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Original scientific paper

FLORISTIC CHARACTERISTICS OF DRY PASTURES AND ROCKY GROUNDS THE SECOND YEAR AFTER THE WILDFIRE ON VIDLIČ MOUNTAIN

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Abstract: *In this paper, the influence of wildfire on dry pastures and rocky grounds the second year after the fire is followed. The results of field studies are presented in the form of phytocoenological table, by applying clustering techniques (WPGMA) and correspondence analysis (CA). Regrouping of the relevés, in comparison with the first year after fire, indicates that specific and more individual directions in vegetation succession have occurred. The situation remained unchanged, only for the rocky sites affected by the fire, at higher altitudes, in the zone of beech forests where the relevés were still standing separately on the graph, as in the previous season, indicating stability in floristic composition, probably caused by faster moving of the fire over the rocky substrate. The quantitative increase in the number of species and diversity index in comparison to the previous season was registered.*

Keywords: wildfire, dry pastures, rocky ground, diversity

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FLORISTIČKE KARAKTERISTIKE SUVIH PAŠNJAKA I KAMENJARA DRUGE GODINE POSLE POŽARA NA PLANINI VIDLIČ

Izvod: U radu je prikazan uticaj požara na suve pašnjake i kamenjare na planini Vidlič druge godine posle požara. Rezultati terenskih istraživanja su prikazani u vidu fitocenološke tabele, primenom klaster analize (WPGMA) i korespondentne analize (CA). Pregrupisanje fitocenoloških snimaka, u poređenju sa prvom godinom posle požara, ukazuje na specifične i individualne pravce u sukcesiji vegetacije. Situacija je ostala nepromenjena samo na stenovitim opožarenim površinama na većim nadmorskim visinama u zoni bukovih šuma, gde fitocenološki snimci i dalje stoje odvojeno na grafiku od ostalih kao i prethodne sezone, što ukazuje na stabilnost u florističkom sastavu, što je najverovatnije uzrokovano brzim prelaskom požara preko stenovite podloge. Zabeleženo je kvantitativno povećanje broja vrsta i indeksa diverziteta u odnosu na prethodnu sezonu.

Ključne reči: požar, suvi pašnjaci, kamenjari, diverzitet

1. INTRODUCTION

Dry pastures and rocky grounds represent open habitats, specific in terms of their floristic composition and vegetation characteristics. In the southeastern Serbia they have been the subject of a number of studies (Jovanović-Dunjić, R., 1955, 1956; Diklić, N., 1962; Diklić, N., Nikolić, V., 1964). They belong to the alliance *Festucion valesiacae* Klika 1931 (class *Festuco-Brometea* Br.-Bl. et Tüxen ex Soó 1947) and alliance *Seslerion rigidae* Zoly. 1939 (class *Festuco-Seslerietea* Barbero et Bonin 1969) with a distinct steppe features which at the same time include certain floristic elements with Mediterranean and sub-Mediterranean distribution. The latter indicates the complexity of living conditions prevailing in these areas. Marković, M. *et al.* (2015) presented vegetation patterns of dry pastures and rocky grounds on the limestone terrain of Mt. Vidlič in the southeastern Serbia.

On the territory of the Natural Park "Stara Planina", a particularly high incidence of forest fires was recorded in July when about 3,000 ha of open space were affected by the wildfire (Živanović, S. *et al.*, 2019). The wildfire on Mt. Vidlič caught, among others, dry pastures and rocky ground on large areas of over 1,000 ha. Taking into consideration the openness of the habitat, the fire quickly swept across skeletal soil causing enormous damage to the xerophilic vegetation.

In the summer, the period of most frequent wildfires, the habitats of thermophilic meadows and rocky grounds are the driest. When a fire occurs, dry plants catch fire easily and their above ground parts burn very quickly. The fire does not last long on such habitat, because there are no mesophilic species to allow the fire to smolder. Because of the above, the fire, so to speak, passes over the substrate and the soil does not even catch fire or is affected by the fire to a small depth.

Our general hypothesis is that the effect of wildfires on plant communities and their diversity will be weaker if carbonate rocks are more pronounced and represent a larger part in the composition of the substrate. We assume that a well-developed rocky fraction, typical for limestone areas, plays an important role in the

fire which passed quickly over the substrate, and therefore the effect on change of vegetation is less pronounced. The soil is less affected and damaged by the fire. The underground organs and seeds in the soil will be better preserved. Some of the perennial plants or even the whole fragments of communities could survive among larger rocks in the area affected by the fire. (Marković, M. *et al.*, 2018).

2. MATERIAL AND METHODS

The field research of the areas of dry pastures and rocky grounds affected by the fire on Mt. Vidlič were conducted in 2009. The plant material collected during the field research was deposited in the Herbarium of the Department of Biology and Ecology, Faculty of Sciences and Mathematics, University of Nis: Herbarium Moesiacum (HMN). The identification of the collected plant material was performed according to Josifović, M. (1970-1986) and Ђорданов, Д. (1963-1995), and the nomenclature was adjusted in accordance with Flora Europaea (Tutin, T.G. *et al.*, 1964-1980, 1993).

