

Flora of the order *Quercetalia pubescentis* Br.-Bl. (1931) 1932 in the forest vegetation of the Požega hill area (NE Croatia)

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This paper is a part of systematic ecological-vegetational research into the forest vegetation of the Slavonian hill area, an exceptionally valuable site in the vegetation of the Republic of Croatia. Particular attention was paid to the presence of the species of the order *Quercetalia pubescentis* in the forest vegetation owing to the fact that they are a special and rare feature in continental forest ecosystems. A total of 123 relevés encompassing 12 forest communities were analysed. The analysis of the floral composition of forest communities of Požega hill area revealed as many as 213 species, of which 31 or 14.5 % belong to the order *Quercetalia pubescentis* in a sociological sense. The species from the order *Quercetalia pubescentis* encompass the warmest, southern, south-eastern and south-western positions in the upper parts of the slopes, the flat tops of ridges and crests, as well as the stands with lighter and drier conditions. In terms of physiognomy and sociology, the species of the order *Quercetalia pubescentis* give the most distinct characteristic to the community *Lathyro-Quercetum petraeae*. The number of species of the order *Quercetalia pubescentis* decreases considerably going from the west to east with the exception of the Požega hill area. A comparison of species occurring in certain areas shows that the western part differs from the eastern part, to which the hills of Požega belong. The spectrum of biological forms and the spectrum of floral geoelements were determined for each community. The results of the research broaden the perception of the number, distribution and importance of species of *Quercetalia pubescentis* order in the forest ecosystems of hills in the Pannonian plain.

Key words: Forest, vegetation, flora, synecology, *Quercetalia pubescentis*, Požega, Croatia

Introduction

The paper deals with systematic synecological-vegetational research into the forest vegetation of the Slavonian mountain area, which has been the subject of study in the last few years (TRINAJSTIĆ et al. 1996, 1997, TOMAŠEVIĆ and SAMARDIĆ 2000, KNEŽEVIĆ 2001, BARIČEVIĆ 2002).

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Slavonian mountains are on the boundary of highly diverse influences (Alpine from the west, Dinaric from the south and the much more arid Pannonian from the north and east) has given rise to the occurrence of a large number of plant species and forest communities.

With their specific relief structure and southern position in particular, they constitute a distinct feature of the spacious Pannonian plain. The southern position affects the climate in the first place, and consequently, the appearance and importance of the entire landscape. In continental Croatia, the Slavonian mountains take up the central geographical position and belong to the western, montane part of Slavonia. In a narrower sense, the hill area of Požega (composed of Požeška and Babja Gora) is located in the southern and south-western part of the Slavonian mountain range (Psunj, Papuk, Krndija, Dilj Gora and Požeška Gora) within the Sava – Drava river basin (Fig. 1).

The hills of Požega are characterised by frequent geomorphological alterations consisting of steep and erosion-prone sides, deeply etched ditches, plateaux and mild slopes. In terms of terrain configuration, parts of the massif in the north west are the highest, those in the centre are slightly steeper, whereas in the eastward direction the terrain gradually decreases and assumes mildly undulating, hilly and flat features. The altitudes are mainly between 200 and 500 m above sea level.

The hills of Požega have a highly heterogeneous geological-lithological structure. They are predominantly composed of Tertiary and Quaternary sediments, and to a smaller degree, of Tertiary igneous rocks. The Oligo-Miocene sediments, represented by sandstones, marls and conglomerates that are constantly changing are the most widely distributed (ŠKORIĆ 1977).

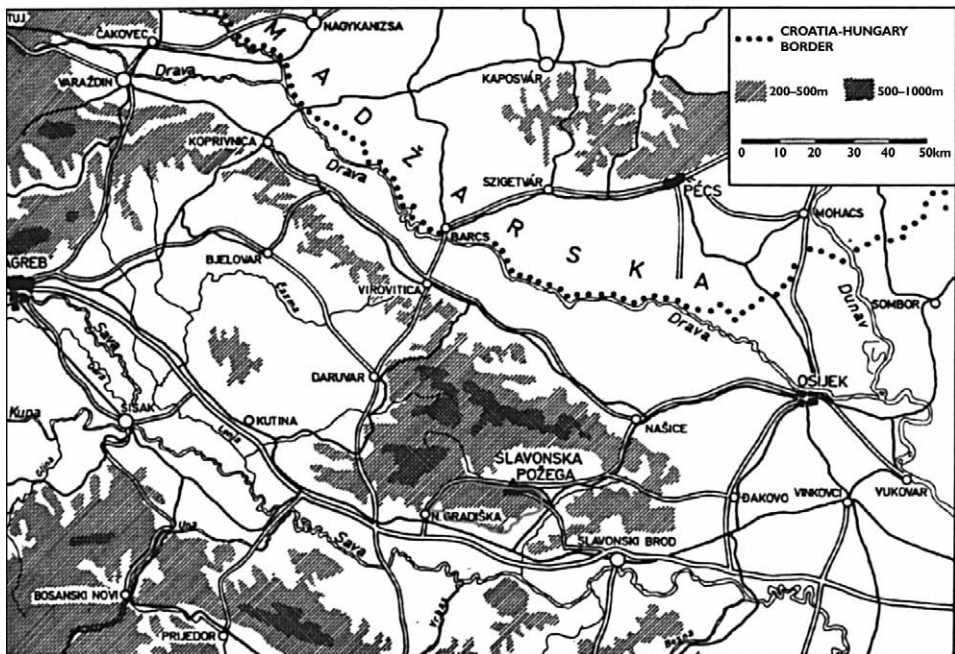


Fig. 1. Central position of Požega hill area in continental Croatia and the south-Pannonian region

