

STRUCTURE AND DYNAMICS OF BUSH WOODS VEGETATION IN ŠUMARICE (CENTRAL SERBIA)

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ABSTRACT. Bush woods of Šumarice (Central Serbia) during the 2002, 2003, 2004 and 2005 on three locality in Memorial park nearby Kragujevac town were observed. In syntaxonomical aspect these structures are the closest to association *Pruno spinosae - Crataegetum* (Soó 1927) Hueck 1931. In all three localities 118 species were registered, and among them there were 99 herbs, 15 species of bushes and 4 species of trees. According to structure and dynamics, vegetation of bush woods in Šumarice connects primary climatogenic vegetation of oak forests with secondary formed meadows vegetation. With the increase of density of bushes, bush wood comes closer to the wood (usually located nearby), while by thinning out of them, it comes closer to meadows.

Key words: bush woods, structure, dynamics, Šumarice, Serbia.

INTRODUCTION

In the middle ages oak woods occupied great space on earth. Nowadays, they can be found in Western Europe, European part of Russia, in the Far East and in North America (HORVAT *et al.*, 1974).

The reason for rare presence of oak-woods among forest associations is that they became exterminated under the influence of anthropogenic factors. In these areas, bush woods exist as bigger or smaller fragments.

By the origin, bush woods represent the remnants of devastated climatogenic wood associations, as well as other (of local character) woods in Šumadija. By other words, in the most cases, bush woods have characteristics of their shrub layer, and only in the some cases of the trees layer (MARKOVIĆ & VELJOVIĆ, 1997).

The aim of this work is to present the structure and dynamics of vegetation of the bush woods in Šumarice (Central Serbia), and their characteristics similar with vegetation in nearby woods and meadows. It is realized as a part of bigger research of

successions (progradations and degradations) between primary and secondary ecosystems on the territory of Kragujevac.

General characteristics of studied area

Šumarice is Memorial park, situated in the north-west part of Kragujevac town, in Central Serbia. Geographical position of Kragujevac is determined by these coordinates: 40° 02' northern latitude and 22° 50' eastern latitude. Šumarice is situated at 210-235m of altitude. Geological base is made of neogenic sediments (shoals, hydrated alumina and marls), and the its type of soil is smonica and smonica in the process of browning. The climate is medium continental. (VELJOVIĆ, 1967)

From the phitogeographical point of view, this area belongs to Mezia province of Eurosibirian-northamerican subarea (HORVAT *et al.*, 1974).

Climatogenic vegetation of this area consists of xerothermal oak forests ass. *Quercetum confertae-cerris* Rud. 1940 (VELJOVIĆ, 1967), versus *Quercetum frainetto-cerris moesiacum* (Rud., 1940) Ht. 1974 (KOJIĆ *et al.*, 1998). The greatest areas of these forests are under the impact of anthropogenic factors (most of all cutting), they are turned into cultivable areas. Meadows take less part in this vegetation, but along roads and at the boundaries, the vegetation of hedgerows develope, and it usually has physiognomic shape of bush woods (VELJOVIĆ, 1967).

MATERIAL AND METHODS

The bush woods of Šumarice were observed during the year 2002 and 2003 on locality 1 (in November, December, March and April), year 2003 and 2004 on locality 2 (in December, January, March, April, May and June), and in 2004 and 2005 on locality 3 (in October, November, December, January, March, April and May twice). The first two localities are in the area of Botanical Garden and the third is located opposite the monument of „Mali čistači” in the Memorial park of Šumarice. Aspects in autumn, winter and spring, which affect the result of this work are included.

At the selected localities in the field, we have made fitocenologic recordings following the method of *Braun-Blanquet-a* (1964). We have also established abiotic parameters about the habitat. We have collected floristic material, which is later herbarized in the laboratory. The identification of herbs was done with the help of flora books: PANČIĆ, (1976), JAVORKA & CSAPODI (1934), JOSIFOVIĆ, M. (Ed. I, 1970-1986), TUTIN *et al.* (Eds. 1964-1980). Fitocenological recordings are shown in dynamic tables for every locality according PAVLOVIĆ-MURATSPAHIĆ (1995).

