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Cirsium candelabrum Griseb.
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Prilozi poznavanju flore Hrvatske

***Picrido hieracioidis-Cirsietum candelabri* Jasprica et al. 2015 -
a ruderal association new to Croatia**

original scientific paper

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Sažetak

Cilj istraživanja jest po prvi put u Hrvatskoj opisati i klasificirati sastojinu u kojoj dominira vrsta *Cirsium candelabrum* Griseb. (Asteraceae). Sastojina je istraživana u Dalmaciji 2015. te uključena u novopredloženu asocijaciju *Picrido hieracioidis-Cirsietum candelabri* Jasprica, Milović & Pandža 2015. Svrstana je unutar vegetacijske sveze *Dauco carotae-Melilotion albi*, reda *Onopordetalia acanthii* i razreda *Artemisietea vulgaris*. Asocijacija je razvijena uzduž cesta, najčešće na odlagalištima građevinskog otpada, a zauzima sunčana i ekstremno suha staništa. U radu je diskutiran odnos novopredložene asocijacije s asocijacijom *Cirsietum candelabri* Matvejeva ex Čarni, Kostadinovski & Matvski 2001 iz Makedonije te Bosne i Hercegovine.

Cljučne riječi: fitocenologija, sintaksonomija, ruderalna staništa, *Artemisietea vulgaris*, nova asocijacija

Abstract

The aim of this study is to describe and classify the stands with a predominance of *Cirsium candelabrum* Griseb. (Asteraceae) for the first time in Croatia. The stands were investigated in south Croatian region of Dalmatia in 2015. In this study, the *Picrido hieracioidis-Cirsietum candelabri* Jasprica, Milović & Pandža 2015 is described and proposed as a new association, belonging to the *Dauco carotae-Melilotion albi* alliance, the *Onopordetalia acanthii* order and the *Artemisietea vulgaris* class. This association is developed along roadsides mostly on freshly filled deposits of construction waste. It occupies intensively sunny and extremely dry habitats. The syntaxonomy of the association is discussed and some comparison with the *Cirsietum candelabri* Matvejeva ex Čarni, Kostadinovski & Matevski 2001 association from Republic of Macedonia and Bosnia and Herzegovina is made.

Keywords: phytosociology, syntaxonomy, ruderal habitats, *Artemisietea vulgaris*, new association

Introduction

Cirsium candelabrum Griseb. (Asteraceae) is a biennial hemicryptophyte scapose plant endemic to the Balkans. According to Flora Europaea, it occurs in Albania, Bulgaria, Greece, Romania and ex-Yugoslav countries (Werner 1976). More precisely, it has been found in Bosnia and Herzegovina, Montenegro, Serbia and Macedonia (Hayek 1931, Greuter 2006), Slovenia (Grošelj 2012) and Kosovo (Prodanović et al. 2008). More recently, it has been recorded in the European part of Turkey (Yıldız et al. 2009).

In Croatia, this species has been found for the first time in the southern part of the country (Dalmatia) in 2008 (Nikolić 2015). The taxon is considered to have been introduced into Croatia during the motorway construction project of the last decade when it became established (Milović et al. 2014). In this area it was mostly found along the roadsides on the intensively sunny and extremely dry, freshly filled deposits of construction waste. In general, beside roadsides, *C. candelabrum* mostly grows within the ruderal habitats in urban and suburban areas (Gajić 1975, Petronić & Pavlović 2006, Prodanović et al. 2008, Jovanović et al. 2013). Additionally, it was also found in Montenegrin wetland

(Bubanja 2013), Greek mountain coniferous forest (Bergmeier 2002) or in inland sand dune communities dominated by *Artemisia campestris* (Pirini et al. 2006).

However, the phytosociology of the *Cirsium candelabrum* stands has only been studied in Republic of Macedonia (Matvejeva 1982, Čarni et al. 2001) and Bosnia and Herzegovina (Petronić & Pavlović 2006). In fact, Matvejeva (1982) described the *Cirsietum candelabri* association for the first time in Macedonia and subordinated it to the *Onopordion acanthii* alliance (*Onopordetalia acanthii*, *Artemisietea vulgaris*). More recently, Čarni et al. (2001) have adjusted nomenclature of the *Cirsietum candelabri* association according to the second edition of the Code of the Phytosociological Nomenclature (Barkman et al. 1986). In addition, the *Cirsietum candelabri* association was also reported from Bosnia and Herzegovina with the same syntaxonomic position (Petronić & Pavlović 2006). On the contrary, again in Bosnia and Herzegovina, Redžić et al. (2011) included the *Cirsium candelabrum* stands from the Prenj and Čvrsnica mountains in the *Cirsion candelabri* alliance, but it has not been published effectively. However, the *Cirsion candelabri* alliance is considered as synonym of the *Onopordion acanthii* alliance (Schaminée et al. 2012).

The aim of this paper is to contribute to the knowledge of the phytosociology of *C. candelabrum* in Croatia, and (ii) highlight the affinities and differences with the related stands reported from Bosnia and Herzegovina and Macedonia.

Study area

The study area belongs to the Dinaric karstic region. It is located in south Croatia and is confined by coordinates 43°35'20" to 43°36'30" N and 16°34'50" to 17°10'30" E (UTM XJ, XH) (Fig. 1). The *Cirsium candelabrum* vegetation type occurs mainly in areas where the substrate is rocky and the slope is low or medium.

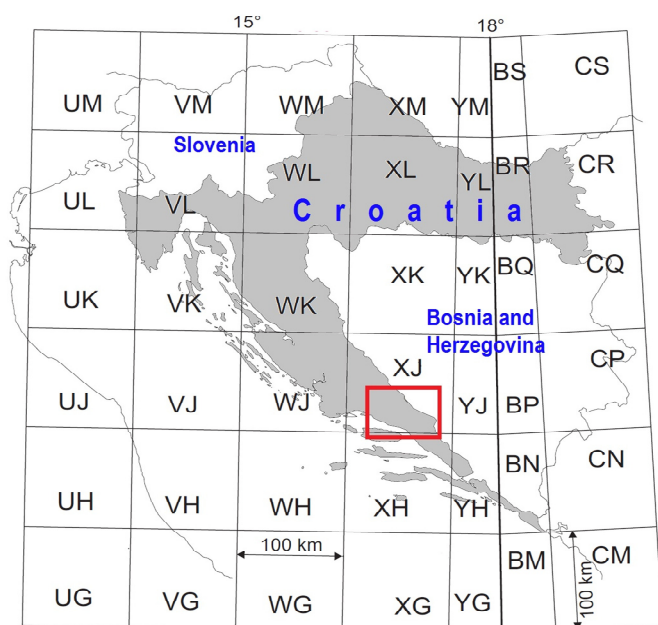


Figure 1. Geographical position of the study area.

(Zaninović 1995). According to Köppen's climate classification Imotski lies within the Cfa climate zone (Köppen & Geiger 1954).

Material and methods

In August 2015, 10 phytocoenological relevés were conducted in the *Cirsium candelabrum* vegetation type in Croatia, in accord with the Braun-Blanquet method (Braun-Blanquet 1964, Dierschke 1994). Species cover abundance was recorded using the 7-grade scale of Braun-Blanquet. The plot size used to sample vegetation was established such as to represent full floristic composition, depending on plant density and homogeneity of vegetation cover. In each relevé the geographi-

The geological substrate is calcareous. Carbonate soils are developed on this geological substrate. Sub-Mediterranean rocky meadows (the *Scorzoneretalia villosae* order, *sensu* Terzi 2015) are developed on these shallow calcareous soils, while low forests of oriental hornbeam (*Carpinus orientalis* Mill.) are common on the cambic soils. In fact, stands with *Carpinus orientalis* (i.e., *Quercus pubescens-Carpinetum orientalis*) represent zonal vegetation in the area within the sub-Mediterranean vegetational zone of the *Ostrya carpinifoliae-Carpinion orientalis* alliance.

The climate of the area is sub-mediterranean, with a dry period during the summer and with harsh winter (Zaninović 1995). In the region of the town of Imotski, situated at an altitude of 400 m, the mean annual air temperature ranges between 13°C and 14°C (Zaninović et al. 2008). Average annual precipitation is 1065 mm yr⁻¹

cal coordinates, slope, exposition, altitude and total vegetation cover were recorded. Most of the plot-sizes were set at 30-32 m², and every effort was made to achieve high ecological and physiognomic homogeneity within each plot (Moravec et al. 1994). These values are clearly higher than those proposed for synanthropic vegetation by Chytrý & Otýpková (2003).

In Table 1, for each taxon frequencies are given as percentages (%). Place and date of relevés are listed in Appendix 1.

Taxonomic nomenclature follows the Flora Croatica Database (Nikolić 2015). Syntaxonomical nomenclature refers to Biondi et al. (2014). The system of characterizing species and the nomenclature of higher taxa were derived from Čarni et al. (2001), Šilc (2002), Šilc & Košir (2006), Láníková (2009), Terzi (2015), etc. Syntaxonomic units mentioned in the text and Table 1, but not in the scheme, are listed in Appendix 2.

Biological form was verified in the field and denoted according to categories reported in Pignatti (1982), these being based on the classification of Raunkiaer (1934). Regarding chorological form, reference was also made to Jasprica et al. (2014, 2015), as well as to the monographs used for taxonomic nomenclature. The abbreviations of life- and chorological forms are given in Table 1, before each species name. The abbreviations of life-forms are as follows: P – Phanerophytes, Ch – Chamaephytes, H – Hemicryptophytes, G – Geophytes, T – Therophytes. Abbreviations of chorological forms are as follows: CM – Circum-Mediterranean, WM – West Mediterranean, EM – East Mediterranean, ISE – Illyrian-South European, IAE – Illyrian-Adriatic endemics, IAP – Illyrian-Apennine, MA – Mediterranean-Atlantic, EUM – European Mediterranean, SEM – South European-Mediterranean, SEP – South European-Pontic, EA – Eurasian, COSM – Cosmopolitan, EUR – European, CHO – Circum-Holarctic, EEUP – East European-Pontic, CUAD – Cultivated and adventive plants, SEE – Southeast European.

Statistical analysis

In order to obtain more complete information about Croatian *Cirsium candelabrum* stands, we compared our relevés with the *Cirsietum candelabri* association from Macedonia (10 relevés) and Bosnia and Herzegovina (five relevés) (Matvejeva 1982, Petronić & Pavlović 2006). Altogether, the matrix consists of 125 species × 25 samples (relevés). Braun-Blanquet (1964) values were transformed according to van der Maarel (1979). Taxa occurring in only one relevé were omitted before the analyses. The cluster analysis using the Bray-Curtis similarity index and the group-average sorting method were done. For these purposes the PC-ORD ver. 5 and PRIMERV6 software packages (McCune & Mefford 2006, Clarke & Gorley 2006) were used.

Results

Hierarchical classification identified two broad groups of significantly different the *Cirsium candelabrum* assemblages in the Balkans (Fig. 2).

