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Report

Ecological and syntaxonomic characteristics of the floristic complex in the sweet chestnut (*Castanea sativa* Mill.) forests of Belasitsa mountain

Ecological and syntaxonomic characteristics of the floristic complex in the sweet chestnut (*Castanea sativa* Mill.) forests of Belasitsa mountain

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Abstract

The sweet chestnut (*Castanea sativa* Mill.) forests are Mediterranean communities with limited distribution in Bulgaria. The forests in Belasitsa mountain where the sweet chestnut is one of the main tree species are the most representative in the country. The report presents the results of a floristic and syntaxonomic investigation into the sweet chestnut forests of Belasitsa mountain. The main geographical elements are those with Mediterranean origin. Perennial herbs and hemicriptophytes prevail among the biological types and in the spectrum of plant life-forms. The communities are neither rich in conservation value species nor in ruderals. In general the sweet chestnut (*Castanea sativa* Mill.) forest vegetation type in Belasitsa mountain is assigned to the association *Tilio tomentosae-Castanetum sativae*, which is typical for the chestnut communities found in Northern Greece.

Key words: sweet chestnut, *Castanea sativa*, floristic complex, forest vegetation, syntaxonomy, Belasitsa mountain

Introduction

Sweet chestnut (*Castanea sativa* Mill.) has an ancient history in the Mediterranean region, where its diffusion has been mostly related to human activity. In Southern Bulgaria, the forest communities dominated by sweet chestnut are widespread on the northern slopes of Belasitsa mountain only. They have typical Mediterranean origin and specific ecological and floristic structure. The origin of sweet chestnut in Southern Bulgaria and in Belasitsa mountain in particular has not been clarified yet. Two hypotheses were suggested – the species was of natural origin and it was transferred from Asia Minor in the time of Roman Empire (Mihaylov et al. 2007, Kochev 1973). Nevertheless, whether the species is indigenous in Bulgaria or not, it is naturalized and it is closely related to the local culture and customs. The dynamics of the chestnut ecosystems is quick. In absence of management and especially in more canopy opened forest structures, the chestnut stands turn to mixed broadleaved ones (Lyubenova 2004, Dimitrova 2007). This is a result of an invasion of shade-tolerant species. This tendency is particularly pronounced in areas outside its ecological optimum (Conedera et al. 1998, Trajkov et al. 2006).

According to the Bulgarian geobotanical regioning (Bondev 2002) the investigated region belongs to the European broadleaved forest area, Macedono-Thracian province and Belasitsa district. This district is comprised by the Bulgarian part of Belasitsa mountain. The natural chestnut dominated forests cover an area of 648 ha in the mountain (Velichkov et al. 2010).

According to the Bulgarian Forest typology (Pavlov 1995) the chestnut forests belong to the northern Mediterranean deciduous forests. According to the phytogeographical classification (Bondev 1991) they belong to the Northern-Mediterranean vegetation of the mesophilous and xeromesophilous microthermic vegetation of the hornbeam-sessile oak forest belt.

A detailed floristic study of the chestnut forests in Belasitsa mountain (Lyubenova et al. 2004) discovered 270 different plant species. The geographical elements with Mediterranean origin – Euro-Med and Euro-subMed, subMed, Med and MedCAs prevail in the studied vegetation (39%). This is typical for zones with transitional continental-Mediterranean climate. Trees, shrubs and especially perennial herbs (which represent 66% from the species diversity) prevail in the chestnut forest vegetation. In

the spectrum of plant life-forms the prevailing groups are hiemicryptophytes (58%) and phanerophytes (21%).

Phytocoenological investigation of chestnut forests in Bulgaria has been conducted by Lyubenova et al. (2004). The following main association types were established using the dominant method: *Castanetum-Mixoherbosum*; *Castanetum-Coryloso-Mixoherbosum*; *Castanetum-Carpino-Mixoherbosum* and *Platano-Castanetum-Mixoherbosum*. The most widespread is the association *Castanetum-Mixoherbosum*.

According to Dimitrova et al. (2007), the chestnut forests are included into the following synoptic scheme: Class *Quercetea robori-petraeae* Braun.-Blanq. et R. Tx. 1943; Order *Quercetalia robori-petraeae* Tuxen. (1931) 1937; Alliance *Quercion robori-petraeae* Tuxen 1943; Association *Castanetum sativae macedonicum* Nikolovski 1951. Because of the presence of geographical term in its name, the association published cannot be verified (see Weber et al. 2000).

Detailed syntaxonomic studies of the chestnut forests were performed in Italy (Arrigoni et al. 1996, Viciani and Gabellini 2000, Arrigoni and Viciani 2001, Lombardi and Viciani 2003), France (Olivier et al. 1995), Turkey (Kargioglu 1988, Ozel 1999), Greece (Dafis 1966, Zoller et al. 1977, Raus 1980, Bergmeier and Dimopoulos 2008, Konstantinidis et al. 2008) and former Yugoslavia (Horvat et al. 1974). The established taxonomic structure could provide some evidence for the level of naturalness of these forests.

The main objectives of the current study were: (1) to establish the taxonomic and phyto-geographic structure of sweet chestnut (*Castanea sativa* Mill.) dominated forests on the northern slopes of Belasitsa mountain; (2) to find the appropriate position of these forests into the existing classification scheme (3) to assess the level of naturalness of these forests with respect to phyto-geographic elements found and (4) to define their importance for the preservation of the species of conservation value.

Methods

Data for the floristic investigation and sample materials was collected from a systematic network of permanent sample plots. As a part of the systematic sampling approach, a grid was drawn between 181 000 and 183 000 meridian lines and between 4 584 500 and 4 587 600 parallel lines (coordinate system: UTM 35 North, WGS 1984) across the

most recently updated forestry map of Belasitsa mountain (PFEM 2010). The interval between grid lines was set to 250 m in both longitudinal and latitudinal direction. A total of 20 plots were randomly selected from the grid to perform the floristic and syntaxonomic investigation.

The floristic communities in the plots were investigated during the spring, summer and autumn of year 2010. Six field expeditions and 20 relevés have been made. Guidance of the vascular plants (Kozhuharov /ed./ 1992) in Bulgaria has been used for the species determination. The plant life-forms were determined according to the classification of Raunkiaer (1937). The geographical floristic elements were described according to Walter (1974) as adapted for Bulgaria from Assyov and Petrova (2002). Comparable floristic analysis was also performed.

The phytocoenological studies have been done according to the methodology of floristic (sigmatic) school (Braun-Blanquet 1964, Mueller-Dombois and Ellenberg 1974, etc). The scale of Braun-Blanquet (1932) for cover/abundance has been used for the phytocoenological relevés. Cluster analysis has been implemented by using the computer program SYN-TAX (Podani 2002). Average linkage method (UPGMA) was used and floristic similarity between relevés was evaluated according to the Horn's index (Krebs 1999). The synoptic similarity was evaluated using PCo Analysis. The Horn's index was also used for the PCo Analysis (Podani 2002).

Results

Close 4% from the Bulgarian flora (160 vascular plant species) – one of them semi-parasite, 1 lichens, 1 moss genera (Appendix 1) have been established in the sample plots. These species belong to 55 families and 106 genera, which presents 33% from the families and 13% from the genera of the Bulgarian flora. The species richness is not very high, because of the ecological and site conditions of the chestnut forests.

Geographical structure of the flora. The geographical elements with Mediterranean origin – Euro-Med and Euro-subMed, subMed, Med and MedCAs prevail in the studied vegetation – 39%. The high presence of taxa with Mediterranean (or close to Mediterranean) origin is mostly typical for the termophilous oak forests. This is an evidence for the strong Mediterranean influence over these forests, in spite of the high presence of mesophilous species such as beech, hornbeam etc.

The second widespread phytogeographic group includes European, Euro-Asian and Euro-Siberian floristic elements – 33%. Their origin is from the temperate forest zone of Eurasia.

The Boreal and Subboreal elements present only 12% from the species composition. The floristic elements with Pontic origin are only 4%.

Balkan endemics and subendemics have comparatively small participation – 4%. These forests are not centre of endemism, which is considered to be typical for Belasitsa mountain by Bondev (2002). The cosmopolites and the adventive species have also low participation – respectively 5% and 4% (Appendix 1, Fig. 1). The small number of anthropophytic taxa is a good evidence for the high level of naturalness of chestnut forests in Belasitsa mountain.

