

# New localities of *Cirsium candelabrum* Griseb. (Asteraceae) in Croatia

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## Abstract

*Cirsium candelabrum* is a Balkan endemic species, non-indigenous to Croatia. In the last 13 years its spread was observed only in Central Dalmatia. From 2015 to 2021 we have been recording its invasive spreading across the Kvarner region and its arrival to the southern edge of Gorski Kotar. The plants appear in diverse numbers in two different habitat types. In the sub-Mediterranean zone, the species inhabits ruderal habitats arising from the degradation of the natural vegetation by the construction works for traffic and communal infrastructure and the erection of industrial zones and shopping centres, accompanied by numerous invasive alien species. In the upper (montane and subalpine) zone of Mali and Veliki Platak, *C. candelabrum* dominates in stands on gravelly road edges, forest ways, on incisions with glacial till, and especially luxuriant and dense populations form on the dug-up soil under the ski lift and along the ski run on Radeševo. Here, *C. candelabrum* is accompanied by native species characteristic for the forest edges and clearings and sometimes for ruderal, chasmophytic or scree habitats.

**Keywords:** *Cirsium candelabrum*, Croatia, Gorski Kotar, invasive spreading, Kvarner

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## Sažetak

*Cirsium candelabrum* je balkanski endem, vrsta koja nije autohtona u Hrvatskoj. Posljednjih 13 godina njezino širenje uočeno je samo u Srednjoj Dalmaciji. No u razdoblju od 2015. do 2021. zabilježili smo njezino invazivno širenje i na području Kvarnera te južnog ruba Gorskog kotara. Biljke se u manjem ili većem broju pojavljuju na dva različita tipa staništa. U submediteranskoj zoni vrsta u pravilu nastanjuje ruderalna staništa nastala degradiranjem prirodne vegetacije pri izvođenju građevinskih radova vezanih uz prometnu i komunalnu infrastrukturu te podizanje industrijskih zona i trgovačkih centara, a karakteriziraju ih brojne invazivne vrste. U višem (montanom i subalpinskom) pojasu na Malom i Velikom Platku, *C. candelabrum* dominira u sastojinama na šljunkovitim rubovima cesta, uz šumske putove, na zasjekama s glacijalnim tilom, a naročito bujne i guste sastojine čini na razrovanom tlu ispod žičare i duž skijaške staze na Radeševu. Na tom tipu staništa uz *C. candelabrum* dolaze autohtone vrste svojstvene zajednicama šumskih rubova i čistina, a ponegdje i one svojstvene ruderalnim staništima te pokoji hazmofit i točilarka.

**Ključne riječi:** *Cirsium candelabrum*, Gorski kotar, Hrvatska, invazivno širenje, Kvarner

## Introduction

*Cirsium candelabrum* Griseb. is a biennial plant from the family Asteraceae which in the first year develops a rosette of basal leaves, while in the following year it flowers, bears fruits and finally dies. It is easily distinguished from other species in the genus by its robust stem branching nearly from the base to synflorescence and the milky white inflorescences (in contrast to most species of the genus *Cirsium*, which have pink or reddish-pink ones). The primary area of this endemite is the Balkans (Greece, Albania, North Macedonia, Kosovo, Montenegro, Serbia, Bosnia and Herzegovina, Bulgaria, and Romania), where it is characteristic for the mountain ruderal vegetation of forest fringes and road sides, but also for disturbed ruderal habitats (Hayek 1931, Strid 1991, Petronić & Pavlović 2006). In the last two decades the species has been noticed to spread into other neighbouring areas. Thus it was observed for the first time in Slovenia in the industrial zone in Logatec in 2002, then near Cerknica in 2009 and along the road Unec – Postojna in 2011 (Grošelj 2012), and in 2006 in the European part of Turkey as well (Yildiz et al. 2009).

The first records in Croatia were by Jasenka Topić who found the plants in 2008 and 2010 in several localities in Central Dalmatia. Based on these findings the species was included in the Flora Croatica Database (FCD) in 2008 (Nikolić 2021). During the systematic research of the species in the region of Central Dalmatia in 2014, the previous findings by Topić were confirmed and the species was recorded in as many as 50 new localities (Milović et al. 2015). Based on phytocenological records of stands dominated by *C. candelabrum* in 2015 a new plant association was described, namely *Picrido hieracioidis-Cirsietum candelabri* Jasprica, Milović & Pandža 2015 (Jasprica et al. 2015). In the same work the relationship of the newly proposed association to the *Cirsietum candelabri* Matvejeva ex Čarni, Kostadinovski & Matevski 2001 association from North Macedonia and Bosnia and Herzegovina (Čarni et al. 2001) was discussed.