The results of the phytocoenological studies of dry pastures and rocky grounds affected by the fire performed on the field using the method of Braun-Blanquet (1964) were presented in the form of phytocoenological table. Nine relevés were sampled.

The analysis of phytocoenological data was carried out using the classification method of Statistica 8.0 software package by applying clustering techniques (WPGMA) (StatSoft, 2007). This analysis uses combining abundance and cover of each species per relevé. Firstly, the combined values were transformed according to the numeric scale proposed by Westhoff, V., Van der Marrel, E. (1973). Alpha diversity of species in the community was determined using the software package of the “Flora” program (Karadžić, B., Marinković, S., 2009). Biodiversity indices were calculated according to Whitaker: the total number of species and Simpson’s diversity index (Whitaker, R.H., 1972).

The results of the study of the floristic composition of dry pastures and rocky grounds the second year after the wildfire were compared with the already published results relating to the first year after the wildfire (Marković, M., Rakonjac, Lj., 2017). For the second year after the fire three relevés (**g.**, **h.**, **i.**) were added compared to the previous season.

3. RESULTS AND DISCUSSIONS

Relevés of dry pastures and rocky grounds affected by the fire on Mt. Vidlič have been sampled at altitudes of 524 to 1280 m, with exposures: S, E, SW and SE, terrain inclination 10 to 50°, and number of species from 33 to 73 (Table 1) and the value of Simpson’s diversity index ranging from 0.965 to 0.986. In 9 relevés (**a.-i.**) 235 species and subspecies in total were recorded. Per individual relevé, 110 species and subspecies were recorded which indicates great diversity.

Annual plant species *Sideritis montana* that was dominant in the first year after the fire on semi-open habitats on sites **a.** and **d.** was replaced by plants from the grass family: *Festuca valesiaca*, *Dichanthium ischaemum*, *Melica ciliata*, *Chrysopogon gryllus*. The abundance and coverage of the annual plant species

Sideritis montana decreased, which was assumed to be related to its short reproductive cycle. The increase in the presence of plant species from the grass family indicates that the area affected by the fire gradually returns to its original state which existed prior to the wildfire. In other relevés, changes in the composition of dominant species are not so distinct. It should be emphasized that the number of woody species increased in both layers compared to the first year after the fire.

The stand on the site **b.** is located on the open habitat of rocky ground affected by the fire, in the zone of beech forests exposed to the east. The soil is shallow, brown, comprising limestone, eroded, permeated by geological substrate, of fine granulometric composition with larger rocks appearing to a lesser extent. This stand dominated by the species *Hieracium pilosella*, with its abundance and coverage remaining the same both the first and the second year after the fire (Table 1). The changes in floristic composition of this stand in the second year after the fire compared to the first year after the fire are insignificant, which, in our opinion, is related to its distance from closed communities under the beech forest. Hence, relevé **b.** has been sampled on open habitat, unlike relevé **a.**, which has been sampled on semi-open habitat. In addition, it is noted that the soil in the stand on site **b.** is shallower than on site **a.**, so the fire passed over the substrate faster and damaged the vegetation to a lesser extent. Due to the openness of the habitat and lesser depth of the soil substrate, the changes in the second year after the fire compared to the first year after the fire are less pronounced in the stand on site **b.**, than on site **a.**

Table 1. *Dry pastures and rocky grounds on Vidlič Mountain the second year after the wildfire (2009)*

Locality	V.Od.	Basarski kamik				Vučje				D	
Altitude (m)	900	1100	1150	1220	1280	710	558	524	843		e
Exposure	S	E		S			SW	SE		g	
Terrain inclination (°)	35		10	40	50	10	30	25	10	r	
Relevé area (m ²)	100										e
Geological substrate	Limestone										e
Type of soil	Shallow skeletal rendzina										
General vegetation coverage (%)	60		80	60	50	60	70		60	o	
Vegetation height (cm)	30				40	90	70		160	f	
Date	13 June 2009	21 June 2009		23 July 2009		5 August 2009	6 June 2009			p	
Relevé number	a	b	c	h	i	d	e	f	g	r	
<u>Floristic composition:</u>											e.
Shrub layer:											
<i>Crataegus monogyna</i> Jacq.	+1	.	+1	+1	.	+1	+1	+1	+1	IV	
<i>Rosa canina</i> L.	.	+1	.	+1	+1	.	+1	+1	1.1	IV	
<i>Ononis pusilla</i> L.	+1	.	.	.	.	+1	.	+1	+1	III
<i>Pyrus pyraeaster</i>	+1	.	.	.	.	.	+1	.	+1	II

