NAT. CROAT. | VOL. 8 | No 4 | 385–398 | ZAGREB | December 31, 1999

ISSN 1330-0520
UDK 581.555(497.5/1-14)

original scientific paper / izvorni znanstveni rad

NATURAL »SAUM« VEGETATION IN ĆIĆARIJA AND ON THE UČKA MOUNTAIN RANGE (NE ISTRIA, CROATIA)[1]

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Čarni, A.: Natural »saum« (fringe) vegetation in Ćićarija and on the Učka mountain range (NE Istria, Croatia). Nat. Croat. Vol. 8, No. 4., 385–398, 1999, Zagreb.

»Saum« (fringe) vegetation was sampled in Ćićarija and on the Učka mountain range according to the standard procedures of the Braun-Blanquet method. The following associations were determined: *Knautio illyricae-Physospermetum verticillati* ass. nova, *Cirsio pannonicae-Peucedanetum cervariae* van Gils *et al*. 1975, *Cirsio-Clematidetum rectae* van Gils *et al*. ex Čarni 1997, *Libanoto-Laserpitietum sileris* van Gils *et al*. 1975, *Scorzonero villosae-Trifolietum alpestris* Čarni 1997 and *Veronicetum barrelieri-jacquinii* van Gils *et al*. 1975 corr. Čarni 1997. The associations are classified within the suballiance *Dictamno-Ferulagenion* van Gils *et al*. 1975 (*Geranion sanguinei* R. Tx. in T. Müller 1962, *Origanetalia* T. Müller 1962, *Trifolio-Geranietea* Müller 1962).

Key words: forest edge, »saum«, fringe, *Dictamno-Ferulagenion*, *Geranion sanguinei*, *Trifolio-Geranietea*, vegetation, Istria, Croatia

Čarni, A.: Vegetacija prirodnih šumskih rubova na području Ćićarije i Učke (NE Istra, Hrvatska). Nat. Croat. Vol. 8, No. 4., 385–398, 1999, Zagreb.

Istaživanje vegetacije prirodnih šumskih rubova u Ćićariji i na Učki obavljeno je po standardnoj Braun-Blanquetovoj metodi. Utvrđene su sljedeće zajednice: *Knautio illyricae-Physospermetum verticillati* ass. nova, *Cirsio pannonicae-Peucedanetum cervariae* van Gils *et al*. 1975, *Cirsio-Clematidetum rectae* van Gils *et al*. ex Čarni 1997, *Libanoto-Laserpitietum sileris* van Gils *et al*. 1975, *Scorzonero villosae-Trifolietum alpestris* Čarni 1997 i *Veronicetum barrelieri-jacquinii* van Gils *et al*. 1975 corr. Čarni 1997. Asocijacije su uvrštene u podsvezu *Dictamno-Ferulagenion* van Gils *et al*. 1975 (*Geranion sanguinei* R. Tx. in T. Müller 1962, *Origanetalia* T. Müller 1962, *Trifolio-Geranietea* Müller 1962).

Ključne riječi: šumski rub, *Dictamno-Ferulagenion*, *Geranion sanguinei*, *Trifolio-Geranietea*, vegetacija, Istra, Hrvatska

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[1] The results were presented as a lecture at the 6th Congress of Croatian Biologists, Opatija, Sept. 22–26, 1997

INTRODUCTION

At the forest edge, in the transitional zone between forest and non-forest areas, two well-defined vegetation types appear, due to the very abrupt change of ecological conditions. They form long and narrow belts around forests. The first, which is found close to the forest, is dominated by shrub species and is termed mantle; the second is dominated by high stalk species and grasses and is called »saum« (fringe) (DIERSCHKE, 1974). The »saum« can be divided into two ecologically distinct groups: the »saum« of humid and eutrophic sites of the *Galio-Urticetea* and the more natural »saum« of the *Trifolio-Geranietea*. This work focuses on natural »saum«. There have been several surveys of this vegetation in Europe (DIERSCHKE, 1974, DE FOUCAULT *et al*., 1983; VAN GILS, 1978; MÜLLER, 1978; MUCINA & KOBLEK, 1993).

