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INTERNATIONAL SCIENTIFIC JOURNAL

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## CONTENTS

### *Preface*

---

### ***Bibliography (monograph articles):***

---

Mandžukovski D. <b>THE LIFE AND WORK OF PROF. DR. RADOŠLAV RIZOVSKI (16.IX 1935 – 20.VII 2008) 80 YEARS SINCE THE BIRTH OF AND OVER 40 YEARS OF EDUCATIONAL AND SCIENTIFIC ACTIVITY</b>	1
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### ***Original Scientific Articles:***

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Baričević D., Vukelić J., Puača M., Šapić I. <b>A PHYTOCOENOLOGICAL STUDY OF FORESTS OF HUNGARIAN OAK AND TURKEY OAK (QUERCETUM FRINETTO-CERRIDIS /RUDSKI 1949/ TRINAJSTIĆ ET AL. 1996) ON THE NORTHWEST BORDER OF ARRIVAL (NATURE PARK PAPUK, CROATIA)</b>	7
Dimitrov M., Natcheva R., Ganeva A., Gyurova D. <b>PLANT BIODIVERSITY OF SPHAGNUM-DOMINATED MIRES IN VITOSHA NATURE PARK</b>	15
Kutnar L., Eler K. <b>PLANT SPECIES DIVERSITY AND INVASIBILITY OF (PERI-)URBAN FORESTS OF LJUBLJANA, SLOVENIA</b>	30
Melovski Lj., Hristovski S. <b>FIRST RECORDS FOR SEVEN SPECIES AND ONE HYBRID FOR THE FLORA OF THE REPUBLIC OF MACEDONIA</b>	36
Nikolov I., Dimitrov M. <b>BOREO-MONTANE FOREST PHYTOCOENOSES IN CENTRAL STARA PLANINA MTS.</b>	43
Novaković-Vuković M., Milošević R. <b>ANALYSIS OF FLORISTIC COMPOSITION OF MOUNTAIN BEECH FOREST ON LIMESTONE AND SERPENTINE IN SERBIA</b>	55
Pedashenko H., Vassilev K., Bancheva S., Delcheva M., Vladimirov V. <b>FLORISTIC AND VEGETATION DIVERSITY IN KONGURA RESERVE (SOUTH-WEST BULGARIA)</b>	59
Teofilovski A., Nikolov Z., Mandžukovski D. <b>JUNCUS FILIFORMIS L. (JUNCACEAE), A NEW SPECIES IN THE FLORA OF MACEDONIA</b>	71
Vassilev K., Gavrilova A. <b>FLORA, HABITATS AND VEGETATION OF CHAMDZHA MANAGED RESERVE, CENTRAL BALKAN RANGE</b>	74
Vukelić J., Šapić I., Baričević D. <b>FLORISTIC-VEGETATIONAL VARIABILITY OF THE ASSOCIATION EPIMEDIO- CARPINETUM BETULI (HORVAT 1938) BORHIDI 1963 IN THE NORTH OF CROATIA</b>	88

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### *Instructions to Authors*

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**A PHYTOCOENOLOGICAL STUDY OF FORESTS OF HUNGARIAN OAK AND TURKEY OAK (*QUERCETUM FRAINETTO-CERRIDIS* /RUDSKI 1949/ TRINAJSTIĆ ET AL. 1996) ON THE NORTHWEST BORDER OF ARRIVAL (NATURE PARK PAPUK, CROATIA)**

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**ABSTRACT:** The paper presents phytocoenological research of forests of Hungarian and Turkey oak in the locality of Otmanov Vis within Papuk Nature Park. These specific and very interesting areas has not so far been included in research of a broader distribution range of the community of Hungarian and Turkey oak and represents a unique feature because of very rare soil type (eutric ranker on trachyandesite). Phytocoenological sampling based on the principles of the Zürich-Montpellier School was performed on five plots. Our own relevés were compared with those from a broader Kutjevo area, Bosnia and Herzegovina and northwestern Serbia. Statistical analysis was accomplished using Syn-tax 2000 software. According to the results, the studied stands belong to the association *Quercetum frainetto-cerridis* (Rudski 1949) Trinajstić et al. 1996, or more precisely to its subassociation *ruscetosum* Jovanović et Dunjić 1951. Syntaxonomically, they belong to the alliance *Quercion frainetto*, order *Quercetalia pubescentis*, and class *Quercio-Fagetea*. In addition to the characteristic species of the association, the subassociation in the study area is well defined by the following differential species of the subassociation: *Cornus mas*, *Helleborus odorus*, *Melica uniflora*, *Teucrium chamaedrys*, *Ruscus aculeatus*, *Physospermum cornubiense* and *Campanula persicifolia*. In terms of synecology, it is characterized by its occurrence in the colline belt, at elevations from 260 to 400 m and inclinations from 5 - 40°. As Otmanov Vis is the only area in Croatia where this subassociation is occurs this work also presents the first description of this subassociation in Croatia. The site should be placed under special protection due to exceptional biological diversity and beauty of the landscape.