Burgsd.										
<i>Malus sylvestris</i>										
Miller	.	+1	.	+1	.	.	.	.	.	II
<i>Sorbus aria</i> (L.)										
Crantz	.	.	.	+1	+1	.	.	.	.	II
<i>Prunus spinosa</i> L.	.	.	.	+1	.	.	+1	.	.	II
<i>Carpinus orientalis</i>										
Miller	.	.	.	+1	.	.	.	.	+1	II
<i>Pinus sylvestris</i> L.	.	+1	.	.	.	.	.	.	.	I
<i>Genista ovata</i>										
Waldst. & Kit.	.	.	.	1.3	.	.	.	.	.	I
<i>Cytisus procumbens</i>										
(Waldst. & Kit. ex Willd.) Sprengel	.	.	.	+2	.	.	.	.	.	I
<i>Quercus cerris</i> L.	.	.	.	+1	.	.	.	.	.	I
<i>Clematis vitalba</i> L.	.	.	.	+1	.	.	.	.	.	I
<i>Rosa pimpinellifolia</i>										
L.	.	.	.	.	1.1	.	.	.	.	I
<i>Rosa glutinosa</i>										
Sibth. & Sm.	.	.	.	.	1.1	.	.	.	.	I
<i>Chamaecytisus ciliatus</i> (Wahlenb.)										
Rothm.	.	.	.	.	+2	.	.	.	.	I
<i>Genista sericea</i>										
Wulfen	.	.	.	.	+2	.	.	.	.	I
<i>Corylus avellana</i> L.	.	.	.	.	+1	.	.	.	.	I
<i>Cotoneaster integerrimus</i>										
Medicus	.	.	.	.	+1	.	.	.	.	I
<i>Populus tremula</i> L.	.	.	.	.	+1	.	.	.	.	I
<i>Chamaecytisus jankae</i> (Velen.)										
Rothm.	.	.	.	.	+1	.	.	.	.	I
<i>Ulmus glabra</i>										
Hudson	.	.	.	.	.	.	.	+1	.	I
<i>Vinca herbacea</i>										
Waldst. & Kit.	.	.	.	.	.	.	.	.	+1	I
<i>Cornus sanguinea</i> L.	.	.	.	.	.	.	.	.	+1	I
<i>Acer monspessulanum</i> L.	.	.	.	.	.	.	.	.	+1	I
<i>Syringa vulgaris</i> L.	.	.	.	.	.	.	.	.	+1	I
Herbaceous layer:										
<i>Teucrium chamaedrys</i> L.	1.1	+1	2.2	+1	1.1	1.1	+2	1.3	1.1	V
<i>Asperula cynanchica</i> L.	+1	+1	1.1	+1	+1	+1	1.1	+1	.	V
<i>Euphorbia cyparissias</i> L.	1.1	+1	+1	+1	+1	+1	.	+1	1.1	V
<i>Fragaria vesca</i> L.	+1	.	+1	+1	.	.	+1	+1	+2	IV
<i>Medicago sativa</i> L. subsp. <i>falcata</i> (L.)										
Arcangeli	1.1	.	2.2	.	.	+1	1.1	+1	+1	IV
<i>Eryngium campestre</i> L.	+1	.	+1	.	.	+1	+1	+1	+1	IV
<i>Satureja kitaibelii</i>										
Wierzb.	2.2	.	.	+2	.	1.2	+2	+1	2.3	IV
<i>Festuca valesiaca</i>										
Schleicher ex Gaudin	2.3	.	.	.	+2	+2	+2	3.4	+2	IV
<i>Asperula purpurea</i>	.	1.1	1.1	1.1	.	.	2.2	+1	+1	IV

(L.) Ehrend.										
<i>Carduus candicans</i> Waldst. & Kit. subsp. <i>candicans</i>	+1	+1	.	+1	.	+1	.	.	+1	III
<i>Centaurea</i> <i>biebersteinii</i> DC. subsp. <i>australis</i> (Pančić) Dostál	+1	.	+1	.	+1	.	.	+1	+1	III
<i>Sideritis montana</i> L.	1.1	.	.	1.1	.	+1	+1	+1	.	III
<i>Teucrium montanum</i> L.	+2	.	.	.	+2	+2	+2	+2	.	III
<i>Petrorhagia</i> <i>saxifraga</i> (L.) Link	.	+1	+1	.	.	+1	+1	+1	.	III
<i>Arenaria</i> <i>serpyllifolia</i> L. subsp. <i>serpyllifolia</i>	.	.	+1	.	+1	+1	.	+1	+1	III
<i>Leontodon hispidus</i> L.	.	.	.	+1	+1	+1	+1	.	+1	III
<i>Linaria rubioides</i> Vis. & Pančić subsp. <i>nissana</i> Niketić & Tomović	.	.	.	+1	+1	1.1	.	+1	+1	III
<i>Hypericum</i> <i>perforatum</i> L.	.	+1	+1	+1	+1	.	.	.	.	III
<i>Leontodon crispus</i> Vill.	.	+1	.	.	+1	+1	.	+1	.	III
<i>Achillea millefolium</i> L.	.	+1	+1	.	+1	.	+1	.	.	III
<i>Chondrilla juncea</i> L.	.	+1	+1	.	.	.	+1	+1	.	III
<i>Sanguisorba minor</i> Scop.	.	+1	+1	.	.	.	.	+1	+1	III
<i>Anthyllis vulneraria</i> L.	.	.	1.1	+1	+1	.	.	.	+2	III
<i>Achillea crithmifolia</i> Waldst. & Kit.	.	.	+1	+1	.	.	+1	.	+1	III
<i>Erysimum diffusum</i> Ehrh.	.	.	.	+1	+1	.	+1	+1	.	III
<i>Acinos arvensis</i> (Lam.) Dandy	.	.	.	1.1	.	+1	+2	.	+1	III
<i>Geranium dissectum</i> L.	.	.	.	+1	.	.	+1	+1	+1	III
<i>Melica ciliata</i> L.	.	.	.	.	+1	2.3	+1	.	+1	III
<i>Thymus glabrescens</i> Willd.	.	.	.	.	+2	.	+2	1.3	1.3	III
<i>Acinos alpinus</i> (L.) Moench subsp. <i>majoranifolius</i> (Miller) P. W. Ball	2.2	.	+1	.	.	.	.	+1	.	II
<i>Artemisia alba</i> Turra	1.2	.	.	.	+2	.	.	.	+2	II
<i>Potentilla cinerea</i> Chaix ex Vill.	+1	.	.	.	+2	.	.	.	+1	II
<i>Sedum acre</i> L.	+1	.	.	.	.	+1	.	+1	.	II
<i>Convolvulus</i> <i>cantabrica</i> L.	+1	.	.	.	.	+1	.	.	+1	II
<i>Carex caryophyllea</i> Latourr.	.	1.1	2.2	+1	.	.	.	.	.	II
<i>Hieracium pilosella</i> L.	.	3.3	1.2	.	.	.	.	+1	.	II
<i>Potentilla argentea</i> L.	.	+1	+1	.	.	.	.	+1	.	II
<i>Hieracium</i> <i>praealtum</i> Vill. ex	.	+1	+1	.	.	.	.	+1	.	II