The results of taxonomic soil determination indicate the dominance of luvisols, followed by dystric cambisol and pseudogley, and less by eutric brown soil or rendzina (BARIČEVIĆ 2002).

In Köppen's classification, the investigated area belongs to the temperate climate of the Cfbw^b type. The mean annual air temperature is 10.8 °C. The total annual precipitation quantity is 795.8 mm, of which 449.3 mm or 56.46 % occurs in the vegetation period (meteorological station Požega, for the period 1981–1998). All the listed climatological data indicate very favourable conditions for the growth of vegetation.

The total surface of the study area is 15,428.81 ha. The area is well covered with mainly sessile oak and common beech.

In this work, special attention was paid to the presence of the species of the order *Quercetalia pubescentis* in the forest vegetation, since they are a specific and rare occurrence in the continental forest ecosystem. The order *Quercetalia pubescentis* embraces forest communities in the warmer regions of southern and central Europe. These communities are particularly well developed in the south-east of Europe. In the south they occur as climatozonal communities, whereas in the north, they are extrazonal communities. The main features of such habitats are dry and shallow soils. The characteristic species of the order are thermophilic floral elements.

Material and methods

The floral composition of forest communities in the hills of Požega was analysed in detail as part of the continuing synecological-vegetational research into the forest vegetation of Požeška and Babja Gora (BARIČEVIĆ 2002).

Forest vegetation was investigated according to the principles of the Zurich-Montpellier school. The scientific names of plants were coordinated with EHRENDORFER (1973).

A total of 123 relevés encompassing 12 forest communities were analysed. Forests of sessile oak were classified in six associations, of beech in three, of pedunculate oak in two and of black alder in one association.

Special attention was given to the species of the order *Quercetalia pubescentis*. Their total number and percentage, the number and percentage in individual associations, as well as the relationship of the species towards habitat conditions (climatic, edaphic and geomorphological factors) were determined. The affiliation of the species to the order *Quercetalia pubescentis* was determined according to REGULA – BEVILACQUA (1978), ŠUGAR (1972), HORVAT et al. (1974) and VUKELIĆ (1991).

The species were also analysed according to biological forms taken from RAUŠ and ŠEGULJA (1983) and some other authors.

The floral geoelements were determined according to OBERDORFER (1983) and were also analysed.

With reference to pedophysiological soil properties, the focus was laid on those that have made the strongest imprint on the ecological features of the rhizosphere and whose variability best corresponded with the characteristics of ground vegetation occurrence in the forest ecosystem, in the first place the pH values (in water and CaCl₂) and the saturation

of the adsorption complex with alkaline cations (method by Kappen). For cluster analyses the program Statistica 6.0 was used.

Results and discussion

The analysis of the floral system of forest communities in the hilly Požega area identified a total of 213 species, of which 31 or 14.5 % belong to the order *Quercetalia pubescentis* in terms of sociology.

As shown in Table 1, the only species of the order *Quercetalia pubescentis* occurring in all three layers of the forest vegetation in the hills of Požega are the wild service tree (*Sorbus torminalis*), Turkey oak (*Quercus cerris*) and manna ash (*Fraxinus ornus*). Apart from these, the shrub layer also contains large quantities of common privet (*Ligustrum vulgare*), Cornelian cherry dogwood (*Cornus mas*), wayfaring tree (*Viburnum lantana*) and hairy broom (*Chamaecytisus hirsutus* and *Ch. supinus*). The best represented species in the layer of ground vegetation are *Lathyrus niger*, *Melittis melissophyllum*, *Dactylis glomerata*, *Viola hirta*, *Potentilla micrantha*, *Campanula persicifolia* and *Carex flacca*.

The Table also shows that the largest number of the species of the *Quercetalia pubescentis* order, amounting to 26, occurs in the thermophilic forest of sessile oak with black pea (*Lathyro-Quercetum petraeae* I. Horvat /1938/ 1958), in the acidothermophilic forest of sessile oak with hawkweed (*Hieracio racemosi-Quercetum petraeae* VUKELIĆ /1990/ 1991), amounting to 21, and in the forest of sessile oak with fescue (*Festuco-Quercetum petraeae* JANKOVIĆ 1968/ HRUŠKA 1974), 20 species. Other sessile oak communities and beech communities contain a much smaller number of species from this order, with the lowest number occurring in the community of pedunculate oak and common alder.