**Keywords:** phytocoenological study, *Quercetum frainetto-cerridis*, Croatia, *ruscetosum*, first description.

## 1 INTRODUCTION

The forest of Hungarian oak and Turkey oak (*Quercetum frainetto-cerridis* Rudski /1949/ Trinajstić et al. 1996) is a climatogenic phytocoenosis occurring over a large part of the Balkan Peninsula. In Croatia, it has been studied in more detail by Trinajstić et al. [23] in the Slavonian uplands, which also form the north-western boundary of its occurrence. Otherwise, the Hungarian oak is a rare forest species in Croatia. It is distributed in Slavonia and in several places in Dalmatia, but it covers more extensive areas only on the southern slopes of Mt. Krndija. It appears in smaller enclaves surrounded by stands of sessile oak and common hornbeam, where it forms stable stands of high commercial and scientific value. Trinajstić et al. [23] define it as a mesophilic subassociation *carpinetosum betuli*, whereas the conclusion of the latest research [19] urges for a clear definition of plant community in the locality of Otmanov Vis, since it was observed that floristically, it differs fundamentally from the neighbouring, mesophilic subassociation studied by Trinajstić et al. [23]. This was corroborated by Vukelić [24] in his general description of the forest of Hungarian and Turkey oaks in Croatia.

The forest stands in the locality of Otmanov Vis, covering an area of 24.76 ha, occur under specific synecological conditions and differ significantly from the neighbouring stands in terms of flora and management. The specific synecological conditions have also enabled the growth of a large number of rare and protected species, making them a valuable object of research. In general, stands of Hungarian and Turkey oaks in the area of the Slavonian uplands cover 894 ha. It is interesting that Hungarian oak in this area was first recorded by the botanist P. Kitaibel as far back as 1808, which was also the first record of this species on the Balkan Peninsula [4]. Hungarian oak stands in the Slavonian uplands were also discussed by Fukarek [4, 5], Fukarek et al. [7],

Cestar et al. [3], and Zelić [26, 27].

All the above prompted us to carry out a phytocoenological study of these stands in the subject area, make a detailed analysis of the floristic composition, compare the new relevés with those from a few previously published studies, and thus provide their clear definition, nomination and description. This paper aims to present the undertaken studies.

## 2 RESEARCH AREA

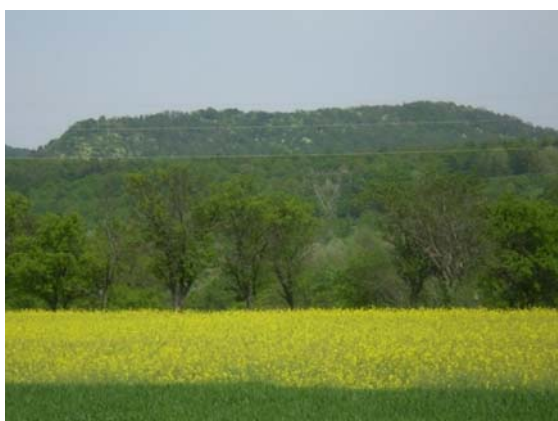
The research area encompasses the locality of Otmanov Vis (45.43° N, 17.95° E) on the southern slopes of Mt Krndija within Papuk Nature Park (Fig. 1). Mt Krndija, together with Psunj and Papuk in the west, and Požeška Gora and Dilj in the south, builds a mountain chain that surrounds the Požega Valley and forms the mountains of Slavonia. The mentioned mountains are isle mountains that stretch between the Podravina and Posavina lowlands in the south-western boundary part of the Pannonian Plain.

The research area is characterized by hilly-colline features. Diverse microrelief, microclimatic, geological and edaphic conditions alternate over a relatively small area. Elevations range between 260 and 400 m a.s.l.

The basic hills of Krndija are made up of diverse metamorphic rocks from the Paleozoic era, which are transgressively followed by the lower Miocene marine sediments with the effusion of trachyandesite, while Quaternary sediments are developed in the lower parts of the terrain. Igneous rocks are covered with Quaternary layers of loess that erodes gradually [22].

According to research Puača et al [19], eutric ranker on trachyandesite is developed on the complex and multilayered lithological bedrock as the dominant soil type. The multi-component composition of pedocartographic units includes eutric ranker, regolithic and browned, eutric brown soil and eutric colluvium

(70:15:15). Pedological data analysis shows that this soil has very high humus content (according to Gračanin) of weak acidic reaction. The soil is very rich in nitrogen and potassium and rich in physiologically active phosphorus. In terms of mechanical composition, the analyzed soil is texturally marked as clayey loam. The limiting factors of soil productivity are its small depth and skeletal nature, which are conditioned by the properties of lithological bedrock, terrain inclination and constant erosion.