Nitrophilous »saum« vegetation is well known in Croatia (MARKOVIĆ, 1964; 1965; 1985; 1987; 1992; etc.), and there are also some data available for Istria (ČARNI, 1994); however, few data exist on natural »saum« in Croatia. There are only few data on this vegetation type from the nearby areas of Rupa and Mune (VAN GILS *et al*., 1975).

The thermophilous natural »saum« in Europe is classified within the alliance of thermophilous »saum« vegetation *Geranion sanguinei*. The communities found in the sub-Mediterranean area are assigned to the endemic suballiance *Dictamno-Ferulagenion* that is characterized by the following species: *Knautia illyrica*, *Ferulago galbanifera*, *Paeonia officinalis*, and several differentials originating from the *Scorzoneretalia villosae* (e.g. *Scorzonera villosa*) and *Quercetalia pubescentis* (e.g. *Sesleria autumnalis*) (ČARNI, 1997). Since the thermophilous »saum« vegetation of the region is classified within the endemic suballiance, POLDINI (1989) proposed that the endemic suballiance of *Trifolion medii* should be described for the mesophilous »saum« vegetation. However, such communities were not found in the area studied.

Various opinions also exist regarding the syntaxonomic preference of some species. POLDINI (1989), for instance, believes that *Knautia illyrica* and *Ferulago galbanifera* are elements of the dry grasslands of the *Scorzonerion villosae* and *Paeonia officinalis* subsp. *officinalis* of the thermophilous forests of the *Ostryo-Carpinion*.

The aim of this work is to record the plant communities in the area studied. The fieldwork was done in 1995 within the framework of my postdoctoral study at Zagreb University.

STUDY AREA AND METHODS

The research territory is situated in the western part of Croatia, in NE Istria: Ćićarija and the Učka mountain range (Fig. 1). Ćićarija extends south of the Slovene border to the Učka mountain range. It can be divided into two parts: in the eastern part, there is a mountain range with summits often exceeding 1000 m such as Žbevnica (1014), Orljak (1106), Županj vrh (1138), Planik (1272), etc., and in the western part a karst plateau at an altitude of 600 m extends to the west of the range to the

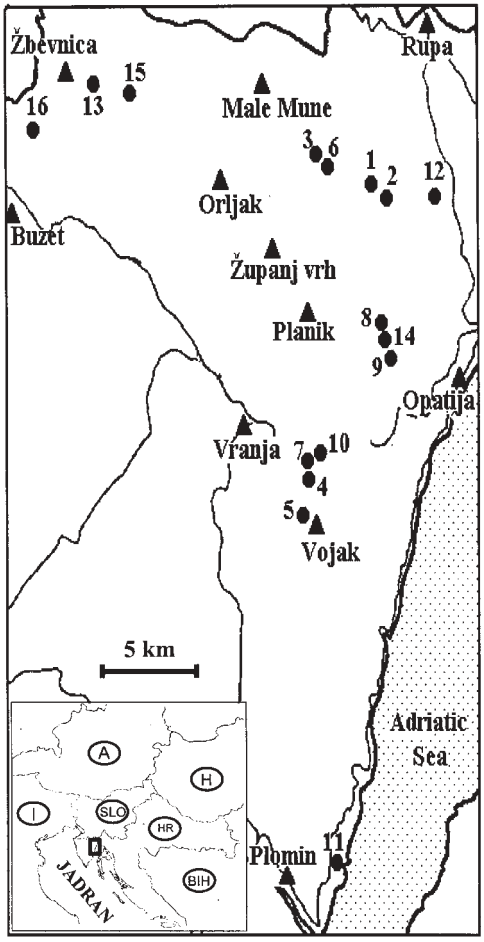

Fig. 1. Localities of the relevés. Numbers correspond to those in Tab. 1 and 2.

