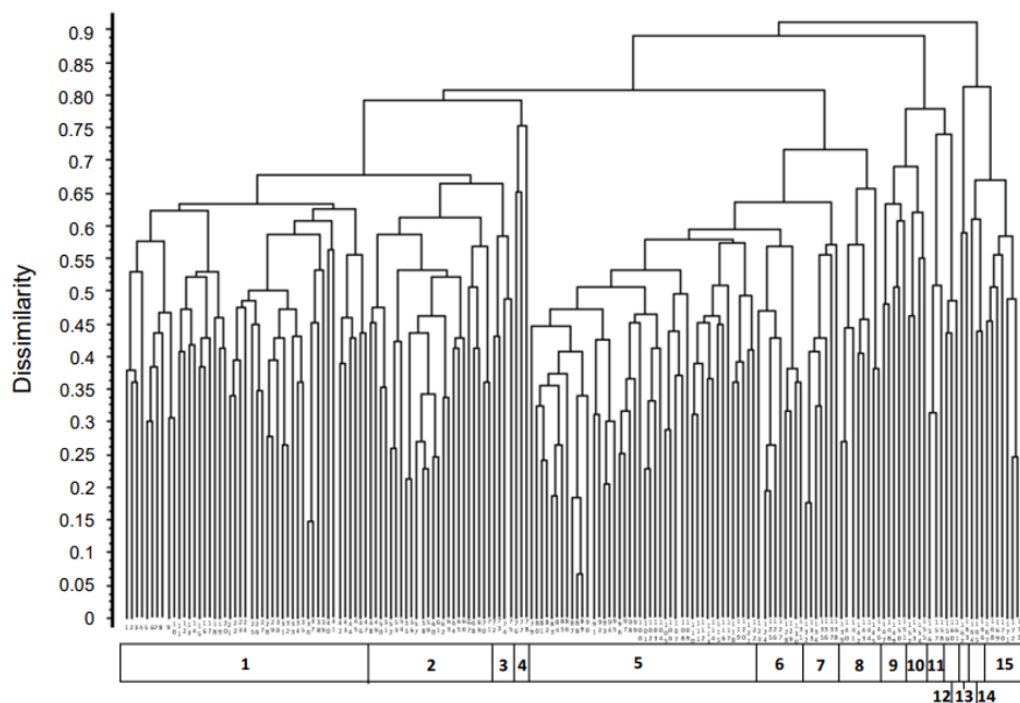


Fig. 2. Cluster dendrogram of the forest phytocoenoses of Plana Mountain.

Note: the numbers correspond to those in the syntaxonomic scheme.

Class *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. et al. 1939

Order *Pinetalia sylvestris* Oberd. 1957

Alliance *Dicrano-Pinion sylvestris* (Libbert 1933) W. Matuszkiewicz 1962

1 Community *Hieracium hoppeanum*-*Pinus sylvestris*

2 Community *Fagus sylvatica*-*Pinus sylvestris*

3 Community *Juniperus communis*-*Pinus sylvestris*

Class *Carpino-Fagetea sylvaticae* Jakucs ex Passarge 1968

Order *Fagetalia sylvaticae* Pawłowski 1928

Alliance *Fagion sylvaticae* Luquet 1926

4 Association *Fago sylvaticae*-*Betuletum pendulae* Theodoropoulos et al. 2003

5 Association *Aremonio agrimonoidis*-*Fagetum sylvaticae* Boşcaiu in Reşmeriță 1972 *violatosum reichenbachianae* Tzonev et al. 2006

6 Association *Festuco drymejae*-*Fagetum sylvaticae* Reşmeriță

- 1977
 8 Association *Galio pseudaristati-Fagetum sylvaticae* Tzonev et al. 2006
 Order *Luzulo-Fagetalia sylvaticae* Scamoni et Passarge 1959
 Alliance *Luzulo-Fagion sylvaticae* Lohmeyer et Tx. In Tx. 1954
 7 Association *Luzulo luzuloidis-Fagetum sylvaticae* Meusel 1937
 Order *Carpinetalia betuli* P. Fukarek 1968
 Alliance *Carpinion betuli* Issler 1931
 9 Community *Carpinus betulus-Quercus petraea*
 Class *Quercetea pubescentis* Doing-Kraft ex Scamoni et Passarge 1959
 Order *Quercetalia pubescenti-petraeae* Klika 1933
 Alliance *Quercion petraeo-cerridis* Lakušić et B. Jovanović ex Čarni et Mucina 2015
 11 Association *Genisto carinalis-Quercetum petraeae* Bergmeier in Bergmeier et Dimopoulos 2008
 Alliance *Quercion confertae* Horvat 1958
 12 Association *Quercetum frainetto-cerridis* (Rudski 1949) Trinajstić et al. 1996
 Order *Aceretalia pseudoplatani* Moor 1976
 Alliance *Ostryo carpinifoliae-Tilion platyphylli* (Košir et al. 2008) Čarni 2016
 10 Community *Acer hyrcanum-Quercus petraea*
 Class *Crataego-Prunetea* Tx. 1962
 Order *Prunetalia spinosae* Tx. 1952
 Alliance *Astrantio-Corylion avellanae* Passarge 1978
 13 Community *Symphytum tuberosum-Corylus avellanae*
 Class *Alno glutinosae-Populetea albae* P. Fukarek et Fabijanić 1968

Order *Alno-Fraxinetalia excelsioris* Passarge 1968

Alliance *Alnion incanae* Pawłowski et al. 1928

14 Association *Stellario nemorum-Alnetum glutinosae* Lohmeyer 1957

15 Association *Alnetum incanae* Lüdi 1921

Scots pine forests

1. Community *Hieracium hoppeanum-Pinus sylvestris*

This syntaxon includes the most widespread Scots pine forests in the area. They occur predominantly on terrains with southern and western exposure, with an average slope of 20 ° and an average elevation of 1110 m a.s.l. (Appendix A, Table A). Soils are mostly fresh, moderately rich Cambisols. The overall canopy cover of tall trees is about 45 %. *Pinus sylvestris* L. is the main edifier, with *Fagus sylvatica* L. and *Picea abies* being the co-edifiers in some stands. *Abies alba* Mill., also with *Pinus nigra* and *Betula pendula* Roth., occur sporadically. The cover of short trees is around 15 % and does not form a distinct layer. *P. sylvestris* and *F. sylvatica* are most common in it, while *P. abies*, *Prunus avium* L. and *Quercus cerris* appear occasionally.

The shrub layer (cover approx. 30 %) is dominated by *Corylus avellana*, *Juniperus communis* L., *Crataegus monogyna* Jacq., *Fagus sylvatica* and *Rubus idaeus* L. The herbaceous layer (about 40 % cover) lacks a clearly expressed dominant. However, depending on the microhabitat, some species, such as *Agrostis capillaris* L., *Brachypodium sylvaticum* (Huds.) P.Beauv., *Calamagrostis arundinacea* (L.) Roth., *Festuca gigantea* (L.) Vill., *Festuca heterophylla* Lam., *Luzula luzuloides*

(Lam.) Dandy & Wilmott, *Poa nemoralis* L., *Rubus idaeus*, *Veronica officinalis* L. and others, may prevail locally.

2. Community *Fagus sylvatica*-*Pinus sylvestris*

This community comprises forests with two well-differentiated tree layers. The upper layer has an overall canopy cover of about 35 %, dominated by Scots pine (Appendix A, Table A). The second tree layer has a cover of around or above 30 %, with the European beech as dominant. Exposures vary, but southern and western aspects prevail. The average slope is about 34 degrees, and soils are fresh, moderately rich and rocky. The mean elevation is approximately 1100 m a.s.l. Among the shrubs, *Corylus avellana* is most common, although without forming a distinct layer (10 % cover). The herbaceous cover is around 25 %. *Aremonia agrimonoides* (L.) DC., *Festuca heterophylla* and *Luzula luzuloides* are most frequent, along with the abundant regeneration of *Fagus sylvatica* and *Quercus petraea* (Matt.) Liebl. Dominant species in some stands are *Calamagrostis arundinacea*, *Festuca drymeja* Mert. & W.D.J.Koch, *Festuca heterophylla*, *Hepatica nobilis* L. and *Poa nemoralis*.

3. Community *Juniperus communis*-*Pinus sylvestris*

These Scots pine forests have the lightest tree canopy and are found at the lowest elevations (around 975 m a.s.l.) (Appendix A, Table A). The aspects are mainly southern and eastern and the inclination is around 21 °. Soils are dry to fresh with rocky outcrops. Sole dominant in the first layer is the Scots pine, with 30 % cover. The short tree layer is with a similar coverage, most abundant in it is *Quercus petraea*. An outlined dominant in the shrub layer is the Common juniper (20 % cover). The total herbaceous layer

cover is about 35 %. The list of constant species includes *Chamaeytiscus hirsutus* (L.) Link, *Festuca heterophylla*, *Fragaria vesca* L. and *Rosa canina* L.

Scots pine forests in Bulgaria are poorly studied from a syntaxonomic perspective. Many stands have secondary origin in some afforested areas, such as abandoned pastures and meadows, burned areas, clearcuts. They represent successional stages in the recovery of the potential climax vegetation. Scots pine forests, studied so far in Rila and the Rhodopes, have been assigned to the alliance *Dicrano-Pinion* and the association *Digitali viridiflorae-Pinetum sylvestris* (Dimitrov 2003). The communities identified in the present study are found at lower elevations and on comparatively gradual slopes. Their floristic composition is more typical to the broadleaved beech and oak forests. For these reasons, the syntaxa distinguished here are not assigned to particular associations on this level of knowledge and are treated as 'plant community'.