**Figure 1:** View at the site Otmanov Vis - spring aspect

According to the data for Požega meteorological station, the mean annual air temperature is about 11 °C, and the mean annual precipitation is between 750 and 800 mm. In the Köppen classification, the climate type is Cfbw“x”. According to the Thornthwaite's classification system, the study area extends in the area of humid climate.

### 3 MATERIAL AND RESEARCH METHODS

Phytocoenological research into the community of Hungarian oak in the study area was performed in two stages. The first stage consisted of collecting phytocoenological relevés. Vegetation in the plots was sampled according to the principles of the Zürich-Montpellier Phytocoenological School [2]. Five phytocoenological plots were established in the locality of Otmanov Vis. Phytocoenological relevés were combined with the collection of individual synecological data in the field, such as the elevation, exposition, inclination and coordinate position of each relevé using a GPS device (Garmin Montana 650). The size of the relevés (plots) was 20m x 20m.

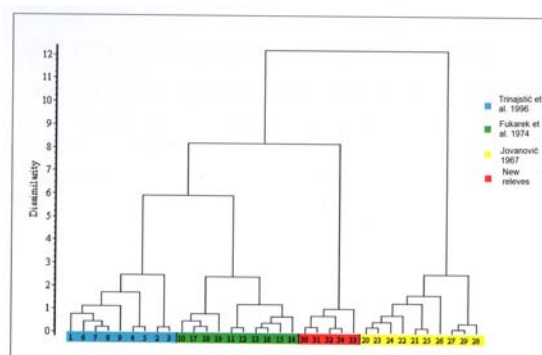
The second stage consisted of processing the data acquired in the field. The relevés were entered into the Turboveg database [10] together with 9 relevés from a wider surroundings of Kutjevo [23], 10 relevés from Bosnia and Herzegovina - including 3 relevés from the area of Croatia [7], and 10 relevés from north-western Serbia [13]. Statistical processing was performed using Syn-tax 2000 software [18]. Two methods of numerical analysis were applied: cluster analysis (Single linkage, Complete linkage, Average linkage method and Increment sum of squares method) and multidimensional scaling (Principal coordinates analysis). The Similarity ratio was used for both methods.

The species in the phytocoenological table were classified according to the social affiliation of the species

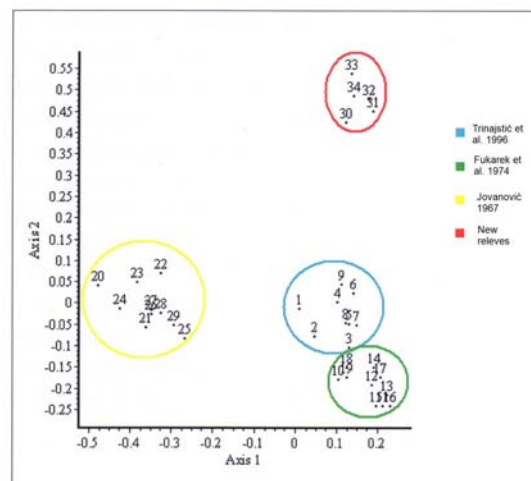
[24], while plant nomenclature was adjusted according to the Flora Croatica database [17].

### 4 RESEARCH RESULTS AND DISCUSSION

The results of classical analysis of 34 phytocoenological relevés and the applied cluster methods (Fig. 2) and the analysis obtained by multidimensional scaling (Fig. 3) showed that the relevés were placed in four groups. Our phytocoenological relevés were grouped into a separate set. In order to clearly define the differences and similarities between individual sets of relevés, the floral composition was analyzed and compared in detail. The results of these analyses clearly show that the relevés in the study area of Otmanov Vis systematically belong to the association *Quercetum frainetto-cerridis* (Rudskii 1949) Trinajstić et al. 1996 (Table 1).



**Figure 2:** Dendrogram produced by cluster analysis – Incremental sum of squares



**Figure 3:** Multidimensional scaling - Principal coordinates analysis

Syntaxonomic affiliation to the association *Quercetum frainetto-cerridis* was confirmed by the species recorded there, including *Quercus frainetto*, *Quercus cerris*, *Pyrus pyraeaster*, *Carpinus betulus*, *Acer campestre*, *Fraxinus ornus*, *Crataegus monogyna*, *Ligustrum vulgare*, *Potentilla micrantha*, *Glechoma hirsuta*, *Brachypodium sylvaticum*, *Hieracium sabaudum*, *Carex flacca*, *Moehringia trinervia* and others, which are characteristic for this association (Table I). Furthermore,