Buzet-Vranja line. The Učka mountain range extends to the south of Ćićarija. Its highest peak is Vojak at 1391 meters.

The climate is warm and humid with warm summers and can be assigned to the category Cfb after Köppen (ŠEGOTA, 1988). The annual precipitation varies in the research area. The annual precipitation at Opatija on the coast is about 1700 mm, on Učka it is more than 3000 mm, and on the other side of this barrier in Pazin it is only 1200 mm. The average annual temperature is 14.0°C in Rijeka and 11.7°C in Pazin (RIĐANOVIĆ, 1975; STRŽIČIĆ, 1971, WALTER & LIETH, 1960)

The bedrock consists mainly of limestone with many characteristic karst features such as sinkholes and dolinas. The main soil type is shallow redzina; the soil layer is deeper only at the bottom of sinkholes or in valleys. The most common forest type is *Ostryo-Quercetum pubescentis* (Ht. 1950) Trinajstić 1974 that can be found up

to 600 or even 800 m. Higher, beech forest appears, *Seslerio autumnalis-Fagetum* (Ht.) Wraber ex Borhidi 1963. This is typical of transitional areas between warm Mediterranean and colder temperate regions. On steep south facing slopes, *Orno-Quercetum ilicis* H-ić (1956) 1958 appears. The grasslands can be classified within the endemic order *Scorzoneretalia villosae* H-ić 1975 (*Festuco-Brometea* Br.-Bl. et Tx. 1943), for example, *Carici-Centaureetum rupestris* Ht. 1931 and *Danthonio-Scorzoneretum villosae* Ht et H-ić (1956) 1958 to mention only the most common (HORVAT, 1962; ŠUGAR, 1970; 1983; 1984; 1992; TRINAJSTIĆ, 1995b; KALIGARIČ, 1997).

From the phytogeographic point of view, the vegetation is classified within the epi-Mediterranean vegetational zone (*Ostryo-Quercetum pubescentis*) and the para-Mediterranean vegetational zone (*Seslerio autumnalis-Fagetum*) (TRINAJSTIĆ, 1995a).

The relevés were made and elaborated according to the standard procedures of the Braun-Blanquet metod (BRAUN-BLANQUET, 1964). The nomenclature of plant species follows DOMAC (1994) except for *Aristolochia lutea* Desf., *Betonica serotina* Host, *Brachypodium rupestre* (Host) R. et S., *Festuca rupicola* Heuff., *Knautia drymeia* subsp. *intermedia* (Pernh. et Wettst.) Ehrend., *Knautia illyrica* G. Beck, *Scorzonera villosa* Scop., *Stipa pennata* subsp. *eriocaulis* (Bork.) Martin. et Skalicky, *Valeriana collina* Wallr., and *Veronica barrelieri* Schott ex Roem. & Schult.

RESULTS

Syntaxonomic scheme

Class: *Trifolio-Geranietea* Müller 1962
Order: *Origanetalia* Müller 1962
Alliance: *Geranion sanguinei* R. Tx. in Müller 1962
Suballiance: *Dictamno-Ferulagenion* van Gils *et al*. 1975
Associations: *Knautio illyricae-Physospermetum verticillati* Čarni ass. nova
Cirsio pannonicae-Peucedanetum cervariae van Gils *et al*. 1975
Cirsio-Clematidetum rectae van Gils *et al*. ex Čarni 1997
Libanoto-Laserpitietum sileris van Gils *et al*. 1975
Scorzonero villosae-Trifolietum alpestris Čarni 1997
Veronicetum barrelieri-jacquinii van Gils *et al*. 1975 corr. Čarni 1997

Knautio illyricae-Physospermetum verticillati ass. nova hoc loco

(Tab 1.)

Knautio-Physospermetum is a new association described in the research area. It appears on shallow redzina soil at the edges of *Seslerio-Fagetum* at altitudes of 550 to 1000 m. In comparison with the other associations is this group, it thrives at the highest altitudes and occupies the most shaded sites. The nomenclature type is relevé 9 (Tab. 1).