Birch forests

4. Association *Fago sylvaticae*-*Betuletum pendulae* Theodoropoulos et al. 2003

These are pioneer forests represented by communities dominated by Silver birch (*Betula pendula*). They were observed in the mountain on an average 1160 m a.s.l., on northwest exposure and 30 ° slopes (Appendix A, Table A). Soils are Cambisols, fresh to moist, moderately rich. The tree layer coverage varies between 35–65 % (avg. 45 %), the shrub layer (20 % coverage) is dominated by the European hornbeam and Common Juniper. The herbaceous layer has a dense coverage of 50 %, with species like *Euphorbia amygdaloides* L., *Cruciata*

glabra (L.) Ehrend., *Mycelis muralis* (L.) Dumortr. and *Aremonia agrimonoides* having the highest constancy. Species with high abundance in certain communities also include *Festuca drymeja*, *Galium odoratum* (L.) Scop., *Luzula sylvatica* (Huds.) Gaudin, *Festuca heterophylla*, *Viola reichenbachiana* Jord. ex Boreau and *Teucrium chamaedrys* L.

The birch forests in Plana Mt. are assigned to the association *Fago sylvaticae-Betuletum pendulae* (Theodoropoulos et al. 2003) based on similarities in floristic composition and ecological conditions. Theodoropoulos et al. (2003) described this association in the Western Rhodopes in northern Greece. The most widespread species there – *Betula pendula*, *Fagus sylvatica*, *Rosa canina*, *Corylus avellana*, *Picea abies*, *Pinus sylvestris*, *Juniperus communis* – are also recorded in the present study. The authors note that the association is part of successional processes leading to the restoration of beech forests, including a stage where *Pinus sylvestris* is a dominant. Birch forests in the Etropole Mountain have also been assigned to this association (Petrova and Tzonev 2020), where they occur between 810 and 1330 m a.s.l. on slopes of various exposures. Notable is the significant participation of *Fagus sylvatica*, which forms a second tree layer in some stands.

Silver birch forests are sporadically distributed throughout all Bulgarian mountains within the range of mesophytic coniferous or beech forests (Bondev 1991). As a result of natural or anthropogenic successions, the birch forms secondary, pure or mixed stands on sites where forests have been destroyed or heavily disturbed.

Mucina et al. (2016) propose that relict and secondary extrazonal birch and aspen

(*Populus tremula* L.) forests in Europe should be referred to the provisional order *Fragario vescae-Populetalia tremulae* of the class *Brachypodio pinnati-Betuletea pendulae*. The proposed alliance *Fragario vescae-Populion tremulae* Willner et Mucina ined. is not validly described; however, the authors state that only relict birch and aspen forests should be included in this alliance (Willner and Mucina 2016). In analysing phytosociological studies and vegetation classifications in Bulgaria, Apostolova (2023) also found no justification for including this alliance in her updated syntaxonomic scheme. Based on this and on the floristic composition observed in Plana Mountain, we adopt the view of Theodoropoulos et al. (2003) and Petrova and Tzonev (2020) that secondary birch forests, developing on former beech forest sites and representing successional stages of their recovery, should be assigned to the alliance *Fagion sylvaticae*. Similar interpretations are given by Nikolov and Dimitrov (2015, 2023), who assigned secondary birch forests near the upper forest line in Central Balkan to *Piceion excelsae* and by Manjukovski et al. (2020), who assign similar communities in North Macedonia to *Geranio striati-Fagion gentile*.

Beech forests

5. Association *Aremonio agrimonoidis-Fagetum sylvaticae* Boşcaiu in Reşmeriță 1972 *violetosum reichenbachianae* Tzonev et al. 2006

These are the most widespread forest phytocoenoses in Plana Mountain, recorded between 860–1265 m a.s.l., predominantly in the upper and middle parts of the slopes (Appendix A, Table A). Exposures are mainly northern and northeastern, with steep average slope of

41 °. The soils are fresh, moderately rich and at some places rich. The appearance is given by the European beech, which has a coverage of 75 % in the first and 10 % in the second tree layer. However, the species has almost no coverage in the shrub layer (10 %). The herbaceous layer cover is about 15 %, with predominance of mesophilous species: *Dentaria bulbifera* L. Crantz, *Symphytum tuberosum* L., *Mycelis muralis*, *Luzula sylvatica*, *Festuca drymeja*, *Melica uniflora* Retz., *Rubus hirtus* Waldst. & Kit. and *Dryopteris filix-mas* (L.) Schott. Diagnostic species of the subassociation *violetosum reichenbachianae* – *Aremonia agrimonoides*, *Viola reichenbachiana*, *Lamium galeobdolon* (L.) Ehrend. & Polatschek, *Helleborus odoratus* Willd. – were recorded (Tzonev et al. 2006).

8. Association *Galio pseudaristati-Fagetum sylvaticae* Tzonev et al. 2006

The most xerophytic beech forests in Plana Mt. are included in this association. Their development is between 700–1015 m a.s.l., on shady eastern and northeastern, as well as southern exposures (Appendix A, Table A). Slopes are steep (45 °). The tree layer has a canopy of 70 % cover and is consisted mainly of *Fagus sylvatica* and *Carpinus betulus*. Significant cover is also provided by *Acer pseudoplatanus* L., *Acer platanoides* L., *Tilia platyphyllos* Scop. and *Quercus petraea*. *Ulmus glabra* Huds., *Tilia tomentosa* Moench and *Prunus avium* occur sporadically. The shrub cover is ~10 %, represented by *Corylus avellana*, *Cornus mas* L. and beech and hornbeam saplings. Reaching values of 35 %, the herbaceous cover involves diagnostic species, such as *Helleborus odoratus* and xerophilous species typical for the oak forests: *Melica uniflora*, *Stellaria holostea* L., *Geranium robertianum* L., *Hepatica*

nobilis, *Lathyrus vernus* (L.) Bernh., *Lathyrus venetus* (Mill.) Wohlf. and *Alliaria petiolata* (M.Bieb.) Cavara & Grande.

6. Association *Festuco drymejae-Fagetum sylvaticae* Reşmeriță 1977

This association includes monodominant beech forests developed on fresh, moderately rich soils. The relevés were recorded between 990–1250 m a.s.l., mainly on northern and northwestern exposures with slopes averaging 37 ° (Appendix A, Table A). While the tree canopy is 75 %, short trees and shrubs are scarce (≤5 %). *Crataegus monogyna* occurs sporadically and there are small sapling groups of *Fagus sylvatica*. As a whole, the herbaceous cover is 20 % dominated by *Festuca drymeja*, with a frequent presence of *Mycelis muralis*, *Dentaria bulbifera*, *Dryopteris filix-mas* and *Luzula luzuloides*. The diagnostic species, considered for Bulgaria, such as *Festuca drymeja*, *Galium odoratum*, *Rubus hirtus*, *Prenanthes purpurea* L., are present.

7. Association *Luzulo luzuloidis-Fagetum sylvaticae* Meusel 1937

These are acidophilous beech forests in the studied area, which inhabit the altitudinal belt between 840–1160 m a.s.l. mainly in the upper and middle slope positions (Appendix A, Table A). Exposures are predominantly northern and western, slopes are with an average inclination of 47 °. Soils are poor to moderately rich. Tree layer cover is 70 %. *Fagus sylvatica* is the main dominant, but *Carpinus betulus*, *Acer campestre* L., *Quercus cerris* and *Pinus sylvestris* have sporadic occurrence. Shrubs are poorly developed (≈5 % cover), represented by groups of *Corylus avellana* and occasionally by regeneration from *Fagus sylvatica* and *Prunus avium*. The herbaceous layer coverage is ~20 %, and it is dominated by *Festuca drymeja*, *Galium*

odoratum, *Luzula forsteri* (Sm.) DC., and *Melica uniflora*, with *Poa nemoralis* abundant in some places. Diagnostic species like *Luzula luzuloides*, *Poa nemoralis* and *Mycelis muralis* are also present (Tzonev et al. 2006).

Beech forests are relatively well studied in Bulgaria (Tzonev et al. 2006). In the present study, the identified forest associations were assigned to alliance and order levels following contemporary concepts of vegetation classification (Mucina et al. 2016, Apostolova 2023). Acidophilous beech forests (*Luzulo-Fagetum*) were classified within the order *Luzulo-Fagetalia* and the alliance *Luzulo-Fagion*, whereas thermophilous associations (*Galio pseudaristati-Fagetum* and *Aremonio agrimonoidis-Fagetum violetosum reichenbachianae*) and mesophilous forests (*Festuco drymejae-Fagetum*) were assigned to the order *Fagetalia sylvaticae* and the alliance *Fagion sylvaticae*.

Hornbeam-durmast oak forests

9. Community *Carpinus betulus-Quercus petraea*

This group comprises mixed hornbeam-durmast oak forests. They develop predominantly on eastern slopes with an inclination of approximately 38 degrees, at around 950 m a.s.l. (Appendix A, Table A). In the first tree layer (65 % cover), *Quercus petraea* and *Carpinus betulus* are co-dominants with nearly equal participation. *Acer hyranum*, *A. campestre*, *Tilia cordata* Mill., *T. tomentosa* and *Quercus cerris* also occur in this layer. In the second tree layer (25 % cover), *Carpinus betulus*, *Sorbus torminalis* (L.) Crantz and locally *Tilia cordata* and *Acer platanoides* are most abundant, with sporadic presence of *Fagus sylvatica*. The shrub layer (15 % cover) mainly includes *Carpinus*

betulus, *Corylus avellana* and *Cornus mas*. The herbaceous layer covers about 35%, dominant species include *Melica uniflora*, *Stellaria holostea* and *Adoxa moschatellina* L. Species with high constancy include *Lamium galeobdolon* (L.) L., *Helleborus odoratus*, *Quercus petraea* and *Carpinus betulus*.