differences in the floristic composition suggest that the association should be affiliated to a lower syntaxonomic unit. To define lower systematic units, we should refer to the already defined subassociations which would possibly correspond to the studied stands. Thus, the association *Quercetum frainetto-cerridis* is divided into several different types that are described as different subassociations. This is the result of diverse variations in the synecological conditions of this association, as already discussed by Glišić [8]. The basic type is the typical forest of Hungarian oak and Turkey oak (*Quercetum frainetto-cerridis* subas. *typicum*). In terms of soil humidity and acidity it is almost identical to the forest of sessile oak and common hornbeam. It is characterized by the relatively rich, luscious and diverse herb layer. The second type is the forest of Hungarian oak and Turkey oak with common hornbeam (*Quercetum frainetto-cerridis* subas. *carpinetosum betuli*). The first was described by Rudski [20], and it encompasses areas that border with the forest of sessile oak and common hornbeam. Their principal differential species are *Carpinus betulus* and some other species of the alliance *Fagion*, then *Acer campestre*, *Prunus avium*, *Moehringia trinervia* and others. The third type is the forest of Hungarian oak and Turkey oak with butcher's broom (*Quercetum frainetto-cerridis* subas. *ruscetosum*) which was described by Jovanović et Dunjić [11]. Ecologically and geographically, it is a separate phytocoenosis that occurs in the southern part of the Pannonian Plane and grows in thermophilic habitats [25]. Its principal differential species is butcher's broom (*Ruscus aculeatus*). The fourth type is the forest of Hungarian oak and Turkey oak with oriental hornbeam (*Quercetum frainetto-cerridis* subas. *carpinetosum orientale*). This is a phytocoenosis with xerophilic species with oriental hornbeam (*Carpinus orientalis*) featuring as the main discriminating species. It should be pointed out that owing to frequent degradation of these forests, their floral composition undergoes changes. The degraded stages include the subassociations *Quercetum frainetto-cerridis* subas. *nudum* and subas. *hieracietosum* [13]. Apart from these subassociations, the Habitat Handbook of Serbia [1] also lists the subassociations *comandretosum* B. Jovanović 1968, *fagetosum* E. Vukičević 1959, *juglandetosum* E. Vukičević 1974, *paeonietosum* M. Janković et Nikolić 1967, *physospermetosum* Rudski 1940, *pubescentosum* Jovanović, *petraeae* Z. Tomić 1989, *roboris* B. Jovanović et Z. Tomić 1978, *virgilianae* B. Jovanović et Vukičević 1977, and *scardicum* Krasniqi (1968) 1972 in Kosovo. In Macedonia, such forests are among the other described in Galičica National Park under the name of *Quercetum frainetto-cerris* Horvat 1954 [14] or *Quercetum frainetto-cerris macedonicum* Oberdorfer 1948 emend Horvat 1959 [15, 16]. Examples of geographic adjectives in the names of the subassociations are found in some other authors, e.g. *thracicum* = *bulgaricum* [9], *moesiicum* = *serbicum* [12]. In the latest analysis of the forest of Hungarian oak and Turkey oak in Bosnia and Herzegovina are described as *Quercetum frainetto-cerridis* (Rudski 1949) Trinajstić et al. 1996 because Trinajstić et al. [23] corrected its original illegitimate name "*Quercetum confertae-cerris serbicum*" [21]. They also conclude that in the southern B&H described association *Quercetum frainetto hercegovinum* [6] could not be separate from other *Quercetum frainetto-cerridis* forests.

The floristic composition of Hungarian oak-Turkey

oak forests in the proximity of the study area (the surroundings of Kutjevo) was described and investigated by Trinajstić et al. [23]. These stands are discriminated from the typically composed stands of the association from the centre of its range in Serbia by the absence of the species *Tilia tomentosa*, *Sorbus domestica*, *Rosa gallica*, *Danna cornubiensis*, *Lychnis coronaria*, *Silene viridiflora*, *Tanacetum corymbosum*, *Trifolium alpestre* and many others. Based on the analysis, they affiliate these stands to the subassociation *carpinetosum betuli*.

However, the association described by Trinajstić et al. [23] also differs fundamentally from the studied stands in the locality of Otmanov Vis in terms of its floral composition and habitat conditions. The analysis of the floristic composition in the study area clearly shows independence at the level of subassociation (Table I). Because of the specific habitat conditions in the study area, there are species that are absent from the previously described subassociation, such as *Tilia tomentosa*, *Danna cornubiensis*, *Tanacetum corymbosum*, *Euphorbia cyparissias*, *Melica uniflora*, *Helleborus odoratus*, *Dryopteris filix-mas*, *Physospermum cornubiense*, *Teucrium chamaedrys*, *Asplenium adiantum-nigrum*, *Calamintha nepeta*, *Poa nemoralis*, *Dictamnus albus*, *Spiraea chamaedryfolia*, *Ruscus aculeatus* and others. In terms of floral composition and the presence of characteristic and differential species, the community in the study area best corresponds to the forest of Hungarian oak and Turkey oak with butcher's broom *Quercetum frainetto-cerridis* subassociation *ruscetosum*, which was described in the work by Jovanović et Dunjić [11]. According to this description, the subassociation is developed over flat and mildly sloping terrains, of weak acid soil reaction. There is occurrence of thermophilic, Mediterranean floral elements, which were preserved during the ice age owing to the warm climate on the shores of the former Pannonian Sea. The described community contains species which were found in the study area, thus determining its affiliation to the subassociation of the forest of Hungarian oak with Turkey oak and butcher's broom. Differential species of this subassociation include *Cornus mas*, *Helleborus odoratus*, *Melica uniflora*, *Teucrium chamaedrys*, *Ruscus aculeatus*, *Physospermum cornubiense* and *Campanula persicifolia*.

