

***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

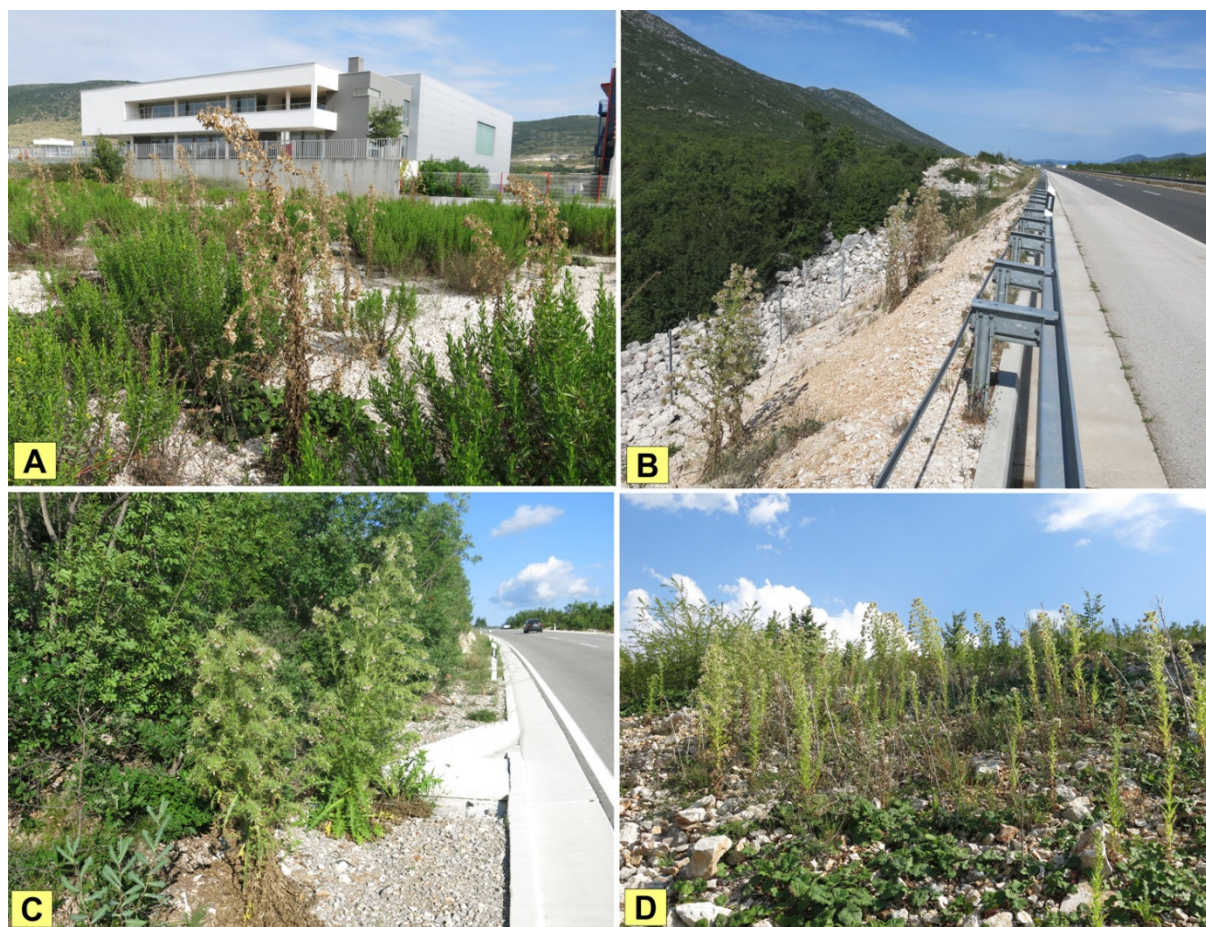


Figure 4. Habitats with *Cirsium candelabrum*: A. an abandoned building plot in the industrial zone of Dugopolje, B. embankment alongside Croatian motorway A1, C. along the road leading to the village of Kamensko, D. the material left after the construction along the road Svib – Aržano (Photos: N. Jasprica).

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.

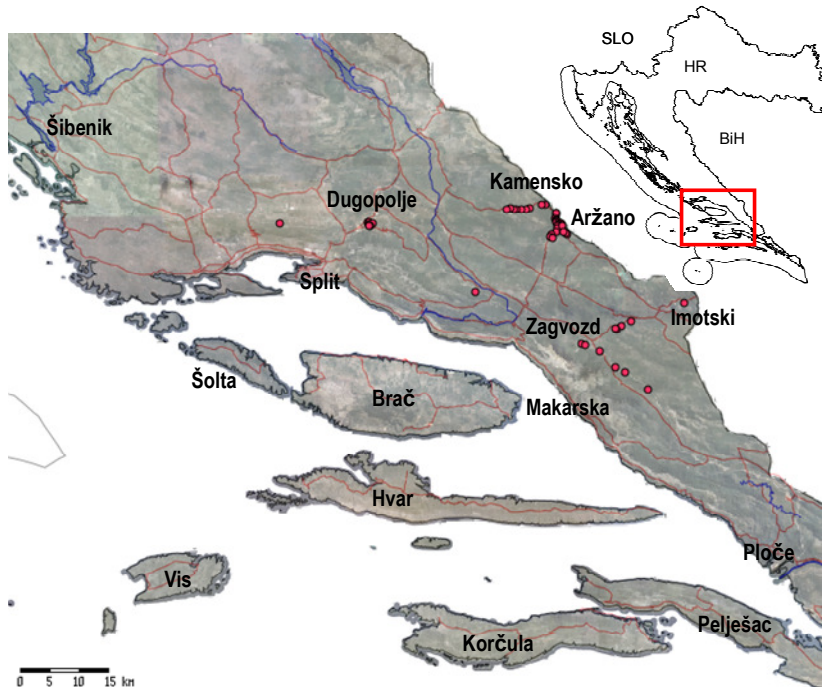


Figure 5. The current state of distribution of *Cirsium candelabrum* in Croatia (after Nikolić (2015) and this study).

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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