The presence of *Quercus cerris* and *Tilia tomentosa*, as well as relatively more xerophilous species, indicates the transitional character of these communities between more mesophilous hornbeam-durmast oak forests and more xerophilous oak forests. In this sense, the *Carpinus betulus-Quercus petraea* community is assigned to the alliance *Carpinion betuli*, but it is transitional towards *Quercion petraeo-cerridis*.

The hornbeam-durmast oak and mesophilous oak forests in the temperate zone of Europe belong to the order *Carpinetaalia betuli* P. Fukarek 1968 (Mucina et al. 2016).

Montane hornbeam-durmast oak forests in Bulgaria are insufficiently studied from a syntaxonomic viewpoint. Most of the authors assign them to the alliance *Carpinion betuli* Issler 1931 (Dimitrov and Glogov 2003; Pavlov and Dimitrov 2004; Apostolova-Stoyanova et al. 2005; Pavlov et al. 2006; Tzonev 2013; Vassilev and Gavrilova 2015; Velev et al. 2016; Tzonev et al. 2009, 2019b; Petrova and Tzonev 2020). Other authors (Alexandrova et al. 2020; Nikolov and Dimitrov 2023), following the interpretation of Mucina et al. (2016), classify them within the alliance *Erythronio-Carpinion betuli*. Based on this, Apostolova (2023) lists both alliances for Bulgaria. The regional character of the studies, the absence of good diagnostic species and the influence of forest syn-dynamics, are reasons why some authors prefer not to describe new associations,

instead of proposing provisional names. For example, Alexandrova et al. (2020) described *Lathyro aurei-Tilietum tomentosae* for Nature Park Bulgarka, while Nikolov and Dimitrov (2023) propose *Galio intermediae-Carpinetum betuli* for Central Balkan. Apostolova-Stoyanova et al. (2005) report *Carpinetum betuli* Dinić 1977 s.l. for the Ostritsa Strict Nature Reserve, which Tzonev et al. (2009) accept as a synonym of *Galio sylvatici-Carpinetum betuli* Oberd. 1957.

Oak forests

11. Association *Genisto carinalis-Quercetum petraeae* Bergmeier in Bergmeier & Dimopoulos 2008

This association comprises of xerophilous *Quercus petraea* forests. They develop at elevations averaging 985 m a.s.l., on steep slopes with an eastern exposition (approx. 33 °) (Appendix A, Table A). The first tree layer (60 % cover) is composed mainly of *Quercus petraea*, with an understorey of *Acer pseudoplatanus*, *A. platanoides*, *Quercus petraea*, and *Fraxinus ornus* L. Shrubs are nearly absent. The herbaceous layer has a coverage of 30 % and is represented by some common species like *Festuca heterophylla*, *Luzula sylvatica* and *Chamaecytisus hirsutus*. Several thermophilous species (*Clinopodium vulgare* L., *Lathyrus niger* (L.) Bernh., *Lychnis coronaria* (L.) Desr., *Physospermum cornubiense* (L.) DC., etc.) are also included, but less abundant compared to typical forests of this type in transitional continental-Mediterranean climates in Bulgaria. Diagnostic and constant species for the association, confirmed in the studied communities, include *Quercus petraea*, *Fraxinus ornus*, *Festuca heterophylla*, *Dactylis glomerata* L. and *Poa nemoralis*. The lack of good diagnostic species

is typical for these communities (Tzonev et al. 2019a).

Montane oak forests in the Central Balkans, including the most thermophilous *Quercus petraea* forests in Bulgaria, belong to the alliance *Quercion petraeo-cerridis*, such as the *Genisto carinalis-Quercetum petraeae* association (Gogushev 2009; Pachedzhieva 2012; Tzonev et al. 2019a; Alexandrova et al. 2020; Nikolov 2025).

12. Association *Quercetum frainetto-cerridis* (Rudski 1949) Trinajstić et al. 1996

Positioned on north and northeast-facing slopes with a medium tilt, the association *Quercetum frainetto-cerridis* takes up on an altitude ranging between 870–930 m a.s.l. (Appendix A, Table A). The canopy is mixed, dominated by *Quercus cerris* and *Q. petraea*, with an overall cover of 55 %. A second tree layer is poorly developed (5 % cover), with an occasional participation of *Carpinus betulus*. The shrub layer is well-developed (35 % cover) and is dominated by *Quercus petraea*; small patches include *Fagus sylvatica* and *Carpinus betulus*, as well as *Rosa canina*. These communities are characterised with a dense herb cover (40 %), dominated by *Agrostis capillaris*, *Festuca heterophylla* and young seedlings of *Q. cerris* and *Q. petraea*. Some confirmed diagnostic and constant species are *Quercus cerris*, *Quercus petraea*, *Festuca heterophylla*, *Dactylis glomerata* and *Crataegus monogyna* (Tzonev et al. 2019a). The relatively open canopy allows the establishment of meadow species, such as *Agrostis capillaris* and *Trifolium pratense* L. The floristic composition, particularly the co-dominance of *Quercus petraea*, makes these communities similar to the variant *Quercus petraea* of the association *Quercetum frainetto-cerridis* described by Alexandro-

va et al. (2020).

The association *Quercetum frainetto-cerridis* and the alliance *Quercion confertae* includes the most thermophilous oak forests of Plana Mt. This association is characterised by a lack of good diagnostic species and polymorphic floristic structure. It is widespread on the Balkan Peninsula, including Bulgaria (Tzonev et al. 2019a; Alexandrova et al. 2020).

The associations recorded in Plana Mt. were assigned to the alliances *Quercion confertae* (*Quercetum frainetto-cerridis*) and *Quercion petraeo-cerridis* (*Genisto carinalis-Quercetum petraeae*), according to Tzonev et al. (2019a).

Ravine forests

10. Community *Acer hyrcanum-Quercus petraea*

The ravine forests of Plana Mt. are found on a lower altitude (670–770 m) and steep slopes (avg. 55 °) with southern and southeastern exposures (Appendix A, Table A). The higher tree layer has a total coverage of 60 % and mixed floristic composition. In some parts, species, such as *Quercus petraea*, *Tilia tomentosa*, *Acer hyrcanum* Fisch. & C.A.Mey. and *Carpinus betulus*, could dominate with accidental participation of *Prunus avium*. The understorey of small trees is represented by *Fraxinus excelsior* L., *Fraxinus ornus* and *Sorbus torminalis*. Shrub cover is around 10 %, with *Crataegus monogyna*, *Cornus mas*, *Fraxinus ornus*, *Corylus avellana*, *Tilia tomentosa*, *Tilia platyphyllos* and *Acer hyrcanum*. The herbaceous layer coverage is about 25 %, and is dominated by *Poa nemoralis*. A high constancy is observed for chasmophytes, such as *Asplenium trichomanes* L., *Polypodium vulgare* L., *Saxifraga rotundifolia* L. and mosses of

class Bryopsida, which inhabit the rocky outcrops.

Ravine forests belong to the order *Aceretalia pseudoplatani*. Initially, in Central and Southwestern Europe, they were assigned to the alliance *Tilio-Acerion* (Košir et al., 2008). Subsequent analyses have distinguished geographically and floristically several alliances (Mucina et al. 2016). The xerothermophilous broad-leaved gorge forests of the Apennines and the Balkan Peninsula belong to the alliance *Ostryo carpinifoliae-Tilion platyphylli*, while mesophilous ones are assigned to *Fraxino excelsioris-Acerion pseudoplatani* (Čarni 2016). In Bulgaria, these specific and vulnerable forest communities are among the least studied in syntaxonomic terms. Some authors, without the support of phytosociological relevés, assign them directly to the alliance *Tilio-Acerion* (Velev et al. 2016; Grigorov et al. 2023), while others assign them to the same alliance and plant community (Pavlov et al. 2006). Apostolova (2023) notes *Fraxino excelsioris-Acerion pseudoplatani* for Bulgaria, which is also accepted by Nikolov and Dimitrov (2023), who assign to it the communities of *Fagus sylvatica* var. *Ostrya carpinifolia* and var. *Acer heldreichii* described for the Central Balkan, although no phytosociological descriptions were provided. The xerophilous ravine forests of Plana Mountain belong to the alliance *Ostryo carpinifoliae-Tilion platyphylli* due to high participation of *Quercus petraea* and xerophilous floristic composition, following Čarni (2016).

Hazel communities

13. Community *Symphytum tuberosum-Corylus avellana*

To monitor successional processes in forest communities, secondary shrub

communities of *Corylus avellana* were studied. Having a 30 ° tilt, they occupy north and northwest exposures in an average of 1150 m a.s.l. (Appendix A, Table A). The first layer, dominated by the Common hazel, has a coverage of 60 %, *Crataegus monogyna* and *Populus tremula* are also present. The herbaceous layer (20 % coverage) includes species with high fidelity, such as *Symphytum tuberosum*, *Populus tremula* and *Salvia glutinosa* L. *Aegopodium podagraria* L., an indicator of rich and moist soils, is the dominant species, with *Dentaria bulbifera* showing high constancy. The species composition and abiotic factors are evidential for the previous beech forests that once were in the place of these communities.