This allowed us to propose new association *Picrido hieracioidis-Cirsietum candelabri* Jasprica, Milović & Pandža 2015 (holotypus Tab. 1 rel. 4). The syntaxonomic scheme of the association is:

ARTEMISIETEA VULGARIS Lohmeyer, Preising & Tüxen ex von Rochow 1951
+*Onopordetalia acanthii* Braun-Blanquet & Tüxen ex Klika in Klika & Hadač 1944
**Dauco carotae-Melilotion albi* Görs ex Rostański & Gutte 1971

***Picrido hieracioidis-Cirsietum candelabri* Jasprica, Milović & Pandža 2015, ass. nova hoc loco**

This association is developed along roadsides in south Croatia (Figs. 3 and 4). It occupies intensively sunny and extremely dry habitats, mostly on freshly filled deposits of construction waste. The habitats are also exposed to disturbances. The stands are generally small (<100 m²), but when the association attains optimal development in August the habitus of the dominant species make them particularly visible. The association is found at altitudes between 308 and 800 m on carbonaceous substrata. It generally occurs with various expositions (S, SW, NW) and inclinations (5-45°), but most of the stands were found on level surface areas. The vascular plant cover varies from 40% to 90%. Altogether, the association had 122 taxa. The number of taxa in the relevés was between 21 and 50 (average 31.4). Among those, 102 were companions.

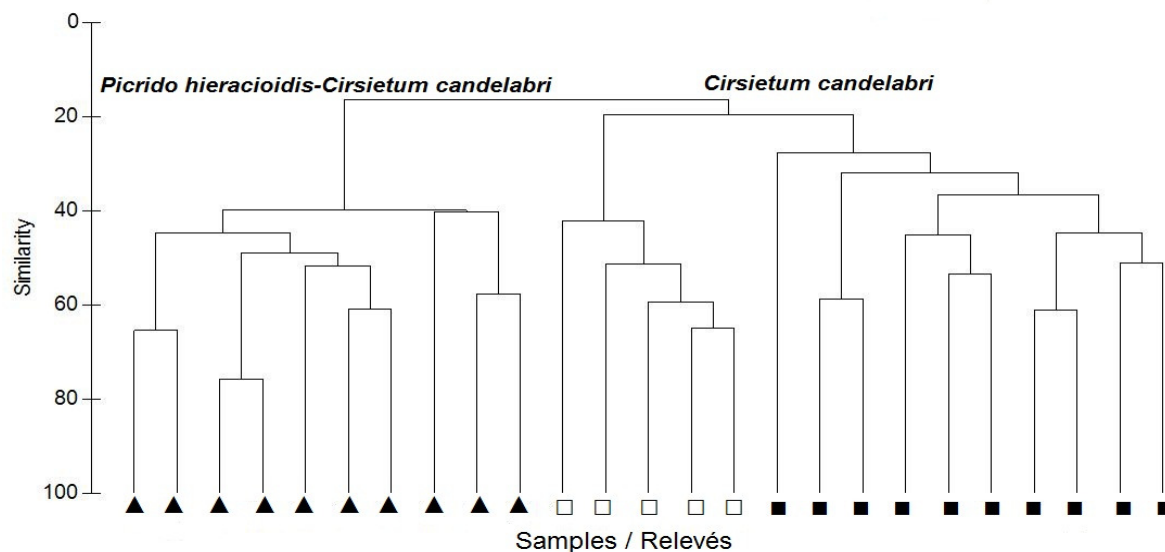


Figure 2. Dendrogram of the relevés. *Picrido hieracioidis-Cirsietum candelabri*: Croatia (▲), *Cirsietum candelabri*: Bosnia and Herzegovina (□) and Macedonia (■).

Among companions, the taxa of *Festuco valesiaca*-*Brometea erecti*, *Stellarietea mediae*, *Quercu roboris-Fagetetea sylvatica*, *Trifolio medii-Geranietea sanguinei*, *Quercetea ilicis*, *Asplenietea trichomanis*, *Molinio-Arrhenatheretea*, *Thlaspietea rotundifolii*, *Thero-Brachypodietea ramosi*, *Galio aparines-Urticetea dioicae*, *Agrostietea stoloniferae*, *Salicetea purpureae* and *Epilobieteae angustifolii* classes are found. The highest number of companions (50 taxa) belonged to the *Festuco valesiaca*-*Brometea erecti* class followed by the *Stellarietea mediae* (18 taxa).



Figures 3-4. The *Picrido hieracioidis-Cirsietum candelabri* association in Croatia (Photos: N. Jasprica).

Altogether, six taxa displayed the greatest presence (100%). Character-species of the association are *Cirsium candelabrum* and *Picris hieracioides*. *Cirsium candelabrum* dominated. Among taxa of the *Daucus carotae-Melilotion albi* alliance and *Onopordetalia acanthii* order, *Daucus carota* and *Tussilago farfara* were an abundant and constant species. Among companions, *Sanguisorba minor* ssp. *muricata* and *Silene vulgaris* ssp. *angustifolia* appeared with high presence (90 and 100%) and low cover.

The analysis of plant life-forms showed that the association was dominated by hemicryptophytes (49.1%), followed by therophytes (25.4%) and chamaephytes (14.4%) (Tab. 2).

South European floral element (29.7%), followed by a considerable proportion of Mediterraneans (26.2%), mostly circum-Mediterranean plants, dominated in the association (Tab. 3).

Life forms	No. of taxa (%)
Hemipterophytes (H)	58 (49.1)
Therophytes (T)	30 (25.4)
Chamaephytes (Ch)	17 (14.4)
Phanerophytes (P)	9 (7.7)
Geophytes (G)	4 (3.4)
Total taxa	118 (100)

Table 2. Life-form spectrum in the *Picrido hieracioidis-Cirsietum candelabri* association in Croatia.

Floral elements	No. of taxa (%)
South European	35 (29.7)
Mediterranean	31 (26.2)
Eurasian (EA)	23 (19.5)
Cosmopolitan (COSM)	18 (15.3)
European (EUR)	4 (3.4)
Circum-Holarctic (CHO)	2 (1.7)
East European-Pontic (EEUP)	2 (1.7)
Cultivated and adventive plants (CUAD)	2 (1.7)
Southeast European (SEE)	1 (0.8)
No. of taxa	118
(%)	(100)

Table 3. Floral elements in the *Picrido hieracioidis-Cirsietum candelabri* association in Croatia.

Discussion

The present investigation in south Croatia revealed the presence of *Cirsium candelabrum* stand which we included in new proposed the *Picrido hieracioidis-Cirsietum candelabri* association (Milović et al. 2014).

The floristic composition of the new association does markedly differ from the related *Cirsietum candelabri* association previously described in Macedonia (Matvejeva 1982) and Bosnia and Herzegovina (Petronić & Pavlović 2006). Alongside *C. candelabrum*, in our case, *Picris hieracioides*, *Daucus carota*, *Tussilago farfara*, *Sanguisorba minor* ssp. *muricata* and *Silene vulgaris* ssp. *angustifolia* had the highest cover and frequency. On the contrary, in Bosnia and Herzegovina these were *Trifolium repens*, *Trifolium pratense* and *Ranunculus repens*. In Macedonia, only *Cirsium acanthoides* appeared with relatively high frequency (IV), but with low cover.

Regarding the ecology, our results suggest that the *Picrido hieracioidis-Cirsietum candelabri* association occurs at the lowest altitudes than the *Cirsietum candelabri* association. In addition, it has higher number of taxa, while life-forms spectra did not show differences between two associations. Hemipterophytes prevailed in both associations. In our case, this may be explained by the high percentage of the *Festuco valesiacae-Brometea erecti* taxa. Additionally, in our study, analysis of chorotypes showed a clear dominance of the taxa of South European and Mediterranean origin. These confirm the peculiarity of the surveyed area from the phytogeographic point of view.

On the other hand, relatively high percentages of Eurasian taxa and cosmopolitans, and the presence of a relatively low number of non-native plant taxa were common characteristics of both associations. Anyway, these taxa had a significant influence on the physiognomy of this type of ruderal habitat. A significant contribution of Eurasian and cosmopolitan taxa has already been found for other ruderal communities in the area (cf. Pajazitaj 2009, Jarić et al. 2011, Jovanović et al. 2013).

Regarding syntaxonomy, we subordinated *Picrido hieracioidis-Cirsietum candelabri* to the *Dauco carotae-Melilotion albi* alliance, which includes associations of biennial and perennial species often forming the initial stage of succession on anthropogenic substrates (cf. Lániková 2009, Šilc & Čarni 2012, Biondi et al. 2014). They usually grow on dry and nutrient-poor soils that contain large amounts of bedrock fragments. By contrast, the *Cirsietum candelabri* association from Macedonia and Bosnia and Herzegovina has been classified in the *Onopordion acanthii* alliance (Matvejeva 1982, Petronić & Pavlović 2006, Čarni et al. 2001). In our case, the majority of taxa of the *Onopordion acanthii* alliance are missing (cf. Mucina 1981, 1982, 1993, Biondi et al. 2004, etc.). Additionally, associations of the *Dauco carotae-Melilotion albi* alliance are linked to anthropic environments developing as various more or less ephemeral stages and can evolve to the populations of the *Festuco*

valesiaca-*Brometea erecti* communities.

Similarly, in Italy, associations of the *Dauco carotae-Melilotion albi* alliance are also linked to the series of the *Carpinion* (= *Ostryo carpinifoliae-Carpinion orientalis*) alliance (Blasi 2010). Generally, associations of the *Dauco carotae-Melilotion albi* alliance originate by evolution from coenosis of *Stellarietea mediae*, i.e. the widely-distributed class of the annual ruderal communities (Taffetani et al. 2011). In our study, the proportion of characteristic taxa of *Stellarietea mediae* was also quite high. In the area, the *Picrido hieracioidis-Cirsietum candelabri* association can mediate with still poorly known association from Croatia – the *Dauco carotae-Picridetum hieracioidis* (Jasprica, unpubl. data), also included in the *Dauco carotae-Melilotion albi* alliance (Láníková 2009).

In summary, our findings contributed to a better understanding of the phytosociology and ecology of *Cirsium candelabrum* in Croatia and in the Balkans generally. The presence of the *Picrido hieracioidis-Cirsietum candelabri* association and its floristic structure are beneficial to richness of biological diversity and diversity of biotope in our country.

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Appendix 1. Place and date of the relevés:

All relevés were collected on August 8, 2015. Gauss-Krüger coordinates were used:

- Rel. 1. X=5627784, Y=4828571;
- Rel. 2. X=5627972, Y=4828968;
- Rel. 3. X=5656901, Y=4831766;
- Rel. 4. (*Holotypus) X=5660995, Y=4828286;
- Rel. 5. X=5660876, Y=4828175;
- Rel. 6. X=5662030, Y=4827260;
- Rel. 7. X=5662045, Y=4827253;
- Rel. 8. X=5662403, Y=4826913;
- Rel. 9. X=5670990, Y=4810227;
- Rel. 10. X=5676481, Y=4799641.

Appendix 2. Syntaxonomic units mentioned in the text and Table 1 (pages 10-12), but not in the scheme (in alphabetical order).