The dominant species is *Physospermum verticillatum* (syn. *Dana verticillata, Laserpitium verticillatum*), which also appears in Algeria, Sicily, and southern Italy as well

Tab. 1. *Knautio illyricae-Physospermetum verticillati* ass. nova, A. Čarni

Number	1	2	3	4	5	6	7	8	9	10
Surface (in m^2)	7	10	7	8	12	7	7	15	10	5
Coverage (in %)	100	80	100	100	100	100	100	100	100	100
Date day	19	12	7	3	3	7	4	29	3	3
month	6	7	7	7	7	7	7	6	7	7
year	95	95	95	95	95	95	95	95	95	95
Altitude (in m)	620	580	550	930	910	550	760	950	950	770
Expostion	NE	NW	SW	N	NW	-	W	-	-	W
Inclination (in °)	10	10	20	30	30	0	20	0	0	20
Number of species	34	26	25	21	32	31	36	40	29	22
Ass. char.										
Physospermum verticillatum	3	2	4	3	4	3	3	3	3	2
DF *DICTAMNO-FERUGALENION*										
Knautia illyrica	+	+	+	+			+	+	+	+
Inula hirta					+				+	
Paeonia officinallis								+	+	
GS *GERANION SANGUINEI*										
Thalictrum minus	+	+				+	+	+	+	
Geranium sanguineum					+		2		1	+
Lilium bulbiferum	+							+	+	
Trifolium alpestre					1	1				+
Cirsium pannonicum					1		+	+		
Thesium bavarum	+								+	
Trifolium rubens		+						+		
Silene nutans						+		+		
TG *TRIFOLIO-GERANIETEA*										
Vicia cassubica	+		1	2	+		+			
Betonica serotina		+	+				+		+	
Vicia tenuifolia			+	+		+	+			
Hypericum perforatum				+	+		1	+		
Tanacetum corymbosum	+		1				+			
Viola hirta		+			+	+				
Agrimonia agrimonioides		+					+			
Campanula persicifolia		+						+		
FB *FESTUCO-BROMETEA*										
Brachypodium rupestre	2	3		2	2	2	1			
Bromus erectus	1	+	+				+	+	+	1
Galium lucidum	+				+	+		+	+	+
Salvia pratensis	+		+	+	+		+	+		+
Buphthalmum salicifolium	+	+	+	1	+		+			
Filipendula hexapetala	+			+		+		1	+	
Euphorbia verrucosa	+				+	+	+		+	
Helianthemum ovatum				+	+			+	+	+
Centaurea triumfetti					1	1	+	1	+	
Hypochoeris maculata	+		+		+	+				
Trifolium montanum	+				+	+		+		

Tab. 1. (continued)

Number	1	2	3	4	5	6	7	8	9	10
Briza media	+					+		+		+
Plantago media		+		+		+		+		
Koeleria pyramidata				+				+	+	+
Galium purpureum					+	+	+		+	
Festuca rupicola						1	2	1		+
Cirsium acaule	+	+				+				
Ranunculus bulbosus	+					+			+	
Carex glauca	+						+			+
Euphorbia cyparissias							+		+	1
Galium verum		+			+					
Gymnadenia conopea		+						+		
Centaurea rupestris		+							+	
Aristolochia lutea					1			+		
Asphodelus albus								+	+	
Veronica jacquini								+	+	
Asperula cynanchica									+	+
Carex humilis									+	+
MA *MOLINIO-ARRHENATHERETEA*										
Lotus corniculatus	1	+	+		+	+	+	+	+	+
Dactylis glomerata	+	+	+		+	+	+	+	+	
Festuca rubra			+		+		+	+		
Galium erectum	+		1		+		+			+
Serratula tinctoria	1		+	+						
Lathyrus pratensis			+	+	+					+
Colchicum autumnale					+	+	+			
Trifolium pratense	+	+								
Achillea millefolium		+				+				
Ranunculus acris			+					+		
Rumex acetosa					+		+			
QF *QUERCO-FAGETEA*										
Sesleria autumnalis	2	2	2	+		+		1		2
Anemone nemorosa	1	+			+	+	+	+		
Melittis melissophyllum	+		+					+	1	
Lilium martagon					+	+	+			
Cyclamen europaeum	+	+								
Hieracium racemosum			+	+						
Galium sylvaticum			+	+						
Other species										
Fragaria vesca		+	+	+		+	+	+		
Pontetilla erecta	+	+	+	1						+
Phyteuma zahlbruckneri	+				+	+		+		
Luzula albida	+				+	+	+			
Inula salicina	+		+						+	
Agrostis tenuis				+		+		+		
Rosa pimpinellifolia							+	+		1
Rubus ulmifolius							+	+		
Verbascum nigrum							+	+		