Hazel thickets on nutrient-rich soils in the pre-mountain and mountain zones of Western, Central, and Southeastern Europe belong to the alliance *Astrantio-Corylion avellanae* of class *Crataego-Prunetea* and order *Prunetalia spinosae* (Mucina et al. 2016). In Bulgaria, no syntaxa dominated by *Corylus avellana* have been described. Within the Balkan Peninsula, one association of hazel communities (*Omphalodo vernaе-Corylletum*) has been identified in Slovenia, differing by the participation of several Illyrian species (Čarni 1997).

Riparian forests

14. Association *Stellario nemorum-Alnetum glutinosae* Lohmeyer 1957

Riparian forests are distributed fragmentarily along the mountainous rivers at the altitudinal range of 900–1150 m a.s.l. (avg. 1030 m a.s.l.) (Appendix A, Table A). The slopes are almost flat (about 5 ° inclination) with varied exposures – northwest, southeast and west. They consist mainly of Black alder and have a tree cov-

erage of 85 %. In the shrub layer (cover 5–10 %), *Prunus padus* L., *Corylus avellana* and a subcanopy of Black alder occur. The herbaceous layer is well developed (55 % cover), dominated by hygrophilous species, such as *Aegopodium podagraria*, *Urtica dioica* L., *Chaerophyllum hirsutum* L., and *Oxalis acetosella* L. Typical nitrophilous and ruderal species of riparian communities are also present, including *Stachys sylvatica* L., *Impatiens noli-tangere* L., *Athyrium filix-femina* (L.) Roth, *Filipendula ulmaria* (L.) Maxim., *Ranunculus repens* L. and *Veronica beccabunga* L. Neighbouring forest communities also have an influence on these forests, and species, such as *Geum urbanum* L., *Oxalis acetosella* L., *Athyrium filix-femina*, *Geranium robertianum* and *Brachypodium pinnatum* (L.) P.Beauv., as well.

The association is established in other Balkan countries (Plišo Vusić et al. 2019, Mandžukovski and Teofilovski 2020, Bojinescu-Iglicea and Roştescu 2023, Mogîldea et al. 2024, Brujić 2025). In Bulgaria, in the Stara Planina Mountain, black alder-dominated forests have been assigned to syntaxa of uncertain rank, e.g. the *Alnus glutinosa-Brachypodium sylvaticum* community in the “Kamenshtitsa” Reserve (Pachedzhieva 2012), the *Alnus glutinosa* community in Etropoleška Stara Planina Mt. (Petrova and Tzonev 2020), and the *Alnus glutinosa-Aegopodium podagraria* community in Slivenska Stara Planina Mt. (Alexandrova et al. 2020). The studied Black alder forests in Plana were assigned to the *Stellario nemorum-Alnetum glutinosae* association based on comparative analysis and high ecological and floristic similarity with the data provided by Douda et al. (2016). Besides the Black alder, species typical of this association are also present: *Asarum europaeum* L. (diagnostic), *Myosotis palustris* L., *Chaero-*

phyllum hirsutum, *Prunus padus*, *Aegopodium podagraria*, *Stachys sylvatica*, *Impatiens noli-tangere*, *Athyrium filix-femina*, *Filipendula ulmaria*, *Ranunculus repens*, *Geranium robertianum* and *Poa trivialis* L.

15. Association *Alnetum incanae* Lüdi 1921

Alnus incana forests have a gallery structure and, unlike black alder forests, occur at relatively higher altitudes (900–1150 m, avg. 1085 m a.s.l.) and on steeper slopes (~10 °) in wet ravines and along mountain streams (Appendix A, Table A). Tree canopy density is 65 %, with *Alnus incana* as a dominant and *Salix alba* L. as a sub-dominant in some communities. The shrub layer (25 % cover) is better developed, dominated by *Prunus padus*, with *Corylus avellana*, *Crataegus monogyna*, *Rubus idaeus* and a subcanopy of *Alnus incana* and *Picea abies*. The herbaceous layer averages at a 60 % cover, represented mainly by *Urtica dioica*, with co-dominants in some communities, such as *Chaerophyllum hirsutum*, *Juncus rariarius* Songeon & E.P.Perrier, *Oxalis acetosella*, *Poa nemoralis*, *Prunus padus* and *Saxifraga rotundifolia*.

Alnetum incanae occurs along rivers in montane submontane zones (Douda et al. 2016). It has been reported in Central Europe (Douda 2008, Skowronek et al. 2011), Apennine Peninsula (Sburlino et al. 2012), and parts of the Balkans (Vukelić et al. 2017). Other similar associations are reported for the Balkan Peninsula: *Telekio speciosae-Alnetum incanae* Coldea 1986, (Coldea 1991, Mogîldea et al. 2024), *Equisetum hyemale-Alnetum incanae* M. Moor 1958 (Vukelić et al. 2017, Koljanin et al. 2023), *Lamio orvalae-Alnetum incanae* Dakskobler 2010 (Dakskobler 2013, Vukelić et al. 2017, Koljanin et al. 2023).

In *Alnus incana* communities in Plana, species reported for *Alnetum incanae* by

Douda et al. (2016) include *Chaerophyllum hirsutum*, *Prunus padus*, *Aegopodium podagraria*, *Stachys sylvatica*, *Filipendula ulmaria*, *Ranunculus repens*, *Viburnum opulus* L., etc. Environmental conditions are similar – more frequent flooding, wetter soils, and high groundwater.

The riparian forests and shrublands belong to the classes of azonal vegetation *Alno glutinosae-Populetea albae* and *Salicetea purpureae* (Douda et al. 2016, Mucina et al. 2016). Both classes are distributed in most European countries and cover the entire territory of the Balkan Peninsula (Preislerová et al. 2022). Based on an analysis of 222 relevés from Bulgaria, Vassilev et al. (2025) presented a classification of riparian forests and shrublands at the alliance level. According to this study, the forests dominated by *Alnus glutinosa* and *A. incana* are included in the class *Alno-glutinosae-Populetea albae*, order *Populetalia albae* and alliance *Alnion incanae*, which is also reported in other syntheses (Tzonev et al. 2009, Apostolova 2023).

Origin and Syndynamics

According to Penev (1938a) and Stefanov (1950), coniferous forests had a significant importance in the vegetation composition in Bulgaria. During the glacial period, the lower boundary of coniferous vegetation was much lower than the contemporary. The retreat of coniferous forests from lower to higher mountains occurred before the prehistoric era. The main drivers of vegetation change are the continentalisation of the climate and anthropogenic activities, such as mining and farming (Stefanov 1950). Around 500 years ago, the autochthonous vegetation of Plana Mt. was mixed, but mainly dominated by coniferous forests. Forests

of *Pinus sylvestris* and *Quercus petraea* were the most common, while mixed *Abies alba*, *Fagus sylvatica*, and *Picea abies* stands also occurred. Intense harvesting of coniferous trees led to the formation of beech forests, with further logging in those areas opening space for hornbeam-beech and oak forests. Fires on northern slopes facilitated the establishment of Scots pine stands and, in some locations, birch forests (Penev 1938a).

Plant communities, recorded in the present study, largely correspond to those reported by Penev (1938a) for Plana Mt. in the early 20th century. Some changes are found, resulting from the cessation of certain anthropogenic pressures, mainly grazing and clear-cutting. Without accurate data, it can be assumed that forestry activities, especially in recent decades, have contributed to the stabilisation of the phytocoenoses. At the same time, afforestation efforts in the past are the reason for establishment of Scots pine plantations in parts of the forested territories. Climate change has likely contributed to the decline or local disappearance of some species associated with coniferous forests, as reported by Penev (1938a). In the present study, only *Vaccinium myrtillus* L. among the ericaceous species was recorded, and again, but only in one locality. Neither *Moneses uniflora* (L.) A. Gray, nor *Melampyrum sylvaticum* L. – species, typical for spruce forests, were observed.

Human activity and climate change, both past and present, are the main factors influencing the conditions and successional dynamics of forest phytocoenoses in the study area. Based on the available historical information on the forest communities of Plana Mt. and their current state, ongoing and potential successional processes can be summarised.

Ascending (shady slopes): *Fagus syl-*

vatica-*Pinus sylvestris*→*Aremonio agrimonoidis-Fagetum sylvaticae*/Luzulo luzuloidis-Fagetum sylvaticae (on more acidic and poor soils); *Symphytum tuberosum-Corylus avellana*→*Aremonio agrimonoidis-Fagetum sylvaticae* (xerophytic series)/*Festuco drymejae-Fagetum sylvaticae* (mesophytic series); *Fago sylvaticae-Betuletum pendulae*→*Aremonio agrimonoidis-Fagetum sylvaticae* (xerophytic series)/*Festuco drymejae-Fagetum sylvaticae* (mesophytic series).

Ascending (sunny slopes): *Juniperus communis*-*Pinus sylvestris*→*Hieracium hoppeanum*-*Pinus sylvestris*.

Descending (sunny slopes, lower altitudes): *Fagus sylvatica*-*Pinus sylvestris*/ *Hieracium hoppeanum*-*Pinus sylvestris*→*Juniperus communis*-*Pinus sylvestris*→*Genisto carinalis-Quercetum petraeae*→*Quercetum frainetto-cerridis*; *Galio pseudaristati-Fagetum sylvaticae*→*Genisto carinalis-Quercetum petraeae*→*Quercetum frainetto-cerridis*; *Carpinus betulus-Quercus petraea*→*Genisto carinalis-Quercetum petraeae*.