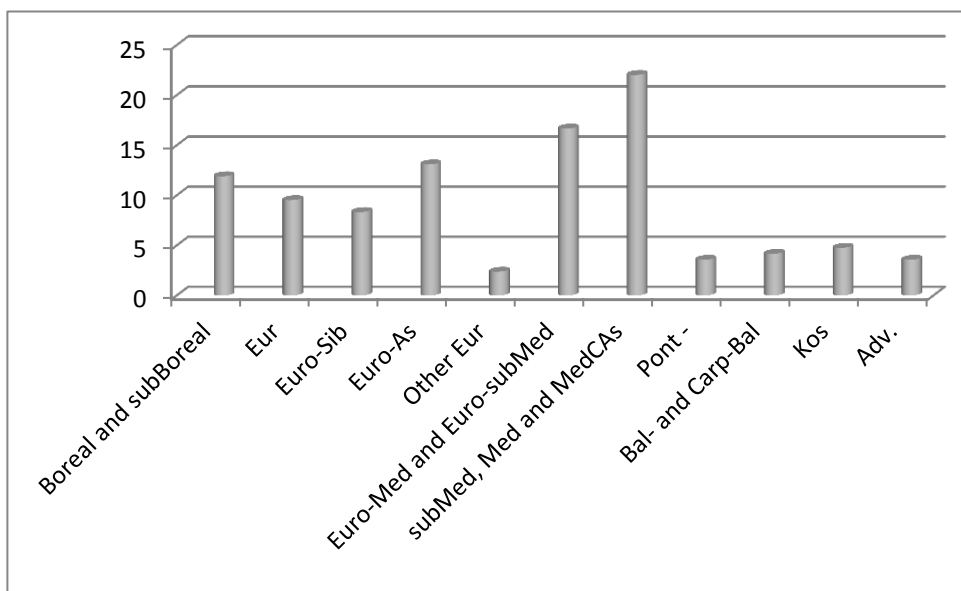


Fig. 1. Geographical structure (%) of the sweet chestnut (*Castanea sativa* Mill.) forests flora on the northern slopes of Belasitsa mountain, Southwestern Bulgaria

Taxonomic structure of the flora. According to the number of species per a family and their share (%) from all species found in the sample plots, the most represented plant families are listed as follows: *Fabaceae*, *Rosaceae*, *Poaceae*, *Asteraceae*, *Lamiaceae* and *Aspleniaceae* (Fig. 2). This percentage distribution is typical for the structure of the Bulgarian flora as a whole, because the families mentioned above are

the most numerous ones in the country. The other 48 less numerous families found are distributed into the following groups: **I** – 23 families: *Araceae*, *Araliaceae*, *Aristolochiaceae*, *Aspidiaceae*, *Colchicaceae*, *Crassulaceae*, *Cyperaceae*, *Dennstaedtiaceae*, *Dioscoreaceae*, *Gentianaceae*, *Hypolepidiaceae*, *Hypericaceae*, *Hypolepidiaceae*, *Iridaceae*, *Juglandaceae*, *Juncaceae*, *Loranthaceae*, *Orobanchaceae*, *Papaveraceae*, *Plantaginaceae*, *Polygonaceae*, *Saxifragaceae* and *Urticaceae*; **II** – 8 families : *Boraginaceae*, *Caprifoliaceae*, *Celastraceae*, *Cornaceae*, *Dryopteridaceae*, *Geraniaceae*, *Oleaceae* and *Primulaceae*; **III** – 7 families : *Campanulaceae*, *Euphorbiaceae*, *Fagaceae*, *Orchidaceae*, *Ranunculaceae*, *Rubiaceae* and *Ulmaceae*; **IV** – 7 families : *Aceraceae*, *Apiaceae*, *Brassicaceae*, *Liliaceae*, *Scrophulariaceae*, *Tiliaceae* and *Violaceae*; **V** – 2 families : *Betulaceae* and *Cariophyllaceae*.

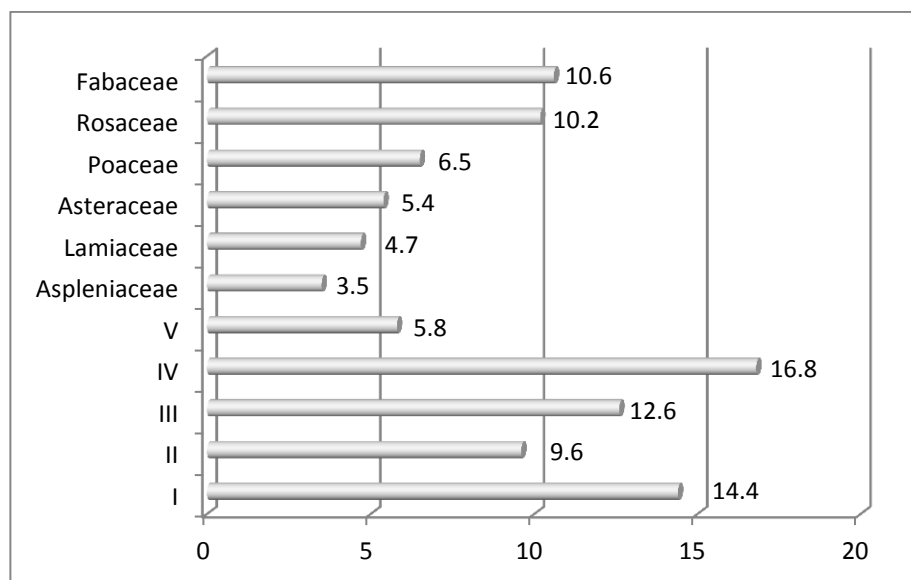


Fig. 2. Taxonomic structure (%) of the sweet chestnut (*Castanea sativa* Mill.) forests flora on the northern slopes of Belasitsa mountain, Southwestern Bulgaria

The genera diversity of the vascular plant species is presented as follows: *Fabaceae* (9 genera), *Rosaceae* (9), *Asteraceae* (7), *Lamiaceae* (8), *Poaceae* (6), *Betulaceae* (4) and *Apiaceae* (4) (Appendix 2). The rest families are represented by 3 genera (7 families), 2 genera (5 families) and 1 genus (35 families).

The taxonomic structure of the chestnut forests flora in Belasitsa mountain does not demonstrate any uniqueness of these forests. But the high presence of species from

Fabaceae and 8 genera from *Lamiaceae* is evidence for the strong Mediterranean influence over the flora of sweet chestnut forests.

Biological types and plant life-forms. According to the biological spectrum of the investigated vegetation, the most prevalent are the perennial herbs, followed by the trees and the shrubs (Fig. 3). The annual herbs are very rare because of their aptitude to grow on more arid, open, dry and sunny places which are not typical for chestnut forests. The highest participation of perennial herbs is common for the forest vegetation characterized by rich site conditions.

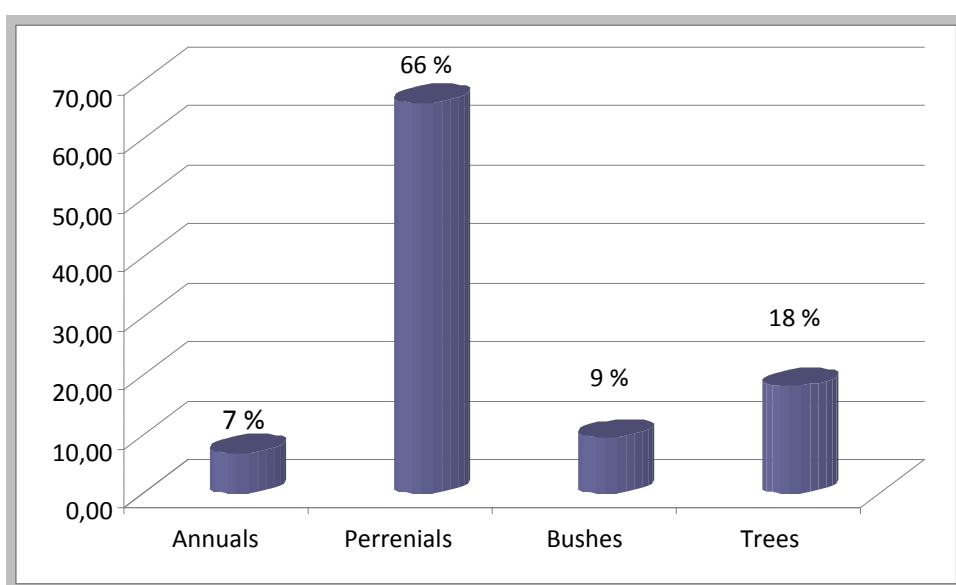


Fig. 3. Distribution of biological types (%) in the sweet chestnut (*Castanea sativa* Mill.) forests flora on the northern slopes of Belasitsa mountain, Southwestern Bulgaria

The spectrum of plant life-forms in the studied chestnut forest communities includes hemicryptophytes (H), phanerophytes (Ph), chamaephytes (Ch), therophytes (Th) and cryptophytes (Cr) (Fig. 4). This spectrum is typical for the mesophilous broadleaved forest vegetation in Bulgaria. The comparatively high presence of chamaephytes and cryptophytes (comprising both 14%) is evidence for the Mediterranean influence and the transitional position of the chestnut forests in Belasitsa mountain. Despite that their canopy layer is rich in mesophilous species (*Fagus sylvatica*, *Acer* spp., *Carpinus betulus* etc.) their floristic, phytogeographic and ecological structure (represented by the herbaceous layer) is more similar to the termophilous oak forests.

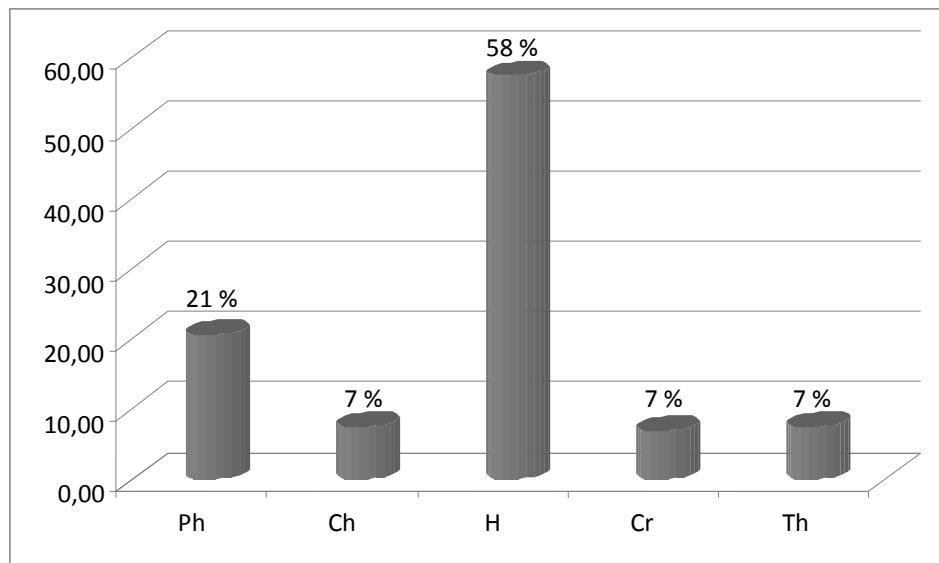


Fig. 4. Spectrum of life forms (%) in the sweet chestnut (*Castanea sativa* Mill.) forests flora on the northern slopes of Belasitsa mountain, Southwestern Bulgaria

The syntaxonomic analysis demonstrates a significant homogeneity of the sample plots excluding sample plot № 9 (referred as № 8 in Fig. 5 and 6), which was excluded from the syntaxonomic analysis as being untypical.