- *Agrostietea stoloniferae* Oberdorfer 1983
- *Asplenetetea trichomanis* (Braun-Blanquet in Meier & Braun-Blanquet 1934) Oberdorfer 1977
- *Cirsietum candelabri* Matvejeva ex Čarni, Kostadinovski & Matevski 2001
- *Cirsion candelabri* Redžić, Barudanović, Trakić & Kulijer 2011
- *Dauco carotae-Picridetum hieracioidis* Görs ex Seybold & Müller 1972
- *Epilobietea angustifolii* Tüxen & Preising ex von Rochow 1951
- *Festuco valesiaca-Brometea erecti* Braun-Blanquet & Tüxen ex Braun-Blanquet 1949
- *Galio aparines-Urticetea dioicae* Passarge ex Kopecký 1969
- *Molinio-Arrhenatheretea* Tüxen 1937
- *Onopordion acanthii* Braun-Blanquet in Braun-Blanquet, Gajewski, Wraber & Walas 1936
- *Ostryo carpinifoliae-Carpinion orientalis* Horvat (1954) 1958
- *Quercetea ilicis* Braun-Blanquet in Braun-Blanquet, Roussine & Nègre 1952
- *Quercu pubescenti-Carpinetum orientalis* Horvatić 1939
- *Quercu roboris-Fagetea sylvaticae* Braun-Blanquet & Vlieger in Vlieger 1937
- *Salicetea purpureae* Moor 1958
- *Scorzoneretalia villosae* Kovačević 1959

- *Stellarietea mediae* Tüxen, Lohmeyer & Preising ex von Rochow 1951
- *Thero-Brachypodietea ramosi* Braun-Blanquet 1947
- *Thlaspietea rotundifolii* Braun-Blanquet 1948
- *Trifolio medii-Geranietea sanguinei* Müller 1962

Table 1. *Picrido hieracioidis-Cirsietum candelabri* Jasprica, Milović & Pandža 2015 (LF- Life form; FL - Floral element; * - holotypus).

		No. of relevés	1	2	3	4*	5	6	7	8	9	10		
		No. of taxa	41	24	33	50	26	30	27	37	21	25		
LF	FE	Altitude (m a.s.l.)	310	308	800	717	725	730	730	717	560	620		
		Slope (°)	.	.	.	45	.	5	5	35	.	40	Fr.	
		Aspect	.	.	.	S	.	NWNW	SW	.	S	.		
		Vascular plant cover (%)	60	60	40	90	70	90	60	80	80	70		
		Plot size (m ²)	32	32	32	30	30	30	20	100	40	30	%	
Char. Ass.														
H	ISE	<i>Cirsium candelabrum</i> Griseb.	1	2	3	4	1	4	2	4	4	4	100	
H	EA	<i>Picris hieracioides</i> L.	1	+	+	1	1	1	1	1	1	+	100	
Daucus carotae-Melilotion albi														
H	COSM	<i>Daucus carota</i> L.	1	1	.	1	+	+	+	1	+	+	90	
H	COSM	<i>Cichorium intybus</i> L.	+	+	+	.	.	.	.	.	+	.	40	
H	EUR	<i>Echium vulgare</i> L.	.	.	.	.	1	.	.	+	+	+	40	
T	EA	<i>Melilotus albus</i> Medik.	.	+	.	+	+	.	.	.	.	.	30	
H	COSM	<i>Reseda lutea</i> L.	.	.	.	+	.	+	.	.	.	.	20	
H	EM	<i>Melilotus officinalis</i> (L.) Lam.	.	.	.	.	+	.	.	+	.	.	20	
H	EEP	<i>Isatis tinctoria</i> L.	.	.	.	.	.	.	.	.	.	+	+	20
Onopordetalia acanthii, Artemisietea vulgaris														
G	EA	<i>Tussilago farfara</i> L.	2	2	.	+	+	3	2	+	1	+	90	
T	SEM	<i>Crepis foetida</i> L.	1	+	+	.	+	.	.	1	.	.	50	
H	EA	<i>Chondrilla juncea</i> L.	1	+	.	.	.	.	.	.	.	+	30	
H	COSM	<i>Diploaxis tenuifolia</i> (L.) DC.	.	+	.	+	.	.	.	+	.	.	30	
Ch	IAE	<i>Haplophyllum patavinum</i> (L.) G.Don	.	.	.	+	.	.	+	+	.	.	30	
H	CM	<i>Dittrichia viscosa</i> (L.) Greuter	+	3	.	.	.	.	.	.	.	.	20	
T	CUAD	<i>Ambrosia artemisiifolia</i> L.	.	.	1	+	.	.	.	.	.	.	20	
H	CM	<i>Foeniculum vulgare</i> Mill.	r	.	.	.	.	.	.	.	.	.	10	
H	CM	<i>Picnoman acarna</i> (L.) Cass.	+	.	.	.	.	.	.	.	.	.	10	
H	EA	<i>Silene latifolia</i> Poir. ssp. <i>alba</i> (Mill.) Greuter et Bourdet	.	.	.	r	.	.	.	.	.	.	10	
G	COSM	<i>Elymus repens</i> (L.) Gould	.	.	.	2	.	.	.	.	.	.	10	
Companions														
Festuco valesiacae-Brometea erecti														
H	SEM	<i>Sanguisorba minor</i> Scop. ssp. <i>muricata</i> Briq.	+	+	1	+	+	+	+	+	+	+	100	
H	SEP	<i>Lactuca viminea</i> (L.) J. Presl & C. Presl	+	+	.	r	.	+	+	1	1	+	80	
H	EA	<i>Melica ciliata</i> L.	.	+	.	.	+	+	+	+	1	+	70	
H	IAE	<i>Centaurea spinosociliata</i> Seenus ssp. <i>cristata</i> (Bertol.) Dostál	.	.	.	+	+	+	+	1	+	+	70	
H	SEM	<i>Galium corrudifolium</i> Vill.	+	.	+	.	+	1	.	+	.	+	60	
H	SEM	<i>Hypericum perforatum</i> L.	.	+	+	+	.	+	+	.	.	+	60	
Ch	WM	<i>Dorycnium pentaphyllum</i> Scop.	.	.	r	1	+	+	+	.	.	+	60	
T	COSM	<i>Medicago lupulina</i> L.	r	.	+	+	+	+	.	.	.	.	50	
H	SEM	<i>Asperula aristata</i> L.f. ssp. <i>scabra</i> (J.Presl et C.Presl) Nyman	.	.	1	+	.	+	+	+	.	.	50	
H	EA	<i>Campanula sibirica</i> L.	.	.	+	+	+	.	.	+	+	.	50	
Ch	SEP	<i>Linum tenuifolium</i> L.	.	.	.	+	+	+	+	+	.	.	50	
H	EA	<i>Carlina vulgaris</i> L.	.	.	.	+	+	+	+	+	.	.	50	
Ch	SEM	<i>Fumana procumbens</i> (Dunal) Gren. et Godr.	r	.	+	.	.	+	+	.	.	.	40	
T	EA	<i>Arenaria leptoclados</i> (Reichenb.) Guss.	.	r	.	+	+	.	.	+	.	.	40	
H	COSM	<i>Arabis hirsuta</i> (L.) Scop.	.	+	+	.	.	.	.	+	.	.	30	
H	COSM	<i>Lotus corniculatus</i> L. ssp. <i>hirsutus</i> Rothm.	.	.	+	.	.	+	.	+	.	.	30	
Ch	IAE	<i>Satureja subspicata</i> Vis.	.	.	+	.	.	+	+	.	.	.	30	

Ch	SEM	<i>Satureja montana</i> L.	.	.	.	+	.	.	+	.	.	+	30
Ch	SEM	<i>Teucrium montanum</i> L.	.	.	.	.	.	+	+	+	.	.	30
Ch	CM	<i>Ononis antiquorum</i> (L.) Arcang.	+	.	+	.	.	.	.	.	.	.	20
T	SEP	<i>Bromus squarrosus</i> L.	.	r	.	.	+	.	.	.	.	.	20
H	SEM	<i>Medicago prostrata</i> Jacq.	.	.	.	.	+	.	.	.	+	.	20
T	SEM	<i>Acinos arvensis</i> (Lam.) Dandy	.	.	.	.	+	.	.	.	+	.	20
H	SEM	<i>Paronychia kapela</i> (Hacq.) A. Kerner	.	.	.	.	.	+	+	.	.	.	20
Ch	SEM	<i>Aethionema saxatile</i> (L.) R.Br.	.	.	.	.	.	+	+	.	.	.	20
Ch	CM	<i>Euphorbia spinosa</i> L.	+	.	.	.	.	.	.	.	.	.	10
Ch	CM	<i>Helichrysum italicum</i> (Roth) G. Don	+	.	.	.	.	.	.	.	.	.	10
H	SEE	<i>Stachys thirkei</i> K.Koch	+	.	.	.	.	.	.	.	.	.	10
H	IAE	<i>Astragalus muelleri</i> Steud. et Hochst.	r	.	.	.	.	.	.	.	.	.	10
Ch	WM	<i>Argyrolobium zanonii</i> (Turra) P.W. Ball	r	.	.	.	.	.	.	.	.	.	10
H	SEM	<i>Ononis pusilla</i> L.	r	.	.	.	.	.	.	.	.	.	10
T	EA	<i>Petrorhagia prolifera</i> (L.) P.W.Ball ex Heywood	.	+	.	.	.	.	.	.	.	.	10
H	SEM	<i>Petrorhagia saxifraga</i> (L.) Link	.	r	.	.	.	.	.	.	.	.	10
Ch	IAE	<i>Genista sylvestris</i> Scop. ssp. <i>dalmatica</i> (Bartl.) H.Lindb.	.	.	.	+	.	.	.	.	.	.	10
H	IAE	<i>Seseli montanum</i> L. ssp. <i>tommassinii</i> (Rchb. F.) Arcang.	.	.	.	+	.	.	.	.	.	.	10
H	EA	<i>Scabiosa triandra</i> L.	.	.	.	.	1	.	.	.	.	.	10
H	EEP	<i>Centaurea weldeniana</i> Rchb.	.	.	.	.	+	.	.	.	.	.	10
H	SEM	<i>Bromus erectus</i> Huds.	.	.	.	.	+	.	.	.	.	.	10
H	EA	<i>Euphorbia cyparissias</i> L.	.	.	.	.	+	.	.	.	.	.	10
T	MA	<i>Desmazeria rigida</i> (L.) Tutin	.	.	.	.	+	.	.	.	.	.	10
H	IAP	<i>Centaurea rupestris</i> L.	.	.	.	.	r	.	.	.	.	.	10
H	SEP	<i>Stachys recta</i> L.	.	.	.	.	r	.	.	.	.	.	10
H	CM	<i>Plantago holosteam</i> Scop.	.	.	.	.	r	.	.	.	.	.	10
Ch	SEM	<i>Sedum sexangulare</i> L.	.	.	.	.	r	.	.	.	.	.	10
H	EUM	<i>Anthyllis vulneraria</i> L.	.	.	.	.	.	+	.	.	.	.	10
Ch	SEM	<i>Helianthemum oelandicum</i> (L.) DC. ssp. <i>italicum</i> (L.) Font Quer et l	.	.	.	.	.	r	.	.	.	.	10
Ch	SEP	<i>Teucrium chamaedrys</i> L.	.	.	.	.	.	.	.	.	+	.	10
H	SEM	<i>Hippocrepis comosa</i> L.	.	.	.	.	.	.	.	.	+	.	10
Ch	SEM	<i>Helianthemum nummularium</i> (L.) Mill.	.	.	.	.	.	.	.	.	+	.	10
T	CM	<i>Trifolium scabrum</i> L.	.	.	.	.	.	.	.	.	.	+	10
Stellarietea mediae													
H	SEM	<i>Silene vulgaris</i> (Moench) Garcke ssp. <i>angustifolia</i> Hayek	+	+	+	+	+	+	+	+	.	+	90
H	COSM	<i>Lactuca serriola</i> L.	.	.	r	+	.	.	.	.	+	.	30
T	EA	<i>Setaria viridis</i> (L.) P.Beauv.	1	.	.	+	.	.	.	.	.	.	20
T	CHO	<i>Fallopia convolvulus</i> (L.) Á.Löve	+	.	.	.	+	.	.	.	.	.	20
T	COSM	<i>Bromus sterilis</i> L.	.	.	.	.	+	.	.	.	.	+	20
T	COSM	<i>Digitaria sanguinalis</i> (L.) Scop.	+	.	.	.	.	.	.	.	.	.	10
G	COSM	<i>Cynodon dactylon</i> (L.) Pers.	+	.	.	.	.	.	.	.	.	.	10
T	COSM	<i>Erodium cicutarium</i> (L.) L'Hér.	r	.	.	.	.	.	.	.	.	.	10
T	COSM	<i>Polygonum aviculare</i> L.	r	.	.	.	.	.	.	.	.	.	10
T	EA	<i>Solanum villosum</i> Mill. ssp. <i>alatum</i> (Moench) Dostál	r	.	.	.	.	.	.	.	.	.	10
T	EA	<i>Polycnemum majus</i> A. Braun	r	.	.	.	.	.	.	.	.	.	10
T	SEP	<i>Avena barbata</i> Pott ex Link	.	+	.	.	.	.	.	.	.	.	10
T	SEM	<i>Reseda phyteuma</i> L.	.	.	.	+	.	.	.	.	.	.	10
T	SEM	<i>Crepis pulchra</i> L.	.	.	.	+	.	.	.	.	.	.	10
T	SEM	<i>Geranium purpureum</i> Vill.	.	.	.	.	+	.	.	.	.	.	10
T	COSM	<i>Atriplex patula</i> L.	.	.	.	.	+	.	.	.	.	.	10
T	EA	<i>Cirsium arvense</i> (L.) Scop.	.	.	.	.	+	.	.	.	.	.	10
T	CUAD	<i>Conyza canadensis</i> (L.) Cronquist	.	.	.	.	r	.	.	.	.	.	10
Quercu roboris-Fagetea sylvaticae													
P	EUR	<i>Clematis vitalba</i> L.	.	.	.	+	.	1	+	+	+	+	70
P	EM	<i>Coronilla emerus</i> L. ssp. <i>emeroides</i> Boiss. et Spruner	.	.	.	.	.	.	+	.	+	+	40
P	COSM	<i>Ulmus minor</i> Miller, juv.	.	.	.	.	+	.	+	.	+	.	30
H	ISE	<i>Sesleria autumnalis</i> (Scop.) F.W. Schultz	.	.	.	+	.	.	.	+	.	.	20
P	CM	<i>Colutea arborescens</i> L.	.	.	.	.	.	.	.	.	.	+	20