The study locality is specifically characterized by a very high abundance of the species *Digitalis grandiflora*, *Carex divulsa*, *Alliaria petiolata*, *Fallopia convolvulus*, *Dictamnus albus* and *Spiraea chamaedryfolia*, which will be the subject of further vegetation and floristic research. Of additional interest are the beautiful seasonal aspects that begin with the awakening of the vegetation in early March, as well as the dominance of hellebore (*Helleborus odoratus*), dogwood (*Cornus mas*) and spring flowers. April is characterized by the dominance of the facies *Alliaria officinalis*. The end of April is marked by the abundant appearance of leopard's bane (*Doronicum columnae*). The beginning of May is characterized by luscious ground vegetation, when the main ridge is covered with nationally protected species (*Dictamnus albus*), early purple orchid (*Orchis mascula*), martagon lily (*Lilium martagon*) and others. Manna ash (*Fraxinus ornus*), germander meadowsweet (*Spiraea chamaedryfolia*) and dog rose (*Rosa canina*) are in full bloom. Large yellow foxglove (*Digitalis grandiflora*) appears in abundance at the beginning of June.



**Table I:** Comparison of the relevés from the study area with the relevés of other types of forests of Hungarian oak and Turkey oak

Nr. of releve		30	31	32	33	34	Presence degree	Presence degree	Presence degree	Presence degree
Date (year/month)		2014/6	2014/6	2014/6	2014/6	2014/6				
Coordinate x		6496766	6496759	6496487	6496407	6496234				
Coordinate y		5031094	5031061	5031006	5031022	5030898				
Releve area (m <sup>2</sup> )		400	400	400	400	400				
Elevation (m)		375	395	380	375	340				
Exposition (degrees)		0	0	300	0	180				
Inclination (degrees)		35	0	25	40	10				
Cover layer of trees (%)		70	50	90	60	70				
Cover layer of shrubs (%)		40	20	5	15	10				
Cover layer of ground vegetation (%)		60	80	30	60	70				
Source							New relevés Otmanov Vis	Trinajstić et al. 1996	Fukarek et al. 1974	Jovanović 1967
Floral composition:										
Characteristic species of association:										
<i>Quercus frainetto</i>	A	4	1	3	1	3	V	V	V	V
<i>Fraxinus ornus</i>		2	2	2	4	3	V	I		III
<i>Quercus cerris</i>		+	3	.	.	1	III	III	V	V
<i>Tilia tomentosa</i>		.	.	3	.	.	I		III	
<i>Ligustrum vulgare</i>	B	.	+	+	.	+	III	V	V	II
<i>Fraxinus ornus</i>		.	.	.	1	1	III	IV	V	III
<i>Acer campestre</i>		+	+	.	.	.	II	V	V	II
<i>Crataegus monogyna</i>		.	+	.	+	.	II	V	V	III
<i>Rosa arvensis</i>		.	.	.	+	+	II	III	IV	
<i>Quercus frainetto</i>		.	.	.	.	+	I	IV		V
<i>Chamaecytisus supinus</i>		.	.	.	.	.		IV		
<i>Quercus cerris</i>		.	.	.	.	.		I		V
<i>Potentilla micrantha</i>	C	1	1	1	1	+	V	V	V	IV
<i>Hypericum perforatum</i>		+	+	+	+	+	V	II		IV
<i>Brachypodium sylvaticum</i>		1	1	1	.	+	IV	III		II
<i>Calamintha nepeta</i> agg.		1	2	1	.	1	IV			II
<i>Fraxinus ornus</i>		+	.	.	.	.	I	II		IV
<i>Quercus frainetto</i>		1	.	.	.	.	I	III	IV	V
<i>Veronica chamaedrys</i>		+	.	.	.	.	I	V		IV
<i>Clinopodium vulgare</i>		.	+	.	.	.	I		V	II
<i>Rosa arvensis</i>		.	+	.	.	.	I			
<i>Trifolium medium</i>		.	.	.	.	+	I	II		
<i>Tilia tomentosa</i>		.	.	.	.	.		I		II
<i>Quercus cerris</i>		.	.	.	.	.		I	III	IV
Differential species of subassociation <i>carpinetosum betuli</i> :										
<i>Prunus avium</i>	A	+	.	.	.	.	I	I	III	
<i>Carpinus betulus</i>		.	.	.	.	.		III		
<i>Acer campestre</i>		.	.	.	.	.		III		
<i>Carpinus betulus</i>	B	.	+	.	.	.	I	V	V	V
<i>Prunus avium</i>		.	.	.	.	.		III		
<i>Moehringia trinervia</i>	C	+	.	+	.	.	II	III	I	
<i>Helleborus croaticus</i>		.	.	.	.	.		V		
<i>Prunus avium</i>		.	.	.	.	.		III		II
<i>Carpinus betulus</i>		.	.	.	.	.		II	III	II
<i>Acer campestre</i>		.	.	.	.	.				II
Differential species of subassociation <i>ruscetosum</i> :										
<i>Cornus mas</i>	B	3	2	.	1	+	IV	II	I	
<i>Ruscus aculeatus</i>		+	.	.	.	1	II			
<i>Helleborus odoratus</i>	C	2	1	2	+	1	V		IV	
<i>Melica uniflora</i>		1	3	1	3	1	V		I	I
<i>Teucrium chamaedrys</i>		.	+	+	+	+	IV		II	
<i>Physospermum cornubiense</i>		+	.	+	.	.	II		III	IV
<i>Campanula persicifolia</i>		+	+	.	.	.	II	I	I	III
<i>Quercetalia pubescentis</i> :										
<i>Sorbus torminalis</i>	B	+	+	.	.	.	II	II	III	I
<i>Acer tataricum</i>		.	.	.	.	.		III	V	II
<i>Sorbus domestica</i>		.	.	.	.	.		II		I
<i>Viola alba</i>	C	+	+	+	.	.	III	III		
<i>Tanacetum corymbosum</i>		+	.	+	+	.	III	I	I	
<i>Lathyrus venetus</i>		+	.	.	.	.	I	II	III	
<i>Tamus communis</i>		.	+	.	.	.	I	I	II	III