There are only two groups of communities, but the differences between them are not so high to divide other subassociations. They could be only variants. European beech participates in the second variant, but is practically absent in the first group of relevés. These groups are also separated on the dendrogram – 1 (21–13) and 2 (19–3), as well as on the ordination diagram – 1 (right and down) and 2 (left and up).

The Bulgarian chestnut communities are typical mesophilous to meso-xerophilous forests (Appendix 3), especially their tree and shrub layers. The tree layer is dominated mainly by *Castanea sativa* (V) which is also the main dominant species. Other widespread species are *Tilia tomentosa* (IV), *Fagus sylvatica* (III), *Carpinus betulus* (IV), *Ostrya carpinifolia* (IV). Some species as *Quercus petraea* (II), *Sorbus torminalis* (II), *Fraxinus ornus* (III), *Acer platanoides* (I) and *Acer pseudoplatanus* (I) are not so common.

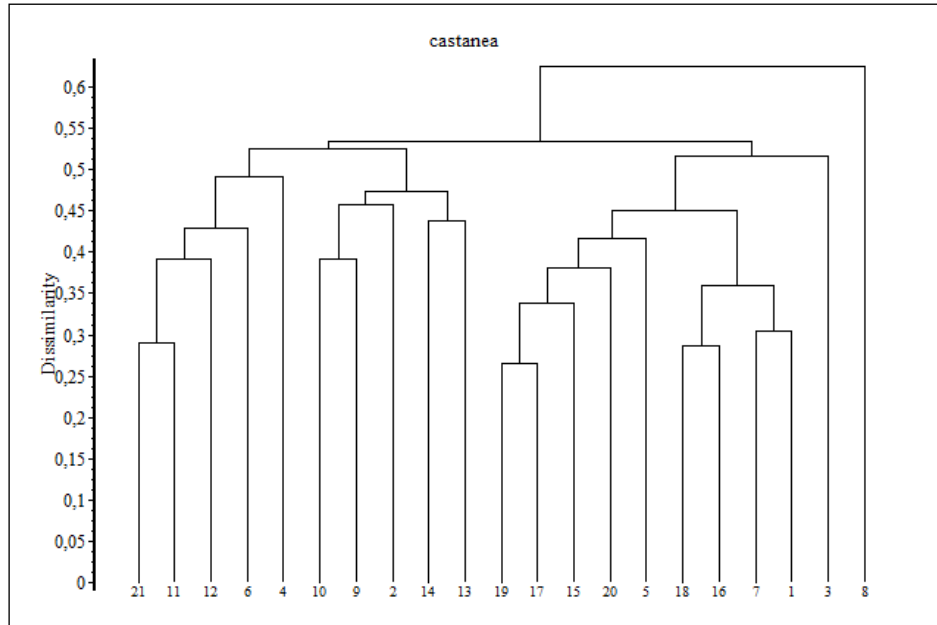


Fig. 5. Cluster dendrogram using Horn's index of dissimilarity (SYN-TAX program)

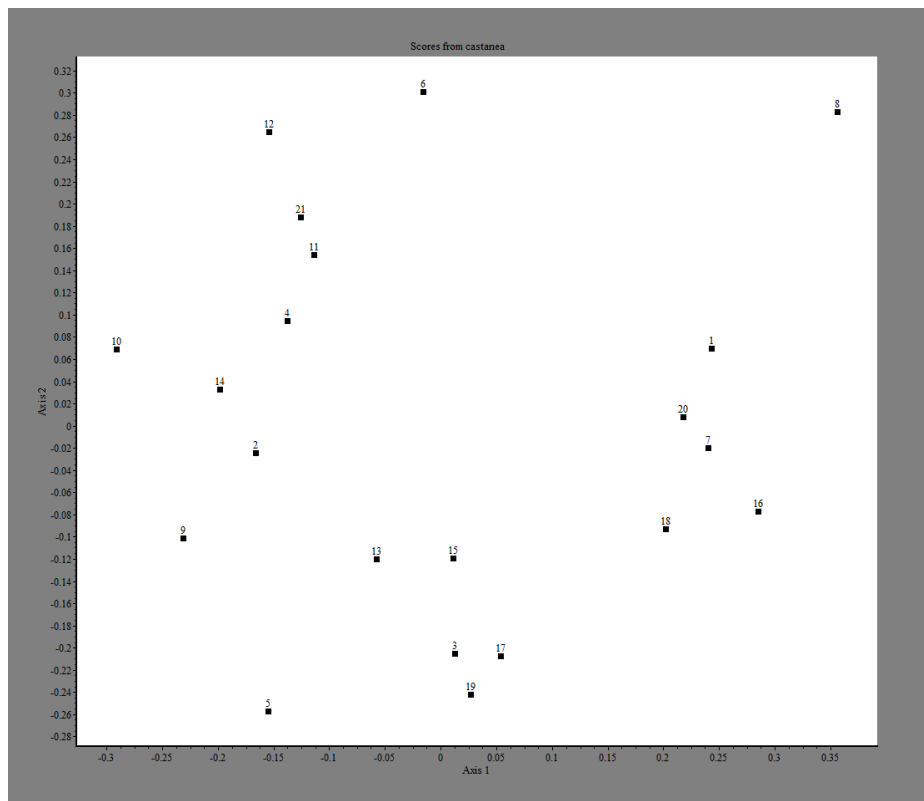


Fig. 6. PCo analysis using Horn's index (SYN-TAX program)

The shrub layer is clearly dominated by hazel (*Corylus avellana*) (V). Other common species in the shrub layer are *Fraxinus ornus* (III), *Rosa arvensis* (III) and rarely found are *Sorbus torminalis* (II), *Carpinus orientalis* (II) etc. The tree species as *Castanea sativa* (V), *Tilia tomentosa* (V) and *Fagus sylvatica* (III) are also common in the shrub layer.

The herbaceous layer is not well developed, because of the dense chestnut forest canopy. It is a mixture of typical for the mesophilous forests species and some thermophilous species. The first group is more typical for the open plain oak forest and the lower forest belt and includes the species *Mycelis muralis* (III), *Luzula luzuloides* (III), *Asperula odorata* (I), *Melica uniflora* (IV), *Hedera helix* (III), *Dentaria bulbifera* (III) and *Lathyrus laxiflorus* (III). The second group includes the species *Galium pseudoaristatum* (III), *Euphorbia amygdaloides* (V), *Potentilla micrantha* (III) and *Physospermum cornubiense* (II). A lot of fern species: *Pteridium aquilinum* (IV), *Asplenium adianthum-nigrum* (II) etc. found serve as an indicator for mesophilous conditions.

Discussion

The established proportion of the geographical elements – prevalence of Mediterranean and Euro-Asian forest elements is typical for the transitional continental-Mediterranean climate and confirmed the results reported by previous studies: Lyubenova et al. (2002, 2004) and Dimitrova et al. (2005, 2009). The Mediterranean origin of chestnut forests is demonstrated by the ecological structure of their floristic composition. The group of hemicryptophytes followed by that of phanerophytes and chamaephytes prevails among the plant life-forms which has been confirmed by previous studies (Lyubenova et al. 2004; Dimitrova et al. 2005). The comparison of the studied chestnut forests spectrum with this of Bulgarian flora indicates preservation of the main proportions. The hemicryptophytes are most widespread and the cryptophytes have the least distribution. The presence of chamaephytes and cryptophytes is comparatively high and indicates strong Mediterranean influence. This fact has been confirmed by the phytogeographical structure of the flora.

The studied chestnut forests are poor in species with nature-conservation value. The species composition established by the current study confirms the results of Lyubenova

et al. (2004) and Dimitrova et al. (2005) that the number of conservation valuable species is not high. Their relative proportion is 4% from the floristic composition of the chestnut communities. The species of high conservation value established by previous studies are:

Juniperus exelsa Bieb. (Biodiversity Act);

Ilex aquifolium L. (Biodiversity Act, old Red Data Book – rare);

Medicago carstiensis Jacq. subsp. *belassitzae* Koz. (Biodiversity act, Red Data Book – threatened);

Dactyloriza incarnata (L.) Soo. (Biodiversity Act, CITES);

Limodorum abortivum (L.) Schwartz. (Biodiversity Act, old Red Data Book – rare and tertiary relict, CITES);

Platanthera chlorantha (Cust.) Rchb. (CITES);

Neottia nidus-avis (L.) L. C. Rich. (CITES);

Cyclamen coum Mill. (Biodiversity Act; Red Data Book – rare, CITES);

Cyclamen hederifolium Ait. (CITES).