P	SEM	<i>Fraxinus ornus</i> L., juv.	.	.	r	.	.	.	.	.	.	.	10
P	ISE	<i>Frangula rupestris</i> (Scop.) Schur, juv.	.	.	.	.	.	.	.	.	.	+	10
Thlaspietea rotundifolii													
H	SEM	<i>Scrophularia canina</i> L.	+	+	1	1	+	.	.	+	.	.	60
T	IAP	<i>Chaenorhinum minus</i> (L.) Lange ssp. <i>litorale</i> (Willd.) Hayek	r	+	.	.	.	.	.	+	.	+	40
T	EUR	<i>Chaenorhinum minus</i> (L.) Lange ssp. <i>minus</i>	.	.	+	.	.	+	+	.	.	.	30
T	EUM	<i>Galeopsis angustifolia</i> Hoffm.	.	.	.	.	.	.	.	+	.	.	10
Quercetea ilicis													
P	MA	<i>Rubus ulmifolius</i> Schott	1	.	.	.	.	.	.	.	.	+	40
P	CM	<i>Clematis flammula</i> L.	+	.	.	.	.	.	.	.	.	.	10
G	CM	<i>Arum italicum</i> Mill.	.	.	.	.	.	.	.	.	.	+	10
Trifolio medii-Geranietea sanguinei													
H	SEM	<i>Arabis turrata</i> L.	.	.	.	.	+	.	+	.	+	.	30
H	SEP	<i>Imula conyza</i> DC.	.	.	.	.	.	+	.	.	.	+	30
H	EA	<i>Cruciata glabra</i> (L.) Ehrend.	.	.	.	.	+	.	.	.	.	.	10
Molinio-Arrhenatheretea													
H	EA	<i>Dactylis glomerata</i> L. ssp. <i>glomerata</i>	.	.	.	.	+	+	.	.	.	.	30
H	COSM	<i>Plantago lanceolata</i> L.	+	.	.	.	.	+	.	.	.	.	20
H	EA	<i>Cirsium vulgare</i> (Savi) Ten.	.	+	+	.	.	.	.	.	.	.	20
H	EA	<i>Trifolium pratense</i> L.	.	.	.	.	.	.	+	+	.	.	20
H	EUR	<i>Lolium perenne</i> L.	+	.	.	.	.	.	.	.	.	.	10
T	SEM	<i>Euphorbia falcata</i> L.	.	.	.	r	.	.	.	.	.	.	10
H	SEM	<i>Plantago altissima</i> L.	.	.	.	.	r	.	.	.	.	.	10
Asplenietea trichomanis													
H	IAE	<i>Campanula pyramidalis</i> L.	.	.	.	.	.	.	.	.	.	+	20
Thero-Brachypodietea ramosi													
H	CM	<i>Bituminaria bituminosa</i> (L.) Stirton	+	.	.	.	.	.	.	.	.	.	10
H	WM	<i>Helictotrichon convolutum</i> (C.Presl) Henrard.	.	.	.	.	.	.	.	.	+	.	10
Agrostietea stoloniferae													
H	COSM	<i>Plantago major</i> L. ssp. <i>intermedia</i> (Gilib.) Lange	.	.	.	.	+	.	.	.	.	.	10
Galio aparines-Urticetea dioicae													
T	EA	<i>Cruciata laevipes</i> Opiz.	.	.	.	.	.	+	.	.	.	.	10
Salicetea purpureae													
P	EA	<i>Salix purpurea</i> L.	.	.	.	.	.	+	.	.	.	.	10
Epilobietea angustifolii													
H	CHO	<i>Epilobium angustifolium</i> L.	10
Others													
		<i>Pastinaca</i> sp.	+	10
		<i>Vicia</i> sp.	+	10
		<i>Medicago</i> sp.	r	10
		<i>Koeleria</i> sp.	+	10

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***Cirsium candelabrum* Griseb. (Asteraceae) in Croatia - the beginning of its invasive spread outside natural range?**

original scientific paper

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Sažetak

Prirodni areal vrste *Cirsium candelabrum* Griseb. (Asteraceae) obuhvaća područje Balkana (balkanski endem): Bosna i Hercegovina, Crna Gora, Albanija, Srbija, Kosovo, Makedonija, Grčka, Bugarska i jugozapadna Rumunjska. Izvan svog prirodnog areala, nedavno je zabilježena u europskom dijelu Turske, u Sloveniji i u Hrvatskoj. Prve nalaze za Hrvatsku navodi Jasenka Topić, koja biljku 2008. i 2010. pronalazi na nekoliko lokaliteta u srednjoj Dalmaciji. Na temelju tih nalaza vrsta je od 2008. uvrštena u bazu podataka „Flora Hrvatske“. Tijekom ljeta 2014. istraživali smo nalazišta *C. candelabrum* u srednjoj Dalmaciji, od zaleđa Splita na sjeveru do Makarske na jugu prema graničnom području s Bosnom i Hercegovinom. Pronađen je veliki broj novih nalazišta (50), najviše na području industrijske zone Dugopolje te oko Aržana i Kamenskoga. Rezultati pokazuju da se ova biljka širi u zaleđu srednje Dalmacije, na ruderalnim staništima uz rubove cesta, naročito na mjestima gdje je zbog gradnje i rekonstrukcije cesta odstranjena prirodna vegetacija. Monitoring će pokazati jesu li najnovija nalazišta vrste *C. candelabrum* izvan prirodnog areala samo privremeni fenomen ili je riječ o početku njezina invazivnog širenja. Za sada dolazi samo na antropogenim staništima i ne pokazuje tendenciju širenja na poljoprivredne površine te prirodna staništa i vegetaciju.

Ključne riječi: balkanski endem, Dalmacija, južna Hrvatska, invazivno širenje, ruderalna staništa

Abstract

The natural range of a species *Cirsium candelabrum* Griseb. (Asteraceae) comprises the territory of the Balkans (Balkan endemic): Bosnia and Herzegovina, Montenegro, Albania, Serbia, Kosovo, Macedonia, Greece, Bulgaria and south-west Romania. Outside of its natural range, *C. candelabrum* has recently been found in the European part of Turkey, in Slovenia and Croatia. First findings in Croatia were reported from south Croatian region of Dalmatia in 2008 and 2010 by Jasenka Topić. The species was included, based on these findings, in Flora Croatica Database in 2008. In summer 2014, we were looking for the localities of *C. candelabrum* in Dalmatia, from the hinterland of cities of Split and Makarska to the border area between Croatia and Bosnia and Herzegovina. A large number of new localities (50) was found, mainly on industrial zone of Dugopolje and along the roads leading towards border crossings of settlements of Aržano and Kamensko. The results indicate the spread of this plant in the hinterland of Dalmatia from Bosnia and Herzegovina. The plant grows in ruderal habitats along roads, especially when the natural vegetation has been removed by means of road building or reconstruction. Monitoring can help us to understand whether the latest findings of *C. candelabrum* on localities outside its natural range is only a temporary phenomenon or is it the beginning of its invasive spread. So far, it occurs only on anthropogenic habitats and shows no tendency to spread on agricultural land or natural habitats and vegetation.

Keywords: Balkan endemic, Dalmatia, south Croatia, invasive spread, ruderal habitats

Introduction

The genus *Cirsium* Mill. (thistle) includes perennial, biennial, and annual members of the family Asteraceae and comprises more than 250 species distributed in subtropical and boreal regions of Euroasia and North America with the majority of taxa in the South Europe and Caucasus (Knees

178) *C. candelabrum* nov. sp. foliis amplexicaulibus pinnatifido-sinuatis lanceolatis acuminatis glabris lobulisque margine spinosis, spinis tenuibus elongatis inaequalibus flavicantibus, capitulis glomeratis ochroleucis, glomerulis rameis nutantibus terminalibusque paniculam elongatam formantibus, involucri oblongo-dilatati squamis lanceolatis adpressis, plerisque spinula patula mucronatis, intimis apice attenuato scariosis inermibus. — Proximum ac persimile *C. sclerantho* MB. (*Echenaidi carlinoidi* Cass.), sed foliis subtus glabris et involucri squamis intimis apice non dilatatis distinctissimum. — Radix biennis videtur. Caulis 4—6 pedalis, strictus, superne e quavis axilla ramulum erecto-patentem 2" longum glomerulo capitulorum nutante terminatum emittens, superne 2" diam., anguloso-striatus, ut omnis planta glaberrimus, internodiis paniculae 1—1½" longis, omnibus plane nudis. Folia caulina superiora 2—3" longa, praeter spinas 8—10" lata, ramea summaeque decrescentia subconformia, bracteantia glomeruli 3—5 elongatis spinis armata linearia, 6—8" longa, omnia nitide glabra, subtus glaucescentia, basi rotundata l. subcordata amplexantia, rhachi lobulos latitudine superante, lobulis inciso-triangularibus, spinis copiosis flavis elongatis tenuibus, aliis 6—4", aliis 2—1" longis patentibus. Panicula saepe bipedalis, 3—4" lata, glomerulis sursum copiosioribus, centrifugali ordine florens. Glomeruli capitula 3—6 subsessilia bracteis earumque spinis cincta, 10" longa, apice 6—8" lata, basi oblongato-obtusa. Involucrum floribus paullo superatum, virens, multis seriebus imbricatum, squamis plerisque conformibus 2—3" longis ½" latis dorso convexis apice in appendiculam scariosam spinescentem patulam ½" longam attenuatis, intimis longioribus linearibus appendicula lanceolata subserrata mutica erecta fere 1" longa ¼" lata auctis. Corollae tubus tenuis, gracilis, 6—8" longus, pappum aequans, lobis 1—1½" longis angustissime linearibus aequalibus. Antherae breviter exsertae, stigmata concreta includentes, apice acutae, basi bisetae, setis tenuissimis, filamentis papillosis. Achenium oblongum, pallide badium, compresso-trigonum, laeve, 2" longum, anthophoro conico exserto, margine achenii superiori arguto. Pappus exterior infra apicem scabrum aequalem plumosus, interior apice scabro clavellato, ceterum aequalis. — It. 2. p. 262.