BARIČEVIĆ D., VUKELIĆ J., PUAČA M., ŠAPIĆ I.  
 A PHYTOCOENOLOGICAL STUDY OF FORESTS OF HUNGARIAN OAK AND TURKEY OAK (*QUERCETUM FRAINETTO-CERRIDIS* /RUDSKI 1949/ TRINAJSTIĆ ET AL. 1996) ON THE NORTHWEST BORDER OF ARRIVAL (NATURE PARK PAPUK, CROATIA)

continuation of Table I

<i>Lathyrus niger</i>		-	-	-	-	-		I	V	IV
<i>Acer tataricum</i>		-	-	-	-	-		I		III
<i>Convallaria majalis</i>		-	-	-	-	-		I		
<i>Polygonatum odoratum</i>		-	-	-	-	-		I		
<i>Sorbus torminalis</i>		-	-	-	-	-				III
<i>Oenanthe pimpinelloides</i>		-	-	-	-	-		I		
<i>Fagetalia :</i>										
<i>Fagus sylvatica</i>	A	-	-	-	-	-		I		
<i>Fagus sylvatica</i>	B	-	-	-	-	-		III		
<i>Mycelis muralis</i>	C	-	+	+	2	+	IV	III		I
<i>Stellaria holostea</i>		+	+	+	1	-	IV	I	III	
<i>Glechoma hirsuta</i>		+	1	-	-	-	II	V	II	
<i>Lilium martagon</i>		+	-	-	-	-	I	I		
<i>Symphytum tuberosum agg.</i>		-	-	-	-	-		III	I	
<i>Viola reichenbachiana</i>		-	-	-	-	-		III		I
<i>Primula vulgaris</i>		-	-	-	-	-		III	IV	
<i>Carex sylvatica</i>		-	-	-	-	-		III	I	
<i>Pulmonaria officinalis</i>		-	-	-	-	-		III	II	
<i>Galium odoratum</i>		-	-	-	-	-		II		
<i>Polygonatum multiflorum</i>		-	-	-	-	-		I		
<i>Sanicula europaea</i>		-	-	-	-	-		I	I	
<i>Neotia nidus-avis</i>		-	-	-	-	-		I		
<i>Scrophularia nodosa</i>		-	-	-	-	-		I		
<i>Geranium robertianum</i>		-	-	-	-	-		II	I	
<i>Dentaria bulbifera</i>		-	-	-	-	-		I		
<i>Melica nutans</i>		-	-	-	-	-		I		
<i>Calamintha grandiflora</i>		-	-	-	-	-		I		
<i>Epimedium alpinum</i>		-	-	-	-	-		I	II	II
<i>Stachys sylvatica</i>		-	-	-	-	-		I		
<i>Circaea lutetiana</i>		-	-	-	-	-		I		
<i>Asarum europaeum</i>		-	-	-	-	-		I	I	
<i>Salvia glutinosa</i>		-	-	-	-	-		I		
<i>Quercetalia robori-petraeae :</i>										
<i>Castanea sativa</i>	A	-	-	-	-	-				I
<i>Castanea sativa</i>	B	-	-	-	-	-		I		I
<i>Festuca heterophylla</i>	C	2	-	1	1	1	IV	I	III	III
<i>Hieracium sabaudum</i>		+	-	-	-	-	I	III		IV
<i>Veronica officinalis</i>		+	-	-	-	-	I	III	II	V
<i>Luzula forsteri</i>		+	-	-	-	-	I	III	II	III
<i>Melampyrum sylvaticum</i>		-	-	-	-	-		III	III	
<i>Serratula tinctoria</i>		-	-	-	-	-		I	I	
<i>Castanea sativa</i>		-	-	-	-	-				I
<i>Quercus-Fagetea :</i>										
<i>Quercus petraea</i>	A	+	-	-	-	-	I	IV	IV	IV
<i>Quercus robur</i>		-	-	-	-	-		I	I	
<i>Pyrus pyraeaster</i>	B	-	+	-	-	+	II	IV	V	
<i>Quercus petraea</i>		-	-	-	-	-		I		III
<i>Rubus hirtus s.lat.</i>		-	-	-	-	-		I		
<i>Corylus avellana</i>		-	-	-	-	-		I	I	I
<i>Euonymus europaeus</i>		-	-	-	-	-		I	II	
<i>Cruciata glabra</i>	C	-	+	-	-	-	I	III		III
<i>Quercus petraea</i>		-	-	-	-	-		III	III	III
<i>Pyrus pyraeaster</i>		-	-	-	-	-				III
<i>Corylus avellana</i>		-	-	-	-	-				I
<i>Galium sylvaticum</i>		-	-	-	-	-		III		
<i>Fragaria vesca</i>		-	-	-	-	-		I		II
<i>Cephalanthera longifolia</i>		-	-	-	-	-		I		
<i>Galium schultesii</i>		-	-	-	-	-		I		
<i>Hedera helix</i>		-	-	-	-	-		I		I
<i>Rhamno-Prunetea :</i>										
<i>Cornus sanguinea ssp. hungarica</i>	B	-	-	-	-	-		IV		
<i>Clematis vitalba</i>		-	-	-	-	-		III	III	
<i>Cornus sanguinea</i>		-	-	-	-	-		II	III	
<i>Crataegus nigra</i>		-	-	-	-	-		II		
<i>Prunus spinosa</i>		-	-	-	-	-		II	II	
<i>Euonymus europaeus</i>	C	-	+	-	-	-	I	I		
<i>Prunus spinosa</i>		-	-	-	-	-		I		
<i>Crataegus monogyna</i>		-	-	-	-	-				II