Conclusions

The forest vegetation of Plana Mountain reflects a complex interplay of environmental gradients, historical land use and long-term successional processes. Soil moisture, nutrient availability, slope and light strongly influenced the distribution and composition of forest communities, from riparian alder forests in wet valleys to xerophilous oak and ravine forests on steep, nutrient-poor slopes. Historical data indicate that coniferous species, particularly Scots pine, once had a wider distribution, but anthropogenic activities, such as logging, grazing and mining, have significantly altered forest structure and species

composition. Current vegetation patterns demonstrate ongoing successional dynamics, with mesophytic beech forests gradually replacing pine and hazel-dominated communities in shaded areas, while thermophilous oak forests expand their distribution on sun-exposed slopes. Conservation and sustainable management are essential to maintain habitat integrity, support natural regeneration, and mitigate the impacts of climate change on these ecologically and floristically diverse forest ecosystems. The findings highlight Plana Mountain as an important area for monitoring of the forest succession and informing biodiversity conservation strategies in the Balkan region.

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Appendix A

Table A1. Synoptic table of forest phytocoenoses of Plana Mt. (The group numbers correspond to the syntaxa numbers in the syntaxonomic scheme).

Group No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
No of relevés	47	24	4	3	44	9	7	8	5	4	3	3	2	3	7
Predominant exposures	S, W	S, W, E	S, E, W	NW	N, E, NW	NW	N, W	E, N	E	S, SE	E	NE	N	N, W, SE	S, N
Average altitude, m	1110	1110	975	1160	1150	1120	1000	810	945	720	985	900	1150	1125	1085
Average slope, degrees	20	34	21	27	41	37	47	47	38	54	33	23	30	5	10
Avg. cover of tall trees, %	A1 45	35	30	45	75	75	70	70	65	60	60	55	0	85	65
Avg. cover of small trees, %	A2 15	30	35	15	15	1	0	6	25	11	15	5	0	0	0
Avg. shrub cover, %	B 30	10	20	20	10	5	5	7	15	10	1	35	65	5	25
Avg. herbaceous layer cover, %	C 40	25	35	50	15	20	20	31	35	25	30	40	20	55	60
<i>Pinus sylvestris</i> L.	A2 66.9 ⁵⁷	9.9 ¹²	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Euphorbia cyparissias</i> L.	C 43.6 ³⁸	---	26.4 ²⁵	---	---	---	---	---	---	---	---	---	---	---	---
<i>Hieracium hoppeanum</i> Schultes	C 41.9 ²⁶	10.9 ⁸	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Lonicera xylosteum</i> L.	C 38.4 ³²	---	28.9 ²⁵	---	2	---	---	---	---	---	---	---	---	---	---
<i>Lonicera xylosteum</i>	B 38.4 ³²	---	28.9 ²⁵	---	2	---	---	---	---	---	---	---	---	---	---
<i>Fragaria vesca</i> L.	C 37.8 ⁶⁵	3 ²⁰	15.9 ⁵⁰	---	20	11	---	---	20	15.9 ⁵⁰	---	5.6 ³³	---	26.3 ⁶⁷	---
<i>Sanguisorba minor</i> Scop.	C 34.7 ¹³	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Veronica officinalis</i> L.	C 32.3 ³²	28.9 ²⁰	---	---	2	---	11.0 ¹⁴	---	---	---	---	---	---	---	---
<i>Briza media</i> L.	C 31.6 ¹¹	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Picea abies</i> (L.) H. Karst.	A2 12.6 ⁹	36.4 ²¹	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Juniperus communis</i> L.	C 16.3 ²⁸	2.6 ¹²	81.8 ¹⁰⁰	---	5	---	---	---	---	---	---	---	---	---	---
<i>Quercus petraea</i> (Matt.) Liebl.	A2 ---	---	50.5 ⁷⁵	16.8 ³³	---	---	---	---	---	---	16.8 ³³	16.8 ³³	---	---	---
<i>Abies alba</i> Mill.	B ---	---	48.7 ²⁵	---	---	---	---	---	---	---	---	---	---	---	---
<i>Pinus sylvestris</i>	C 1.6 ⁹	5.8 ¹²	45.2 ⁵⁰	---	---	---	---	---	---	---	27.7 ³³	---	---	---	---
<i>Chamaespartium sagittale</i> L.	C 3.3 ⁴	3.1 ⁴	39.7 ²⁵	---	2	---	---	---	---	---	---	---	---	---	---
<i>Betula pendula</i> Roth.	A1 ---	---	---	84.8 ¹⁰⁰	8.5 ¹⁸	1.9 ¹¹	---	---	---	---	---	---	---	---	---
<i>Betula pendula</i>	C ---	---	---	77.9 ⁶⁷	2	---	---	---	---	---	---	---	---	---	---
<i>Carex vulpina</i> L.	C ---	---	---	56.4 ³³	---	---	---	---	---	---	---	---	---	---	---
<i>Quercus robur</i> L.	A2 ---	---	---	56.4 ³³	---	---	---	---	---	---	---	---	---	---	---
<i>Campanula persicifolia</i> L.	C ---	---	---	56.4 ³³	---	---	---	---	---	---	---	---	---	---	---
<i>Achillea millefolium</i> aggr. L.	C 6.2 ⁶	---	---	51.1 ³³	---	---	---	---	---	---	---	---	---	---	---
<i>Betula pendula</i>	A2 2.7 ⁴	---	---	51.0 ³³	2	---	---	---	---	---	---	---	---	---	---
<i>Euphorbia amygdaloides</i> L.	C 9	8	---	42.5 ⁶⁷	14	11	---	12	---	9.5 ²⁵	---	---	29.3 ⁵⁰	---	---

Group No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Pinus sylvestris</i>	B	18.1 ¹⁷	6.1 ⁸	40.6 ³³	---	---	---	---	---	---	---	---	---	---	---
<i>Pinus pyraeaster</i> Burgsd.	B	---	4	27.8 ²⁵	39.0 ³³	---	---	---	---	---	---	---	---	---	---
<i>Veronica chamaedrys</i> L.	C	---	4	---	38.1 ³³	2	---	---	---	27.2 ²⁵	---	---	---	---	---
<i>Picea abies</i>	A1	11.1 ¹³	16.2 ¹⁷	---	38.1 ³³	2	---	---	---	---	---	---	---	---	---
<i>Campanula rapunculus</i> L.	C	---	---	37.8 ³³	---	---	---	10.6 ¹²	20.4 ²⁰	---	---	---	---	---	---
<i>Geranium sanguineum</i> L.	C	10.1 ¹³	---	25.5 ²⁵	36.0 ³³	---	---	---	---	---	---	---	---	---	---
<i>Teucrium chamaedrys</i> L.	C	12.1 ¹⁵	---	24.4 ²⁵	34.6 ³³	2	---	---	---	---	---	---	---	---	---
<i>Corylus avellana</i> L.	C	19.0 ⁴⁷	18.3 ⁴⁶	---	32.5 ⁶⁷	---	---	---	---	---	9.8 ³³	---	21.1 ⁵⁰	---	6.5 ²⁹
<i>Mycelis muralis</i> (L.) Dumort.	C	13.6 ⁴⁷	7.8 ³⁸	25.9 ⁶⁷	4.3 ³²	39.6 ⁸⁹	2.3 ²⁹	---	25	---	---	---	---	5.2 ³³	14
<i>Festuca drymeja</i> Mert. & W.D.J Koch	C	---	---	17.7 ³³	9	36.1 ⁵⁶	25.6 ⁴³	10.8 ²⁵	---	---	---	---	---	---	---
<i>Prenanthes purpurea</i> L.	C	1.3 ⁶	3.6 ⁸	---	---	33.5 ³³	10.7 ¹⁴	8.6 ¹²	---	---	---	---	---	---	---
<i>Clematis vitalba</i> L.	C	---	---	---	---	32.3 ¹¹	---	---	---	---	---	---	---	---	---
<i>Mercurialis perennis</i> (L.) Clairv.	C	---	---	---	---	---	78.0 ⁶²	---	---	---	---	---	---	---	---
<i>Lamiumstrum galeobdolon</i> (L.) L.	C	4	21	---	16.6 ⁴⁵	1.2 ²²	---	52.8 ¹⁰⁰	26.2 ⁶⁰	3	25	---	---	---	14
<i>Lunaria rediviva</i> L.	C	---	---	---	---	---	---	48.7 ²⁵	---	---	---	---	---	---	---
<i>Tilia platyphyllos</i>	A1	---	---	---	---	---	---	48.7 ²⁵	---	---	---	---	---	---	---
<i>Acer pseudoplatanus</i>	A1	---	---	---	---	---	---	34.3 ¹²	---	---	---	---	---	---	---
<i>Ulmus glabra</i> Huds.	A1	---	---	---	---	---	---	34.3 ¹²	---	---	---	---	---	---	---
<i>Fraxinus excelsior</i> L.	B	---	---	---	---	---	---	34.3 ¹²	---	---	---	---	---	---	---
<i>Hepatica nobilis</i> L.	A1	---	---	---	---	---	---	34.3 ¹²	---	---	---	---	---	---	---
<i>Hepatica nobilis</i> L.	C	---	14.3 ²¹	---	6.8 ¹⁴	---	7.5 ¹⁴	31.7 ³⁸	13.5 ²⁰	---	---	---	---	---	---
<i>Tilia cordata</i> Mill.	B	2	---	---	---	---	---	---	60.2 ⁴⁰	---	---	---	---	---	---
<i>Stellaria holostea</i> L.	C	---	8	---	---	---	---	1.1 ¹²	58.4 ⁸⁰	---	18.8 ³³	---	---	---	---
<i>Tilia cordata</i>	C	---	---	---	---	---	---	13.1 ¹²	53.1 ⁴⁰	---	---	---	---	---	---
<i>Anthriscus sylvestris</i> (L.) Hoffm.	C	---	---	---	---	---	---	---	43.5 ²⁰	---	---	---	---	---	---
<i>Tilia cordata</i>	A1	---	---	---	---	---	---	---	43.5 ²⁰	---	---	---	---	---	---
<i>Polygonatum latifolium</i> (Jacq.) Desf.	C	---	---	---	---	---	---	---	43.5 ²⁰	---	---	---	---	---	---
<i>Tilia cordata</i>	A2	---	---	---	---	---	---	---	43.5 ²⁰	---	---	---	---	---	---
<i>Acer campestre</i> L.	A1	---	---	---	---	---	---	---	43.5 ²⁰	---	---	---	---	---	---
<i>Acer platanoides</i>	C	---	---	---	2	---	24.2 ²⁹	20.3 ²⁵	36.7 ⁴⁰	---	---	---	---	---	---
<i>Cystopteris fragilis</i> (L.) Bernh.	C	---	---	---	3.6 ⁵	---	17.3 ¹²	30.2 ²⁰	---	---	---	---	---	---	---
<i>Asplenium trichomanes</i> L.	C	---	---	---	---	---	---	---	100 ¹⁰⁰	---	---	---	---	---	---
<i>Polypodium vulgare</i> L.	C	2	11.1 ²¹	---	---	2 ¹¹	---	---	85.3 ¹⁰⁰	---	---	---	---	---	---
<i>Campanula rapunculoides</i> L.	C	---	---	---	---	---	---	7.6 ¹²	78.9 ⁷⁵	---	---	---	---	---	---
<i>Euonymus verrucosus</i> Scop.	C	---	4	---	---	---	---	19.0 ²⁵	71.6 ⁷⁵	---	---	---	---	---	---
<i>Acer hyrcanum</i> Fisch. & C.A.Mey.	B	---	---	---	---	---	---	---	69.5 ⁵⁰	---	---	---	---	---	---
<i>Fraxinus ornus</i> L.	B	---	---	---	---	---	---	---	69.5 ⁵⁰	---	---	---	---	---	---