Accordingly, the species of the *Quercetalia pubescentis* order give the most important physiognomical and sociological feature to the community *Lathyro-Quercetum petraeae*. In the tree layer these are Turkey oak, manna ash and wild service tree, whereas in the shrub layer there is the dominance of thermophilic species *Fraxinus ornus*, *Sorbus torminalis*, *Cornus mas*, *Ligustrum vulgare* and *Chamaecytisus hirsutus*. The physiognomy of the community is particularly well expressed in the vegetation of the ground layer. This layer is also dominated by thermophilic species from the *Quercetalia pubescentis* order, among which *Lathyrus niger*, *Carex flacca*, *Dactylis glomerata*, *Viola hirta*, *Clinopodium vulgare* and *Melittis melissophyllum* are particularly prominent by their coverage (Fig. 2).

These species also play a very important role in the community *Hieracio racemosi-Quercetum petraeae*, where they indicate a fundamentally different climate of south-eastern Europe, give this community an acidothermophilic character and separate it from similar Central European communities, similarly to the community *Festuco-Quercetum petraeae*.

In terms of percentage share of the species from the *Quercetalia pubescentis* order for individual communities, the relations are very similar. The largest share of the species from the *Q. pubescentis* order is found in the forest of sessile oak with hawkweed (28.0 %), in the forest of sessile oak with fescue (25.32 %) and in the forest of sessile oak with black pea (22.94 %) (Fig. 3).

A comparison of synecological conditions of the occurrence of individual forest communities and the number and share of the species from the *Quercetalia pubescentis* order

Tab. 1. Species from the *Quercetalia pubescentis* order in forest communities of Požega hill area

Species	Associations										
	L.-Q.	Q.-C.	H.r.-Q.	F.-Q.	E.-C.	F.-C.	L.-F.	V.o.-F.	C.p.-F.	G.e.-Q.	C.b.-A.
<i>Quercus cerris</i> A	III (2-3)		II (1)		I (1)						
<i>Sorbus torminalis</i>	I (+-1)			I (+)		I (1)					
<i>Fraxinus ornus</i>	I (1)			II (+-1)							
<i>Sorbus torminalis</i> B	V (+-2)	I (1)	IV (+-1)	I (+)	II (+)	IV (+-1)	I (+)	I (+)	I (+)		
<i>Fraxinus ornus</i>	V (1-3)	V (+-2)	V (1-3)	III (+-2)	III (+-1)	II (+-1)	I (1)	I (+-1)	I (+-1)		
<i>Ligustrum vulgare</i>	IV (+-2)	I (+)	III (+-2)	I (+)	IV (+-2)			I (+)	I (+-1)	III (+-2)	III (+-1)
<i>Acer tataricum</i>	II (+-2)		I (+-1)	I (+)	IV (+-2)	I (+)		I (+-1)	I (+)	II (2)	III (1-2)
<i>Cornus mas</i>	IV (+-2)		I (+-1)	III (+-2)	I (1-2)			I (+-1)	I (+-1)		
<i>Chamaecytisus hirsutus</i>	III (+-2)	II (1)	III (+-2)	I (+-1)			I (1)		I (+)		
<i>Chamaecytisus supinus</i>	I (+-1)	I (+)	III (+-2)	II (+-1)			I (1)	I (+)			
<i>Viburnum lantana</i>	II (+-2)		I (+)		II (+-1)						
<i>Sorbus domestica</i>	I (+)		II (+-1)	II (+)							
<i>Quercus cerris</i>	I (+-2)		I (+)			I (+-1)					
<i>Lathyrus niger</i> C	IV (+-3)	I (1)	III (+-2)	IV (+-2)	I (+)	II (+)	I (+)	I (+)	II (+)		
<i>Melittis melissophyllum</i>	III (+-2)	II (+)	II (+)	III (+-1)	II (+-1)	I (+-1)			II (+-1)		
<i>Viola hirta</i>	III (+-1)		II (+-1)	II (+-1)	II (+-1)	I (+)			I (+-1)		
<i>Potentilla micrantha</i>	II (+-2)	III (+)	III (+-1)	IV (+)				I (1)	I (+)		
<i>Campanula persicifolia</i>	II (+-2)		IV (+-2)	I (+)	I (+)	I (+)			I (+-1)		
<i>Dactylis glomerata+polygama</i>	III (+-3)	I (2)	V (1-3)	IV (1-2)	I (+)	II (+-1)					
<i>Carex flacca</i>	IV (+-3)		II (+-2)	I (+-1)				I (1)	I (3)		
<i>Tamus communis</i>	I (+)				II (+-1)			II (+-1)	I (+)	I (+)	
<i>Calamintha clinopodium</i>	III (+)		II (+)	I (+)							
<i>Quercus cerris</i>	III (1-2)		I (+)			I (+)					