as in the coastal region of the Adriatic Sea and in the mountainous grasslands of Ćićarija and Učka (POSPICHAL, 1989; THELLUNG, 1926). According to our observations in the area, the species rarely thrives in grasslands, where it is eaten by livestock (mainly sheep) or mown. Furthermore, its typical »saum« reproductive strategy of late flowering and fructification (in the beginning of July) does not enable it to complete its reproductive cycle. In these conditions, the species soon disappears. The species can also be found in forests, but its optimum environment is at the forest edge in the »saum« belt.

Knautia illyrica can also be found in this community. It is closely related to the species *Knautia purpurea* found in southern France, Italy, Switzerland, and Spain. *Knautia illyrica* is an endemic species of the karst region and can also be found in NE Italy, W Slovenia, and NE Croatia (EHRENDOFER, 1976).

Cirsio pannonicae-Peucedanetum cervariae van Gils *et al.* 1975

(Tab 2/11–12)

This association was first discovered and described in the vicinity of Rupa, Pivka, and Sežana. VAN GILS *et al.* (1975) found that the ecological amplitude of *Peucedanum cervaria* is narrower here than in Central Europe and treated it as a characteristic regional species (MUCINA, 1993). This association can be found on shaded sites on limestone and terra rossa.

Cirsio-Clematidetum rectae van Gils *et al.* ex Čarni 1997

(Tab 2/13)

Cirsio-Clematidetum rectae is found on shallow redzina over a limestone bedrock. The sites are stony and less shaded than the previous ones. The association was described on low karst (at an altitude of about 300 m) near Sežana (VAN GILS *et al.*, 1975; ČARNI, 1997). The locality on Žbevnica is the highest known locality of the association.

Libanoto-Laserpitietum sileris van Gils *et al.* 1975

(Tab 2/14)

This association appears at higher altitudes in the zone of *Seslerio-Fagetum*. *Laserpitium siler* is a typical species of »saum« habitats in other regions as well. The association supports a relatively high degree of insolation and occupies well-developed soil types. In the process of reforestation, *Laserpitium siler* often spreads over large surfaces.

Scorzonero-Trifolietum alpestris Čarni 1997

(Tab 2/15)

This association is a central association of the suballiance *Dictamno-Ferulagenion* (ČARNI, 1997). It thrives on shallow rendzina on partially shaded sites. The association does not have its own characteristic species but is described as a central association of the suballiance. The characteristic species of the alliance are at the same time the characteristic species of the association (DIERSCHKE, 1974)