Some of them (*Ilex aquifolium*, *Cyclamen hederifolium*) were confirmed from the present study and one new species was found – *Corallorhiza trifida* (CITES).

In summary – 6 species from the Biodiversity Act (2002) (Annexes 3 and 2a), 4 species from the old Red Data Book of Bulgaria and 7 species from the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES-1991) have been established in the studied communities. That means chestnut forests are not rich in rare, endangered and endemic species because of their similarity with other mesophilous forests in Bulgaria dominated by *Fagus sylvatica*, *Tilia tomentosa* and *Caprinus betulus*. All these forests have similar floristic structure which is not rich in nature-conservation valuable species.

The ruderal flora in the chestnut forests of Belasitsa mountain is presented by 13 species or 8% from the whole floristic structure. This represents 4% from the antropophytic flora of the country (Petrova, Vladimirov 2002). The penetration of ruderal species is due to anthropogenic influence – forestry activities, tourism, grazing, chestnut fruits picking and close proximity of the surrounding settlements. But the ruderal species are not numerous ones which also indicates the high level of naturalness

of Belasitsa chestnut forests. The adventive species are neophytes. They have penetrated during the last several decades.

Horvat et al. (1974), Zoller et al. (1977), Raus (1980), Konstantinidis et al. (2008), Bergmeier and Dimopoulos (2008) described several chestnut associations distributed at the Balkan Peninsula (Greece and former Yugoslavia) which all belong to the European chestnut forests. The species range is mostly related to the Mediterranean and Southern Atlantic region (Tutin 1993). The chestnut communities (Appendix 3) in Belasitsa mountain demonstrate strong relations with the similar communities in Northern Greece and FYROM. The association *Castanetum sativae macedonicum* Nikolovski 1951 described in FYROM was also accepted by Konstantinidis et al. (2008) as the main syntaxon for continental Greece. The association is not validly described because of the geographical epithet in the name according to the codex of syntaxonomic nomenclature (Weber et al. 2000). According to Horvat et al. (1974) only *Castanea sativa* was indicated as diagnostic species. Konstantinidis et al. (2008) have listed the following diagnostic species: *Corylus avellana*, *Trifolium ochroleucon*, *Polygonatum odoratum*, *Viola hirta*, *Calystegia sylvatica*, *Filago arvensis*, *Silene coronaria*, *Hieracium murorum*, *Scutellaria altissima*, *Euphorbia amygdaloides*. Only four of them – *Corylus avellana*, *Polygonatum odoratum*, *Hieracium murorum* (syn. *Hieracium gentile*) and *Euphorbia amygdaloides* are species typical also for the communities in Belasitsa mountain but they are widespread in all beech (*Corylus avellana*, *Hieracium murorum*) or other deciduous forests (*Euphorbia amygdaloides*, *Polygonatum odoratum*) in Bulgaria. Therefore they are not good diagnostic species for the chestnut forests in Bulgaria also because of their ecological flexibility. There is not any similarity with other syntaxa described by Konstantinidis et al. (2008).

The thermophilous communities with the participation of *Castanea sativa* have been generalized from Bergmeier and Dimopoulos (2008) into four main associations: *Quercus frainetto-Castanetum sativae* Zoller et al. 1977; *Tilio tomentosae-Castanetum* Dafis 1973; *Cytiso villosi-Castanetum sativae* Barbero & Quezel 1976 and *Lathyro laxiflori-Castanetum sativae* Brullo et al. 2004. The first two associations occur in Northern and Central Greece, the second two – only in Southern Greece. There is a similarity between the communities in Belasitsa mountain and the associations *Quercus frainetto-Castanetum sativae* Zoller et al. 1977 and *Tilio tomentosae-Castanetum* Dafis

1973. The first association includes more thermophilous and xerophilous communities at lower altitude. The climatic conditions in Belasitsa mountain are different as far as the chestnut forests are localized on the northern wetter slopes of the mountain where the presence of mesophilous forest species *Tilia tomentosa*, *Fagus sylvatica* and *Carpinus betulus* is significant. The existence of *Tilia tomentosa* (V) is a good evidence for the similarity of the Belasitsa communities with those of the association *Tilio tomentosae-Castanetum*. The silver lime is a typical species for South-Eastern Europe and Asia Minor. The participation of silver lime in the chestnut communities in Belasitsa emphasizes the northern periphery range of *Castanea sativa* (Mediterranean and Atlantic species) in Bulgaria. Most of the diagnostic species (see Raus 1980; Bergmeier & Dimopolous 2008) in spite of their different constancy are common to the Greek and the Bulgarian chestnut communities.

The analysis of the constant and diagnostic species demonstrates the following synoptic scheme:

Synoptic scheme of *Castanea sativa* communities in Belasitsa mountain (Bulgaria)

Class *Quercio-Fagetea* Braun-Blanq. et Vieg. 1937

Order *Quercetalia pubescentis* Braun-Blanq. 1932

Alliance *Quercion frainetto* Horvat 1958

Association *Tilio tomentosae-Castanetum sativae* Dafis 1973

Association *Tilio tomentosae-Castanetum sativae* Dafis 1973

Constant species: *Castanea sativa*, *Tilia tomentosa*, *Mycellis muralis*, *Galium pseudoaristatum*, *Campanula trachelium*, *Fagus sylvatica*, *Euphorbia amygdaloides*, *Pteridium aquilinum*, *Lathyrus laxiflorus*, *Potentilla micrantha*, *Ostrya carpinifolia*, *Fraxinus ornus*, *Dentaria bulbifera*, *Clinopodium vulgare*, *Carpinus betulus*, *Quercus petraea*, *Coryllus avellana*, *Veronica chamaedrys*, *Luzula luzuloides*, *Hedera helix*, *Primula veris*.

Diagnostic species: *Castanea sativa*, *Tilia tomentosa*, *Mycellis muralis*, *Galium pseudoaristatum*, *Campanula trachelium*, *Lathyrus venetus*, *Asperula odorata*, *Prunella vulgaris*, *Polystichum setiferum*, *Festuca drymeja*.

Dominant species: *Castanea sativa*, *Fagus sylvatica*, *Coryllus avellana*.

Conclusions

The sweet chestnut communities of Belasitsa mountain are similar to the chestnut communities in Northern Greece and especially to the association *Tilio tomentosae-Castanetum* Dafis 1973. Their floristic composition includes species typical for the thermophilous oak forest and the mountain beech and hornbeam forests simultaneously. This ecological feature is also typical for the silver lime forests. Both species (chestnut and lime) form mixed communities in the transitional zone of contact localized in Northern Greece and Southwestern Bulgaria. The syntaxonomical position of the studied chestnut forests is close to that of chestnut forests in Northern Greece. The strong similarities between the Bulgarian and Northern Greece chestnut forests indicate the role of Belasitsa mountain as a northern periphery zone of the natural and most optimal range of sweet chestnut on the Balkan peninsula.

The geographical elements with Mediterranean origin – Euro-Med and Euro-subMed, subMed, Med and MedCAs prevail in the studied floristic complex of Belasitsa mountain chestnut forests. The high presence of taxa with Mediterranean (or close to Mediterranean) origin is mostly typical for the thermophilous oak forests. This is an evidence for the strong Mediterranean influence over the studied forests, in spite of the high presence of mesophilous species such as beech, hornbeam etc.

The established 160 species in the sample plots represent 63% from the previously published 270 species by Dimitrova et al. (2005), Dimitrova et al. (2009). Some species which were not described in the former studies are established for the first time.

The high level of naturalness of chestnut forests in Belasitsa mountain is similar to that of the broadleaved mesophilous forests in other Bulgarian mountains. The current study confirmed the fact that Belasitsa mountain chestnut forests are poor in endemic and relict species as well as they are poor in adventive and other anthropophytic species. The forests are also poor in species with high conservation value. The most valuable species in these forests is the sweet chestnut itself.

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Appendix 1. Checklist of established plant species in the sweet chestnut forests flora of Belasitsa mountain, Soutwestern Bulgaria

Legend:

Biological types: T (tree), B (bush), P (perennial herb), A (annual herb).

Life forms: Ph (phanerophyt), C (chamaephyt), H (hemicryptophyt), Cr (cryptophyt), T (therophyt).