Tab. 1. – continued

Species	Associations										
	L.-Q.	Q.-C.	H.r.-Q.	F.-Q.	E.-C.	F.-C.	L.-F.	Vo.-F.	C.p.-F.	G.e.-Q.	C.b.-A.
<i>Tanacetum corymbosum</i>	I(+1)		I(+1)	I(1)							
<i>Sorbus torminalis</i>	I(+2)	I(+)	I(+)								
<i>Buglossoides purpureoaeerulea</i>	I(1-2)				I(2)			I(2)			
<i>Acer tataricum</i>	I(+1)				I(+)	I(+)					
<i>Chamaecytisus hirsutus</i>	I(+)	I(+)	I(+)								
<i>Astragalus glycyphyllos</i>	I(+)			II(+1)							
<i>Cornus mas</i>	I(1)		I(+)								
<i>Silene nutans</i>	I(+)	I(1)									
<i>Fraxinus ornus</i>	I(+1)								I(+)		
<i>Sedum maximum</i>		I(+)	I(+)								
<i>Ligustrum vulgare</i>											
<i>Hypericum montanum</i>	I(+)										
<i>Peucedanum cervaria</i>	I(+)										
<i>Peucedanum oreoselinum</i>	I(+)										
<i>Trifolium rubens</i>			I(+)								
<i>Hypericum umbellatum</i>										I(+)	
<i>Viola alba</i>										I(+)	
<i>Vincetoxicum hirundinaria</i>											I(+)

Key:

L.-Q. – *Lathyro-Quercetum*, Q.-C. – *Quercocastanetum*, H.r.-Q. – *Hieracio racemosi-Quercetum*, F.-Q. – *Festuco-Quercetum*, E.-C. – *Epimedio-Carpinetum*, F.-C. – *Festuco-Carpinetum*, L.-F. – *Luzulo-Fagetum*, Vo.-F. – *Vicio oroboidi-Fagetum*, C.p.-F. – *Carici pilosae-Fagetum*, G.e.-Q. – *Genisto elatae-Quercetum roboris*, C.b.-A. – *Carici brizoidis-Alnetum*

A – tree layer, B – shrub layer, C – layer of ground vegetation

I-V – degree of participation

+ – 5 – combined abundance/cover scale (Braun-Blanquet)



Fig. 2. The most distinct characteristic of the community of sessile oak and black pea are the species from the *Quercetalia pubescentis* (Photo: D. Baričević)

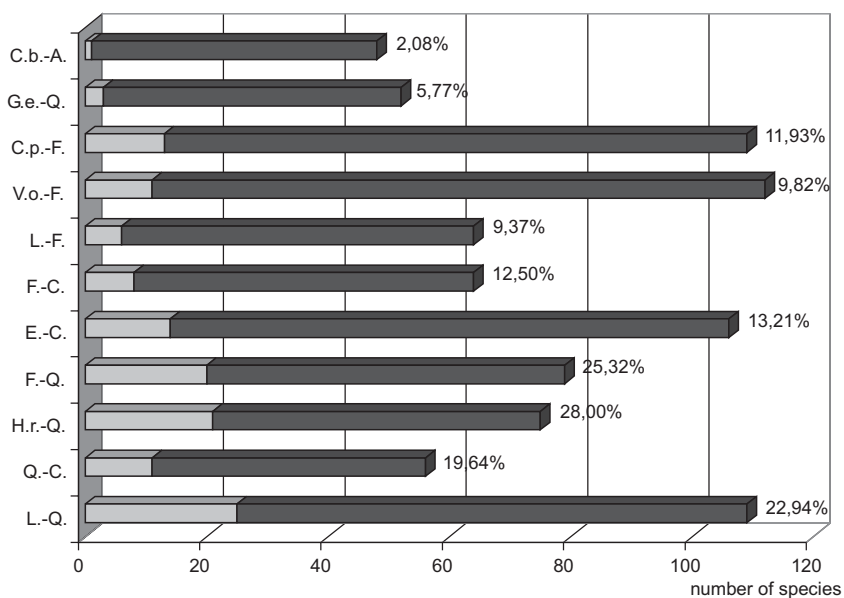


Fig. 3. Percentage share of the species from the *Quercetalia pubescentis* order (grey) in the total number of the species for a given forest community