## Material and methods

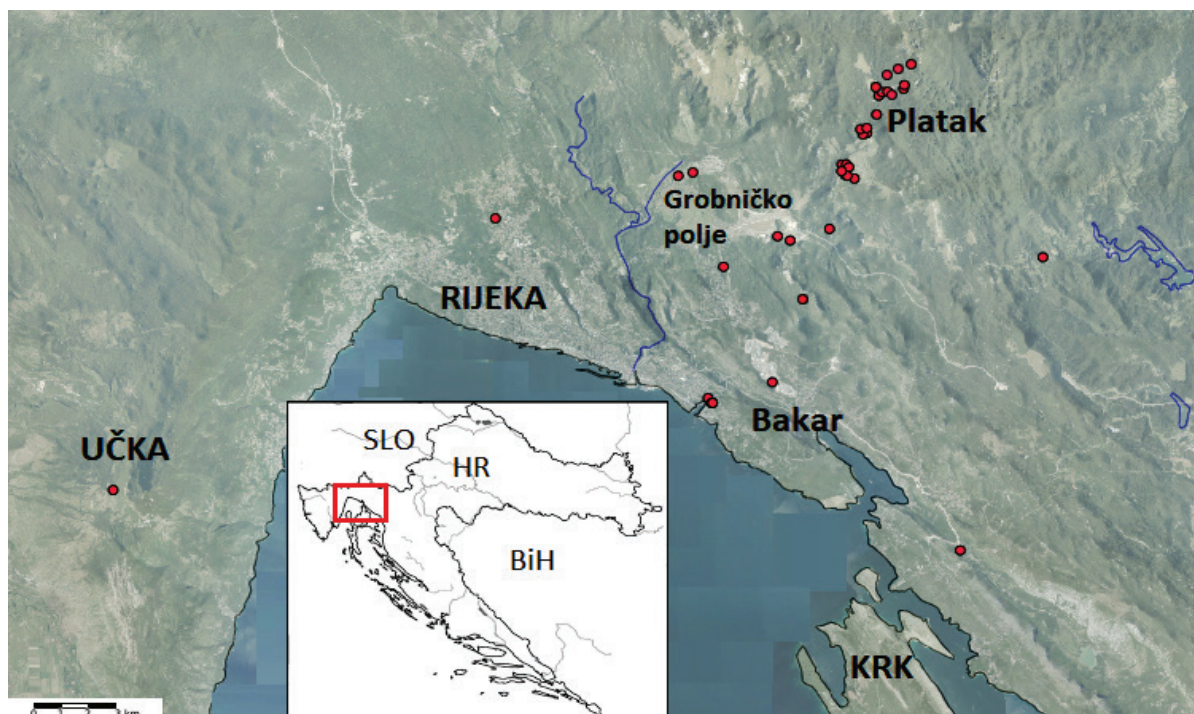
Within the course of various field studies from 2016 till 2021 we frequently visited the regions of Kvarner and Gorski Kotar and recorded the relatively numerous sites with *C. candelabrum*.

In some localities we just recorded the presence of the species, with a brief description of the habitat and the microlocality coordinates, while in some spots we made a list of all the species present, even phytosociological relevés. In the same period a considerable amount of photodocumentation was gathered as well. The acquired data were fed into the FCD as “Observations”, in part also as photodocumentation in the “Gallery”. The species identification was done using Domac (1994), Martinčić et al. (2010) and Nikolić (2019) and the nomenclature follows the FCD (Nikolić 2021). The nomenclature of syntaxonomic units is in conformity with Škvorc et al. 2017.