<i>Cerastium banaticum</i> (Rochel) Heuffel	.	.	.	+1	+1	.	.	.	.	II
<i>Scabiosa argentea</i> L.	.	.	.	+1	+1	.	.	.	.	II
<i>Trifolium montanum</i> L.	.	.	.	+1	1.1	.	.	.	.	II
<i>Rhinanthus alectorolophus</i> (Scop.) Pollich	.	.	.	+1	+1	.	.	.	.	II
<i>Hieracium gymnocephalum</i> Griseb. ex Pant.	.	.	.	+1	+1	.	.	.	.	II
<i>Dianthus petraeus</i> Waldst. & Kit.	.	.	.	+1	+1	.	.	.	.	II
<i>Euphorbia seguierana</i> Necker subsp. <i>niciciana</i> (Borbás ex Novák) Rech.	.	.	.	+1	.	.	+2	.	.	II
<i>Onobrychis alba</i> (Waldst. & Kit.) Desv.	.	.	.	+1	.	.	.	.	+1	II
<i>Hyacinthella leucophaea</i> (C. Koch) Schur	.	.	.	+1	.	.	.	.	+1	II
<i>Muscari neglectum</i> Guss. ex Ten.	.	.	.	+1	.	.	.	.	+1	II
<i>Agropyron cristatum</i> (L.) Gaertner	.	.	.	.	+1	+1	.	.	.	II
<i>Helianthemum nummularium</i> (L.) Miller	.	.	.	.	1.1	.	+1	.	.	II
<i>Linaria genistifolia</i> subsp. <i>sofiana</i> (Velen.) Chater & D.A. Webb	.	.	.	.	+1	.	+1	.	.	II
<i>Ptilostemon afer</i> (Jacq.) W. Greuter	.	.	.	.	+1	.	+1	.	.	II
<i>Trifolium badium</i> Schreber	.	.	.	.	+1	.	.	+1	.	II
<i>Dichanthium ischaemum</i> (L.) Roberty	.	.	.	.	.	3.3	1.2	.	.	II
<i>Allium moschatum</i> L.	.	.	.	.	.	+1	+1	.	.	II
<i>Bromus squarrosus</i> L.	.	.	.	.	.	+1	+1	.	.	II
<i>Koeleria nitidula</i> Velen.	.	.	.	.	.	+2	.	.	1.1	II
<i>Althaea hirsuta</i> L.	.	.	.	.	.	+1	.	.	+2	II
<i>Cuscuta europaea</i> L.	.	.	.	.	.	+1	.	.	1.2	II
<i>Carlina vulgaris</i> L.	.	.	.	.	.	.	+1	+1	.	II
<i>Xeranthemum annuum</i> L.	.	.	.	.	.	.	+1	+1	.	II
<i>Poa compressa</i> L.	.	.	.	.	.	.	+1	+1	.	II
<i>Poa pratensis</i> L.	.	.	.	.	.	.	+1	+1	.	II
<i>Linaria vulgaris</i> Miller	.	.	.	.	.	.	.	+1	+1	II
<i>Agrostis capillaris</i> L.	.	.	.	.	.	.	.	+1	+1	II
<i>Alyssum alyssoides</i> (L.) L.	.	.	.	.	.	.	.	+1	+1	II