Group No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Acer hyrcanum</i>	C	---	---	---	---	---	---	---	---	69.5 ⁵⁰	---	---	---	---	---
<i>Sorbus torminalis</i> (L.) Crantz	C	---	4	---	---	---	---	---	---	68.5 ⁷⁵	---	26.2 ³³	---	---	---
<i>Cornus mas</i> L.	C	---	---	---	---	---	---	---	---	66.4 ⁵⁰	---	---	---	---	---
<i>Hedera helix</i> L.	C	---	---	---	---	---	5 ¹⁴	15.0 ²⁵	10.3 ²⁰	61.8 ⁷⁵	---	---	---	---	---
<i>Acer hyrcanum</i>	A1	---	---	---	---	---	---	11.1 ¹²	---	61.3 ⁵⁰	---	---	---	---	---
<i>Sorbus torminalis</i> (L.) Crantz	A2	---	---	---	---	---	---	---	19.4 ²⁰	57.4 ⁵⁰	---	---	---	---	---
<i>Tilia tomentosa</i>	B	---	---	---	---	---	---	---	19.4 ²⁰	57.4 ⁵⁰	---	---	---	---	---
<i>Galium album</i> Mill.	C	---	---	---	---	---	---	9 ¹²	---	54.4 ⁵⁰	---	---	---	---	11.1 ¹⁴
<i>Festuca gigantea</i> (L.) Vill.	C	3.5 ⁹	---	---	---	---	---	---	16.9 ²⁰	52.0 ⁵⁰	---	---	---	---	---
<i>Fraxinus ornus</i>	C	---	---	---	---	---	---	---	---	48.7 ²⁵	---	---	---	---	---
<i>Pulmonaria rubra</i> Schott	C	---	---	---	---	---	---	---	---	48.7 ²⁵	---	---	---	---	---
<i>Tilia tomentosa</i>	C	---	---	---	---	---	---	---	---	48.7 ²⁵	---	---	---	---	---
<i>Viola hirta</i> L.	C	---	---	---	---	---	---	---	---	48.7 ²⁵	---	---	---	---	---
<i>Primula veris</i> L.	C	---	---	---	---	---	---	---	---	48.7 ²⁵	---	---	---	---	---
<i>Fraxinus excelsior</i>	A2	---	---	---	---	---	---	---	---	48.7 ²⁵	---	---	---	---	---
<i>Tilia platyphyllos</i> Scop.	B	---	---	---	---	---	---	---	---	48.7 ²⁵	---	---	---	---	---
<i>Lilium martagon</i> L.	C	---	---	---	---	---	---	---	---	48.7 ²⁵	---	---	---	---	---
<i>Tilia platyphyllos</i>	C	---	---	---	---	---	---	16.4 ¹²	---	37.2 ²⁵	---	---	---	---	---
<i>Prunus avium</i> L.	A1	---	---	---	---	---	---	16.4 ¹²	---	37.2 ²⁵	---	---	---	---	---
<i>Polystichum setiferum</i> (Forsk.) Wyonar	C	---	2.3 ⁴	---	---	---	---	15.8 ¹²	---	36.1 ²⁵	---	---	---	---	---
<i>Fraxinus excelsior</i>	B	---	---	---	---	---	---	---	26.6 ²⁰	34.5 ²⁵	---	---	---	---	---
<i>Lathyrus niger</i> (L.) Bernh.	C	---	---	8.4 ²⁵	---	---	---	---	---	27.7 ⁵⁰	66.1 ¹⁰⁰	14.8 ³³	---	---	---
<i>Lychnis coronaria</i> (L.) Desr.	C	---	---	---	---	---	---	---	---	56.4 ³³	---	---	---	---	---
<i>Physospermum cornubiense</i> (L.) DC.	C	---	5 ¹⁷	12.1 ²⁵	---	---	---	---	---	12.1 ²⁵	47.9 ⁶⁷	---	---	---	2.9 ¹⁴
<i>Luzula sylvatica</i> (Huds.) Gaudin	C	11.1 ²⁵	---	---	18.1 ³³	1.7 ¹⁴	2.2 ¹⁴	---	---	---	45.8 ⁶⁷	---	---	---	---
<i>Fraxinus ornus</i>	A2	---	---	---	---	---	---	---	---	29.2 ²⁵	40.7 ³³	---	---	---	---
<i>Clinopodium vulgare</i> L.	C	15.1 ³⁴	5 ²¹	---	---	---	---	---	---	8.2 ²⁵	40.0 ⁶⁷	---	14.5 ³³	---	14
<i>Poa nemoralis</i> L.	C	2 ³⁶	---	---	---	---	---	---	---	---	38.3 ¹⁰⁰	---	9.8 ⁵⁰	---	13.9 ⁵⁷
<i>Picea abies</i>	B	---	4	13.6 ¹⁷	---	---	---	10.7 ¹⁴	---	---	33.5 ³³	---	---	---	---
<i>Potentilla micrantha</i> DC.	C	---	---	---	---	---	---	---	---	---	33.5 ³³	---	---	---	---
<i>Dactylis glomerata</i> L.	C	2	---	---	---	---	---	---	---	---	19.4 ³³	---	---	---	---
<i>Quercus cerris</i> L.	C	12.1 ²⁶	---	---	---	---	---	---	7.9 ²⁰	---	---	76.9 ¹⁰⁰	---	---	---
<i>Agrostis capillaris</i> L.	C	20.2 ³⁶	---	---	---	---	2.6 ¹⁴	---	7.4 ²⁰	---	---	75.1 ¹⁰⁰	---	---	---
<i>Quercus cerris</i>	A1	---	---	---	---	---	---	---	6.8 ²⁰	---	---	73.0 ¹⁰⁰	---	---	---
<i>Pyrus pyraeaster</i> Bugsd.	C	---	---	---	---	---	8.1 ¹⁴	---	14.2 ²⁰	---	---	63.9 ⁶⁷	---	---	---
<i>Festuca valesiaca</i> Gaudin	C	---	---	---	27.3 ³³	---	---	---	---	---	---	61.9 ⁶⁷	---	---	---
<i>Quercus petraea</i>	B	9.5 ¹⁹	---	4	14.9 ²⁵	---	---	---	10.3 ²⁰	---	---	56.4 ³³	---	---	---
												53.9 ⁶⁷	---	---	---