continuation of Table I

<i>Ligustrum vulgare</i>		.	.	.	.	.	.	.	.	II
Other species:										
<i>Genista tinctoria</i>	B	1	.	.	.	.	I	III	IV	
<i>Rubus ulmifolius</i>		.	.	.	.	.	.	IV		
<i>Juniperus communis</i>		.	.	.	.	.	.	II		III
<i>Dactylis glomerata</i>	C	2	2	1	.	+	IV	V	V	
<i>Geum urbanum</i>		.	+	.	.	.	I	III		
<i>Carex flacca</i>		.	.	.	.	+	I	III		
<i>Galium lucidum</i>		+	.	.	.	.	I	II		
<i>Vicia species</i>		+	.	.	.	.	I	II		
<i>Silene nutans s.lat.</i>		.	.	.	+	.	I	I		
<i>Vincetoxicum hirsundinaria</i>		.	+	.	.	.	I	I		
<i>Ajuga reptans</i>		.	.	.	.	.	.	V	IV	I
<i>Ranunculus ficaria</i>		.	.	.	.	.	.	I	I	
<i>Prunella grandiflora</i>		.	.	.	.	.	.	IV		
<i>Galeopsis pubescens</i>		.	.	.	.	.	.	III		
<i>Astragalus glycyphyllos</i>		.	.	.	.	.	.	III	I	
<i>Lysimachia nummularia</i>		.	.	.	.	.	.	III		
<i>Urtica dioica</i>		.	.	.	.	.	.	I		
<i>Galium species</i>		.	.	.	.	.	.	I		
<i>Galium mollugo</i>		.	.	.	.	.	.	I	IV	I
<i>Symphytum officinale</i>		.	.	.	.	.	.	I		
<i>Myosotis ramosissima</i>		.	.	.	.	.	.	I		
<i>Erigeron annuus</i>		.	.	.	.	.	.	I		
<i>Limodorum abortivum</i>		.	.	.	.	.	.	I		
<i>Lysimachia nemorum</i>		.	.	.	.	.	.	I		
<i>Auremonia agrimonoides</i>		.	.	.	.	.	.	I		
<i>Viola mirabilis</i>		.	.	.	.	.	.	I		
<i>Lysimachia vulgaris</i>		.	.	.	.	.	.	I		
<i>Galium aparine</i>		.	.	.	.	.	.	I		
<i>Hieracium murorum</i>		.	.	.	.	.	.	I		II
<i>Hieracium species</i>		.	.	.	.	.	.	I	V	
<i>Origanum vulgare</i>		.	.	.	.	.	.	I	I	
<i>Juniperus communis</i>		.	.	.	.	.	.	.	II	III
<i>Genista tinctoria</i>		.	.	.	.	.	.	.		II
Other specific species the study area:										
<i>Spiraea chamaedryfolia</i>	B	.	.	+	1	.	II			
<i>Rubus canescens</i>		.	+	.	.	.	I		III	
<i>Malus sylvestris</i>		+	.	.	.	.	I		I	
<i>Alliaria petiolata</i>	C	3	2	2	3	3	V	I		
<i>Digitalis grandiflora</i>		3	1	+	.	+	IV	I		
<i>Fallopia convolvulus</i>		+	1	+	1	+	V	I		
<i>Dictamnus albus</i>		.	2	1	.	2	III			
<i>Carex divulsa</i>		+	.	.	+	+	III	I		
<i>Euphorbia cyparissias</i>		.	.	+	.	+	II		II	
<i>Dryopteris filix-mas</i>		+	.	.	+	.	II		I	
<i>Asplenium adiantum-nigrum</i>		+	.	.	+	.	II			
<i>Poa nemoralis</i>		1	.	+	.	.	II			
<i>Achillea millefolium</i>		.	+	.	.	.	I		I	
<i>Thymus pulegioides ssp. montanus</i>		.	.	.	+	.	I			II
<i>Rubus canescens</i>		+	.	.	.	.	I			I
<i>Prenanthes purpurea</i>		.	+	.	.	.	I			
<i>Trifolium repens</i>		.	+	.	.	.	I			
<i>Allium species</i>		.	.	.	+	.	I			
<i>Asplenium trichomanes</i>		.	.	.	1	.	I			
<i>Ranunculus bulbosus</i>		.	.	.	+	.	I			
<i>Sedum maximum</i>		.	.	.	+	.	I			
<i>Doronicum columnae</i>		.	.	.	.	+	I			
<i>Veronica montana</i>		.	.	+	.	.	I		II	