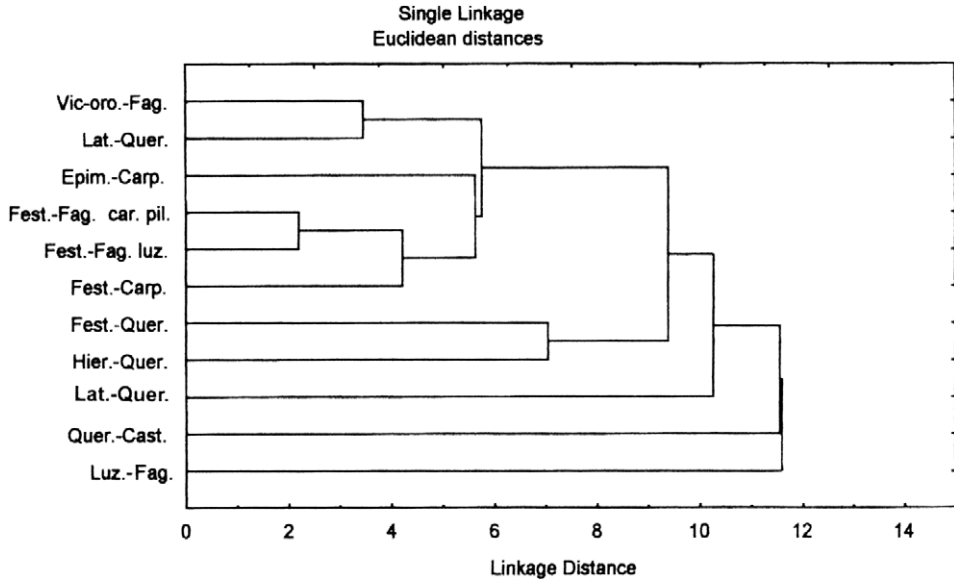


Fig. 4. Analysis of forest communities according to soil parameters (pH values in water, organic carbon content, total nitrogen content, sum of changeable bases and the degree of base saturation)

reveals that these species occur in areas with very limited synecological conditions and small amplitudes.

These are the warmest, southern, south-eastern and south-western positions in the upper parts of slopes, flat parts of ridge tops and crests. The geological substrate is made up of alkaline breccias and conglomerates overtopped by layers of sand, sandy clays and pebbles and sandy marls. The dominant soils supporting these species are dystric cambisols illimerised and slightly less typical and luvisols on silicate-carbonate substrate, shallow to medium deep. They occur from 150 to 550 m above sea level, and the inclinations range from 0 and 45° (mostly up to 20°).

In northern expositions, species of the *Quercetalia pubescentis* order decrease considerably in quantity. Their numbers also decline as the slopes descend towards valleys and ditches, as well as in localities with deeper and more humid soils. A typical soil type is pseudogley on the slope.

This is illustrated by a dendrogram obtained with the cluster analysis (Fig. 4), which shows clear community clustering according to habitat type. Thus, one cluster is composed of communities with a significant presence of the species from the order *Quercetalia pubescentis*, while a completely different one is made up of a more or less neutrophilic community. The independence of the association *Luzulo-Fagetum*, occurring in extremely bad ecological conditions (soil acidity, soil shallowness), is clearly denoted.

KNEŽEVIĆ (2001) obtained very similar results in his study of eco-indicating values of the species making up the community of sessile oak on Požeška Gora. Thus, thermophilic communities (*Lathyro-Quercetum petraeae* and *Hieracio racemosi-Quercetum petraeae*) occur in stands with more light and in drier conditions, whereas neutrophilic communities

Tab. 2. Biological spectrum of sessile and beech communities

Association	Biological spectrum (%)				
	Ph	Ch	H	G	Th
<i>Lathyro-Quercetum</i>	30.8	4.7	48.6	14.0	1.9
<i>Hieracio racemosi-Quercetum</i>	40.0	6.7	42.7	9.3	1.3
<i>Festuco-Quercetum</i>	31.6	6.3	45.6	15.2	1.3
<i>Quercu-Castanetum</i>	35.7	8.9	37.5	16.1	1.8
<i>Epimedio-Carpinetum</i>	29.5	5.7	43.8	18.1	2.9
<i>Festuco-Carpinetum</i>	36.0	7.8	32.8	20.3	3.1
<i>Vicio oroboidi-Fagetum</i>	31.3	5.8	42.2	20.7	0
<i>Carici pilosae-Fagetum</i>	31.6	2.6	39.5	26.3	0
<i>Luzulo-Fagetum</i>	17.6	17.6	41.2	17.6	5.9

(*Epimedio-Carpinetum betuli* and *Festuco-Carpinetum betuli*) are found in more shaded and humid sites.

The biological spectrum of the communities dominated by the species from the *Quercetalia pubescentis* order shows that they are hemicryptophytic-phanerophytic (Tab. 2). These communities clearly have a thermophilic character, since there are fewer chamaephytes and therophytes, whereas hemicryptophytes and geophytes exceed those contained in a typical thermophilic community of the order *Quercetalia pubescentis*. However, this is understandable, since these communities develop in the research area extra-zonally. An increase in the share of geophytes indicates significantly more mesophilic, neutrophilic and deeper soils in other communities (with the exception of the *Luzulo-Fagetum* community).

The spectrum of floral geoelements confirms the introductory hypotheses claiming that the study area is located on the crossroads of highly diverse influences. This is clearly illustrated by a very large number of floral geoelements and their combinations (Fig. 5) with no dominance of one or a group of similar geoelements. Five groups of the most important floral geoelements are only slightly more distinct. These are: 1) a group of sub-Atlantic species occurring in humid south-European mountains under the sub-Mediterranean influence, 2) north-eastern European species, 3) eastern sub-Mediterranean species, 4) Illyrian and Illyrian-like species, and finally, 5) sub-Mediterranean species, occurring mostly in communities characterised by the species of the order *Quercetalia pubescentis*. There are as many as 30% of sub-Mediterranean species – *Hieracio racemosi-Quercetum petraeae* 29.7 %, *Lathyro-Quercetum petraeae* 28.6 % (KNEŽEVIĆ 2001).