Group No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Quercus ceris</i>	A2	6.2 ⁶	-	-	-	-	-	-	-	-	-	51.1 ³³	-	-	-
<i>Quercus ceris</i>	B	17.7 ¹⁵	-	-	-	-	-	-	-	-	-	45.6 ³³	-	-	-
<i>Cruciata glabra</i> (L.) Ehrend.	C	-	21	22.7 ⁶⁷	20	9.6 ⁴⁴	14	-	20	-	3 ³³	42.5 ¹⁰⁰	12.9 ⁵⁰	-	-
<i>Sorbus torminalis</i>	B	-	-	-	-	-	-	-	-	29.2 ²⁵	-	40.7 ³³	-	-	-
<i>Crataegus monogyna</i> Jacq.	C	2	4	-	2	-	-	-	21.3 ²⁰	-	-	39.2 ³³	-	-	-
<i>Crataegus monogyna</i>	B	-	-	6.7 ²⁵	-	-	-	-	3.1 ²⁰	25.1 ⁵⁰	-	37.3 ⁶⁷	25.1 ⁵⁰	-	14
<i>Carpinus betulus</i> L.	B	17	-	-	-	-	5.4 ²⁹	3.1 ²⁵	26.3 ⁶⁰	3.1 ²⁵	-	30.7 ⁶⁷	19.7 ⁵⁰	-	-
<i>Symphytum tuberosum</i> L.	C	2	-	-	7.6 ²³	7.2 ²²	-	-	-	29.2 ⁵⁰	-	-	68.7 ¹⁰⁰	-	-
<i>Populus tremula</i> L.	B	-	-	-	2	-	-	-	-	-	-	-	67.8 ⁵⁰	-	-
<i>Salvia glutinosa</i> L.	C	-	-	-	1.3 ⁵	-	-	-	-	-	-	-	66.2 ⁵⁰	-	-
<i>Populus tremula</i>	C	-	5.8 ⁸	-	-	-	-	-	-	-	-	-	62.4 ⁵⁰	-	-
<i>Ribes alpinum</i> L.	C	6.9 ¹³	2 ⁸	-	5.3 ¹¹	-	-	-	-	-	-	-	47.4 ⁵⁰	-	8.5 ¹⁴
<i>Sanicula europaea</i> L.	C	-	-	-	4.4 ¹¹	-	7.4 ¹⁴	18.5 ²⁵	-	-	-	-	44.5 ⁵⁰	-	-
<i>Asarum europaeum</i> L.	C	-	-	-	-	-	4.9 ¹⁴	26.6 ³⁸	-	-	-	-	38.3 ⁵⁰	22.7 ³³	-
<i>Adoxa moschatellina</i> L.	C	-	-	-	-	1.5 ¹¹	-	-	28.0 ⁴⁰	-	-	21.9 ³³	37.1 ⁵⁰	-	-
<i>Alliaria petiolata</i> (M.Bieb.) Cavara & Grande	C	-	-	-	-	-	-	14.2 ²⁵	27.8 ⁴⁰	14.2 ²⁵	-	-	37.0 ⁵⁰	-	-
<i>Galium aparine</i> L.	C	11	-	-	-	11.4 ²²	-	-	-	-	-	-	36.5 ⁵⁰	21.4 ³³	17.1 ²⁹
<i>Corylus avellana</i>	B	21.5 ⁷⁷	4.5 ⁴⁶	6.8 ⁵⁰	16.0 ⁶⁷	-	-	25	1.3 ⁴⁰	6.8 ⁵⁰	-	-	34.4 ¹⁰⁰	-	2.9 ⁴³
<i>Alnus glutinosa</i>	A1	-	-	-	-	-	-	-	-	-	-	-	100 ¹⁰⁰	79.8 ¹⁰⁰	29.1 ⁴³
<i>Oxalis acetosella</i> L.	C	4	4	-	-	-	-	-	-	-	-	-	73.2 ⁶⁷	-	-
<i>Holcus mollis</i> L.	C	8.9 ¹³	-	-	-	-	-	12	-	-	-	-	29.1 ⁵⁰	68.6 ¹⁰⁰	12.2 ²⁹
<i>Galeopsis speciosa</i> Mill.	C	4	-	-	2	-	-	-	-	-	-	-	64.5 ⁶⁷	23.6 ²⁹	-
<i>Lysimachia nummularia</i> L.	C	-	4	-	-	-	-	-	-	-	-	-	63.9 ¹⁰⁰	10.3 ²⁹	-
<i>Rubus idaeus</i> L.	C	28.8 ⁵³	1.3 ¹⁷	-	14	11	-	-	-	-	-	-	58.2 ⁶⁷	6.3 ¹⁴	-
<i>Brachypodium pinnatum</i> (L.) P.Beauv.	C	4	-	-	25.2 ³³	-	-	-	-	-	-	-	56.4 ³³	-	-
<i>Scrophularia scopoli</i> Hoppe	C	-	-	-	-	-	-	-	-	-	-	-	56.4 ³³	-	-
<i>Berula erecta</i> (Huds.) Coville	C	-	-	-	-	-	-	-	-	-	-	-	56.4 ³³	-	-
<i>Geum rivale</i> L.	C	-	-	-	-	-	-	-	-	-	-	-	56.4 ³³	-	-
<i>Poa sylvicola</i> Guss.	C	-	-	-	-	-	-	-	-	-	-	-	56.4 ³³	-	-
<i>Alnus glutinosa</i>	B	-	-	-	-	-	-	-	-	-	-	-	56.4 ³³	-	-
<i>Alnus glutinosa</i>	C	-	-	-	-	-	-	-	-	-	-	-	56.4 ³³	-	-
<i>Veronica beccabunga</i> L.	C	-	-	-	-	-	-	-	-	-	-	-	56.4 ³³	-	-
<i>Euonymus latifolius</i> (L.) Mill.	C	-	-	-	-	-	-	-	-	-	-	-	56.4 ³³	-	-
<i>Myosotis scorpioides</i> L.	C	-	-	-	-	-	-	-	-	-	-	-	54.4 ³³	-	-
<i>Carex sylvatica</i> Huds.	C	-	-	-	2	-	-	-	-	-	-	-	54.4 ³³	-	-
<i>Senecio nemorensis</i> L.	C	-	-	-	2	-	-	-	-	-	-	-	54.4 ³³	-	-
<i>Geranium robertianum</i> L.	C	19	12	-	9.1 ³³	1.6 ²²	3.5 ²⁵	-	-	-	-	-	20.3 ⁵⁰	53.8 ¹⁰⁰	14

Group No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Sorbus aucuparia</i> L.	C 5.1 ⁶	-	-	-	5.7 ⁷	-	-	-	-	-	-	-	-	46.6 ³³	-
<i>Viburnum opulus</i> L.	C -	-	-	-	-	-	-	-	-	-	-	-	-	46 ³³	16.9 ¹⁴
<i>Caltha palustris</i> L.	C -	-	-	-	-	-	-	-	-	-	-	-	-	46 ³³	16.9 ¹⁴
<i>Filipendula ulmaria</i> (L.) Maxim.	C -	-	-	-	-	-	-	-	-	-	-	-	-	46 ³³	16.9 ¹⁴
<i>Cardamine impatiens</i> L.	C -	-	-	-	-	-	-	-	-	-	-	-	-	46 ³³	16.9 ¹⁴
<i>Paris quadrifolia</i> L.	C 1 ⁴	-	-	-	1.4 ⁵	10.9 ¹¹	-	-	-	-	-	-	-	43 ³³	-
<i>Impatiens noli-tangere</i> L.	C -	-	-	-	-	7.8 ¹¹	-	-	-	-	-	-	-	35.4 ³³	29.4 ²⁹
<i>Alnus incana</i>	A1 -	-	-	-	-	-	-	-	-	-	-	-	-	-	100 ¹⁰⁰
<i>Ajuga reptans</i> L.	C 2.7 ⁹	-	4	-	7	-	-	-	-	-	-	-	-	27.6 ³³	67.6 ⁷¹
<i>Juncus ranarius</i> Songeon & E.P.Perrier	C -	-	-	-	-	-	-	-	-	-	-	-	-	-	-
<i>Prunus padus</i> L.	C -	-	-	-	-	-	-	-	-	-	-	-	-	-	52.1 ²⁹
<i>Festuca altissima</i> All.	C -	-	-	-	-	-	-	-	-	-	-	-	-	-	52.1 ²⁹
<i>Saxifraga rotundifolia</i> L.	C -	-	-	-	-	-	-	-	-	26.3 ²⁶	-	-	-	-	49.3 ⁴³
<i>Rubus idaeus</i>	B 24.1 ²³	-	-	-	2	-	-	-	-	-	-	-	-	-	49.0 ⁴³
<i>Pulmonaria officinalis</i> L.	C 4	-	4	-	3.1 ¹⁴	-	3.7 ¹⁴	13.2 ²⁵	-	-	-	-	-	20.6 ³³	41.7 ⁵⁷
<i>Mespilus germanica</i> L.	B -	-	-	-	-	-	-	-	-	-	-	-	-	-	36.7 ¹⁴
<i>Salix alba</i> L.	C -	-	-	-	-	-	-	-	-	-	-	-	-	-	36.7 ¹⁴
<i>Salix alba</i>	A1 -	-	-	-	-	-	-	-	-	-	-	-	-	-	36.7 ¹⁴
<i>Alnus incana</i>	B -	-	-	-	-	-	-	-	-	-	-	-	-	-	36.7 ¹⁴
<i>Prunella vulgaris</i> L.	C 2.7 ²	-	-	-	-	-	-	-	-	-	-	-	-	-	33.9 ¹⁴
<i>Lapsana communis</i> L.	C 2.7 ²	-	-	-	-	-	-	-	-	-	-	-	-	-	33.9 ¹⁴
<i>Cirsium arvense</i> (L.) Scop.	C 7.3 ⁴	-	-	-	-	-	-	-	-	-	-	-	-	-	31.6 ¹⁴
<i>Rosa canina</i> L.	C 33.6 ⁶⁴	8.8 ²⁹	41.5 ⁷⁵	-	7	11	-	-	-	-	-	11.8 ³³	-	11.8 ³³	-
<i>Fagus sylvatica</i> L.	A2 10.6 ³⁸	50.4 ¹⁰⁰	18.1 ⁵⁰	-	35.7 ⁷⁷	11	-	12	11.7 ⁴⁰	-	-	-	-	-	-
<i>Luzula luzuloides</i> (Lam.) Dandy & Wilmott	C 1.9 ¹³	30.7 ⁴⁶	-	-	5	48.8 ⁶⁷	15.7 ²⁹	-	-	-	-	-	-	-	-
<i>Camaecytisus hirsutus</i> (L.) Link	C 1.3 ¹²	9.3 ²⁵	54.7 ⁷⁵	-	-	-	-	-	-	-	47.6 ⁶⁷	-	-	-	-
<i>Trifolium alpestre</i> L.	C 13.0 ³⁰	9.3 ²⁵	48.7 ⁷⁵	-	2	-	-	-	-	-	42.1 ⁶⁷	-	-	-	-
<i>Trifolium pratense</i> L.	C 2	-	-	36.7 ³³	-	-	-	-	-	-	-	36.7 ³³	-	-	-
<i>Acer pseudoplatanus</i>	A2 -	-	-	31.6 ³³	-	-	-	-	16.3 ²⁰	-	31.6 ³³	-	-	-	-
<i>Acer campestre</i>	C -	-	-	31.2 ³³	2	-	-	7.5 ¹²	38.8 ⁴⁰	-	-	-	-	-	-
<i>Dryopteris filix-mas</i> (L.) Schott	C 4	12	-	-	1.2 ²⁰	32.9 ⁶⁷	-	38.6 ⁷⁵	-	4.3 ²⁵	-	-	-	10.1 ³³	16.6 ⁴³
<i>Dentaria bulbifera</i> L.	C 11	4	-	-	25.6 ⁵⁹	30.6 ⁶⁷	5.4 ²⁹	11.3 ³⁶	-	-	-	-	52.7 ¹⁰⁰	-	-
<i>Carpinus betulus</i>	A1 -	-	-	7.8 ³³	7	-	23.4 ⁵⁷	43.2 ⁸⁸	25.2 ⁶⁰	35.0 ⁷⁵	-	-	-	-	-
<i>Helleborus odoratus</i> Willd.	C -	4	-	-	2	-	5.3 ¹⁴	39.1 ⁵⁰	48.6 ⁹⁰	-	-	-	-	-	-
<i>Carpinus betulus</i>	A2 -	17	-	-	5	-	33.2 ⁶²	45.8 ⁸⁰	24.2 ⁵⁰	-	-	12.2 ³³	-	-	-
<i>Melica uniflora</i> Retz.	C 13	-	25	5.1 ³³	25	11	10.9 ⁴³	7.6 ³⁸	46.1 ¹⁰⁰	30.7 ⁷⁵	-	-	-	-	14
<i>Acer platanoides</i>	A2 -	-	-	-	-	-	-	43.5 ⁴⁰	-	-	35.3 ³³	-	-	-	-