In Macedonia boreali; gregarie in campis pr. Kalkandele alt. 1000' (substr. alluv.)! Fl. Jul. E.

Figure 1. *Cirsium candelabrum* – the original description (Grisebach 1844: 251–252).

C. candelabrum stands has only been studied in Macedonia (Matvejeva 1982, Čarni et al. 2001) and Bosnia and Herzegovina (Petronić & Pavlović 2006).

C. candelabrum is a Balkan endemic plant (Fig. 3), distributed in Bosnia and Herzegovina, Montenegro, Albania, Serbia, Kosovo, Macedonia, Greece, Bulgaria and south-west Romania (Hayek 1931, Gajić 1975, Werner 1976, Greuter 2006-). The western limit of its natural range is on the territory of Bosnia and Herzegovina. As an adventitious plant, it has recently been found in the European part of Turkey (Yildiz et al. 2009), in Slovenia (Grošelj 2012) and Croatia (Nikolić 2015).

First findings in Croatia were reported by Professor Jasenka Topić who found it on five localities in south Croatian region of central Dalmatia in 2008 and 2010 (Nikolić 2015). These were: the town of Imotski; along the road between the village of Zagvozd and the town of Imotski, and three localities along the Croatian motorway A1. After these findings, the species was included in *Flora Croatica Database* in 2008 (Milović et al. 2014).

2000, Bureš et al. 2004, Kadereit & Jeffrey 2007). In Croatia, *Cirsium* is represented by 19 taxa, 17 species and 2 subspecies (Hršak 2000, Nikolić 2015). Among them, *Cirsium candelabrum* is the only taxon of foreign origin and has been found for the first time in Croatia in 2008 (Milović et al. 2014, Nikolić 2015).

As a new taxon for science, *C. candelabrum* was first described by the German botanist Grisebach in „Spicilegium Florae Rumelicae et Bithynicae“ (Grisebach 1846: 251-252; Fig. 1). Type specimens originating from Greece (Kalkadele, Greek region of Macedonia) are housed at the Göttingen University Herbarium (GOET).

Cirsium candelabrum (= *C. chelmeum* Orph.) is a biennial plant that develops a rosette of basal leaves in the first year and a tall much branched stem with numerous flower heads in the following year (Fig. 2). This plant has a very peculiar habitus and it can be easily distinguished from other *Cirsium* species by the following features: plants completely glabrous, stems greatly branched nearly from base to synflorescence, capitula in clusters of 4 – 12 at tips of the lateral branches, branches pendulous due to the weight of capitula (which is reflected in the characteristic name of the species), corolla 13 – 17 mm in diameter, white or whitish-yellow.

It grows in ruderal habitats, mostly along the mountain roads, on a bed of anthropogenic deposols (Petronić & Pavlović 2006). It is a characteristic species of mountain roads in North and Central Greece, generally at 800 – 1700 m above sea level, occasionally at higher altitudes (Strid 1991). The phytosociology of the

The aim of this study was to determine whether the populations of *C. candelabrum* are still present on the sites where they had previously been recorded as well as to determine whether it is present



Figure 2. *Cirsium candelabrum*: A. habitus, B. basal rosette, C. flowering capitulas, D. stem leaves, E. fruiting capitulas with ripe achenes (Photos: M. Milović).

in other localities in central Dalmatia.

Materials and methods

Field research was conducted in the summer of 2014. Firstly explored were the sites of



Figure 3. Distribution map of *Cirsium candelabrum* (taken from Greuter (2006-), URL: http://euromed.luomus.fi/euromed_map.php?taxon=406100&size=medium).

Cirsium candelabrum that have been previously recorded by J. Topić (Nikolić 2015). Further, with the aim of discovering the new sites, we surveyed the area of the hinterland of central Dalmatia, between the cities of Split and Makarska towards the border with Bosnia and Herzegovina. Assuming that the plant was introduced to Croatia across the border with Bosnia and Herzegovina, we searched in detail the area from the village of Kamensko in the north to the town of Metković in the south.

For all localities with *C. candelabrum* the following data were noted: the name of locality, Gauss-Krüger coordinates, the type of habitat, number of specimens and the date of observation. The GPS receiver „GARMIN etrex Vista HCx“ and 1:25000 topographic maps were used for determination of the position in the field.

Results and discussion

During this research, all sites with *Cirsium candelabrum* in the study area recorded by J. Topić (5) were confirmed. Additionally, in our study, 50 new localities were found (Tab. 1). The majority of finding sites are situated along the roads leading towards border crossings of Aržano and Kamensko as well as on the industrial area of Dugopolje

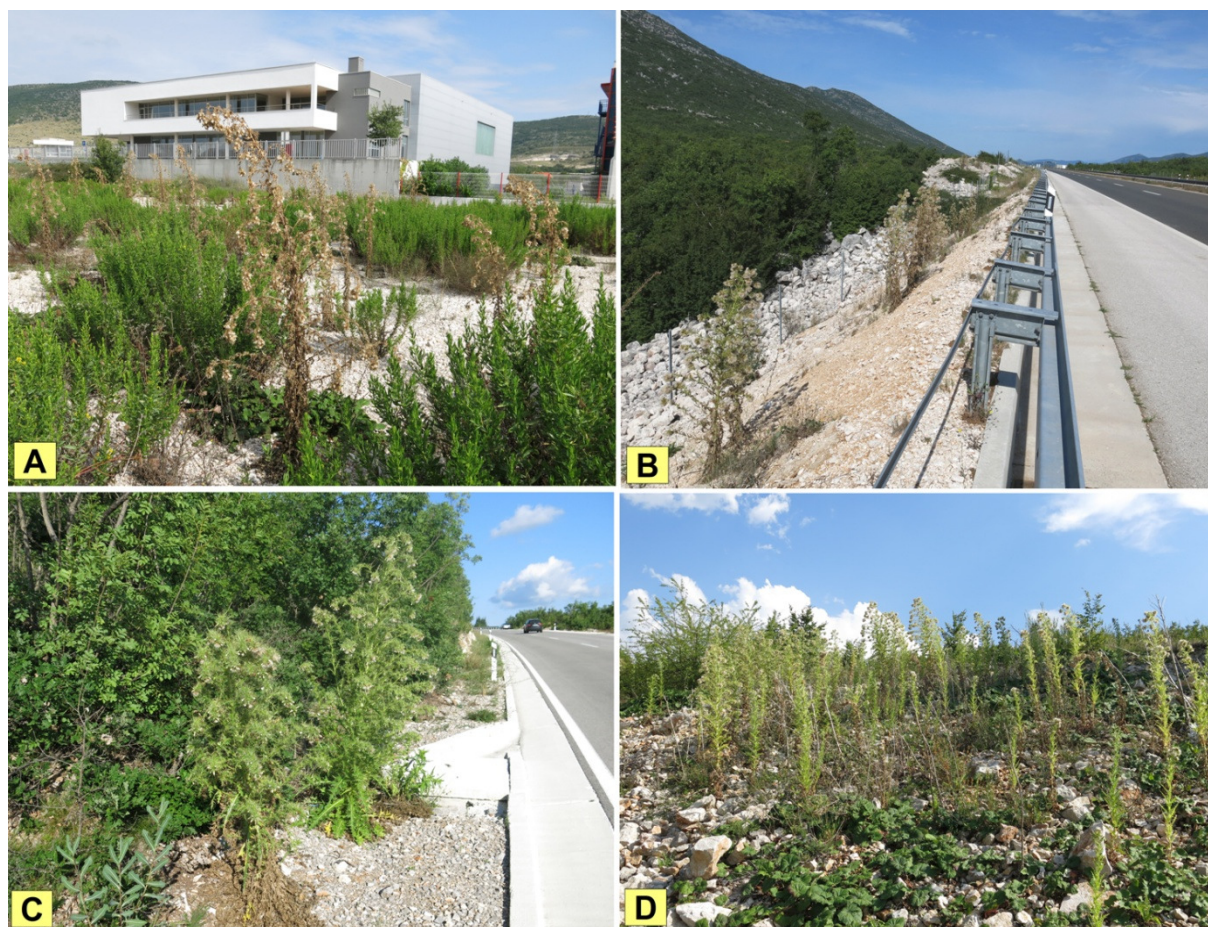


Figure 4. Habitats with *Cirsium candelabrum*: A. an abandoned building plot in the industrial zone of Dugopolje, B. embankment alongside Croatian motorway A1, C. along the road leading to the village of Kamensko, D. the material left after the construction along the road Svib – Aržano (Photos: N. Jasprica).

near the city of Split (Fig. 5). The number of individuals on the localities ranges from a few to cca. 300 plants (Tab. 1). *C. candelabrum* mostly grows in ruderal habitats along roads, especially where the natural vegetation was removed by means of road building or reconstruction (Fig. 4). In the southern part of the study area, along the roads leading to the border crossings of Vinjani Donji (near Imotski), Mali Prolog – Crveni Grm and Metković – Doljani, *C. candelabrum* was not found.

Table 1. New localities of *Cirsium candelabrum* in south Croatia (Dalmatia).