Phytogeographic elements: Adv (adventive), Ap-Bal (Apenino-Balkan), Bal (Balkan endemic), Bal-Anat (Balkan-Anatolian), Bal-Dac (Balkan-Dacian), Boreal (Boreal), Carp-Bal (Carpathic-Balkan), Eur (European), Euro-As (Euro-Asian), Euro-Med (Euro-Mediterranean), Euro-SubMed (Euro-SubMediterranean), Eur-Pont (Euro-Pontic), Euro-OT (Euro-Orientalo-Turannian); Euro-Sib (Euro-Siberian), Kosm (Cosmopolitian), Med (Mediterranean), MedCAs (Mediterrano-Central Asian), Pan-Bal (Panonic-Balkan), Pont-Med (Pontic-Mediterranean), Pont-SubMed (Pontic-Submediterranean), SubBoreal (Sub-Boreal), SubMed (Sub Mediterranean), sPont (Sub-Pontic)

№	Species	Biological Type	Life Form	Phyto-geographic element	Family
1	<i>Acer campestre</i> L.	T	Ph	Euro-OT	<i>Aceraceae</i>
2	<i>Acer platanoides</i> L.	T	Ph	subMed	<i>Aceraceae</i>
3	<i>Acer pseudoplatanus</i> L.	T	Ph	Euro-Med	<i>Aceraceae</i>
4	<i>Acer tataricum</i> L.	T	Ph	subMed	<i>Aceraceae</i>
5	<i>Acinos rotundifolius</i> Pers.	P	H	MedCAs	<i>Lamiaceae</i>
6	<i>Ajuga reptans</i> L.	P	H	Eur-Med	<i>Lamiaceae</i>
7	<i>Allium paniculatum</i> L.	P	Cr	Pont-subMed	<i>Liliaceae</i>
8	<i>Anemone ranunculoides</i> L.	P	Cr	Boreal	<i>Ranunculaceae</i>
9	<i>Arabis turrata</i> L.	A	H	subMed	<i>Brassicaceae</i>
10	<i>Arctium lappa</i> L.	P	H	Euro-Med	<i>Asteraceae</i>
11	<i>Aremonia agrimonioides</i> (L.) DC.	P	H	sub-Med	<i>Rosaceae</i>
12	<i>Aristolochia rotunda</i> L.	P	H	Med	<i>Aristolochiaceae</i>
13	<i>Arum italicum</i> Mill.	P	Cr	Med	<i>Araceae</i>
14	<i>Asplenium adiantum-nigrum</i> L.	P	H	subBoreal	<i>Aspleniaceae</i>
15	<i>Asplenium ruta-muraria</i> L.	P	H	Boreal	<i>Aspleniaceae</i>
16	<i>Asplenium septentrionale</i> (L.) Hoffm.	P	H	Boreal	<i>Aspleniaceae</i>

17	<i>Asplenium trichomanes</i> L.	P	H	Kos	<i>Aspleniaceae</i>
18	<i>Asplenium viride</i> Hudson	P	H	Boreal	<i>Aspleniaceae</i>
19	<i>Astragalus glycyphyllos</i> L.	P	H	sPont	<i>Fabaceae</i>
20	<i>Betula pendula</i> Roth	T	Ph	Euro-Sib	<i>Betulaceae</i>
21	<i>Brachypodium sylvaticum</i> (Huds.) Beauv.	P	H	Euro-As	<i>Poaceae</i>
22	<i>Buglossoides purpureocaerulea</i> (L.) I. M. Johnston	P	H	Euro-As	<i>Boraginaceae</i>
23	<i>Calamintha sylvatica</i> Bromf.	P	H	Euro-OT	<i>Lamiaceae</i>
24	<i>Campanula trachelium</i> L.	P	H	Boreal	<i>Campanulaceae</i>
25	<i>Campanula persicifolia</i> L.	P	H	Euro-Sib	<i>Campanulaceae</i>
26	<i>Campanula patula</i> L. ssp. <i>Patula</i>	p	H	Eur	<i>Campanulaceae</i>
27	<i>Cardamine bulbifera</i> (L.) Crantz.	p	H	Carp-Bal	<i>Brassicaceae</i>
28	<i>Carex muricata</i> L.	p	H	Euro-As	<i>Cyperaceae</i>
29	<i>Carpinus betulus</i> Lam.	t	Ph	Euro- subMed	<i>Betulaceae</i>
30	<i>Carpinus orientalis</i> L.	t	Ph	subMed	<i>Betulaceae</i>
31	<i>Castanea sativa</i> Mill.	t	Ph	Med.	<i>Fagaceae</i>
32	<i>Centaurium erythraea</i> Rafin.	p	H	subMed	<i>Gentianaceae</i>
33	<i>Cephalanthera damasonium</i> (Miller) Druce	p	Cr	EuroAs	<i>Orchidaceae</i>
34	<i>Cerasus avium</i> (L.) Moench	t	Ph	sub-Med	<i>Rosaceae</i>
35	<i>Ceterah officinarum</i> DC	p	H	sub-Med	<i>Aspleniaceae</i>
36	<i>Chamaecytisus absinthioides</i> (Janka) Kuzmanov ssp. <i>Absinthioides</i>	b	C	Bal	<i>Fabaceae</i>
37	<i>Chamaecytisus hirsutus</i> (L.) Link.	b	C	Euro-Sib	<i>Fabaceae</i>
38	<i>Circaea luteciana</i> L.	p	H	Boreal	<i>Onagraceae</i>
39	<i>Clematis vitalba</i> L.	b	Ph	Eur	<i>Ranunculaceae</i>
40	<i>Clinopodium vulgare</i> L	p	H	subBoreal	<i>Lamiaceae</i>
41	<i>Colchicum autumnale</i> L.	p	Cr	Eur	<i>Colchicaceae</i>
42	<i>Corallorhiza trifida</i> Chatel.	p	Cr	Boreal	<i>Orchidaceae</i>
43	<i>Corydalis bulbosa</i> (L.) DC	a	Cr	Euro-Med	<i>Papaveraceae</i>
44	<i>Cornus mas</i> L.	b	Ph	subMed	<i>Cornaceae</i>

45	<i>Cornus sanguinea</i> L.	b	C	subMed	<i>Cornaceae</i>
46	<i>Coronilla emerus</i> L.	b	C	subMed	<i>Fabaceae</i>
47	<i>Corylus avellana</i> L.	b	Ph	Boreal	<i>Betulaceae</i>
48	<i>Crataegus monogyna</i> Jacg.	b	Ph	subBoreal	<i>Rosaceae</i>
49	<i>Crocus flavus</i> West.	p	Cr	Euro-Pont	<i>Iridaceae</i>
50	<i>Cyclamen hederifolium</i> Aiton	p	Cr	subMed	<i>Primulaceae</i>
51	<i>Cystopteris fragilis</i> (L.) Bernh.	p	H	Kos	<i>Dryopteridaceae</i>
52	<i>Dactylis glomerata</i> L.	p	H	Euro-As	<i>Poaceae</i>
53	<i>Daucus carota</i> L.	a	T	Euro-As	<i>Apiaceae</i>
54	<i>Dicranium</i> sp.				Moss
55	<i>Digitalis viridiflora</i> Lind.	p	H	Bal	<i>Scrophulariaceae</i>
56	<i>Doronicum orientale</i> Hoffm.	p	H	Bal-Dac	<i>Asteraceae</i>
57	<i>Driopteris filix-mas</i> (L.) Shott.	p	H	Boreal	<i>Dryopteridaceae</i>
58	<i>Euonymus europaeus</i> L.	t	Ph	Eur-As	<i>Celastraceae</i>
59	<i>Euonymus latifolius</i> (L.) Miller	t	Ph	Euro-Med	<i>Celastraceae</i>
60	<i>Euphorbia amygdaloides</i> L.	p	H	Eur	<i>Euphorbiaceae</i>
61	<i>Euphorbia cyparissias</i> L.	p	H	Eur	<i>Euphorbiaceae</i>
62	<i>Euphorbia polychroma</i> Kern.	p	H	Eur	<i>Euphorbiaceae</i>
63	<i>Fagus sylvatica</i> L.	t	Ph	Eur	<i>Fagaceae</i>
64	<i>Festuca drymeja</i> Mert. et Koch.	p	H	subMed	<i>Poaceae</i>
65	<i>Festuca heterophylla</i> Lam.	p	H	Boreal	<i>Poaceae</i>
66	<i>Ficaria verna</i> Huds.	p	Cr	Euro-Sib	<i>Ranunculaceae</i>
67	<i>Fragaria vesca</i> L.	p	H	subBoreal	<i>Rosaceae</i>
68	<i>Fraxinus excelsior</i> L.	t	Ph	Euro-Med	<i>Oleaceae</i>
69	<i>Fraxinus ornus</i> L.	t	Ph	subMed	<i>Oleaceae</i>
70	<i>Galium odoratum</i> (L.) Scop.	p	H	Euro-As	<i>Rubiaceae</i>
71	<i>Galium pseudoaristatum</i> Schur.	p	H	Pann-Bal	<i>Rubiaceae</i>
72	<i>Gallium aparine</i> L.	a	T	EuroAs	<i>Rubiaceae</i>
73	<i>Genista januensis</i> Viv.	p	H	subMed	<i>Fabaceae</i>
74	<i>Geranium lucidum</i> L.	a	T	Euro-As	<i>Geraniaceae</i>
75	<i>Geranium robertianum</i> L.	p	H	subBoreal	<i>Geraniaceae</i>
76	<i>Geum urbanum</i> L.	p	H	subBoreal	<i>Rosaceae</i>
77	<i>Glechoma hirsuta</i> Waldst. et Kit.	p	H	Euro-Med	<i>Lamiaceae</i>
78	<i>Hedera helix</i> L.	p	C	Euro-As	<i>Araliaceae</i>

