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New localities of *Berberis croatica* Horvat in Croatia

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The Croatian barberry (*Berberis croatica* Horvat) is an endemic Illyrian-Balkanic species growing on rocky slopes at the upper limit of the wooded zone in Croatia, Bosnia and Herzegovina, Montenegro, and Macedonia. The paper deals with eleven new localities of the Croatian barberry in Croatia. New small and isolated populations of the Croatian barberry were found on Mt Učka, in the hinterland of Rijeka and on Mt Velebit.

Keywords: *Berberis croatica*, flora, Učka, Velebit, Rijeka

Introduction

The Croatian barberry (*Berberis croatica* Horvat) is an endemic Illyrian-Balkanic species, which grows on rocky slopes, at the upper limit of the wooded zone in Croatia, Bosnia and Herzegovina, Montenegro, and Macedonia (KUŠAN 1969; TRINAJSTIĆ 1973; MARTINIS 1994; ŠILIĆ 1996, 2005). In literature, the Croatian barberry is also known under the following names: *B. aetnensis* var. *brachyacantha* (BORBÁS 1886), *B. vulgaris emarginata* (ANIĆ 1946), *B. vulgaris* var. *aetnensis* (KUŠAN 1955), *B. vulgaris* var. *alpestris* (TRINAJSTIĆ 1973), *B. aetnensis* (DOMAC 1984), *B. illyrica* (BORZAN et al. 1992). In references describing European flora the Croatian barberry was not mentioned (KRÜSSMANN 1976; POLUNIN 1987; AKEROYD and WEBB 1993).

The Croatian barberry is a deciduous, up to 60 cm high, spiny shrub with short shoots. Spines are 3–5-fid. Leaves are oblong-obovate or oblong-elliptic shaped, 1–3 cm long, coriaceous with serrated margins. Flowers are up to 1 cm in diameter, yellow in colour and are grouped (5 to 12 flowers, rarely more) in erect racemes. Perianth is composed of 6 sepals and 6 petals; 3 inner petals have 2 nectaries beside the base. Fruit is an oblong berry, red in colour, up to 0.6 cm long and with 1–2 seeds (TRINAJSTIĆ 1973).

The Croatian barberry was first mentioned (under name *B. aetnensis* var. *brachyacantha*) by BORBÁS (1886). He found this species on Mt Učka, Risnjak and Velebit. After that HIRC (1896) described some localities in Gorski kotar (Gerovo, Delnice, Brod, Sv.

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Gora, Čabar, Velika Viševica, Burni Bitoraj). HORVAT (1925) mentioned the possibility of the existence of new *Berberis* L. species on Lička Plješevica. The same author (1962) found the Croatian barberry on the peaks Sleme near Platak and Obruč. DEGEN (1938) registered the presence of the Croatian barberry on Razvala vrh above the village Pejakuša, in Kovač cave, above Šugarsko korito and on Goli vrh under the village Brušani. Most localities were registered by KUŠAN (1969): Krivac (near Brod na Kupi), Čabar (near the source of Čabranka river), Prezid, Risnjak, Vrbovsko, Bjelolasica, Obruč, western slopes of Vela Učka, Lička Plješevica (Mala Plješevica, Ruda Poljana, Crni vrh, Trovrh and Lisac above Glogovo), Velebit (Veliki Zavižan, Balinovac, Rajinac, Rožanski kuk, Badanj, Šugarska duliba), Biokovo (Kaoce). RADIĆ (1976) mentioned the presence of the Croatian barberry on Mt Biokovo (on the western slopes of Kozjak). Distribution of the Croatian barberry on Mt Velebit (Mali Rajinac, Zavižan, Kiza, Mali Brizovac, Sadikovac, Panas vrh and Crnopac) was also described by FORENBACHER (1990).

In Flora Croatica Database (http://hirc.botanic.hr/fcd/) the locality Sv. Gera in Žumberak is mentioned. This locality was taken from the paper of KUŠAN (1969) who wrongly cited the locality »Sv. Gora – Gorski kotar« from Hirc (1896). MARTINIS (1994) mentioned that the Croatian barberry is distributed on Dinaric mountains: from Učka and Gorski kotar, across Velebit, Lička Plješivica, Dinara, Troglav and Kamešnica to Biokovo (Fig. 1).

During the field work eleven new localities of this species were encountered. A short description of the new localities is given as a useful contribution to the knowledge of distribution of the Croatian barberry in Croatia.

Study sites

The research was carried out in the south western region of Croatia.