RESULTS AND DISCUSSION

Totally we registered 118 plant species on all three localities. Among them 4 tree species, 15 shrubs and 99 herbal species.

The locality 1 is situated in Šumarice, in the Botanical Garden, at the edge of an orchard, at 230m altitude, geologic basis is tertiary sediment, and the type of ground is smonica in the process of browning. Its exposition is north with terrenian inclination of 10°. The height of vegetation is 2.5m, perimeter of tree stem is 1.5cm, and general coverage of vegetation is 80-100%. The size of the surface is 50m² (Table 1).

Table 1. The structure and dynamic of the vegetation of the bush woods on locality 1

Locality:	Šumarice-Botanical garden			
Altitude:	230 m			
Exposition:	North			
Inclination	10°			
Geologic basis:	Tertiary sediment			
Type of ground:	Smonica in the process of browning			
Height of vegetation:	2.5 m			
Perimeter of tree stem:	1.5 cm			
Coverage:	80%	80%	80%	100%
Size of surface:	50m ²			
Date:	15.11.2002.	27.12.2002.	11.03.2003.	22.04.2003.
Shrub layer:				
<i>Cornus sanguinea</i>	3.3	2.3	2.3	3.3
<i>Rosa canina</i>	1.2	+2	+2	+2
<i>Prunus spinosa</i>	1.2	+2	+2	+2
<i>Ligustrum vulgare</i>	+1	+1	+1	+1
<i>Crataegus monogyna</i>	+1	+1	+1	+1
<i>Rubus caesius</i>	1.2	.	.	+1
Herb layer:				
<i>Glechoma hirsuta</i>	1.2	+2	+2	1.1-1.2
<i>Geum urbanum</i>	+1	+1	1.1	+1
<i>Glechoma hederacea</i>	+1	+1	+2	+2
<i>Fragaria vesca</i>	+1	+1	+1	+1
<i>Viola odorata</i>	+1	+1	+1	+1
<i>Carex sp.</i>	+1	+2	.	+1
<i>Galium mollugo</i>	+2	.	.	+2
<i>Veronica chamaedrys</i>	.	+2	.	+1
<i>Galium mollugo</i>	.	.	+1	+2
<i>Daucus carota</i>	.	.	+1	+1
<i>Rumex acetosa</i>	.	.	+1	+1
<i>Hypnum cupressiforme</i>	.	.	+1	+1
<i>Prunus institicia</i>	.	.	.	1.2
<i>Viola sylvestris</i>	.	.	.	1.1
<i>Festuca heterophylla</i>	.	.	.	+2
<i>Calepina irregularis</i>	.	.	.	+1
<i>Euphorbia cyparissias</i>	.	.	.	+1
<i>Lathyrus pratensis</i>	.	.	.	+1
<i>Euphorbia salicifolia</i>	.	.	.	+1
<i>Antriscus sylvestris</i>	.	.	.	+1
<i>Melandrium album</i>	.	.	.	+1
<i>Ajuga genevensis</i>	.	.	.	+1
<i>Artemisia vulgaris</i>	.	.	.	+1
<i>Scrophularia nodosa</i>	.	.	.	+1

It is determined that there are 30 species totally in locality 1. Six species are registered in the shrub layer, and 24 species in the herb layer. Among them, *Cornus sanguinea* dominates, and also, in less level the bush: *Rosa canina* and *Prunus spinosa*, and herbs: *Geum urbanum*, *Fragaria vesca*, *Glechoma hirsuta*, *G. headracea*, etc. The majority of species is registered in the vernal aspect, exactly 30 species, and the minimum in the hibernal aspect, exactly 12. The plants, which leaves are kept over the winter, stay in that aspect. This bush wood is cut on the 1st October 2003, so it does not exist any more.