Apart from these species are accompanied the following species, with presence degree: *Fukarek (Galium aristatum V, Brachypodium pinnatum V, Carex pilosa V, Prunella vulgaris IV, Cytisus nigricans IV, Fragaria moschata III, Viola hirta III, Dorycnium germanicum II, Silene italica II, Agrimonia eupatoria II, Melittis melissophyllum II, Peucedanum cervaria II, Potentilla erecta I, Thymus serpyllum I, Aristolochia clematidis I, Buglossoides purpureoaeerulea I, Anemone nemorosa I, Euphorbia amygdaloides I, Populus tremula I, Tilia cordata I, Digitalis species I, Solidago virgaurea I, Stachys species I, Ulmus minor I, Aposeris foetida I, Centaurea species I, Chamaecytisus hirsutus I, Orlaya species I, Galeobdolon luteum I, Quercus polycarpa I, Conyza canadensis I, Erigeron candidus I, Myosotis sylvatica I, Persicaria maculosa I, Plantago media I, Solanum dulcamara I, Galium verum I) and Jovanović (Campanula patula V, Hieracium bauhini V, Genista ovata IV, Chamaecytisus hirsutus IV, Rumex acetosella IV, Chamaecytisus austriacus III, Pteridium aquilinum III, Rubus hirtus III, Sedum cepaea III, Fagus moesiaca II, Luzula campestris II, Silene viridiflora II, Melampyrum pratense II, Polygala vulgaris I, Centaurium erythraea I, Epilobium lanceolatum I, Luzula pilosa I, Anthoxanthum odoratum I, Festuca drymeia I, Hypericum montanum I, Carex caryophylla I, Lathyrus vernus I, Poa angustifolia I).*

#### 4 CONCLUSIONS

The conducted phytocoenological analysis of the forests of Hungarian oak and Turkey oak in the study area show that the studied stands belong to the association *Quercetum frainetto-cerridis* Rudski (1949) Trinajstić et al. 1996, or more precisely, to its subassociation with butcher's broom *ruscetosum* Jovanović et Dunjić 1951.

Syntaxonomically, this community belongs to the class *Quercu-Fagetea* Braun-Blanquet et Vlieger 1937, order *Quercetalia pubescentis* Klika 1933 and alliance *Quercion frainetto* Horvat 1954.

Along with the characteristic species of the association, the subassociation in the study area is well defined by the differential species of the subassociation *ruscetosum*: *Cornus mas*, *Helleborus odoratus*, *Melica uniflora*, *Teucrium chamaedrys*, *Ruscus aculeatus*, *Physospermum cornubiense* and *Campanula persicifolia*. Synecologically, it characteristically occurs in the colline belt, in the Central European vegetation zone of thermophilic forests. It grows at elevations between 260 and 400 m and inclinations of 5-40° and on the dominantly eutric ranker on a trachyandesite base. The limiting factors of soil productivity are its depth and skeletal nature, which are conditioned by the properties of the bedrock, terrain slope and constant erosion. As a consequence, the stands are of poorer quality and lower commercial value.

As Otmanov Vis is the only area in Croatia in which this subassociation was detected, we provide the first description of this subassociation in Croatia. It should be placed under special protection owing to exceptional biological diversity and beauty of the landscape.

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