<i>Astragalus onobrychis</i> L.	.	.	.	.	.	.	+2	+1	II
<i>Thymus striatus</i> Vahl	.	+2	.	.	.	.	.	.	I
<i>Danthonia decumbens</i> (L.) DC.	.	+2	.	.	.	.	.	.	I
<i>Koeleria splendens</i> C. Presl	.	.	1.2	.	.	.	.	.	I
<i>Trifolium arvense</i> L.	.	.	1.1	.	.	.	.	.	I
<i>Stachys recta</i> L.	.	.	.	2.2	.	.	.	.	I
<i>Sesleria argentea</i> (Savi) Savi	.	.	.	1.3	.	.	.	.	I
<i>Thalictrum aquilegifolium</i> L.	.	.	.	.	+3	.	.	.	I
<i>Micromeria cristata</i> (Hampe) Griseb.	.	.	.	.	+2	.	.	.	I
<i>Cerastium decalvans</i> Schlosser & Vuk.	.	.	.	.	+2	.	.	.	I
<i>Chrysopogon gryllus</i> (L.) Trin.	.	.	.	.	.	1.3	.	.	I
<i>Carex humilis</i> Leysser	.	.	.	.	.	+2	.	.	I
<i>Calamintha nepeta</i> (L.) Savi	.	.	.	.	.	.	2.3	.	I
<i>Medicago minima</i> (L.) Bartal.	.	.	.	.	.	.	2.2	.	I
<i>Centaurea calcitrapa</i> L.	.	.	.	.	.	.	1.1	.	I
<i>Galium mollugo</i> L.	.	.	.	.	.	.	.	2.2	I
<i>Festuca paniciana</i> (Hackel) K. Richter	.	.	.	.	.	.	.	+2	I
<i>Thymus pulegioides</i> L.	.	.	.	.	.	.	.	+2	I

Legend: V. Od. – Visočki Odorovci, Degree of pre. – Degree of presence

Only in one relevé with the value of +.1 the following species were recorded:

Relevé a: *Bromus erectus* Hudson, *Thymus pannonicus* All., *Allium scorodoprasum* L. subsp. *rotundum* (L.) Stearn, *Ornithogalum pyramidale* L., *Petrorhagia illyrica* (Ard.) P. W. Ball & Heywood, *Thlaspi perfoliatum* L., *Paeonia tenuifolia* L., *Globularia punctata* Lapeyr., *Linum bienne* Miller, *Fragaria viridis* Duchesne, *Stachys germanica* L.;

Relevé b: *Euphrasia pectinata* Ten., *Thymus alpestris* Tausch ex A. Kerner, *Luzula campestris* (L.) DC., *Lotus corniculatus* L., *Crepis sancta* (L.) Babcock, *Scabiosa ochroleuca* L., *Dactylorhiza sambucina* (L.) Soó;

Relevé c: *Rhinanthus rumelicus* Velen., *Vicia sativa* L. subsp. *nigra* (L.) Ehrh., *Euphrasia salisburgensis* Funck, *Briza media* L., *Scabiosa columbaria* L. subsp. *columbaria*;

Relevé d: *Bupleurum praealtum* L., *Lactuca saligna* L., *Viola odorata* L., *Helleborus odorus* Waldst. & Kit., *Campanula glomerata* L., *Cerastium brachypetalum* Pers., *Thymus longicaulis* C. Presl, *Helianthemum ledifolium* (L.) Miller, *Helianthemum salicifolium* (L.) Miller, *Lactuca viminea* (L.) J. & C. Presl, *Allium sphaerocephalon* L.;

Relevé e: *Cichorium intybus* L., *Onobrychis arenaria* (Kit.) DC., *Arabis sagittata* (Bertol.) DC., *Trifolium striatum* L., *Sedum urvillei* DC., *Lens nigricans* (Bieb.) Godron,

Scrophularia canina L., *Cuscuta epithymum* (L.) L., *Picris hieracioides* L., *Carduus acanthoides* L., *Myosotis arvensis* (L.) Hill;