Tab. 2. Other communities of the *Dictamno-Ferulagenion*

Number	1	1	1	1	1	1
	1	2	3	4	5	6
Surface (in m^2)	10	50	6	20	10	10
Coverage (in %)	100	100	100	100	100	100
Date day	19	13	8	3	29	9
month	6	6	6	7	6	6
year	95	95	95	95	95	95
Altitude (in m)	50	320	850	950	700	600
Exposition	E	-	S	SW	NE	-
Inclination (in °)	5	0	30	20	20	0
Number of species	13	28	30	38	35	22
Ass. char.						
Peucedanum cervaria	4	3				
Clematis recta			4			
Laserpitium siler				3		
Libanotis daucifolia				1		
Trifolium alpestre			+	+	3	
Veronica jacquini						3
DF *DICTAMNO-FERULAGENION*						
Knautia illyrica			+	+	+	
Paeonia officinallis		1			+	
Inula hirta				1	+	
GS *GERANION SANGUINEI*						
Trifolium rubens	+	+			+	
Silene nutans		+	+	+		
Teucrium chamaedrys		+		1		+
Geranium sanguineum			2	1		
Polygonatum officinale				1	+	
Lilium bulbiferum				+	+	
TG *TRIFOLIO-GERANIETEA*						
Betonica serotina		+		+	+	2
Viola hirta	+	+				+
FB *FESTUCO-BROMETEA*						
Bromus erectus	1	2	2		+	1
Centaurea triumfetti		+	+	+	+	
Brachypodium rupestre	2	2			1	
Satureja montana	+		+			+
Euphorbia cyparissias	+		1	+		
Euphorbia verrucosa		1	+		1	
Salvia pratensis		+	+		+	
Filipendula hexapetala		+		1	+	
Polygala nicaensis		+		+	+	
Linum narbonense			+	+	1	
Carex humilis			+	1		1
Leucanthemum liburnicum				+	+	+
Galium purpureum				+	+	+

Tab. 2. (continued)

Number	1 1	1 2	1 3	1 4	1 5	1 6
Buphthalmum salicifolium		+	+			
Koeleria pyramidata		+	+			
Centaurea rupestris		+		1		
Scorzonera villosa		+		+		
Hippocrepis comosa		+		+		
Briza media		+		+		
Asphodelus albus		+		+		
Peucedanum oreoslinum		+			+	
Nrcissus radiiflorus			+		+	
Genista sericea			+		+	
Festuca rupicola			2			+
Trifolium montanum				+	+	
Stachys recta				+	+	
Dorycnium germanicum				+		+
Dianthus liburnicus				+		+
QF *QUERCO-FAGETEA*						
Aristolochia lutea		+	+	+	+	
Helleborus multifidus		+	+		+	
Potentilla alba				+	+	
Other species						
Dactylis glomerata	1					+
Genista sagittalis		+		+		
Phyteuma zahlbruckneri			+		+	
Vebascum austriacum			+			+

Veronicetum barrelieri-jacquinii van Gils *et al.* 1975 corr. Čarni 1997

(Tab 2/16)

This association is typical of semi-shaded habitats on shallow soils. The association is relatively rare in the area. It was first described as *Veronicetum spicatae-jacquinii*, but in the original description a taxonomic misinterpretation of the species *Veronica spicata* appeared. As the nomenclature of the work of van Gils (VAN GILS *et al.*, 1975) refers to MARTINČIČ & SUŠNIK (1969), *Veronica spicata* was reported to occur in his relevés, but according to the new edition of the cited flora (MARTINČIČ & SUŠNIK, 1984; POLDINI, 1991; EHRENDORFER, 1973), only *Veronica barrelieri* Schott ex Roem. et Schult. (*Pseudolysimachion barrelieri* (Schott ex Roem. et Schult.) Holub) occurs in the region. The name of the syntaxon was therefore later corrected (ČARNI, 1997).

DISCUSSION

During our field work, six associations of »saum« vegetation were discovered. This type of vegetation is well developed and very biodiverse. It contributes very much to the natural heritage of the region.

These communities were formed under human influence that lasted for centuries. With the abandonment of traditional farming, the typical landscape changed. »Saum« species spread over the limestone grassland, and the process of reforestation began. Reforestation can begin from the forest edge to the grassland, or a so-called »nucleus of reforestation« may appear in the center of grassland (some »saum« species with shrub species in the center) and then advance over the grassland. This process has interested many investigators (e.g., FEOLI *et al.*, 1980; 1982; 1983; ČARNI *et al.*, 1991; 1992). The »saum« and mantle species often spread over larger surfaces and make the mantle and »saum« hardly recognizable. In this case, the floristic composition of the area is a mosaic of grassland, »saum«, mantle, and forest species.