Group No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Ribes alpinum</i>	B 20.0 ⁴	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Sorbus aucuparia</i>	B 20.0 ⁴	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Coronilla varia</i> L.	C 20.0 ⁴	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Ligustrum vulgare</i> L.	B 20.0 ⁴	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Pyrola minor</i> L.	C 9.1 ²	---	---	---	9.8 ²	---	---	---	---	---	---	---	---	---	---
<i>Epipactis helleborine</i> (L.) Crantz	C ---	---	---	---	20.6 ⁵	---	---	---	---	---	---	---	---	---	---
<i>Neottia nictus-avis</i> (L.) Rich.	C ---	---	---	---	20.6 ⁵	---	---	---	---	---	---	---	---	---	---
<i>Eryngium campestre</i> L.	C 7.1 ²	15.5 ⁴	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Prunus avium</i>	A2 24.5 ⁶	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Knautia arvensis</i> (L.) Coult.	C 24.5 ⁶	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Poa pratensis</i> L.	C 24.5 ⁶	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Ligustrum vulgare</i>	C 24.5 ⁶	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Chamaecytisus supinus</i> (L.) Link	C 24.5 ⁶	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Galium pseudoaristatum</i> Schur	C 6.8 ²	---	---	---	16.5 ⁵	---	---	---	---	---	---	---	---	---	---
<i>Vaccinium myrtillus</i> L.	C ---	28.0 ⁸	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Potentilla argentea</i> L.	C 28.3 ⁹	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Agrimonia eupatoria</i> L.	C 28.3 ⁹	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Thymus serpyllum</i> spp. L.	C 28.3 ⁹	---	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Verbascum phoeniceum</i> L.	C 4.6 ²	24.5 ⁸	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Knautia drymeia</i> Heuff.	C 18.2 ⁶	11.1 ⁴	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Deschampsia flexuosa</i> (L.) Trin.	C 22.4 ⁹	9.7 ⁴	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Epilobium montanum</i> L.	C ---	---	---	---	3.9 ²	29.0 ¹¹	---	---	---	---	---	---	---	---	---
<i>Picea abies</i>	C 8.8 ⁴	19.8 ⁸	---	---	3.5 ²	---	---	---	---	---	---	---	---	---	---
<i>Tanacetum corymbosum</i> (L.) Sch.Bip.	C 8.6 ⁴	---	---	---	---	26.8 ¹¹	---	---	---	---	---	---	---	---	---
<i>Astragalus onobrychis</i> L.	C 18.7 ⁹	18.3 ⁸	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Hypericum perforatum</i> L.	C 23.9 ¹¹	7.6 ⁴	---	---	2.9 ²	---	---	---	---	---	---	---	---	---	---
<i>Acer pseudoplatanus</i>	C ---	---	---	---	13.1 ⁷	---	---	26.6 ¹²	---	---	---	---	---	---	---
<i>Galium rotundifolium</i> L.	C 25.8 ¹³	15.7 ⁸	---	---	---	---	---	---	---	---	---	---	---	---	---
<i>Populus tremula</i>	A1 ---	15.4 ⁸	---	---	1.8 ²	21.6 ¹¹	---	---	---	---	---	---	---	---	---
<i>Actaea spicata</i> L.	C 1.4 ²	---	---	---	16.8 ⁹	21.2 ¹¹	---	---	---	---	---	---	---	---	---
<i>Rubus hirtus</i> Waldst. & Kit.	C ---	2	---	---	27.0 ¹⁶	17.8 ¹¹	---	---	---	---	---	---	---	---	---
<i>Fagus sylvatica</i>	B 13.2 ^{4,3}	1.9 ²⁵	1.9 ²⁵	28.8 ⁶⁷	23.9 ⁵⁹	14.4 ⁴⁴	4.2 ²⁹	1.9 ²⁵	---	---	---	---	---	---	14
<i>Tilia tomentosa</i>	A1 ---	---	---	---	---	---	---	12.1 ¹²	22.5 ²⁰	29.5 ²⁵	---	---	---	---	---
<i>Brachypodium sylvaticum</i> (Huds.) P.Beauv.	C 23.9 ²¹	6.1 ⁸	---	---	4 ⁷	25.2 ²²	---	---	---	---	---	---	---	---	---
<i>Acer platanoides</i>	A1 ---	---	---	---	---	---	13.3 ¹⁴	27.5 ²⁵	20.8 ²⁰	---	---	---	---	---	---
<i>Hieracium latifolium</i> L.	C 18.1 ¹⁹	25.4 ²⁵	25.4 ²⁵	---	---	---	---	---	---	---	---	---	---	---	---
<i>Hieracium murorum</i> gr. L.	C 6.7 ¹³	---	---	---	10.1 ¹⁶	4.9 ¹¹	---	20.0 ²⁵	---	---	---	29.0 ³³	---	---	---

Group No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
<i>Aremonia agrimonoides</i> (L.) DC.	C 9.8 43	9.3 42	25	24.4 67	3.3 32	11	12	12	12	12	12	24.4 67	14.3 50	4.2 33	14
<i>Prunus avium</i>	B 1.3 9	18.3 25	18.3 25	2	2	7.3 14	7.3 14	18.3 25	18.3 25	18.3 25	18.3 25	26.9 33	25.6 33	25.6 33	25.6 33
<i>Pteridium aquilinum</i> (L.) Kuhn	C 4.8 12	4.8 12	16.6 25	21.8 30	21.8 30	14.5 22	6.5 14	6.5 14	6.5 14	6.5 14	6.5 14	24.7 33	24.7 33	24.7 33	24.7 33
<i>Rosa canina</i>	B 21.3 30	16.6 25	16.6 25	24.7 33	24.7 33	24.7 33	24.7 33	24.7 33	24.7 33	24.7 33	24.7 33	24.7 33	24.7 33	24.7 33	24.7 33
<i>Galium odoratum</i> (L.) Scop.	C 12.9 33	12.9 33	12.9 33	10.2 30	10.2 30	9.4 29	25.2 50	17.8 40	17.8 40	17.8 40	17.8 40	25.2 50	25.2 50	25.2 50	25.2 50
<i>Viola reichenbachiana</i> Jord. ex Boreau	C 3.8 21	17	6.5 25	12.6 33	6.5 25	20.7 44	6.5 25	6.5 25	6.5 25	6.5 25	6.5 25	24.7 33	24.7 33	24.7 33	24.7 33
<i>Lathyrus vernus</i> (L.) Bernh.	C 4.8 20	4.8 20	18.4 50	29.2 67	9.5 36	11	9 29	15.5 38	17.3 40	24.5 50	24.5 50	12.4 33	12.4 33	12.4 33	12.4 33
<i>Prunus avium</i>	C 21	4.8 20	18.4 50	29.2 67	9.5 36	11	9 29	15.5 38	17.3 40	24.5 50	24.5 50	12.4 33	12.4 33	12.4 33	12.4 33
<i>Fagus sylvatica</i>	C 6.4 45	16.5 62	22.3 73	22.3 73	22.3 73	25.2 79	29.6 86	2.3 38	2.3 38	2.3 38	2.3 38	9.4 50	9.4 50	9.4 50	9.4 50

Note: The group numbers correspond to the syntaxa numbers in the syntaxonomic scheme. Threshold values of fidelity and frequency perceived as high are shaded in dark grey, while values of the same indicators perceived as low are shaded in light grey; the threshold values defining 'high' and 'low' are described in the methodology.