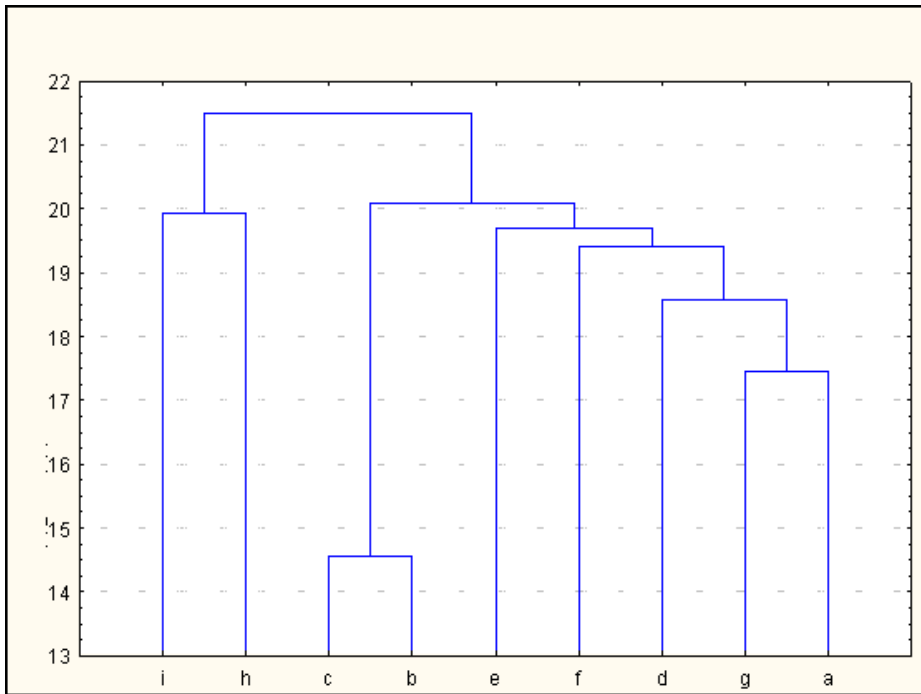
Relevé f: *Scandix australis* L., *Lathyrus nissolia* L., *Trifolium scabrum* L., *Achillea clypeolata* Sibth. & Sm., *Coronilla scorpioides* (L.) Koch, *Thesium arvense* Horvatovszky, *Erodium cicutarium* (L.) L'Hér., *Cerastium semidecandrum* L., *Torilis leptophylla* (L.) Reichenb., *Allium paniculatum* L.;

Relevé g: *Ajuga chamaepitys* (L.) Schreber subsp. *chia* (Schreber) Arcangeli, *Viola kitaibeliana* Schultes, *Stipa pulcherrima* C. Koch, *Linum tenuifolium* L., *Crupina vulgaris* Cass., *Aethionema saxatile* (L.) R. Br., *Euphorbia falcata* L., *Lathyrus cicera* L., *Thesium divaricatum* Jan ex Mert. & Koch, *Alopecurus pratensis* L., *Alyssum minus* (L.) Rothm.;

Relevé h: *Salvia nemorosa* L., *Silene bupleuroides* L., *Arabis hirsuta* (L.) Scop., *Fagus moesiaca* (K. Malý) Czech., *Torilis japonica* (Houtt.) DC., *Verbascum vandasii* (Rohlena) Rohlena, *Verbascum thapsus* L., *Campanula sparsa* Friv. subsp. *sphaerothrix* (Griseb.) Hayek, *Astragalus depressus* L., *Scilla bifolia* L., *Malcolmia orsiniana* (Ten.) Ten. subsp. *angulifolia* (Boiss. & Orph.) A. L. Stork;

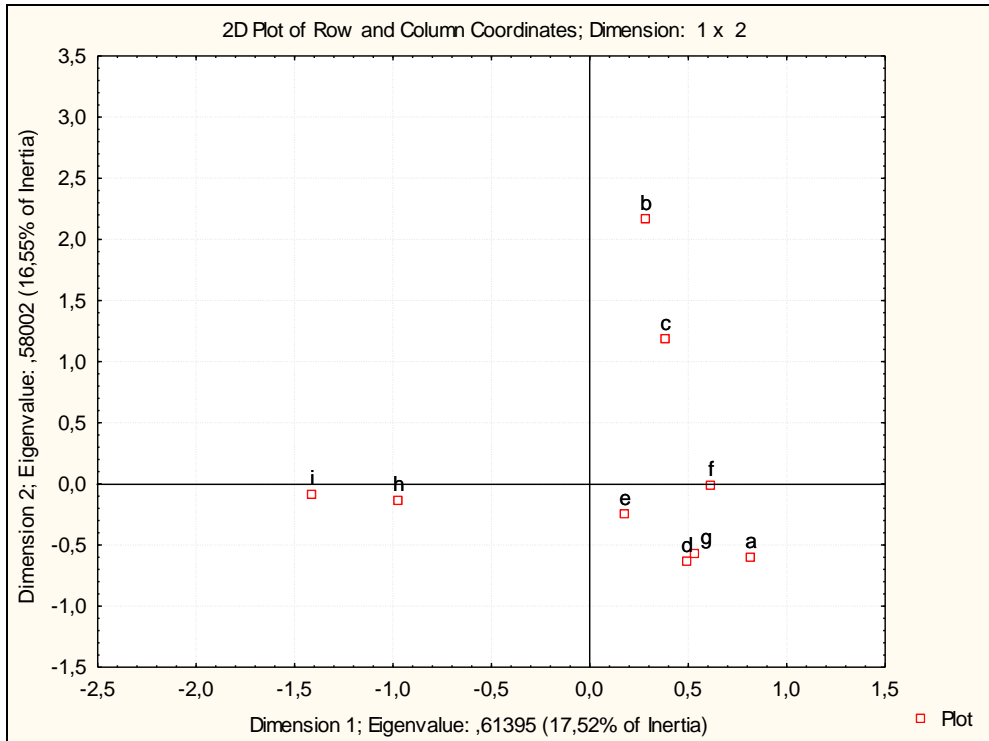
Relevé i: *Poa nemoralis* L., *Veronica spicata* L. subsp. *orchidea* (Crantz) Hayek, *Geranium robertianum* L., *Achillea serbica* Nyman, *Seseli libanotis* (L.) Koch, *Campanula bononiensis* L., *Euphrasia illyrica* Wettst., *Saxifraga paniculata* Miller, *Ferulago sylvatica* (Besser) Reichenb., *Geranium macrorrhizum* L., *Lamium garganicum* L., *Veratrum nigrum* L., *Viola mirabilis* L., *Primula veris* L., *Veronica austriaca* L. subsp. *austriaca*, *Draba lasiocarpa* Rochel.