The locality 2 is also situated in Šumarice (near the road to Gornji Milanovac town), in the Botanical Garden, at 235m altitude, on north-west exposition. The inclination of terrain is 5°. Geological basis is tertiary sediment and type of ground is the smonica in the process of browning. The height of vegetation is 6m and the age of vegetation is estimated to 30 years (Table 2).

Table 2. The structure and dynamic of the vegetation of the bush woods on locality 2

Locality:	Šumarice-Botanical garden					
Altitude see-level:	235 m					
Exposition:	North – west					
Inclination	5 °					
Geologic basis:	Tertiary sediment					
Type of ground:	Smonica in the process of browning					
Height of vegetation:	6 m					
Age of vegetation:	30 years					
Coverage:	70%	70%	70%	70%	100%	100%
Date:	05.12.03.	16.01.04.	16.03.04.	06.04.04.	11.05.04.	09.06.04.
Tree layer:						
<i>Prunus domestica</i>	1.1	1.1	1.1	1.1	2.1	2.1
<i>Robinia pseudoacacia</i>	1.1	1.1	1.1	1.1	1.1	1.1
<i>Fraxinus excelsior</i>	1.1	1.1	1.1	1.1	1.1	1.1
<i>Malus sylvestris</i>	+1	+1	+1	+1	+1	+1
Shrub layer:						
<i>Prunus spinosa</i>	2.2	2.2	2.2	2.2	2.2	2.2
<i>Cornus sanguinea</i>	1.2	1.2	1.2	1.2	1.2	1.2
<i>Evonymus europaeus</i>	1.1	1.1	1.1	1.1	1.2	1.2
<i>Ligustrum vulgare</i>	1.1	1.1	1.1	1.1	1.1	1.1
<i>Crataegus monogyna</i>	+2	+2	+2	+2	1.2	1.2
<i>Rosa canina</i>	+1	+1	+1	+1	+1	+1
<i>Carpinus betulus</i>	+1	+1	+1	+1	+1	+1
<i>Fraxinus excelsior</i>	+1	+1	+1	+1	+1	+1
<i>Prunus domestica</i>	+2	+2	+2	+2	1.2	1.2
<i>Robinia pseudoacacia</i>	+1	+1	+1	+1	1.1	1.1
<i>Ulmus minor</i>	+1	+1	+1	+1	+1	+1
<i>Acer campestre</i>	+1	+1	+1	+1	+1	+1
Herb layer:						
<i>Hypnum cupressiforme</i>	+2	1.3	1.3	1.3	1.3	1.3
<i>Stellaria media</i>	+1	+1	+1	+2	2.2	+2

Glechoma hirsuta	+1	+1	+1	+1	+2	1.1
Geum urbanum	+2	+2	+1	1.2	+1	+1
Carex sp.	+2	+1	+1	+1	+2	+2
Antriscus sylvestris	.	+2	1.1	1.2 – 1.3	2.2	1.2
Lamium purpureum	+1	+1	.	1.1	1.1	1.1
Viola odorata	.	+1	1.2	1.2	1.2	+2
Festuca heterophylla	.	.	+2	+2	+2	+2
Taraxacum officinale	.	.	+1	+1	+1	+1
Alliaria officinalis	.	.	.	1.2	2.2	1.2
Lamium maculatum	1.2	.	+1	+1	+1	+1
Dactylis glomerata	.	.	.	+2	+2	+2
Viola sylvestris	.	.	.	+1	+1	+1
Ornithogalum pyrenaicum	.	.	.	R	+1	+2
Galium aparine	.	.	.	+1	.	.
Lepidium draba	.	.	.	+1	+1	+1
Arum maculatum	.	.	.	R	+1	+1
Rubus caesius	.	.	.	+1	+1	+1
Tamus communis	.	.	.	.	.	+1
Ranunculus nemorosus	.	.	.	.	.	+1
Carex brizoides	.	.	.	.	.	+2
Lactuca scariola	.	.	.	.	.	+1
Polygonum convolvulus	.	.	.	.	.	+1
Clematis vitalba	.	.	.	.	.	+1
Chenopodium album	.	.	.	.	.	+1
Urtica dioica	.	.	.	.	.	+1
Rumex acetosa	.	.	+1	.	.	.
Galium verum	.	.	+1	.	.	.