In order to give a clearer picture of the importance of the species of the order *Quercetalia pubescentis* for the forest vegetation of Požega hills and the wider area, the occurrence of the species of this order in the association *Lathyro-Quercetum petraeae* was compared in the continental part of Croatia from Strahinčica (REGULA-BEVILACQUA 1978) and Samoborsko Gorje (ŠUGAR 1972) in the west, over Kalnik (VUKELIĆ 1991) and Moslavačka Gora (HRUŠKA-DELL'UOMO 1974) to Požega hills (BARIČEVIĆ 2002) and Fruška Gora (JANKOVIĆ and MIŠIĆ 1980) in the easternmost part (Tab. 3).

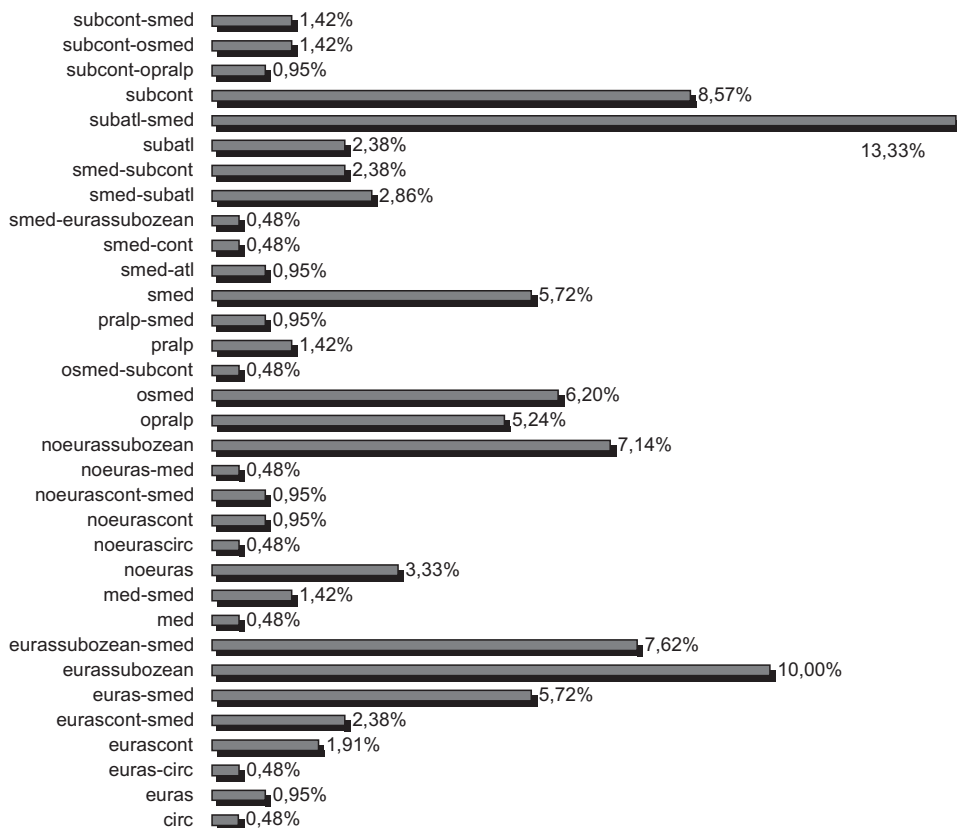


Fig. 5. Spectrum of floral goelements

According to the Table, the number of the species of the *Quercetalia pubescentis* order decreases significantly going from west to east: thus, 36 species were recorded on Strahinčica, 25 on Samoborsko Gorje, 15 on Kalnik, 15 on Moslavačka Gora and 14 species on Fruška Gora. Požega hill area is the only exception, containing 27 species of the order *Quercetalia pubescentis* in its floral composition, which in itself is an indication of the particularity, diversity and value of this area.

A comparison of the species occurring in certain areas shows that the western part differs from the eastern, to which the hill area of Požega belongs. The western part is characterised by the occurrence of the species such as *Ostrya carpinifolia*, *Sorbus aria*, *Acer obtusatum*, *Teucrium chamaedrys*, *Origanum vulgare*, *Laserpitium latifolium*, *Galium lucidum* and others. These species are either absent or are present in a much smaller number.

On the other hand, in relation to other regions, the Požega hill area is characterised by the species such as *Sorbus domestica*, *Peucedanum oreoselinum*, *Potentilla micrantha* and *Silene nutans*. It should be pointed out that this is the first record of the occurrence of the service tree (*Sorbus domestica*) in the study area, which broadens the concepts of its distribution in the Republic of Croatia.