79	<i>Hieracium gentile</i> Jord. ex Boreau	p	H	subMed	<i>Asteraceae</i>
80	<i>Hieracium pilosella</i> L.	p	H	Euro-Med	<i>Asteraceae</i>
81	<i>Huetia cynapoidea</i> (Guss.) Ball.	p	H	Ap-Bal	<i>Apiaceae</i>
82	<i>Hypericum perforatum</i> L.	p	H	Kos	<i>Hypericaceae</i>
83	<i>Hypochaeris glabra</i> L.	a	T	Euro-Med	<i>Asteraceae</i>
84	<i>Juglans regia</i> L.	t	Ph	Euro-As/Paleo	<i>Juglandaceae</i>
85	<i>Lathyrus niger</i> (L.) Bernh.	p	H	Euro-Med	<i>Fabaceae</i>
86	<i>Laburnum anagiroides</i> Medic.	b	C	adv	<i>Fabaceae</i>
87	<i>Lamium garganicum</i> L.	a	T	Med	<i>Lamiaceae</i>
88	<i>Lathyrus laxiflorus</i> (Desf.) O.Kuntze	p	H	subMed	<i>Fabaceae</i>
89	<i>Lathyrus sphaericus</i> Retz	p	H	Euro-As	<i>Fabaceae</i>
90	<i>Lathyrus venetus</i> (Miller) Wohf.	p	H	Euro-Med	<i>Fabaceae</i>
91	<i>Lathyrus vernus</i> (L.) Bernh.	p	H	Euro-Sib	<i>Fabaceae</i>
92	<i>Leucanthemum vulgare</i> Lam.	p	H	Euro-Sib	<i>Asteraceae</i>
93	<i>Lobaria pulmonaria</i> (L.) Hoffm.				Lichen
94	<i>Lolium temulentum</i> L.	p	H	Boreal	<i>Poaceae</i>
95	<i>Lonicera xylosteum</i> L.	b	C	Euro-Sib	<i>Caprifoliaceae</i>
96	<i>Lunaria rediviva</i> L.	p	H	Eur	<i>Brassicaceae</i>
97	<i>Luzula luzuloides</i> (Lam.) Dandy	p	H	Eur	<i>Juncaceae</i>
98	<i>Malus sylvestris</i> Miller	t	Ph	Eur	<i>Rosaceae</i>
99	<i>Melica uniflora</i> Retz.	p	H	Eur	<i>Poaceae</i>
100	<i>Mycelis muralis</i> (L.)Dum.	p	H	Med	<i>Asteraceae</i>
101	<i>Orchis</i> sp.	p	Cr		<i>Orchidaceae</i>
102	<i>Orobanche</i> sp.	p	T		<i>Orobanchaceae</i>
103	<i>Ostrya carpinifolia</i> Scop.	t	Ph	subMed	<i>Betulaceae</i>
104	<i>Physospemum cornubiense</i> (L.) DC.	p	H	Euro-Med	<i>Apiaceae</i>
105	<i>Phytolacca americana</i> L.	p	H	adv	<i>Phytolaccaceae</i>
106	<i>Platanus orientalis</i> L.	t	Ph	Med.	<i>Plantaginaceae</i>
107	<i>Poa bulbosa</i> L.	p	H	Euro-As	<i>Poaceae</i>
108	<i>Poa nemoralis</i> L.	p	H	Boreal	<i>Poaceae</i>
109	<i>Poa sylvicola</i> Guss.	p	H	Euro-As	<i>Poaceae</i>
110	<i>Polygonatum multiflorum</i> (L.)All.	p	H	Boreal	<i>Liliaceae</i>

111	<i>Polygonatum odoratum</i> (Mill.) Druce	p	H	Euro-Sib	<i>Liliaceae</i>
112	<i>Polypodium vulgare</i> L.	p	H	Boreal	<i>Polypodiaceae</i>
113	<i>Polystichum setiferum</i> (Forsk.) Moore	p	H	Kos	<i>Aspidiaceae</i>
114	<i>Potentilla micrantha</i> Ramond ex DC	p	H	Euro-Med	<i>Rosaceae</i>
115	<i>Primula veris</i> L.	p	H	Euro- subMed	<i>Primulaceae</i>
116	<i>Prunella grandiflora</i> (L.) Scholler	p	H	subMed	<i>Lamiaceae</i>
117	<i>Prunella vulgaris</i> L.	p	H	Kos	<i>Lamiaceae</i>
118	<i>Prunus avium</i> L.	t	Ph	subMed	<i>Rosaceae</i>
119	<i>Prunus cerassifera</i> Ehrh.	t	Ph	EuroAs	<i>Rosaceae</i>
120	<i>Pseudotsuga menziesii</i> (Mirbel) Franco	t	Ph	Nam(Adv.)	<i>Hypolepidiaceae</i>
121	<i>Pteridium aquilinum</i> (L.) Kuhn.	p	H	Kos	<i>Dennstaedtiaceae</i>
122	<i>Quercus petraea</i> Ten.	t	Ph	subMed	<i>Fagaceae</i>
123	<i>Robinia pseudoacacia</i> L.	t	Ph	adv	<i>Fabaceae</i>
124	<i>Rosa arvensis</i> Hudson	b	C	subMed	<i>Rosaceae</i>
125	<i>Rosa canina</i> L.	b	C	subMed	<i>Rosaceae</i>
126	<i>Rubus hirtus</i> W. K.	b	C	subMed	<i>Rosaceae</i>
127	<i>Rumex sanguineus</i> L.	p	H	Euro-Med	<i>Polygonaceae</i>
128	<i>Sambucus nigra</i> L.	b	C	Euro-Med	<i>Caprifoliaceae</i>
129	<i>Sanicula europaea</i> L.	p	H	Euro-Sib	<i>Apiaceae</i>
130	<i>Saxifraga rotundifolia</i> L.	p	H	subMed	<i>Saxifragaceae</i>
131	<i>Scilla bifolia</i> L.	p	Cr	Pont- subMed	<i>Liliaceae</i>
132	<i>Scutellaria columnae</i> All.	p	H	subMed	<i>Lamiaceae</i>
133	<i>Sedum cepaea</i> L.	a	T	subMed	<i>Crassulaceae</i>
134	<i>Silene italica</i> (L.) Pers.	p	H	Euro-Med	<i>Caryophyllaceae</i>
135	<i>Silene vulgaris</i> (Moench.) Garcke	p	H	Euro-As	<i>Caryophyllaceae</i>
136	<i>Sorbus domestica</i> L.	t	Ph	Euro-Med	<i>Rosaceae</i>
137	<i>Sorbus torminalis</i> (L.) Cr.	t	Ph	Pont-Med	<i>Rosaceae</i>
138	<i>Stachys sylvatica</i> L.	p	H	Eur-As	<i>Lamiaceae</i>

139	<i>Stellaria media</i> (L.) Vill.	a	T	Kos	<i>Caryophyllaceae</i>
140	<i>Symphytum ottomanum</i> Friv.	p	H	Bal-Anat	<i>Boraginaceae</i>
141	<i>Tamus comunis</i> L.	p	H	subMed	<i>Dioscoreaceae</i>
142	<i>Tanacetum corymbosum</i> (L.) Shultz.-Bip.	p	H	Pont-Med	<i>Asteraceae</i>
143	<i>Tilia cordata</i> Mill.	t	Ph	Eur	<i>Tiliaceae</i>
144	<i>Tilia tomentosa</i> Moench.	t	Ph	Euro-Med	<i>Tiliaceae</i>
145	<i>Trifolium hybridum</i> L.	p	H	Euro-Med	<i>Fabaceae</i>
146	<i>Trifolium dubium</i> Sibth.	p	H	Euro-Med	<i>Fabaceae</i>
147	<i>Trifolium medium</i> L.	p	H	Euro-As	<i>Fabaceae</i>
148	<i>Trifolium repens</i> L.	p	H	Euro-Sib	<i>Fabaceae</i>
149	<i>Ulmus glabra</i> Huds.	t	Ph	Euro-Med	<i>Ulmaceae</i>
150	<i>Ulmus minor</i> Miler	t	Ph	Euro-Med	<i>Ulmaceae</i>
151	<i>Urtica dioica</i> L.	p	H	Boreal	<i>Urticaceae</i>
152	<i>Verbascum nigrum</i> L.	p	H	Pont-CAs	<i>Scrophulariaceae</i>
153	<i>Veronica chamaedrys</i> L.	p	H	Euro-As	<i>Scrophulariaceae</i>
154	<i>Veronica hederifolia</i> L.	a	T	Euro-Med	<i>Scrophulariaceae</i>
155	<i>Veronica officinalis</i> L.	p	H	Euro-Sib	<i>Scrophulariaceae</i>
156	<i>Vicia cassubica</i> L.	p	H	Euro-Med	<i>Fabaceae</i>
157	<i>Viola hirta</i> L.	p	H	Euro-As	<i>Violaceae</i>
158	<i>Viola mirabilis</i> L.	P	H	Euro-As	<i>Violaceae</i>
159	<i>Viola odorata</i> L.	P	H	Euro-Med	<i>Violaceae</i>
160	<i>Viola reichenbachiana</i> Jord. ex Boreau	P	H	Euro-As	<i>Violaceae</i>
161	<i>Viscaria vulgaris</i> Rohl. <i>ssp.</i> <i>athropurpurea</i> (Griseb.) Stoj.	P	H	Euro-Sib	<i>Caryophyllaceae</i>
162	<i>Viscum album</i> L.	B	C	Euro-As	<i>Loranthaceae</i>

Appendix 2. Genus diversity of established plant species families in the sweet chestnut forests flora of Belasitsa mountain, Soutwestern Bulgaria