Here is a level of small trees (up to 6m), which forms a specific microclimate that is especially apparent in the vegetation period. The herbs are mostly here in the shadow, the humidity is greater and the temperature is higher. Comparing the first two localities, we concluded that they have 14 common herbal species. The number of herbs is almost the same as in the first locality, but it gets behind the third one greatly.

Forty six species are registered in locality 2: 16 species are registered in the tree layer and shrub layer, while 29 species are registered in the herb layer. The majority of species is registered on the 9th June 2004, exactly 43, and the minimum on the 5th December 2003, exactly 19 species. *Prunus domestica*, *Fraxinus excelsior* and *Robinia pseudoacacia* from tree layer have the greatest abundance and coverage, while in the shrub layer *Prunus spinosa*, *Cornus sanguinea*, *Evonymus europaeus*, *Ligustrum vulgare*, etc.. *Stelaria media*, *Carex sp.* and *Glechoma hirsuta* dominate in the herb layer.

The locality 3 is situated in Šumarice not far from „Mali čistači” monument, at 230m altitude. Exposition is south-east, inclination of terrain is 5°. Geological basis is tertiary sediment, type of ground is smonica in the process of browning. The size of studied surface is 100m², and the general coverage is 100%.

Table 3. The structure and dynamics of the vegetation of bush woods on locality 3

Locality:	Šumarice – opposite of the monument „Mali čistači”							
Altitude see-level:	230m							
Exposition:	South-east							
Inclination	5°							
Geologic basis:	Tertiary sediment							
Typ of ground:	Smonica in the process of browning							
Size of surface:	100m ²							
Coverage:	100%	100%	100%	100%	100%	100%	100%	100%
Height of vegetation:	2 m							
Date:	25.10.04.	22.11.04.	20.12.05.	10.01.05.	21.03.05.	11.04.05.	09.05.05.	30.05.05.
Shrub layer:								
Rubus fruticosus	+1	+1	+1	+1	+1	+1	+1	+1
Genista tinctoria	+1	+1	+1	+1	+1	+1	+1	+1
Cytisus austriacus	1.2	+2	+2	+2	+2	+2	1.2	1.2
Prunus spinosa	3.3	1.3	1.3	1.3	1.3	1.3	3.3	3.3
Crataegus monogyna	1.2	+2	+2	+2	+2	+2	1.2	1.2
Rubus caesius	1.2	+2	.	.	.	.	+1	+1
Acer tataricum	1.2	1.2	+2	+2	+2	+2	1.2	1.2
Rosa canina	1.2	+2	+2	+2	+2	+2	+2	1.2
Cornus sanguinea	+2	+2	+2	+2	+2	+2	+2	+2
Fraxinus ornus	+1	.	.	.	.	.	.	.
Ulmus minor	+2	.	.	.	.	.	.	.
Herb layer:								
Festuca pseudovina	3.3	3.3	3.3	3.3	4.4	4.4	2.2	1.2
Veronica chamaedrys	+1	1.1	1.1	+1	+1	+2	1.1	1.1
Dypsacus sylvester	1.1	1.1	1.1	+1	+1	1.1	+1-1.1	+1
Achillea millefolium	+1	1.1	1.1	+1	+1	+1	1.1	1.1
Salvia verticillata	+1	+1	+1	+1	+1	+1	+1	+1
Fragaria vesca	+1	1.1	+1	+1	+1	+1	1.1	1.1
Sanguisorba minor	+1	+1	+1	+1	+1	+1	+1	+1
Filipendula hexapetalla	+1	+1	+1	+1	+1	+1	1.1	+1
Dorycnium herbaceum	2.2	1.2	1.2	+1	+1	+2	1.3	1.3
Ranunculus nemorosus	+1	+1	+1	.	+1	1.1	1.1	1.1
Cirsium lanceolatum	+1	+1	.	+1	+1	+1	+1	+1
Agrimonia eupatoria	2.2	1.1	.	.	.	+1	1.1	1.1
Daucus carota	+1	+1	+1	.	.	+1	+1	+1
Leucanthemum vulgare	+1	+1	.	.	+1	+1	+1	+1
Geum urbanum	+1	+1	+1	.	.	+1	+1	+1
Potentilla argentea	+1	+1	+1	.	.	+1	+1	+1
Galium verum	1.2	+2	.	.	.	+1	+1	1.1
Ononis spinosa	1.2	+2	.	.	.	+1	+1	+1
Mentha spicata	+1	+1	+1	.	.	.	+2	+1
Picris hieracioides	+1	+1	.	.	.	1.1	+1	+1