Tab. 3. Occurrence of species of the order *Quercetalia pubescentis* in the association *Lathyro-Quercetum petraeae* in different regions

Species	<i>Lathyro-Quercetum petraeae</i>					
	Strahiščica	Samob. Mt.	Kalnik Mt.	Mosl. Mt.*	Požeš. Mt.	Fruška Mt.*
<i>Fraxinus ornus</i> A	III (+)	III (2)	IV (+-1)	I (+)	I (1)	II (r-1)
<i>Quercus cerris</i>	V (+)	I (+)	III (+-2)		III (2-3)	I (2)
<i>Sorbus torminalis</i>	IV (+-2)	II (+-2)	V (+-1)		I (+-1)	I (r)
<i>Ostrya carpinifolia</i>	II (+)	IV (+-3)				
<i>Sorbus aria</i>	II (+)		I (+)			
<i>Cornus mas</i>	I (+)					
<i>Sorbus torminalis</i> B	IV (+-2)	III (+-1)	IV (+)	II (+)	V (+-2)	II (r-2)
<i>Fraxinus ornus</i>	V (+-3)	IV (2)	V (+-2)	V (+-2)	V (1-3)	IV (r-2)
<i>Chamaecytisus hirsutus</i>	IV (+-1)		III (+-1)	III (+)	III (+-2)	II (r+)
<i>Ligustrum vulgare</i>	I (+)	II (+)		I (+)	IV (+-2)	
<i>Cornus mas</i>	III (+)	I (1)		I (+)	IV (+-2)	
<i>Chamaecytisus supinus</i>	II (+-1)	V (+-1)		II (+)	I (+-1)	
<i>Viburnum lantana</i>	IV (+)	IV (+-2)			II (+-2)	
<i>Quercus cerris</i>		I (+)	I (+)		I (+-2)	
<i>Sorbus aria</i>	IV (+)	III (+-2)	II (+)			
<i>Ostrya carpinifolia</i>	II (+)	II (+)				
<i>Acer tataricum</i>					II (+-2)	
<i>Sorbus domestica</i>					I (+)	
<i>Acer obtusatum</i>	II (+)					
<i>Lathyrus niger</i> C	V (+)	V (1)	IV (+-1)	V (1-3)	IV (+-3)	III (+-2)
<i>Dactylis glomerata+polygama</i>	V (+-1)	V (+-1)	V (+-1)	IV (+-2)	III (+-3)	IV (r-3)
<i>Calamintha clinopodium</i>	II (+)	IV (+-1)	IV (+)	I (+)	III (+)	I (+-2)
<i>Melittis melissophyllum</i>	V (+)	I (+)	II (+)		III (+-2)	I (r)
<i>Campanula persicifolia</i>	V (+)	III (+)	III (+)	IV (+)	II (+-2)	
<i>Tamus comunis</i>	IV (+-1)	III (+-1)	I (+)	III (+)	I (+)	
<i>Tanacetum corymbosum</i>	V (+-2)	IV (+-1)	IV (+-1)	V (+)	I (+-1)	
<i>Hypericum montanum</i>	IV (+)	II (+)	IV (+)	I (+)	I (+)	
<i>Astragalus glycyphyllos</i>	II (+)		II (+)		I (+)	I (r)
<i>Galium lucidium</i>	III (+)	I (2)	II (2)			I (3)
<i>Carex flacca</i>	V (+-3)	III (+-1)			IV (+-3)	
<i>Digitalis grandiflora</i>		V (+-1)	IV (+)			I (+-2)
<i>Vincetoxicum hirundinaria</i>	II (+-1)			IV (+)		I (1)
<i>Sorbus torminalis</i>					I (+-2)	II (+-1)
<i>Buglossoides purpureocaerulea</i>		I (+)			I (1-2)	
<i>Fraxinus ornus</i>					I (+-1)	III (r-2)
<i>Peucedanum cervaria</i>	IV (+-2)				I (+)	

Tab. 3. contd.

Species	<i>Lathyro-Quercetum petraeae</i>					
	Strahiščica	Samob. Mt.	Kalnik Mt.	Mosl. Mt.*	Požeš. Mt.	Fruška Mt.*
<i>Trifolium rubens</i>	II (+)	II (+-1)				
<i>Viola alba</i>	III (+)					I (+)
<i>Teucrium chamaedrys</i>	III (+)	II (+)				
<i>Origanum vulgare</i>	II (+)	II (+)				
<i>Laserpitium latifolium</i>	III (+)	II (+)				
<i>Cephalanthera rubra</i>	I (+)			I (+)		
<i>Viola hirta</i>				III (+)	III (+-1)	
<i>Peucedanum oreoselinum</i>					I (+)	
<i>Cornus mas</i>					I (1)	
<i>Silene nutans</i>					I (+)	
<i>Acer tataricum</i>					I (+-1)	
<i>Chamaecytisus hirsutus</i>					I (+)	
<i>Potentilla micrantha</i>					II (+-2)	
<i>Quercus cerris</i>					III (1-2)	
<i>Brachypodium pinnatum</i>	III (+)					
<i>Geranium sanguineum</i>	IV (+-1)					
<i>Iris graminea</i>	III (+)					
<i>Inula salicina</i>	III (+)					
<i>Viburnum lantana</i>	II (+)					
<i>Euphorbia angulata</i>	V (+)					
<i>Sedum maximum</i>	II (+)					
<i>Allium pulchellum</i>		II (+)				
<i>Ligustrum vulgare</i>						I (+-1)
Number of species:	36	25	15	15	27	14