Locality	Gauss-Kruegers coordinates	No. of specimens	Habitat	Date
Industrial zone of Dugopolje	x=5627802; y=4828602	30	embankment beside the road	6.9.2014.
Industrial zone of Dugopolje	x=5627876; y=4828963	40	abandoned building plot	6.9.2014.
Industrial zone of Dugopolje	x=5628004; y=4828957	~150	abandoned building plot	6.9.2014.
Industrial zone of Dugopolje	x=5628098; y=4828539	3	along the road	6.9.2014.
Industrial zone of Dugopolje	x=5628622; y=4828722	6	abandoned building plot	6.9.2014.
Industrial zone of Dugopolje	x=5628191; y=4828203	10	along the road	6.9.2014.
Industrial zone of Dugopolje	x=5628049; y=4828364	2	along the road	6.9.2014.
Motorway A1, east from the tunnel of Crna Brda	x=5646614, y=4816721	5	embankment beside the motorway	19.8.2014.
Motorway A1, surroundings of Zagvozd	x=5668194; y=4806388	18	embankment beside the motorway	19.8.2014.
Motorway A1, surroundings of the village of Biokovsko selo	x=5670895; y=4803765	~50	embankment beside the motorway	19.8.2014.
Motorway A1, surroundings of the village of Župa	x=5672657; y=4802874	9	embankment beside the motorway	19.8.2014.
Motorway A1, surroundings of the village of Raščane Donje	x=5676549; y=4799802	6	embankment beside the motorway	19.8.2014.
Road Zagvozd–Imotski, surroundings of the village of Poljica	x=5672021; y=4810838	~30	along the road	19.8.2014.
Road Zagvozd–Imotski, surroundings of the village of Grubine	x=5673728, y=4811644	4	along the road	19.8.2014.
Road Imotski–Vinjane Gornje	x=5682925, y=4814808	3	along the road	19.8.2014.
Road Zagvozd–tunnel of Sveti Ilija (Rastovac, Stanići)	x=5665764; y=4807473	20	along the road	6.9.2014.
Road Zagvozd–tunnel of Sveti Ilija (Rastovac, Stanići)	x=5665047; y=4807596	2	along the road	6.9.2014.
Road Tijarica–Kamensko, the village of Kamensko	x=5658738, y=4831985	9	along the road	4.8.2014.
Road Tijarica–Kamensko, the village of Kamensko	x=5658071, y=4832086	10	along the road	4.8.2014.
Road Tijarica–Kamensko	x=5656087, y=4831445	9	along the road	4.8.2014.
Road Tijarica–Kamensko	x=5655502, y=4831203	7	along the road	4.8.2014.
Road Tijarica–Kamensko	x=5654633, y=4831187	20	along the road	4.8.2014.

Road Tijarica–Kamensko, lane road to the village of Voštane	x=5653766, y=4831117	12	along the road	4.8.2014.
Road Tijarica–Kamensko	x=5653232, y=4831281	13	along the road	4.8.2014.
Road Tijarica–Kamensko	x=5652610, y=4831338	~50	along the road	4.8.2014.
Road Tijarica–Kamensko, the village of Donja Tijarica	x=5652055; y=4831133	10	along the road	4.8.2014.
Aržano, road to the village of Brekalo	x=5660614, y=4830192	5	along the road	19.8.2014.
Aržano, road to the village of Brekalo	x=5660618, y=4830650	8	along the road	19.8.2014.
Aržano, road to the village of Brekalo (near Dujmići)	x=5660535, y=4829532	10	along the road	19.8.2014.
Aržano, road to the village of Brekalo (near Dujmići)	x=5660625, y=4830624	9	along the road	19.8.2014.
Aržano, road to the village of Brekalo (south of Dujmići)	x=5660641, y=4829399	6	along the road	19.8.2014.
Aržano, road to the village of Brekalo (south of Dujmići)	x=5660609, y=4829201	7	along the road	19.8.2014.
Aržano, road to the village of Brekalo (south of Dujmići)	x=5660608, y=4829129	10	along the road	19.8.2014.
Aržano, crossing road to Tijarica and Brekalo	x=5660644, y=4828930	5	along the road	19.8.2014.
Aržano	x=5661131, y=4828810	~100	along the road	19.8.2014.
Aržano	x=5661304, y=4828719	30	along the road	19.8.2014.
Aržano	x=5661538, y=4828606	~50	along the road	19.8.2014.
Aržano, lane road to the village of Cista Provo	x=5661629, y=4828566	15	along the road	19.8.2014.
Aržano, lane road to the village of Cista Provo	x=5661702, y=4828305	~50	along the road	19.8.2014.
Aržano, lane road to the village of Cista Provo	x=5661318, y=4828342	~30	along the road	19.8.2014.
Aržano, lane road to the village of Cista Provo	x=5661135, y=4828336	~100	embankment beside the road	19.8.2014.
Road Aržano–Cista Provo, surroundings of the village of Ljubičići	x=5660910, y=4828219	~150	along the road	19.8.2014.
Road Aržano–Cista Provo, surroundings of the village of Ljubičići	x=5660891, y=4827793	20	along the road	19.8.2014.
Road Aržano–Cista Provo, between villages of Svib and Završje	x=5660556, y=4827189	20	along the road	19.8.2014.
Road Aržano–Cista Provo, between Svib and Petrova draga	x=5659844, y=4826805	20	along the road	19.8.2014.
Road Aržano–Cista Provo, between Svib and Petrova draga	x=5559681, y=4826403	8	along the road	19.8.2014.
Road Aržano–Cista Provo, between villages of Svib and Marketići	x=5659967, y=4826225	5	along the road	19.8.2014.
Road Aržano–Cista Provo, northeast from Svib	x=5662648; y=4826841	150-200	along the road	6.9.2014.

Road Aržano–Cista Provo, northeast from Svib	x=5662422; y=4826962	~50	along the road	6.9.2014.
Road Aržano–Cista Provo, northeast from Svib	x=5661928; y=4827289	200-300	along the road	6.9.2014.

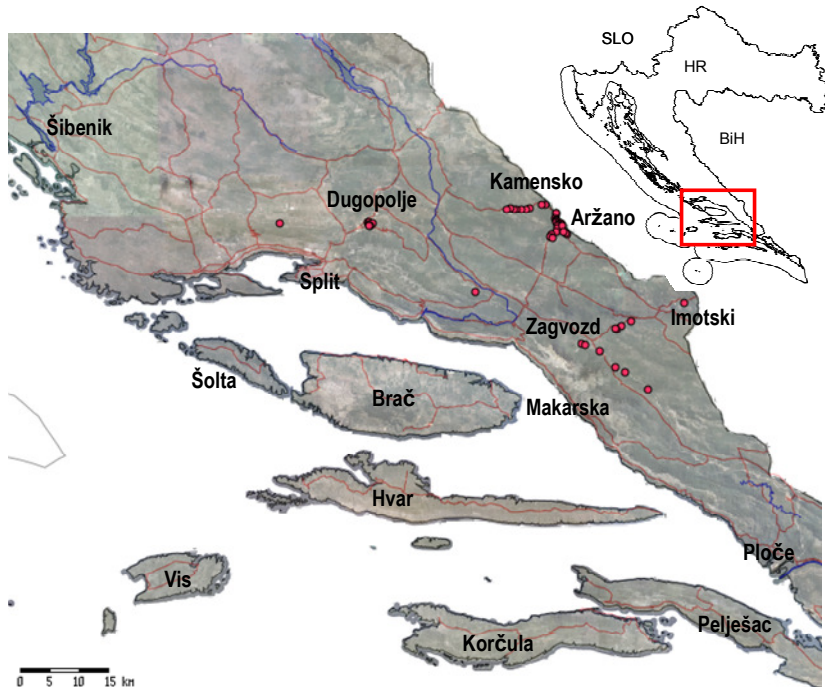


Figure 5. The current state of distribution of *Cirsium candelabrum* in Croatia (after Nikolić (2015) and this study).

The populations were vital at most sites, and among fertile individuals, numerous basal rosettes of young plants were observed. Each individual produces a large amount of tiny achenes with pappus of plumose setae (Idu & Omonhinmin 2001) that can be easily dispersed by wind or vehicles on locations significantly far from original ones. Since 2008, *Cirsium candelabrum* has become not only fully established species but it significantly spread in the hinterland of central Dalmatia. According to proposals given by Richardson et al. (2000), it can be categorized as naturalized invasive species in Croatia. With the construction of the A1 motorway with access roads

and reconstruction of the roads leading to the border crossings with Bosnia and Herzegovina, the suitable habitats for the immigration of this ruderal species were created. Distribution of the known localities along the border area with Bosnia and Herzegovina (Fig. 5) indicates that the most likely immigration route is from this country into Croatian territory.

The most recent findings in Croatia, Slovenia and Turkey indicate the possible start of invasive spreading of *C. candelabrum* from the Balkans into surrounding countries as well as to southwest Asia through the territory of Turkey. So far, it occurs only on anthropogenic habitats and shows no tendency to spread on agricultural land or natural habitats and vegetation.

Conclusion

The Balkans endemic *Cirsium candelabrum* has become naturalized invasive species in the hinterland of south Croatian region of Dalmatia. Due to the efficient ways of transferring seeds by vehicles on long-distance it can be expected to find new localities of *C. candelabrum* not only in Dalmatia, but also in other parts of Croatia.

Monitoring can help us to understand whether the findings of *C. candelabrum* on localities outside of its natural range represent only a temporary phenomenon or is it the beginning of its invasive spread.

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A contribution to the knowledge on the distribution of *Damasonium polyspermum* Coss. (Alismataceae) in Croatia

short communication

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Sažetak

Vrsta *Damasonium polyspermum* Coss. rasprostranjena je isključivo u Mediteranu, s relativno rijetkom pojavnošću u čitavom arealu. Uspijeva u plitkim, slatkovodnim stajaćicama kod kojih dolazi do značajne fluktuacije razine vode, te se smatra karakterističnom vrstom za mediteranske povremene lokve, rijetka i ugrožena staništa. Ova vrsta je globalno procijenjena kao osjetljiva (VU), dok za nacionalnu procjenu prilikom izrade aktualne Crvene knjige nije bilo dovoljno podataka, pa je vrsta označena kao nedovoljno poznata (DD). Ipak, novija razmatranja ukazuju na to da je vrsta ugrožena (EN) do kritično ugrožena (CR). U Hrvatskoj je do sada zabilježena na svega dva lokaliteta u sjevernoj Dalmaciji. U lipnju 2014. pronašli smo novo nalazište ove vrste, na području Vranskog jezera u sjevernoj Dalmaciji. Zbog vrlo specifičnih ekoloških zahtjeva, koji su odgovorni za mali broj nalaza ove vrste, novi nalazi predstavljaju značajan doprinos poznavanju rasprostranjenosti ove vrste.

Ključne riječi: novi nalaz, rijetka i ugrožena vrsta, IUCN

Abstract

Damasonium polyspermum Coss. occurs only in the Mediterranean, and is relatively rare across the whole distributional range. It grows in shallow standing water bodies with significant fluctuations of the water level, and it is considered characteristic for Mediterranean temporary ponds, which are rare and endangered habitats. According to IUCN, *D. polyspermum* is globally vulnerable (VU). In Croatia this species is denoted as data deficient (DD), however, more recently it was proposed to category endangered (EN), to critically endangered (CR). Until this record, there were only two known localities of *D. polyspermum* in Croatia, both in Northern Dalmatia. In June 2014 we have discovered a new locality of *D. polyspermum* in the area of Vrana Lake in Northern Dalmatia. Due to the specific ecological requirements which account for the small number of findings, new localities of *D. polyspermum* represent a significant contribution to the knowledge on its distribution.