ACKNOWLEDGEMENTS

I would like to express my special thanks to Prof. Ljerka Marković and Prof. Ivan Šugar for the necessary information acquired during my stay in Croatia. Thanks also to Prof. Ivo Trinajstić and Boško Čušin for the determination of some plants. I owe thanks to Prof. L. Poldini and Prof. I. Trinajstić for their comments on the previous version of the manuscript. I would like to express my thanks to Miss Polonca Renko, Mrs Barbara Šuštar, and Mr. Marjan Jarnjak for their technical help. Mr. Boško Čušin kindly translated the abstract and summary into Croatian. The study was financed by a grant from the Ministry of Science and Technology of the Republic of Slovenia.

Received February 15, 1999

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SAŽETAK

Vegetacija prirodnih šumskih rubova na području Ćićarije i Učke (NE Istra, Hrvatska)

A. Čarni

U radu je obrađena vegetacija šumskih rubova u sjeveroistočnoj Istri (u Ćićariji i na Učki). To područje ima po Köpennu umjereno toplu klimu s toplim ljetom (grupa Cfb). Geološki supstrat tvori uglavnom vapnenac na kojemu se razvijaju plitka karbonatna tla – rendzine. Vegetaciju smo popisivali i obrađivali po standardnoj Braun-Blanquetovoj metodi.

Zbog nagle promjene ekoloških činilaca na šumskim rubovima se razvija poseban tip vegetacije. Tu su prisutna dva tipa zajednica. U prvome, neposredno uz šumu, dominiraju zajednice grmlja (zastor). Drugi tip zajednica predstavlja prijelaz od zajednica grmlja prema livadnim zajednicama (rub) i u njemu dominiraju visoke zeleni i trave. S obzirom na ekološke uvjete, taj pojas možemo uvrstiti u razred *Galio-Urticetea* (pojavljuje se na svježim i hranjivim tvarima bogatim tlima) ili u razred *Trifolio-Geranietea*, u koji spadaju zajednice iz prirodnijih staništa. U radu su obrađeni prirodni rubovi šuma, koji spadaju u endemičnu podsvezu *Dictamno-Ferulagenion* van Gils *et al*. 1975 u okviru sveze termofilnih šumskih rubova *Ge-*

ranion sanguinei R. Tx. in T. Müller 1962 (*Origanetalia* T. Müller 1962, *Trifolio-Geranietea* Müller 1962).

Utvrdili smo sljedeće asocijacije: *Knautio illyricae-Physospermetum verticillati* ass. nova, koju nalazimo na rubovima bukovih šuma na većim nadmorskim visinama; *Cirsium pannonicae-Peucedanetum cervariae* van Gils *et al*. 1975 je zajednica sjenovitih staništa na vapnencu i flišu; *Cirsio-Clematidetum rectae* van Gils *et al*. ex Čarni 1997 je razvijena na plitkim, kamenitim tlima na djelomice sjenovitim staništima; *Libanoto-Laserpitietum sileris* van Gils *et al*.1975 – zajednica koju susrećemo na većim nadmorskim visinama gdje su razvijena dublja tla; *Scorzonero villosae-Trifolietum alpestris* Čarni 1997 – je opažena na malo zasjenjenim mjestima na plitkim karbonatnim tlima i *Veronicetum barrelieri-jacquinii* van Gils *et al*. 1975 corr. Čarni 1997 – razvijena na polusjenovitim staništima.

Na području obuhvaćenom istraživanjima nalaze se dobro razvijene zajednice, koje pridonose biodiverzitetu i prirodnom bogatstvu regije. Zbog napuštanja tradicionalnog načina zemljoradnje ponegdje su veće travnate površine zahvaćene procesom zarašćivanja. U tom procesu sudjeluju rubne i zastorne vrste, tako da susrećemo mozaik livadnih, rubnih, zastornih i šumskih vrsta, što onemogućuje prepoznavanje osnovnih zajednica.