## Results

Since 2015 and 2016, when a few plants were discovered along the forest way between Platak and Veliko Tešnje in the belt of beech-fir forests (*Aremonio-Fagion* (Horvat 1950) Borhidi in Török et al. 1989 alliance), on disturbed calcareous soil in a forest devastated by ice break at Lepenica and on glacial till by the road on Mali Platak, further

spreading of *C. candelabrum* was regularly observed at the southern edge of Gorski Kotar and along the Kvarner region. In 2017 a great number of individuals were recorded on the wildfire-burned slopes of Mt Jazvina under Mali Platak. New records followed in 2018 on the outskirts of the town of Rijeka (Martinščica), not far from the sea shoreline, at only a few meters above sea level. In 2019 a lot of individuals were found at the Recreation center Platak, where they have overgrown the stony dug up surface at the parking lot, and along the ski run near the top of Radeševo, reaching up to 1363 m a.m.s.l. The same year individuals in lush bloom were recorded below Mt Kamenjak at the milestone in the curve of the Louisiana road (497 m a.m.s.l.) in the zone of thermophilous scrub vegetation of the *Fraxino orni-Ostryion* Tomažič 1940 (= *Ostryo-Carpinion orientalis* Horvat 1959) alliance. The most localities, however, were discovered in 2020, mainly within the project “Mapping of selected alien and invasive plant species in priority regions” viz. Kukuljanovo, Rijeka (Viškovo), Dražice and Soboli on the edge of Grobničko polje, Križišće



**Figure 1.** Distribution map of the species *Cirsium candelabrum* in Kvarner and Gorski Kotar.

**Table 1.** Findings of *Cirsium candelabrum* in the regions of Kvarner and Gorski Kotar.

LOCALITY	GAUSS-KRÜGER COORDINATES		HABITAT	YEAR OF OBSERVATION
	X	Y		
between Platak and Veliko Tešnje	5467634	5032579	forest edge along the way in the zone of the silver fir and European beech forests	2015
Lepenica	5472651	5024918	disturbed calcareous soil in a forest devastated by icebreak	2016
Mali Platak	5465800	5029792	glacial till bordering the road	2016
Učka	5437247	5015671	gravelly and stony clearing in a Juniperus thicket	2016
	5465262	5028494		
Jazvina below Mali Platak	5465169	5028607	wildfire-burned slopes	2017
	5464992	5028594		
	5465111	5028340		
Kostrena, Vrh	5460032	5019131	sewer line excavation	2018
Martinšćice	5460070	5019132		
Martinšćica, "Viktor Lenac" shipyard	5459899	5019324	by the shipyard parking lot	2018
Recreation center	5466401	5031329	by the parking lot and on the	
Platak all the way to the top of	5466529	5031465	ski run, dug up soil at the upper	2019
Radeševo	5467376	5031750	terminal of the ski lift	
below Kamenjak by the Louisiana road	5464525	5026042	gravelly and stony edge by the road	2019

LOCALITY	GAUSS-KRÜGER COORDINATES		HABITAT	YEAR OF OBSERVATION
	X	Y		
Kukuljanovo	5462309	5019989	gravel excavation	2020
Rijeka, Viškovo	5451805	5026460	ruderal along the road	2020
Dražice	5458692	5028198	construction waste dump	2020
Dražice (Ivanova greda)	5459308	5028265	construction waste dump	2020
Mali Platak	5465975	5029885	gravel by the parking lot	2020
Kostrena, Vrh Martinšćice	5460060	5019140	sewer line excavation	2020
Križišće	5469506	5013278	ruderal along the road	2020
Lišćevica (Podčudnić, Grobnišćina)	5460489	5024534	motorway rest area	2020
Soboli (Grobnišćina)	5462546	5025746	ruderal along the gravel road	2020
Mali Platak	5465710	5029998	gravelly and stony edges by the road, incisions with glacial till	2021
	5465945	5030042		
	5466318	5030583		
Jazvina below Mali Platak	5465473	5028041	gravelly and stony edges and slopes by the road	2021
	5465205	5028150		
	5465117	5028187		
Recreation center Platak all the way to the top of Radeševo	5464983	5028335	dug up soil under the ski lift, the ski run	2021
	5466739	5031489		
	5467346	5031605		
Soboli (Grobnišćina)	5463029	5025580	construction waste dump	2021



Tešnje, along the road Platak – pass under Snježnik	5466805	5032080	in the middle of the gravel road	2021
top of Tešnje	5467162	5032408	ski run	2021
foot of Radeševo	5466793	5031395	artificial pond shore	2021
Platak, the meadow Mali Pribeniš	5466204	5031861	along the ski run	2021

near the Krk Bridge and new spots along the road to Mali and Veliki Platak. In the course of 2021 most of the previous findings were confirmed (all except those at the milestone by the Louisiana road, at Križišće, at the parking lot of the shipyard in Martinšćica, and one of the two localities in Dražice), a new spot was discovered in Soboli, and hundreds of new individuals were observed lining the road to Platak with only short interruptions. On the construction waste dump in Dražice the plants have disappeared since the construction vehicles had removed almost all vegetation while levelling terrain, and on the parking lot of the shipyard in Martinšćica and along the road in Križišće no further spreading has taken place beyond the previously recorded single individuals. As for the locality at the curve of Louisiana road we suppose that secondary succession and the consequent formation of a groundcover comprising more competitive species had the decisive role in gradual disappearance of *C. candelabrum*. Until the time of writing up this paper we have recorded altogether 38 localities with *C. candelabrum* in Kvarner and Gorski Kotar (Fig. 1, Table 1).