N_f	Family	Genus	N_g
1	<i>Aceraceae</i>	<i>Acer</i>	1
2	<i>Apiaceae</i>	<i>Daucus, Huetia, Physospemum, Sanicula</i>	4
3	<i>Araceae</i>	<i>Arum</i>	1
4	<i>Araliaceae</i>	<i>Hedera</i>	1
5	<i>Aristolochiaceae</i>	<i>Aristolochia</i>	1
6	<i>Aspidiaceae</i>	<i>Polystichum</i>	1
7	<i>Aspleniaceae</i>	<i>Asplenium, Ceterah</i>	2
8	<i>Asteraceae</i>	<i>Arctium, Doronicum, Hieracium, Hypochaeris, Leucanthemum, MycelisTanacetum</i>	7
9	<i>Betulaceae</i>	<i>Betula, Carpinus, Corylus, Ostrya</i>	4
10	<i>Boraginaceae</i>	<i>Buglossoides, Symphytum</i>	2
11	<i>Brassicaceae</i>	<i>Arabis, Cardamine, Lunaria</i>	3
12	<i>Campanulaceae</i>	<i>Campanula</i>	1
13	<i>Caprifoliaceae</i>	<i>Lonicera, Sambucus</i>	2
14	<i>Cariophyllaceae</i>	<i>Viscaria, Silene, Stellaria</i>	3
15	<i>Celastraceae</i>	<i>Euonymus</i>	1
16	<i>Colchicaceae</i>	<i>Colchicum</i>	1
17	<i>Cornaceae</i>	<i>Cornus</i>	1
18	<i>Crassulaceae</i>	<i>Sedum</i>	1
19	<i>Cyperaceae</i>	<i>Carex</i>	1
20	<i>Dennstaedtiaceae</i>	<i>Pteridium</i>	1
21	<i>Dioscoreaceae</i>	<i>Tamus</i>	1
22	<i>Dryopteridaceae</i>	<i>Cystopteris, Driopteris</i>	2
23	<i>Euphorbiaceae</i>	<i>Euphorbia</i>	1
24	<i>Fabaceae</i>	<i>Astragalus, Chamaecytisus, Coronilla, Genista, Lathyrus, Robinia, Trifolium, Laburnum</i>	9
25	<i>Fagaceae</i>	<i>Castanea, Fagus, Quercus</i>	3
26	<i>Gentianaceae</i>	<i>Centaurium</i>	1
27	<i>Geraniaceae</i>	<i>Geranium</i>	1
28	<i>Hypericaceae</i>	<i>Hypericum</i>	1

29	<i>Hypolepidiaceae</i>	<i>Pseudotsuga</i>	1
30	<i>Iridaceae</i>	<i>Crocus</i>	1
31	<i>Juglandaceae</i>	<i>Juglans</i>	1
32	<i>Juncaceae</i>	<i>Luzula</i>	1
33	<i>Lamiaceae</i>	<i>Ajuga, Acinos, Scutellaria, Calamintha, Clinopodium, Glechoma, Lamium, Prunella</i>	8
34	<i>Liliaceae</i>	<i>Allium, Polygonatum, Scilla</i>	3
35	<i>Loranthaceae</i>	<i>Viscum</i>	1
36	<i>Oleaceae</i>	<i>Fraxinus</i>	1
37	<i>Onagraceae</i>	<i>Circea</i>	1
38	<i>Orchidaceae</i>	<i>Cephalanthera, Corallorhiza, Orchis</i>	3
39	<i>Orobanchaceae</i>	<i>Orobanche</i>	1
40	<i>Papaveraceae</i>	<i>Corydalis</i>	1
41	<i>Phytolaccaceae</i>	<i>Phytolacca</i>	1
42	<i>Plantaginaceae</i>	<i>Platanus</i>	1
43	<i>Poaceae</i>	<i>Brachypodium, Dactylis, Festuca, Lolium, Melica, Poa</i>	6
44	<i>Polygonaceae</i>	<i>Rumex</i>	1
45	<i>Polypodiaceae</i>	<i>Polypodium</i>	1
46	<i>Primulaceae</i>	<i>Cyclamen, Primula</i>	2
47	<i>Ranunculaceae</i>	<i>Anemone, Clematis, Ficaria</i>	3
48	<i>Rosaceae</i>	<i>Aremonia, Cerasus, Crataegus, Fragaria, Geum, Prunus, Rosa, Rubus, Sorbus</i>	9
49	<i>Rubiaceae</i>	<i>Galium</i>	1
50	<i>Saxifragaceae</i>	<i>Saxifraga</i>	1
51	<i>Scrophulariaceae</i>	<i>Digitalis, Verbascum, Veronica</i>	3
52	<i>Tiliaceae</i>	<i>Tilia</i>	1
53	<i>Ulmaceae</i>	<i>Ulmus</i>	1
54	<i>Urticaceae</i>	<i>Urtica</i>	1
55	<i>Violaceae</i>	<i>Viola</i>	1

Appendix 3. Diagnostic table

Association *Tilio tomentosae*–*Castanetum sativae* Dafis 1973

Number in order of SYN-TAX program	21	11	12	6	4	10	9	2	14	13	19	17	15	20	5	18	16	7	1	3	C	C	
Number of sample area	25	12	13	7	5	11	10	3	17	14	23	21	19	24	6	22	20	8	1	4	o	o	
Location - GPS coordinates	N	4587049	4587313	4587304	4586550	4586540	4587039	4587052	4586041	4587546	4587299	4585292	4584804	4586043	4585801	4586550	4584785	4585041	4586045	4587056	4586302	n	n
	E	182753	182508	182759	182745	182490	182487	182245	182257	181005	181000	182758	182244	182993	183009	182253	182495	182489	181999	181014	182495	s	s
UTM 35 N WGS 1984																							
Sample plot area (sq. m)	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144	144		
Altitude (m)	490	497	403	494	615	548	652	782	532	583	622	897	574	573	720	785	740	853	640	706			
Exposition (in degrees)	22	22	45	90	22	67	90	135	45	45	45	45	315	270	0	135	90	135	270	67			
Inclination (in degrees)	40	35	25	41	40	20	15	23	18	8	37	45	30	43	22	5	29	28	25	40			
Total coverage (layers, in %):																						%	c
Layer																							
t- Tree layer	45	55	30	90	75	80	80	85	70	65	90	95	95	80	90	80	85	90	70	90		l	
s - Shrub layer	60	60	50	45	25	40	60	15	10	30	40	10	50	20	20	50	20	40	25	20		a	
h - Herbaceous layer	10	20	65	5	30	30	30	10	70	30	40	3	10	20	15	5	2	20	30	15		s	
d - Mosses and lichens, + = 0-1%	0	1	2	0	15	2	0	0	0	0	0	+	0	1	0	1	+	+	0	1		s	

Diagnostic species of association

<i>Castanea sativa</i>	t	3	3	4	3	3	4	4	5	4	3	2	1	4	1	4	4	4	3	3	4	100	V
<i>Castanea sativa</i>	s	+	1	1	+		+	1	1	+	1	+		+	+	+	1	+	1	2		85	V
<i>Castanea sativa</i>	h	1	1	1	+	+	2	1	1	1	+	+	+	3	+	1	+	+	+	1	+	100	V
<i>Tilia tomentosa</i>	t	+	2			3	+	+		1	1	2	+			+	+	1		+	+	70	IV
<i>Tilia tomentosa</i>	s	+	1			1		+	+		1	2		+	+	+	+	+	+		+	70	IV
<i>Tilia tomentosa</i>	h	+	+	+		+	+	3	+	1	2	1	+	+	+	+	+	1	+	1		90	V
<i>Mycellis muralis</i>	h	+	+	1	+		+		+	1	+		+				r				+	45	III
<i>Galium pseudoaristatum</i>	h	+		+	+	+			+				+		+		+	+	1	1	+	60	III
<i>Campanula trachelium</i>	h						+		+	+	+				+					+	+	35	II
<i>Lathyrus venetus</i>	h			+				+								+	+	+	2	+		35	II

<i>Asperula odorata</i>	h		+						1										2	20	I	
<i>Prunella vulgaris</i>	h			+																	10	I
<i>Polystichum setiferum</i>	h									+										1	10	I
<i>Festuca drymeja</i>	h																				5	I
variant <i>Fagus sylvatica</i>																						
<i>Fagus sylvatica</i>	t																				50	III
<i>Fagus sylvatica</i>	s										+										55	III
<i>Fagus sylvatica</i>	h																				50	III
Alliance <i>Quercion frainetto</i> Horvat 1958																						
<i>Euphorbia amygdaloides</i>	h	+		+	+	+	+	+	+	2	+	+	+	+	+	+	+	+	+	+	85	V
<i>Pteridium aquilinum</i>	h	+	+	2			+	+	2	+	1	+	+	+					1		65	IV
<i>Lathyrus laxiflorus</i>	h	+	+				+		+		1	+		1				+	1	+	55	III
<i>Potentilla micrantha</i>	h	+	+		+	+	+	+	+	1								+	+	+	60	III
<i>Lathyrus niger</i>	h							+	+		+							+	1		30	II
<i>Physospermum cornubiense</i>	h						+	+	1		+										25	II
<i>Sorbus torminalis</i>	t	+								+								+	+		25	II
<i>Sorbus torminalis</i>	s		+															+	+	+	30	II
<i>Sorbus torminalis</i>	h		+			+				+	+							+	+		45	III
<i>Doronicum orientale</i>	h																				5	I
<i>Tanacetum corymbosum</i>	h																		+	+	10	I
<i>Crocus flavus</i>	h									+	+										10	I
<i>Huetia cynapioides</i>	h										+										10	I
Order <i>Quercetalia pubescentis</i> Braun-Blanq. 1932																						
<i>Ostrya carpinifolia</i>	t				+	1	+		+	+	+	1	2	+	2			+	+		65	IV
<i>Ostrya carpinifolia</i>	s	+			+														+		20	I
<i>Ostrya carpinifolia</i>	h						+												+		10	I
<i>Fraxinus ornus</i>	t	+			+	1	+		+	+		+	1		+			+	1		55	III
<i>Fraxinus ornus</i>	s	1	1	+	+	1			+	+	1	+	+	1		1	1	2	2	+	45	IV
<i>Fraxinus ornus</i>	h	+	+	+	+	+		1	+	+	+	1	+	+		+	1	+	+		85	V
<i>Carpinus orientalis</i>	t	+	+							1				+							20	I
<i>Carpinus orientalis</i>	s	1	1	2	1					1						1			+		40	II