Keywords: new locality, rare and endangered species, IUCN

Introduction

Damasonium polyspermum is distributed only in the Mediterranean, with rare occurrence in the whole distributional range (de Bélair et al. 2010, Fig. 1). It grows in shallow freshwater ponds and lakes with seasonal fluctuations of the water level, and is considered characteristic for Mediterranean temporary ponds, rare and endangered habitats (Zacharias & Zamparas 2010) listed on the Habitats directive as priority natural habitat type (Anonymous 1992, code *3170). Due to the high habitat specificity (association with threatened habitats) and rare occurrence, *D. polyspermum* is found globally vulnerable (VU) according to IUCN criteria (de Bélair et al. 2010). In the current Red Book of Vascular Flora of Croatia (Nikolić &

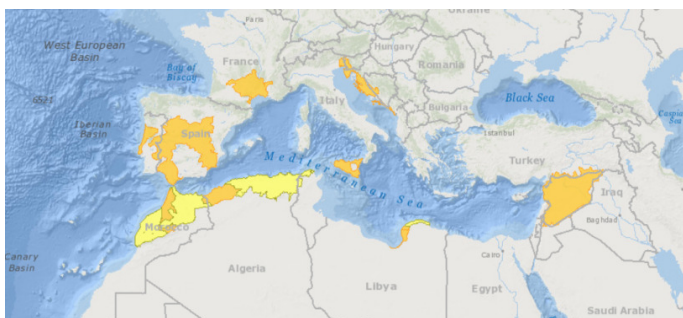


Figure 1. Global distribution of *Damasonium polyspermum*. Orange – present, yellow – probably present. Adopted from de Bélair et al. (2010).

Topić 2005), *D. polyspermum* is denoted as data deficient (DD), however, more recent finding by Boršić & Posavec Vukelić (2012) was followed by the proposal to denote it as endangered (EN) to critically endangered (CR).

Prior to this record, *D. polyspermum* was registered in Croatia only in two localities, Jezera on the island Murter (Trinajstić et al. 1995, Pandža 1998) and more recently, pond Bunari near the Na-



Figure 2. Habitus and fruits of *Damasonium polyspermum* in Vrana Lake on 13th June 2014 (Photos: N. Vuković).



Figure 3. Habitat of *Damasonium polyspermum* on Vrana Lake site 1 dominated by common reed, *Phragmites australis* (Photos: N. Vuković).



Figure 4. Habitat of *Damasonium polyspermum* on Vrana Lake site 2 dominated by common water-plantain, *Alisma plantago-aquatica* (Photo: N. Vuković).

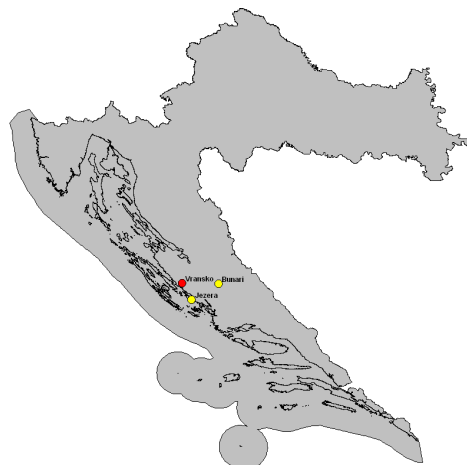


Figure 5. Distribution of *Damasonium polyspermum* in Croatia. Yellow dots – previous records from the literature, red dot – new record from Vrana Lake.

tional Park Krka (Boršić & Posavec Vukelić 2012). Noteworthy, the record from Jezera was not confirmed in recent times, and the last search was conducted in 2012 (Pandža pers. comm.).

Materials and methods

Northern part of the Vrana Lake Nature Park was surveyed on 13th June 2014. Gauss-Krueger coordinates of *D. polyspermum* populations were recorded using Garmin e-trex GPS device (site 1: 5542840, 4866754; site 2: 5542625, 4866720). The species was photographed on both locations, along with the corresponding habitats.

Results and discussion

D. polyspermum was found in the area which was previously subjected to long lasting floods, but dry at the time of the finding (the flood water had only recently been withdrawn). Two nearby populations were recorded, with altogether around 15 individuals, all fructifying at the time (Fig. 2). One population (site 1, approximately five plants) was recorded on the abandoned macadam road going through a reed bed, while the other population (site 2, approximately ten plants) was recorded on the edge of an abandoned field. The first site was overgrown and dominated by common reed (*Phragmites australis* (Cav.) Trin. ex Steud., Fig. 3), while the other site was mostly covered by common water-plantain (*Alisma plantago-aquatica* L., Fig. 4).

Recorded populations on Vrana Lake represent the third known locality of *D. polyspermum* in Croatia (Fig. 5). Regarding previous findings, there is a possibility that the population from the first known locality (Jezera on the island Murter) no longer persists on the site. Although the site was searched in several occasions, *D. polyspermum* was not confirmed in recent times (Pandža pers. comm.). On the other hand, large number of plants was present on the second finding (pond Bunari) in 2015 (Šegota pers. comm.). Moreover, habitat on this site seems to be in a favourable state, while the population appears to be stable (Šegota pers. comm.).

Conclusion

Newly found populations on Vrana Lake are extremely small, therefore rather vulnerable and unstable. Although *D. polyspermum* most probably also occurs on other sites around the Lake, a detailed specific search is necessary to get a more accurate overview on its distribution. Considering the association of *D. polyspermum* with rare and endangered habitats, which accounts for the small number of findings, this record represents a valuable contribution to the knowledge on its distribution. Moreover, it offers the opportunity to review the current DD status of this extremely rare species and assign a more appropriate threat level.

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Glatki sunčac (*Fumana laevis* (Cav.) Pau) i na otoku Mljetu

kratko priopćenje

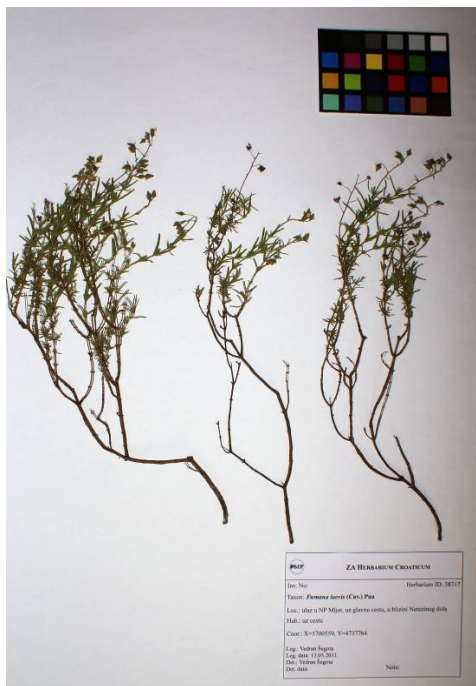
Vedran Šegota (Botanički zavod, Biološki odsjek, Prirodoslovno-matematički fakultet, Marulićev trg 20/2, 10000 Zagreb; vedran.segota@biol.pmf.hr; autor za korespondenciju)

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Sukladno nedavnoj taksonomskoj reviziji roda sunčac (*Fumana*) u Hrvatskoj (Bogdanović i sur. 2012, Boršić 2013) determiniran je obilni herbarijski materijal koji je sakupljen tijekom florističkog kartiranja Nacionalnog parka Mljet u periodu od 2008. do 2012. godine. Kao najčešće vrste sunčaca u Parku izdvojile su se vrste *Fumana ericifolia* Wallr. i *F. thymifolia* (L.) Spach ex Webb, dok je nešto rjeđa *F. procumbens* (Dunal) Gren. et Godr. Najrjeđa vrsta sa samo jednim nalazištem jest *F. laevis* (Cav.) Pau (Sl. 1), zabilježena 13.05.2011. na ulazu u Nacionalni park, uz glavnu cestu, iznad



Slika 1. Herbarijski list s primjercima glatkog sunčaca (*Fumana laevis*) sabranim na otoku Mljetu (leg. et det. V. Šegota, dta. 13.05.2011., ZA, ID:38717).

Nerezinog dola (MTB polje 3270/234, koordinate: N5700259,27, E4737769,96), zajedno s vrstama *Sedum sediforme* (Jacq.) Pan., *Convolvulus althaeoides* L. ssp. *tenuissimus* (Sibth. et Sm.) Stace, *Dorycnium hirsutum* (L.) Ser., *Bromus madritensis* L., *Euphorbia spinosa* L., *Brachypodium retusum* (Pers.) P.Beauv., *Sonchus asper* (L.) Hill ssp. *glaucescens* (Jord.) Ball, *Reichardia picroides* (L.) Roth, *Stachys cretica* L. ssp. *salviifolia* (Ten.) Rech. f., *Sedum ochroleucum* Chaix, *Dorycnium germanicum* (Gremli) Rikli, *Trifolium campestre* Schreber, *Medicago orbicularis* (L.) Bartal., *Lolium perenne* L., *Securigera cretica* (L.) Lassen, *Foeniculum vulgare* Mill. i dr.

Vrsta *Fumana laevis* spomenutom je taksonomskog revizijom uvrštena u popis hrvatske flore, te je dosada zabilježena na samo dva otoka – Visu i Biševu (Bogdanović 2012). Stoga ovaj nalaz predstavlja treće, također otočko nalazište vrste u Hrvatskoj. Osim navedene četiri vrste, na otoku Mljetu je ranije zabilježena i vrsta *F. arabica* (L.) Spach (Ilijanić 1982), na području mjesta Goveđari, no tijekom ovog kartiranja ona nije potvrđena. Uključujući i taj nalaz, na otoku Mljetu (ujedno i Nacionalnom parku Mljet) nalazimo ukupno pet od sedam poznatih vrsta ovog roda u Hrvatskoj. S obzirom da vrsta *F. laevis* donedavno nije bila prepoznata u hrvatskoj flori, ne postoji ni njeno hrvatsko ime, pa predlažemo korištenje naziva „glatki sunčac“, zbog golih listova (lat. *laevis* – gladak) koji je razlikuju od vrlo slične (i češće) vrste *F. thymifolia* koja ima dlakave listove.

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Silene vs. Heliosperma u flori Hrvatske**kratko priopćenje**

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Prema novijim molekularno filogenetskim radovima koji se baziraju na jezgrinim i kloroplastnim DNA sekvencama (Oxelman i sur. 2001, Frajman i Oxelman 2007, Frajman i sur. 2009a, b, 2013), iz roda *Silene* L. izdvojeni su u hrvatskoj flori od ranije prepoznat rod *Heliosperma* (Rchb.) Rchb., te za hrvatsku floru novi rodovi *Atocion* Adans. i *Eudianthe* (Rchb.) Rchb., a koji imaju dovoljno dobru filogenetsku i morfološku podršku. Analize su također pokazale da se rodovi *Agrostemma* L., *Lychnis* L. i *Viscaria* Bernh., koji se u hrvatskoj flori već tradicionalno smatraju samostalnim rodovima (Nikolić 2015), opravdano izdvajaju iz roda *Silene*. Na temelju ovih rezultata provedene su i odgovarajuće taksonomsko-nomenklaturne revizije (Frajman i sur. 2009b, 2013), te je shodno tome potrebno provesti nomenklaturne preinake popisa flore Hrvatske, a u FCD-u i prijenos drugih podataka vezanih uz ove svojte (nalazišta, fotodokumentaciju, redeterminaciju materijala u herbarijskim zbirkama i dr.).