### Discussion and conclusions

How did *Cirsium candelabrum* reach the Kvarner region and the southern edge of Gorski Kotar? The nearest Croatian finding site is more than 200 km to the south, in Central Dalmatia. We suppose that its spreading to these regions is connected to the

construction of traffic and communal infrastructure, industrial and craft zones, shopping centers etc. Big construction vehicles and trucks certainly have a hand in the spreading of diaspores, and the excavations remove the natural vegetation and create totally degraded open habitats, most often with a gravel and/or stony substrate, which best suits this species, inviting it to spread (gravel strewn edges and ditches lining roads, construction gravel excavations, construction materials and waste dumps, wildfire burned areas, ski runs). The excavated material and construction gravel and stone, contaminated with diaspores, are conveyed by trucks to other localities and so the spreading continues. Another possibility is the spreading of fruits in clods of soil and mud that stick to tires and other parts of construction vehicles and equipment, even passenger cars as well. Once the plants have been brought into a certain area, additional natural dispersal by seed (anemochory) follows. Since the members of the Istrian Botanical Society found the species on Mt. Učka in 2016 (Anonymous 2021) we can anticipate further spreading of the species toward the Istrian Peninsula.

In habitats produced by degradation of larger areas in construction works (Fig. 2) we found *C. candelabrum* accompanied by other ruderal species, many of them alien as well as invasive, viz. *Ambrosia artemisiifolia* L., *Erigeron annuus* (L.) Desf., *Bidens subalternans* DC., *Conyza* spp., *Artemisia annua* L., *Sorghum halepense* (L.) Pers., *Xanthium strumarium*

*L. ssp. italicum* (Moretti) D. Löve, *Datura stramonium* L. and *Phytolacca americana* L. The commonest autochthonous species in those habitats are *Reseda lutea* L., *Portulaca oleracea* L., *Picris hieracioides* L., *Cichorium intybus* L., *Artemisia absinthium* L., *Chaenorhinum minus* (L.) Lange, *Petrorhagia saxifraga* (L.) Link, *Galeopsis angustifolia* Hoffm., *Solanum nigrum* L., *Echium vulgare* L., *Daucus carota* L., *Scabiosa triandra* L., *Hypericum perforatum* L., *Anagallis arvensis* L., *Sedum sexangulare* L., *Ononis spinosa* L., *Scolymus hispanicus* L., *Dittrichia viscosa* (L.) Greuter and *Ajuga chamaepitys* (L.) Schreb. In addition, in the city of Rijeka and its environs another alien species *Senecio inaequidens* DC. was recorded for the first time for this region, in several places during the 2020 mapping of invasive species. In Croatian flora it has been mentioned as potentially invasive since 2013 (Borovečki-Voska 2013). On the sewer line excavation at Vrh Martinšćice it forms common stands with *C. candelabrum*.

As already stated, the habitats of *C. candelabrum* in Kvarner and Gorski Kotar are characterized by disturbed soil, gravelly to mixed gravelly and stony substrate on open or at least partially open places with low competition from other plant species, while the differences among different finding sites regarding some other ecological factors can be considerable. Based on our records, the species shows appreciable tolerance regarding ecological factors that change with altitude, namely we have found it on a vertical gradient between the sea level and as high as 1363 m a.m.s.l., a span which extends from the zone of sub-Mediterranean thermophilous vegetation of the *Ostryo-Carpinion orientalis* alliance to the montane and subalpine zones with beech and mixed beech-fir forests of the *Aremonio-Fagion* alliance. Accordingly, floristic composition of stands in the montane and subalpine zones, recorded in the stretch from Mali Platak up to the top of Radeševo (Figs. 3 and 4), is substantially different from those in the lower, sub-Mediterranean zone. In this upper zone, there are no other invasive species and the stands are dominated by