<i>Carpinus orientalis</i>	h	+	+	+	+				+		+		+	+				40	II
<i>Cornus mas</i>	s	+	+		1	1	+			1	+							35	II
<i>Cornus mas</i>	h		+	+	+	1	+		+				+					35	II
<i>Acer campestre</i>	t						+											5	I
<i>Acer campestre</i>	s						+		+					+				10	I
<i>Acer campestre</i>	h			+														5	I
<i>Malus sylvestris</i>	t							1	+	+								15	I
<i>Malus sylvestris</i>	s		+								+		+					20	I
<i>Malus sylvestris</i>	h							+										5	I
<i>Juglans regia</i>	s								+									5	I
<i>Juglans regia</i>	h						+										+	10	I
<i>Sorbus domestica</i>	s		r															5	I
<i>Polygonatum odoratum</i>	h							+		+	1	r	+	+	+	+	+	55	III
<i>Dentaria bulbifera</i>	h		+	+			+	1	+	+	+	+	+		+		+	60	III
<i>Clinopodium vulgare</i>	h	+	+	+												r	+	35	II
<i>Tammus communis</i>	h	+	+				+	+	+		+				+			30	II
<i>Asplenium adiantum-nigrum</i>	h	+		+	+	+	+								+			30	II
<i>Stellaria media</i>	h		+	+		+	+		r	1								30	II
<i>Aristolochia rotunda</i>	h								+									5	I
<i>Euphorbia polychroma</i>	h									+								5	I
<i>Cephalanthera damassonium</i>	h									+		+	r	+				20	I
<i>Festuca heterophylla</i>	h							+								r		15	I
<i>Cyclamen hederifolium</i>	h		+							+		+	+					20	I
<i>Silene vulgaris</i>	h							+		+					+			15	I
<i>Acer tataricum</i>	h								+									5	I
<i>Astragalus glycyphyllus</i>	h									+								5	I
<i>Campanula persicifolia</i>	h			+														5	I
Class <i>Quercus-Fagetea</i> Braun-Blanq. et Vieg. 1937																			
<i>Carpinus betulus</i>	t	1	+	+		+			1	1		+	+	+	+	2		65	IV
<i>Carpinus betulus</i>	s	+	+	+	+					+	+	+	+	+	+		1	55	III
<i>Carpinus betulus</i>	h									+	+	+			1	+		25	II
<i>Quercus petraea</i>	t				1						3				3	1	2	35	II

<i>Primula veris</i>	h	+	+	+		1		1	1	+		+	+			+	50	III		
<i>Hedera helix</i>	h	+	+	1		+						2		1	1	+	2	45	III	
<i>Poa nemoralis</i>	h	+	+	+	+		+									+	+	+	40	II
<i>Aremonia agrimonioides</i>	h	+						+	+	1			r		+		+	35	II	
<i>Cystopteris fragilis</i>	h	+	+	+	+	+	+										+	35	II	
<i>Geum urbanum</i>	h			+		+		+	+									25	II	
<i>Silene italica</i>	h	+	+	+		r	+											25	II	
<i>Dactylis glomerata</i>	h			+			1						r		+	+		20	II	
<i>Ficaria verna</i>	h	+		+		+			4									20	I	
<i>Hieracium gentile gr.</i>	h												+	r	+	1		20	I	
<i>Dryopteris filix-mas</i>	h			+		+	+						+					20	I	
<i>Viola reichenbachiana</i>	h					+		+	+	+								20	I	
<i>Circaea lutetiana</i>	h					+			2							+		15	I	
<i>Euonymus europaeus</i>	h					+										+	+	15	I	
<i>Lunaria rediviva</i>	h	+	+												+			15	I	
<i>Sanicula europaea</i>	h			+		+			+									15	I	
<i>Anemone ranunculoides</i>	h	1	+			+	1									+		10	II	
<i>Glechoma hirsuta</i>	h	+		+														10	I	
<i>Arabis turritta</i>	h				+	+												10	I	
<i>Lathyrus vernus</i>	h												+		1			10	I	
<i>Scilla bifolia</i>	h							1	1									10	I	
<i>Viscum album</i>	s											+						5	I	
<i>Geranium robertianum</i>	h					2												5	I	
<i>Carex muricata</i>	h									+								5	I	
<i>Buglossoides purpureo-coeruleum</i>	h																+	5	I	
<i>Corydalis bulbosa</i>	h																+	5	I	
<i>Lonicera xylosteum</i>	h				+													5	I	
<i>Digitalis viridiflora</i>	h		+															5	I	
Other species																				
<i>Platanus orientalis</i>	t		1		1													10	I	
<i>Robinia pseudoacacia</i>	t						2											5	I	

<i>Robinia pseudoacacia</i>	s							+										5	I	
<i>Crataegus monogina</i>	h			+	+		+			+								20	I	
<i>Rubus hirtus gr.</i>	s	+								+	+					+		20	I	
<i>Rubus hirtus gr.</i>	h	1	+	+	+	+	2	1	+			+	1		1	+		60	III	
<i>Cornus sanguinea</i>	s	+	+				+											15	I	
<i>Cornus sanguinea</i>	h			+			+					+						20	I	
<i>Coronilla emerus ssp. emeroides</i>	s												+			+		10	I	
<i>Prunus cerasifera</i>	s												+					10	I	
<i>Prunus cerasifera</i>	h	+		+			+	+	+	+								30	II	
<i>Genista janensis</i>	s																1	5	I	
<i>Rosa canina gr.</i>	s	r								+								10	I	
<i>Laburnum anagiroides</i>	s						+											5	I	
<i>Laburnum anagiroides</i>	h		+															5	I	
<i>Asplenium trichomanes</i>	h	+	+	+	+	+	+						+			+		40	II	
<i>Orobanche sp.</i>	h		+			+	+	+				+	r					30	II	
<i>Campanula patula ssp. patula</i>	h						+	+	r						+		+	25	II	
<i>Symphytum ottomanum</i>	h					+				+	+		r					25	II	
<i>Arum italicum</i>	h					r		+		+								20	I	
<i>Asplenium ruta-muraria</i>	h		+		+				r							+		20	I	
<i>Rumex sanguineus</i>	h			+			+	+		+								25	I	
<i>Saxifraga rotundifolia</i>	h	+	+	+		2												20	I	
<i>Scutellaria columnae</i>	h								+	+							1	1	20	I
<i>Viscaria vulgaris</i>	h								r						+	+		15	I	
<i>Calamintha sylvatica</i>	h									+	+							10	I	
<i>Clematis vitalba</i>	h			+					1									10	I	
<i>Colchicum autumnale</i>	h						+							+				10	I	
<i>Corralorhiza trifida</i>	h														r	+		10	I	
<i>Fragaria vesca</i>	h	+		+														10	I	
<i>Galium aparine</i>	h					+				1								10	I	
<i>Lamium garganicum</i>	h					+				1								10	I	

<i>Orchis sp.</i>	h						r	+			10	I		
<i>Trifolium hybridum</i>	h	+		+							10	I		
<i>Trifolium medium</i>	h						r	+			10	I		
<i>Vicia cassubica</i>	h	+		+							10	I		
<i>Viola odorata</i>	h	+		+							10	I		
<i>Acinos rotundifolius</i>	h					+					5	I		
<i>Ajuga reptans</i>	h						+				5	I		
<i>Allium paniculatum</i>	h							r			5	I		
<i>Arctium lappa</i>	h						+				5	I		
<i>Asplenium viride</i>	h										+	5	I	
<i>Brachypodium pinnatum</i>	h									+	5	I		
<i>Centaureum erythraeum</i>	h										+	5	I	
<i>Ceterah officinarum</i>	h									+	5	I		
<i>Coronilla emerus ssp. emeroides</i>	h									+	5	I		
<i>Daucus carota</i>	h										+	5	I	
<i>Euphorbia cyparissias</i>	h									+	5	I		
<i>Genista tinctoria</i>	h										+	5	I	
<i>Geranium lucidum</i>	h									+	5	I		
<i>Hieracium pilosella</i>	h										+	5	I	
<i>Hypochaeris glabra</i>	h									+	5	I		
<i>Hypericum perforatum</i>	h										+	5	I	
<i>Lathyrus sphaericus</i>	h	+									5	I		
<i>Leucanthemum vulgare</i>	h										+	5	I	
<i>Lolium temulentum</i>	h										+	5	I	
<i>Phytolacca americana</i>	h										+	5	I	
<i>Poa sylvicola</i>	h	+									5	I		
<i>Polygonatum multiflorum</i>	h									+	5	I		
<i>Polypodium vulgare</i>	h										+	5	I	
<i>Prunella grandiflora</i>	h										+	5	I	
<i>Pseudotsuga mensiesii</i>	h										r	5	I	
<i>Sedum cepaea</i>	h										+	5	I	
<i>Stachys sylvatica</i>	h											1	5	I
<i>Trifolium dubium</i>	h											+	5	I

<i>Trifolium repens</i>	h		+													5	I	
<i>Urtica dioica</i>	h		+														5	I
<i>Verbascum nigrum</i>	h					r											5	I
<i>Veronica hederifolia</i>	h						1										5	I
<i>Veronica officinalis</i>	h		+														5	I
<i>Viola hirta</i>	h					+											5	I
<i>Viola mirabilis</i>	h						+										5	I
<i>Lobaria pulmonaria</i>	d					+						r					10	I
<i>Dicranium sp.</i>	d	1		2				+	1	1	+	+			1	40	II	