On the dendrogram of vegetation of fire affected dry pastures and rocky grounds of Mt. Vidlič in the second year after the wildfire (2009) (Graph 1) separation of relevés by floristic similarity may be observed. Relevés **a.** and **g.** are on the same branch, and relevés **d.** and **f.** are similar, but separated specially and placed on implanted branches. Relevé **e.**, which was on the same branch with relevé **f.** in the previous year, is now singled out on separate branch. This means that there is a change compared to the previous year. Regrouping of relevés indicates that the directions of succession are specific and individual. The situation remains unchanged only on fire affected rocky areas on higher altitudes in the zone of beech forests, where relevés **b.** and **c.** still stand separated from others on the graph, as well as in the previous season, which indicates stability in floristic composition. The latter is most probably caused by quick passing of the fire over the rocky substrate.



Graph 1. Cluster analysis of the vegetation of dry pastures and rocky grounds affected by the wildfire the second year after the fire

Based on the correspondence analysis (CA) it can be observed that relevés **a.**, **d.**, **e.**, **f.** and **g.** situated in the zone of oak forests and scrubs of hornbeam and at the altitude of up to 900 m are more closely grouped (Graph 2) unlike relevés **b.** and **c.**, and especially **h.** and **i.** The latter four relevés are sampled in the zone of beech forest on Basarski kamik. According to their close spatial position they should be similar at this stage of succession. However, they are separated on the graph due to different exposure, although all other aspects of their habitats are similar. (Table 1, 2). Namely, the stands on sites **b.** and **c.** are exposed to the east (E), while **h.** and **i.** are exposed to the south (S), which probably affects their floristic composition. Therefore, except the altitude, other orographic factors (exposure and terrain inclination) are also included when separating communities into groups.



Graph 2. Correspondence analysis of vegetation formed on fire affected dry pastures and rocky grounds the second year after the wildfire

In Table 2 alpha diversity of fire affected dry pastures and rocky grounds of Mt. Vidlič in the second year after the fire is presented. Except in the first relevé, compared to the previous season (2008) an increase in the number of species and diversity index is recorded (Marković, M., Rakonjac, Lj., 2017). In the second year after the fire the average value of the number of species on fire affected dry pastures and rocky grounds of Mt. Vidlič (51.67) is recorded compared to the previous season (41.17). The average value of diversity index (0.9769) increased accordingly compared to the previous season (0.9707). The increase in number of species occurred due to immigration of species from adjacent areas not affected by the fire.

Table 2. Dry pastures and rocky grounds on Vidlič Mountain the second year after the wildfire (2009)

Relevé	Altitude (m)	Exposure	Terrain inclination (°)	Number of species	Diversity index
a	900	S	35	38	0.97
b	1100	E	35	33	0.965
c	1150	E	10	36	0.969
d	710	S	10	48	0.976
e	558	S	30	56	0.98
f	524	SW	25	57	0.98
g	843	SE	10	59	0.982
h	1220	S	40	65	0.984
i	1280	S	50	73	0.986

4. CONCLUSION

On the fire affected dry pastures and rocky grounds in the second year after the wildfire on Mt. Vidlič on a number of sites the dominant species are the ones from the family of grasses: *Dichanthium ischaemum*, *Melica ciliata*, *Chrysopogon gryllus*. Statistical analyses (Cluster analysis-WPGMA and correspondence analysis-CA) showed that the situation remained unchanged only on fire affected rocky areas on higher altitudes in the zone of beech forests, which indicates stability in floristic composition. The latter is most probably caused by quick moving of fire over the rocky substrate. However, on lower altitudes, in the zone of oak forests and scrubs of hornbeam, regrouping occurred on the graphs which indicates significant changes compared to the previous season. Namely, *Therophyta* species *Sideritis montana*, which was dominant in the first year after fire, was replaced by plants from the family of grasses in the studied stands in the second year after the fire. Due to immigration of species from adjacent areas undamaged by the fire, the average value of the number of species and diversity increased compared to the previous season.