Premještanje u rod *Heliosperma*:

- *Silene alpestris* Jacq. → *Heliosperma alpestre* (Jacq.) Griseb.
- *Silene chromodonta* Boiss. et Reuter → *Heliosperma chromodontum* (Boiss. et Reut.) Juratzka
- *Silene pusilla* Waldst. et Kit. → *Heliosperma pusillum* (Waldst. et Kit.) Rchb.
- *Silene pusilla* Waldst. et Kit. ssp. *malyi* (H. Neumayer) Greuter et Burdet → *Heliosperma malyi* (H. Neumayer) Degen
- *Silene pusilla* Waldst. et Kit. ssp. *pusilla* → *Heliosperma pusillum* (Waldst. et Kit.) Rchb. ssp. *pusillum*
- *Silene retzdorffiana* (K. Malý) H. Neumayer → *Heliosperma retzdorffianum* K. Malý
- *Silene tommasinii* Vis. → *Heliosperma tommasinii* (Vis.) Rchb.
- *Silene veselskyi* (Janka) H. Neumayer → *Heliosperma veselskyi* Janka

Premještanje u rod *Atocion*:

- *Silene armeria* L. → *Atocion armeria* (L.) Raf.
- *Silene rupestris* L. → *Atocion rupestris* (L.) Oxelman

Premještanje u rod *Eudianthe*:

- *Silene coeli-rosa* (L.) Godron et Godron → *Eudianthe coeli-rosa* (L.) Rchb.

U rod *Heliosperma* ubrajaju se višegodišnje vrste koje se mogu pronaći u planinskim predjelima središnje i jugoistočne Europe. Većina tih vrsta je endemična s malog područja i to uglavnom s Balkanskog poluotoka, izuzev vrste *H. pusillum* (Waldst. et Kit.) Rchb. koja je šire rasprostranjena (od Sierre Cantabrice u Španjolskoj do Karpata). Vrste ovog roda mogu se lako prepoznati po prisustvu dugačkih papila na rubu sjemenki. Broj vrsta unutar roda je varijabilan, ovisno o tumačenju pojedinih autora, a kreće se od 3 do 18 (Trinajstić 1979a, Frajman i Rabeler 2006, Niketić i Stevanović 2007). U planinskim predjelima Hrvatske rasprostranjena je vrsta *H. pusillum* (Waldst. et Kit.) Rchb., a prema bazi podataka FCD (Nikolić 2015) dvojbena status s obzirom na njihovo upitno pojavljivanje imaju sljedeće vrste: *H. alpestre* (Jacq.) Griseb., *H. chromodontum* (Boiss. et Reut.) Juratzka, *H. malyi* (H. Neumayer) Degen, *H. retzdorffianum* K. Malý, *H. tommasinii* (Vis.) Rchb. i *H. veselskyi* Janka. Jedna od rijetkih, endemičnih vrsta naše flore je i donedavno marginalizirana vrsta *H. insulare* Trinajstić (Sl. 1), koja nije imala svoju potvrdu od kada je otkrivena. To je stenoendemična vrsta s otoka Mljeta, koja je opisana iz pukotina svijetlih karbonatnih stijena Velikog Grada iznad Babinog polja (Trinajstić 1979b). Ovaj endem bio je uključen i u molekularno-

filogenetske analize, ali njegov položaj unutar roda *Heliosperma* ostaje i nadalje nejasan (Frajman i Oxelman 2007, Frajman i sur. 2009a).



Slika 1. *Heliosperma insulare* Trinajstić; 1/ habitus, 2/ dio cvata (Foto: B. Frajman, otok Mljet, Veli Grad, 26.04.2006.).

Rod Atocion uključuje jednogodišnje do kratko živuće trajnice, a biljke su modro-zelene nahukane. Cvat je sastavljen vršni dihajzij, a ponekad su to gusti glavičasti cvatovi. Tri su tučka. Rod je široko rasprostranjen u Sjevernoj Americi i Europi, a u Hrvatskoj je zastupljen s vrstom *A. armeria* (L.) Raf., dok je prisutnost vrste *A. rupestris* (L.) Oxelman u hrvatskoj flori dvojbeno i trebalo bi se brisati iz popisa flore Hrvatske.

Rodu Eudianthe pripadaju jednogodišnje gole biljke sa uskim, linearnim do lancetastim listovima i roza cvjetovima koji su grupirani u rahle dihajzije. Rod je autohton na području zapadnog Mediterana, a u Hrvatskoj se u kulturi pojavljuje vrsta *Eudianthe coeli-rosa* (L.) Rchb.

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Nove vrste u flori Hrvatske

kratko priopćenje

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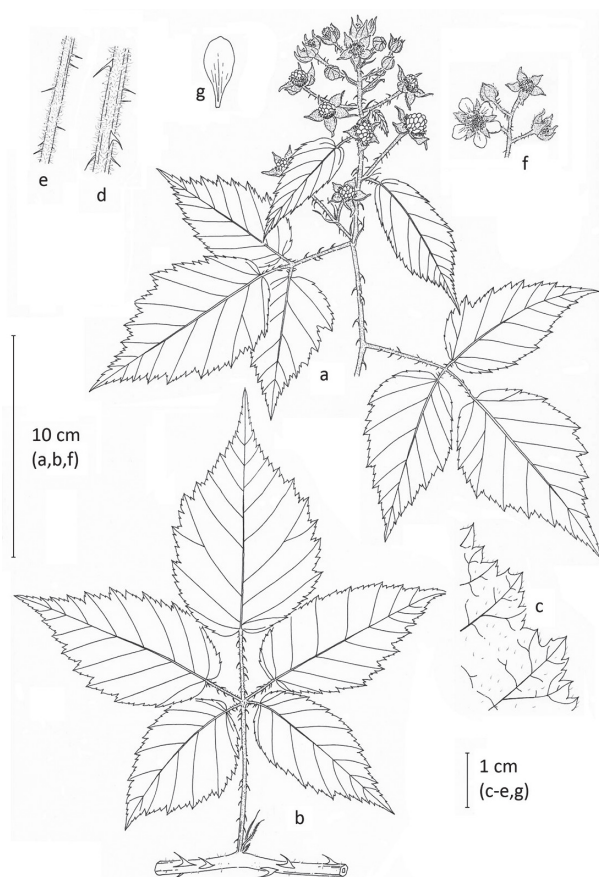
***Rubus slavonicus* Király, Trávníček et Žila**

Mjesto prvog objavljivanja: *Phytotaxa* 195: 283 (2015)

Nalazišta u Hrvatskoj: Bjelovar, Letičani, Kupinovac, Mala Pisanica, Međurača, Nova Ploščica, Podgarić kod Garića, Trnovitički Popovac (lokaliteti su preuzeti iz Király i sur. 2015)

Prema navodu Király i sur. (2015) opisana je nova vrsta za znanost iz jugozapadne Mađarske (*locus classicus*: regija Somogy, Kaszó).

Holotip je pohranjen u BP herbariju, a jedan od izotipova je pohranjen u ZA herbariju. *Rubus slavonicus* (Sl. 1) je apomiktična vrsta koja pripada sekciji *Rubus*, a zbog prisutnosti sjedećih žlijezda na sterilnim stabljikama, na osi cvata i palisticima nedvojbeno pripada seriji *Micantes* Sudre. Vrsta je rasprostranjena na području južne i jugozapadne Mađarske, središnje i istočne Hrvatske (Posavina i Slavonija), a južni dio areala seže u Bosnu i Hercegovinu. *R. slavonicus* je termofilna i heliofilna vrsta koja raste na sunčanim staništima (uz šumske rubove, putove i čistine) te obično dolazi u sastavu šuma hrasta lužnjaka i običnog graba.



Slika 1. *Rubus slavonicus*: a/ cvat, b/ list, c/ rub vršne liske, d/ os cvata, e/ stapka cvijeta, f/ detalj cvijeta, g/ latica (autor crteža J. Tábořská, preuzeto iz Király i sur. (2015), Sl. 3, str. 283).

***Panicum riparium* H. Scholz**

Mjesto prvog objavljivanja: *Feddes Repert.* 113(3-4): 275 (2002)

Nalazišta u Hrvatskoj: Rijeka, Kamena Gorica, Knin, Slavonski Brod, Stubičke Toplice, Vodice, Zagreb (Borovje, Lanište, Savski most), Sesvete (preuzeto iz Király i Alegro 2015)

Tijekom revizije nekoliko herbarijskih zbirki i *Panicum capillare* kompleksa otkrivena je nova vrsta u flori Hrvatske (Király i Alegro 2015).

***Echinochloa colona* (L.) Link**

Mjesto prvog objavljivanja: *Hort. Berol.* [Link] 2: 209 (1833)

Sinonimi: *Panicum colonum* L. (*Syst. Nat.* ed. 10, 2: 870. 1759), *Milium colonum* (L.) Moench (*Methodus*: 202. 1794); *Oplismenus colonus* (L.) Kunth (*Nov. Gen. Sp.* 1: 108. 1816), *Echinochloa zonalis* (Guss.) Parl. (*Fl. Panorm.* 1: 119. 1839), *Brachiaria longifolia* Gilli (*Ann. Naturhist. Mus. Wien* 69: 39. 1966)

Nalazišta u Hrvatskoj: Medvednica (Vugrovec), grad Zagreb (Volovčica)

Tijekom florističkih istraživanja istočnih dijelova Medvednice (Zagreb) provedenih u periodu 2007. - 2010. pronađena je ova neofitska vrsta, porijeklom iz Indije, do sada ne zabilježena na području Hrvatske (Hruševar i sur. 2015).

***Cardamine parviflora* L.**

Mjesto prvog objavljivanja: Syst. Nat., ed. 10, 2: 1131 (1759)

Nalazište u Hrvatskoj: Slatina u Slavoniji

Nova vrsta u flori Hrvatske prema navodu u Prlić (2015). Sitnocvjetna režuha, *Cardamine parviflora*, pronađena je 2014. god. na području Slatine u okolici sela Medinci i Novi Senkovac. Vrsta raste u prizemnom sloju poplavne šumske zajednice poljskog jasena s kasnim drijemovcem (*Leucojo aestivi-Fraxinetum angustifoliae* Glavač 1959). Morfološki je vrlo slična vrsti *C. pratensis* L., ali ima sitnije latice, a od vrste *C. impatiens* L. razlikuje se po tome što ima cjelovite liske (Prlić 2015).

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Novosti

6th Balkan Botanical Congress held in Rijeka, Croatia (14 - 18 September 2015)

Željka Modrić Surina (Natural History Museum Rijeka, Lorenzov prolaz 1, HR-51000 Rijeka, Croatia; zeljka@prirodoslovni.com)

This year, for a whole week in September, Rijeka was the centre of botany of the Balkans. Natural History Museum Rijeka, Croatian Botanical Society and Botanical Society of Slovenia, together with University of Rijeka, organized a central gathering of the botanists researching the diversity of plant life of the Balkan Peninsula.

The Congress brought together around 200 participants from 19 European countries, presenting and discussing recent progress on various botanical topics. The Congress Book of Abstracts, available at the www.prirodoslovni.com/6bbc website, comprises over 200 presentations by more than 500 scientists, covering the areas of plant anatomy and morphology, taxonomy, floristics, alien and invasive plants researches, phylogeography and phylogeny, conservation issues, vegetation and



ecology, traditional uses of plants and ethnobotanical studies, historical and archaeobotanical researches and other botanical disciplines, all contributing to better understanding of beautiful, vibrant, rich and mysterious plant life of the Balkans.

During five work days of the Congress, the participants had a pleasure to attend four invited lectures, 50 oral and 160 poster presentations as well as two round tables. Botanists had the opportunity to join two mid-congress expert guided excursions to the Northern Velebit National park and the island of Krk (Croatia), as well

as the post-congress excursion to the Mt Snežnik (Slovenia).

The Congress provided an excellent opportunity to hear and discuss the latest research results, to share experiences and to develop new and strengthen the existing contacts between colleagues from different countries.

Željka Modrić Surina, President of the Organizing Committee