APPENDIX

Appendix to Table 1:

The species only in one relevé: 1. *Lathyrus vernus* +, *Senecio doronicum* +, *Hieracium murorum* +, *Symphytum tuberosum* +, *Polygala nicaeensis* +, *Genista sylvestris* +, *Cirsium erisithales* +, *Aposeris foetida* +, 2. *Linum catharticum* +, *Hedera helix* +, *Cornus sanguinea/hungarica* +, *Asarum europaeum* +, 3. *Clinopodium vulgare* +, *Cytisus hirsutus* +, *Calamagrostis epigeios* +, 4. *Ceterach javorkeanum* +, 5. *Pulsatilla montana* +, *Potentilla australis* +, *Plantago lanceolata* +, *Leucanthemum liburnicum* +, *Arrhenatherum elatius* +, 6. *Valeriana collina* +, *Taraxacum officinale* +, *Rosa gallica* +, *Ranuculus platanifolius* +, *Muscari botryoides* +, *Maianthemum bifolium* +, *Leontodon hispidus* +, *Convallaria majalis* +, *Aconitum sp*. +, 7. *Helleborus multifidus* 1, *Vicia cf. angustifolia* +, *Potentilla alba* +, *Polygonatum officinale* +, *Mercurialis ovata* +, *Dentaria bulbifera* +, 8. *Primula columnae* +, 9. *Teucrium chamaedrys* +, *Stachys recta* +, *Scorzonera villosa* +, *Molinia arundinacea* +, *Laserpitium latifolium* +, 10. *Genista sagittalis* 1, *Fragaria elatior* +, *Solidago virgaurea* +.

Localities of the relevés 1. under Jelinak, 2. upon Perka, 3. Žejane, 4. Vela Učka, 5. under Vojak, 6. Žejane, 7. Stražica (Učka), 8. Zvončen vrh, 9. Zvončen vrh, 10. Stražica (Učka).

Appendix to Table 2:

Species only in one relevé: 1. *Sesleria autumnalis* 2, *Carex glauca* +, *Centaurea jacea* agg. +, *Dorycnium herbaceum* +, *Fraxinus ornus* juv. +, *Serratula tinctoria* +; 2. *Dictamnus albus* +, *Linum catharcticum* +, *Plantago holosteum* +, *Thalictrum minus* +; 3. *Achillea millefolium* +, *Ajuga chamaepitys* +, *Asparagus tenuifolius* +, *Cirsium pannonicum* +,

Inula salicina +, *Lathyrus pratensis* +, *Mercurialis ovata* +, *Senecio doronicum* +, *Symphytum tuberosum* +, *Valeriana collina* +; 4. *Asperula cynanchica* +, *Globularia willkommii* +, *Gymnadenia conopea* +, *Helianthemum ovatum* +, *Hypochoeris maculata* +, *Laserpitium latifolium* +, *Potentilla australis* +, *Teucrium montanum* +, *Thlaspi praecox* +, *Veronica barrelieri* +; 5. *Cynanchum vincetoxicum* 1, *Anthericum ramosum* +, *Aristolochia lutea* +, *Gentiana lutea* +, *Melittis melissophyllum* +, *Ornithogalum gussonei* +, *Pulmonaria angustifolia* +, *Pulsatilla montana* +, *Ranunculus bulbosus* +, *Rhinanthus* sp. +; 6. *Acer monspessulanum* +, *Hypericum perforatum* +, *Knautia drymeia* subsp. *intermedia* +, *Lotus corniculatus* +, *Muscari botryoides* +, *Prunus mahaleb* +, *Rosa glauca* +, *Scorzonera austriaca* +, *Stipa pennata* subsp. *eriocaulis* +.

Localities of relevés: 11. Brestova, 12. Mali Brgud, »saum« of the *Ostryo-Quercetum pubescentis*, 13. Žbevnica, 14. Zvončen vrh, Učka,1 5. Trstenik, 16. under Mt. Kuk.