Centarium umbelatum	+1	+1	.	.	.	+1	+1	+1
Centaurea jacea	+1	+1	.	.	.	+1	+1	+1
Lathyrus pratensis	.	+1	.	.	+1	.	1.2	1.2
Vicia sativa	.	+1	.	.	.	+1	+1	+1
Ornithogalum pirenaicum	+1	.	.	.	.	+1	+1	+1
Linaria vulgaris	+1	+1	.	.	.	.	+1	+1
Viola odorata	+1	+1	.	.	.	+1	+1	+1
Ornithogalum umbelatum	.	.	.	.	+1	.	+1	+1
Euphorbia virgata	.	.	.	.	.	+1	+1	+1
Stenactis anua	+1	.	.	.	.	.	+1	+1
Rumex acetosa	+1	+1	.	.	.	.	.	+1
Carex verna	.	.	.	+2	+2	1.2	1.2	1.2
Dactylis glomerata	.	.	.	.	+2	+2	.	.
Potentilla recta	+1	+1	.	.	.	.	.	.
Carduus acanthoides	.	.	+1	+1	.	.	.	.
Potentilla reptans	.	.	.	+1	.	+1	.	.
Ajuga genevensis	.	.	.	.	.	.	+1	+1
Myosotis arvensis	.	.	.	.	.	.	+1	+1
Galium mollugo	.	.	.	.	.	.	+1	+1
Anthoxanthum odoratum	.	.	.	.	.	.	+1	+1
Veronica serpyllifolia	.	.	.	.	.	.	+1	+1
Moenchia mantica	.	.	.	.	.	.	+1	+1
Picris hieracoides	.	.	.	.	.	+2	+2	1.2
Inula britannica	.	+1	.	.	.	.	.	.
Cynodon dactylon	.	+1	.	.	.	.	.	.
Carlina vulgaris	.	.	+1	.	.	.	.	.
Plantago lanceolata	.	.	+1	.	.	.	.	.
Prunella vulgaris	.	.	+1	.	.	.	.	.
Geranium dissectum	.	.	+1	.	.	.	.	.
Hypericum perforatum	.	.	.	+1	.	.	.	.
Plantago media	.	.	.	+1	.	.	.	.
Setaria glauca	.	.	.	+1	.	.	.	.
Cerastium caespitosum	.	.	.	.	+1	.	.	.
Salvia pratensis	.	.	.	.	+1	.	.	.
Geranium pyrenaicum	.	.	.	.	+1	.	.	.
Verbascum sp.	.	.	.	.	.	+1	.	.
Cirsium eriophorum	.	.	.	.	.	.	+1	.
Serratula tinctoria	.	.	.	.	.	.	+1	.
Festuca pratensis	.	.	.	.	.	.	.	+1
Chrysanthemum parthenium	.	.	.	.	.	.	.	+1
Lathyrus nissolia	.	.	.	.	.	.	.	+1
Euphorbia cyparissias	+1	.	.	.	.	.	.	.

Seventy five species are registered in the third locality: 13 species in the shrub layer and among them *Prunus spinosa*, *Rosa canina*, *Cornus sanguinea*, *Crataegus monogyna*, *Acer tataricum*, *Cytisus austriacus*, *Rubus fruticosus*, *Genista tinctoria* are dominate. The herb layer includes 63 species, and the most abundant are: *Festuca pseudovina*, *Ranunculus nemorosus*, *Latiyrus pratensis*, *Filipendula hexapetala*, *Sanguisorba minor*, etc. There are 8 common species with the first locality, and 11 common species with the second locality.