indigenous species characteristic for forest edges and clearings. In the places with disturbed soil the ruderal species are also present, and in some localities also chasmophytic plants and plants typical for screes occur. The most common accompanying species in this upper zone are *Carduus nutans* L., *Cirsium erisithales* (Jacq.) Scop., *Cirsium arvense* (L.) Scop., *Cirsium vulgare* (Savi) Ten., *Rubus idaeus* L., *Galeopsis speciosa* Mill., *Galeopsis ladanum* L., *Heracleum sphondylium* L., *Myrrhis odorata* (L.) Scop., *Silene dioica* (L.) Clairv., *Silene latifolia* Poir. ssp. *alba* (Mill.) Greuter et Bourdet, *Silene vulgaris* (Moench) Garcke, *Calamagrostis varia* (Schrad.) Host, *Tussilago farfara* L., *Geum urbanum* L., *Hypericum perforatum* L., *Eupatorium cannabinum* L., *Atropa bella-donna* L., *Stachys sylvatica* L., *Urtica dioica* L., *Scrophularia nodosa* L., *Scrophularia heterophylla* Willd. ssp. *laciniata* (Waldst. et Kit.) Maire et Petitm., *Lapsana communis* L., *Verbascum chaixii* Vill., *Senecio ovatus* (P. Gaertn., B. Mey. et Scherb.) Willd., *Carex sylvatica* Huds., *Deschampsia cespitosa* (L.) P. Beauv., *Geranium purpureum* Vill., *Acinos arvensis* (Lam.) Dandy, *Ligusticum lucidum* Mill., *Corydalis ochroleuca* W. D. J. Koch, *Chaenorhinum minus* (L.) Lange and *Moehringia muscosa* L. This clearly indicates that *C. candelabrum* is an ecologically very adaptable species, capable of spreading from sub-Mediterranean xerophytic habitats, all the way up to the zone of subalpine beech forests with humid and relatively cold climate.

A unique case was observed on the slopes of Mt Jazvina where the explosive spreading of *C. candelabrum* occurred. A grassland of the fine-leaved moor grass (*Sesleria tenuifolia* Schrad.) of the *Saturejion subspicatae* Tomić-Stanković 1970 alliance was devastated by wildfire in 2013 and the monitoring of the secondary succession revealed that the most significant species – the moor grass – has failed to recover until present. Over the years, besides a number of species that had managed to survive the wildfire, some species appeared on the burned site that had not been characteristic for these grasslands, or had been scarce before the wildfire,



viz. *Centaurea weldeniana* Rchb., *Erigeron annuus*, *Chaenorhinum minus*, *Calamagrostis villosa* (Chaix) J. F. Gmel., *Acinos arvensis*, *Crepis foetida* L., and from mosses particularly *Bryum argenteum* Hedw. In this group of newcomer species *C. candelabrum* had a prominent role, as dozens of individuals have appeared on the wildfire-burned steep slopes eroded and denuded by torrents (Fig. 5). It should be added that in September 2013, when Mt Jazvina was affected by wildfire, the reconstruction of the road to Platak and the parking lot at the recreation center had begun. It is therefore highly likely that *C. candelabrum* fruits were brought to Platak by the construction vehicles or with the contaminated stone aggregate and that the first sprouts had appeared there even before 2015, when they were observed for the first time.



**Figure 2.** Construction waste dump at Soboli (Photo: LJ. Borovečki-Voska, 30 July 2021).



**Figure 3.** The beech forest edge along the road on Mali Platak (Photo: LJ. Borovečki-Voska, 8 August 2020).



**Figure 4.** Radeševo – dug up soil on the slope above the artificial pond (Photo: M. Randić, 26 September 2021).



**Figure 5.** Mt Jazvina – *Cirsium candelabrum* taking over wildfire-burned slopes (Photo: M. Randić, 24 August 2017).

Considering also the great reproductive potential of the species it is obvious that *C. candelabrum* has enormous invasive potential. Interestingly, the members of the Istrian Botanical Society made a detailed measurement of an individual found on Mt. Učka: the height of the plant was 185 cm, it had 31 branches carrying 2283 inflorescences; a single flower head contained from 30 to 50, occasionally even more fruits with pappus, which for a single plant might amount to between 68.490 and 114.150 fruits for seed dispersal by anemochory (Anonymous 2021). For this reason one should continue the monitoring of its spreading and the influence on the changes of the vegetation composition in the regions where it shows up.



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