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FLORISTIC CHARACTERISTICS OF DRY PASTURES AND ROCKY GROUNDS THE SECOND YEAR AFTER THE WILDFIRE ON VIDLIČ MOUNTAIN

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Summary

The second year after the wildfire on Vidlič Mountain was characterized by an increasing number of perennial plants, giving the advance to grass species. From the dendrogram of vegetation similarity two years later diversification among plots according to their floristic composition can be observed. Relevés **a.** and **g.** are placed at the same branch, while **f.** and **d.** are separated. Relevé **e.**, which was previously on the same branch with **f.**, was later separated on special branch. Regrouping of the relevés indicated that specific and more individual directions in succession have occurred. The situation remained unchanged only for the rocky sites affected by fire, at higher altitudes (**b.** and **c.**), still

standing separately as in previous season, indicating stability in floristic composition, probably caused by less severe fire impact. Based on CA-analysis, the samples that belong to the oak forest belt (**a.**, **d.-g.**), are more closely grouped in contrast to plots **b.** and **c.**, and especially **h.** and **i.**, that show rather unexpected position in the graph. According to their close spatial position, they should be more similar at this stage of succession. Otherwise, they became distinct as a reaction on specific exposure, since all of the other aspects of their habitats are similar. Namely, plots **b.** and **c.** were exposed to the east, while **h.** and **i.** were exposed to the south, which probably influenced their floristic composition. However, excluding altitude, some other orographic variables (e.g. exposure and terrain inclination) were also involved as valuable, in communities differentiation toward later stages of succession.

The presence of limestone rocks in the soil directly improved vegetation survival and post-fire recovery. Well represented rocky fraction, typical for the limestone areas, could play an important role in the following phenomena: the fire was moving faster, and therefore, its impact could be less severe; the soil layer could be only shallowly affected; the seed bank in the ground was better preserved; some of the more durable plant forms, or even the whole community fragments, could survive in sheltered places between the larger rocks of the fire impacted area.

The quantitative increase in the number of species, richness and Simpson's index was registered in comparison to the previous values. The increase in species richness reflects more intense process of species immigration from surrounding preserved vegetation toward burned plots. Hence, during the second year, diversity of fire affected xeric vegetation on the mountain was improved and more stable in most of the cases.

FLORISTIČKE KARAKTERISTIKE SUVIH PAŠNJAKA I KAMENJARA DRUGE GODINE POSLE POŽARA NA PLANINI VIDLIČ

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Rezime

Druga godina posle požara na planini Vidlič je karakteristična po povećanju broja višegodišnjih vrsta, pogotovo biljaka iz porodice trava. Iz dendrograma vegetacije druge godine posle požara može se uočiti razdvajanje fitocenoloških snimaka prema florističkoj sličnosti. Snimci **a.** i **g.** su grupisani na istoj grani, dok su snimci **f.** i **d.** razdvojeni. Fitocenološki snimak **e.** koji je prethodne godine bio na istoj grani sa fitocenološkim snimkom **f.** sada se izdvaja na posebnoj grani. Pregrupisavanje fitocenoloških snimaka ukazuje da na to da je došlo do specifičnih i individualnih pravaca u sukcesiji. Situacija je ostala nepromenjena samo na stenovitim opožarenim površinama na većim nadmorskim visinama (**b.** i **c.**), koji i dalje stoje odvojeno na grafikonu od ostalih, kao i prethodne sezone, što ukazuje na stabilnost u florističkom sastavu, što je najverovatnije uzrokovano brzim prelaskom požara preko stenovite podloge. Na osnovu CA-analize vidimo da su grupisani zajedno fitocenološki snimci, koji se nalaze u zoni hrastovih šuma (**a.**, **d.-g.**), dok se posebno izdvajaju fitocenološki snimci **b.** i **c.**, a posebno **h.** i **i.** koji pokazuju neočekivanu poziciju na grafikonu. Prema njihovom bliskom prostornom položaju, oni bi u ovoj fazi sukcesije trebali biti sličniji. Međutim, došlo je do njihovog razdvajanja zbog različitih ekspozicija, jer su svi ostali aspekti njihovih staništa slični. Naime, fitocenološki snimci **b.** i **c.** su uzimani na istočnoj ekspoziciji, dok su fitocenološki snimci **h.** i **i.** uzimani na južnoj ekspoziciji, što je imalo uticaja na njihov floristički sastav. Dakle, osim

nadmorske visine i druge orografske karakteristike (ekspozicija i nagib terena) takođe učestvuju u diferencijaciji zajednica idući prema kasnijim fazama sukcesije.

Prisustvo krečnjačkih stena u tlu direktno je uticalo na preživljavanje vegetacije i oporavak nakon požara. Dobro zastupljena kamenita frakcija, tipična za krečnjačke površine, ima značajnu ulogu u: požaru koji je brzo prešao preko podloge, pa je stoga uticaj na promenu vegetacije manje izražen; zemljište je manje zahvaćeno i oštećeno požarom; semena u tlu će biti bolje sačuvana; neke od višegodišnjih biljaka ili čak čitavi fragmenti zajednica mogu da prežive između većih stena u oblast zahvaćenoj požarom.

Zabeleženo je kvantitativno povećanje broja vrsta i Simpsonovog indeksa diverziteta u poređenju sa prethodnom sezonom. Povećanje bogatstva vrsta odražava intenzivniji proces imigracije vrsta sa susednih neopožarenih površina. Dakle, druge godine posle požara, kserofilna vegetacija na planini pokazuje veći diverzitet i stabilizaciju florističkog sastava u većini sastojina.