The structure and the dynamics of a hedgerow vegetation mostly depends on the way of creating and the phase of their today's progradation.

Comunities, which are "residuum of devastated climatogenic community, *Quercetum frainetto-cerris* (Rud. 1940) Ht 1974" have close-grained conformation of shrub layer, with or without trees, and relatively small number of species in herb layer (MARKOVIĆ & VELJOVIĆ, 1997). Quantitatively, herb species are less presented, and among them there are more species from nearby woods. Shrub layer is richer in species and we can find all of them in nearby woods, where they create their own layer. Seasonal dynamics of these associations is similar to the seasonal dynamics of woods with explicit early spring aspect (the locality 1 and 2).

The association created as the result of neglecting of meadows and progradation of vegetation (the locality 3) has poorly developed its shrub layer. Here, sloe (*Prunus spinosa*) dominated with several species from shrub layers from nearby woods: *Crataegus monogina*, *Acer tataricum*, *Cornus sanguineus*. In the parts of community located closer to the woods, *Quercus frainetto* and *Quercus cerris* dominated. In parts of associations with less-grained conformation, herbal species common with nearby meadows dominate. Seasonal dynamics of this association, as well as the previous two, has changes connected to falling of leaves in the autumn and leafing in the spring, as in well as in the woods. In herb layer, which is qualitatively and quantitatively richer, the maximum of development is at the end of May and beginning of June, like on the meadows, and much later than in the woods.

Studying hedgerows in Šumadija, VELJOVIĆ & MARKOVIĆ (1980), and MARKOVIĆ & VELJOVIĆ (1997) single out three associations: *Prunetum spinosae* Soó 1927, *Crataegetum monoginae* Veljović V., Marković A. 1980 and *Lycietum halinifolii* Veljović V., Marković A. 1980. Our opinion is that associations studied in our work belong to ass. *Pruno spinose-Crataegetum* (Soó 1927) Hueck 1931.

From syntaxonomic point of view, this association belongs to vegetational association *Prunion spinosae* Soó 1940, order of *Prunetalia spinosae* Tx. 1952 and vegetational class *Querco – Fagetea* Br.-Bl. et Vlieg. 1937.

The main anthropogenic factors which affect changing of bush wood vegetation in Šumarice are physical destruction (like on the locality 1) and neglecting of meadows (like on on the locality 3).

The significance of this vegetation at the territory of Šumarice is rising and progradation of vegetation from meadows to climatogenic wood association.

CONCLUSION

In Šumarice, Memorial park near Kragujevac town, the three localities were analyzed in this study. The bush woods on two localities are formed by cutting the level of trees in primary forest structures, where bushes with low trees build thick complex

and therefore the number of species in the herb layers is small. The structure of bush wood on the third locality was made by progradation of vegetation on the neglected meadow. It has more rich floristic structure, and meadow plants dominate in the herb layer.

Microclimatic factors in areas of all the localities are very similar and minimal differences can be attributed to various exposition and years in which the observing was performed.

Totally, on all the three localities, 118 plant species were registered, and among them 4 trees species, 15 bush 99 and herbs. On all localities, common species from the shrub layer are *Cornus sanguinea*, *Rosa canina*, *Prunus spinosa* and *Crataegus monogyna*, and of herbs *Viola odorata*, *Geum urbanum* and *Rumex acetosa*.

Syntaxonomically studied bush woods are the closest to the association *Prunospinosae-Crataegetum* (Soó 1927) Hueck 1931.

The studied vegetation of bush woods is under great influence of antropogenic factors even today.

The significance of these vegetation on the territory of Šumarice is in the development and progradation from meadows towards climatogenic association *Quercetum frainetto - cerris* Rud. (1940) Ht. 1974.

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