Kex:

* *Festuco drymeiae-Quercetum petraeae lathyretosum nigrae*

Source: Strahinčica (Regula-Bevilacqua 1978) – 10 relevés

Samoborsko Gorje (Šugar 1972) – 5 relevés

Kalnik (Vukelić 1991) – 5 relevés

Moslavačka Gora (Hruška dell' Uomo 1974) – 5 relevés

Požega hill area (Baričević 2002) – 10 relevés

Fruška Gora (Janković and Mišić 1980) – 10 relevés

Importantly, the communities in the investigated area containing the largest number of the species of the *Quercetalia pubescentis* order represent a permanent stage in the development of the vegetation on the shallows soils of ridges and upper parts of southern slopes, which is demonstrated by the mono-dominance of sessile oak and the relatively poor appearance of stands (more stunted trees). In such habitats, European beech and hornbeam usually do not occur because the soil is too dry and too shallow. As the inclination becomes less steep and the soil more humid and deeper, the Turkey oak, followed by the common hornbeam and finally the European beech gradually appear.

In steep and exposed terrains, species of the order *Quercetalia pubescentis* have a very high protective role, primarily in the sense of preventing erosion. These species also enrich the biological diversity and promote the sustainability of forests in adverse ecological conditions.

They are special and rare in continental forest ecosystems which form specific communities, such as the community of sessile oak with hawkweed. In relation to northern and central Europe, the specific nature of this community has ensured its place and role in the floral picture of Europe as a specific acidothermophilic community.

In conclusion, the results of this work give a better insight into the number, distribution and importance of the order *Quercetalia pubescentis* in forest ecosystems of the mountains in the Pannonian plain and thus enrich the vegetational picture of the Republic of Croatia and a wider area.

Conclusions

This paper is a part of systematic synecological-vegetational research into the forest vegetation of the mountains in Slavonia. Special focus was placed on the presence of the species of the *Quercetalia pubescentis* order, since these species are a specific and rare feature of continental forest ecosystems.

The analysis of 123 relevés encompassing 12 forest communities in the hilly Požega area provided 213 species, of which 31 (14.5%) belong to the order *Quercetalia pubescentis*.

The best represented species of the order are *Sorbus torminalis*, *Fraxinus ornus*, *Ligustrum vulgare*, *Cornus mas*, *Lathyrus niger*, *Melittis melissophyllum*, *Dactylis glomerata*, *Viola hirta*, *Potentilla micrantha*, *Campanula persicifolia* and *Carex flacca*.

The species of the order *Quercetalia pubescentis* occur in areas with highly limited synecological conditions and low amplitudes. These include the warmest, southern, south-eastern and south-western positions in the upper parts of slopes, flat tops of ridges and crests, as well as stands with more light and drier conditions.

In terms of the percentage share of the species of the *Quercetalia pubescentis* order in the total number of species for a given community, the highest share of the species of this order is in the forest of sessile oak with hawkweed (28.0%), then in the forest of sessile oak with fescue (25.32%) and in the forest of sessile oak with black pea (22.94%).

The biological spectrum of the communities with the highest number of the species of the order *Quercetalia pubescentis* indicates the thermophilic character of these communities. However, a transitional character is also visible, since there are fewer chamaephytes and therophytes and more hemicryptophytes and geophytes than in a typical thermophilic community of the order *Quercetalia pubescentis*. This is understandable, since the communities in the study area develop extrazonally.

The spectre of floral geoelements confirms the introductory assumptions and claims that the study area is on the crossroads of highly diverse influences. This is clearly indicated by a large number of floral geoelements and their combinations with no dominance of one or a set of similar geoelements.

The number of the species of the order *Quercetalia pubescentis* decreases significantly in the west – east direction, with the exception of Požega hill area, where the floral compo-

sition of the community *Lathyro-Quercetum petraeae* contains 27 species of the order *Quercetalia pubescentis*, which in itself testifies to a special character, diversity and value of this area.

A comparison of the species occurring in given areas shows that the western part differs from the eastern part, to which the hills of Požega belong. In relation to other regions, this area is characterised by the occurrence of the species such as *Sorbus domestica*, *Peucedanum oreoselinum*, *Potentilla micrantha* and *Silene nutans*. It should be pointed out that this is the first record of the occurrence of the service tree (*Sorbus domestica*) in the investigated area, which broadens the perception of its distribution in the Republic of Croatia.

The species of the order *Quercetalia pubescentis* have a very important protective role on steep and exposed terrains, primarily in the sense of protection against erosion. They also contribute to biological diversity and promote forest sustainability in adverse ecological conditions.

The results of this work broaden the perception of the number, distribution and importance of the species of the *Quercetalia pubescentis* order in forest ecosystems of the Pannonian mountain region and complement the vegetation picture of both the Republic of Croatia and the wider area.

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