According to Köppen's classification, the climate of the western part of the study area (Mt Učka, the hinterland mountains of the town of Rijeka) belongs to the climatic type »Cfsbx«. It is a temperate rainy climate with precipitation uniformly distributed throughout the year. The least rain falls in the warm part of the year. There are two precipitation maximums, first at the beginning of the warm part of the year and the second in the autumn. The second precipitation maximum is greater than the first. The climate of the north western (Snježnik massif) and south eastern part (Mt Velebit) of the study area belongs to the climatic type »Dfsbx«. This is a boreal climate without a dry period and with precipitation rather uniformly distributed throughout the year. There are no dry periods, but the least rain falls in the warm part of the year. The mean air temperature in the coldest month (January) is less than –3 °C, while in the warmest month (July) it is less than 22 °C. During the four months the mean air temperature is above 10 °C. There are two precipitation maximums (in spring and autumn). This climate type occurs at altitudes above 1200 m. Below, the climatic characteristics of the meteorological stations Učka, Delnice and Zavižan are given.

Annual air temperature for the meteorological station Učka is 5.4 °C. The absolute minimum recorded was –20.4 °C, and the absolute maximum 28.3 °C. The average annual precipitation is 1411 mm. Annual air temperature for the meteorological station Delnice is 7.7 °C. The absolute minimum recorded was –25.0 °C, and the absolute maximum 34.0 °C. The average annual precipitation is 2486 mm. Annual air temperature for the meteorological station Zavižan is 3.6 °C. The absolute minimum recorded was –24.5 °C, and the absolute maximum 27.6 °C. The average annual precipitation is 1892 mm.

The average annual air temperature on the highest mountain peaks where the Croatian barberry grows is below 4 °C. On other peaks the annual mean air temperature is higher, that is, in zone of the common beech (*Fagus sylvatica* L.) and silver fir (*Abies alba* Mill.) forest it is about 8 °C. At the lowest altitudes where the Croatian barberry occurs, and which is situated in the zone of European hop hornbeam (*Ostrya carpinifolia* Scop.) the average annual air temperature is about 11 °C.

Snježnik massif, and nearby Risnjak massif, are the places with the highest average annual precipitation in Croatia (more than 3000 mm). Interval between the first and the last day with snow is more than five months (185 days for Platak). The greatest depth of snow recorded in this area was 320 cm for Platak and 448 cm for Risnjak massif. Cloudiness and fog are greater at higher altitudes. November and December are the months with the cloudiest weather while the sunniest days occur in July. Air pressure is low on the highest mountain peak (Zavižan 5.4 mm Hg) while the highest air pressure was recorded in the forest of common beech and silver fir (Delnice 7.1 mm Hg). A strong influence of south western and north eastern winds is present (BERTOVIĆ 1975, SELETKOVIĆ and KATUŠIN 1992, MARTINOVIĆ 2003).

The geological substrate in research area is made up of compact limestone. Two types of soil are present on habitats of the Croatian barberry, lithosol and limestone melanosol. Lithosol is formed with the horizon structure (A)-R on rocks which in mechanic decomposition give rock detritus. Domination of stone and robust gravel is the basic physical characteristic of lithosol. This type of soil is common in subalpine and mountain areas. Melanosol is formed with the horizon structure Amo-R on hard limestone and dolomite, which contain more than 98% $CaCO_3$. It is the primary developmental stage of soil on limestone and it can be found in different climate types, most often on steep ground in mountain and subalpine areas (MARTINOVIĆ 2003).

Results and discussion

During the collection of plant material of the Croatian barberry we unfortunately did not find plants on some locations (Vela Učka, Risnjak, Veliki Zavižan, Sadikovac, Kaoce) which are known from literature (KUŠAN 1969, FORENBACHER 1990). The possible reasons for that are the great extent of the area (Vela Učka, Kaoce) and the dense wood of European mountain pine – *Pinus mugo* Turra (Risnjak, Veliki Zavižan). On some other locations (Čabar, Krivac) populations of the Croatian barberry were undersized. For example, near the source of Čabranka River we found only three plants of the Croatian barberry. The Krivac population has been almost completely destroyed by the building of a telecommunication structure. Locations on Lička Plješevica were in the war area and today are not secure for collecting material. For this reason we endeavoured to find some other populations of the Croatian barberry. New localities of the Croatian barberry were found on three distinct geographical sites: Mt Učka, the hinterland mountains of the town of Rijeka and Mt Velebit (Fig. 1).

On Mt Učka, the Croatian barberry was found on the ridge Suhi vrh (1321 m a.s.l.). This population is situated at the end of the ridge and from that point there is a clear view of Rijeka and Kvarner Bay. Shrubs of the Croatian barberry cover an area of about 15 m^2. Among the shrubs of the Croatian barberry grow the common beech (*Fagus sylvatica*),

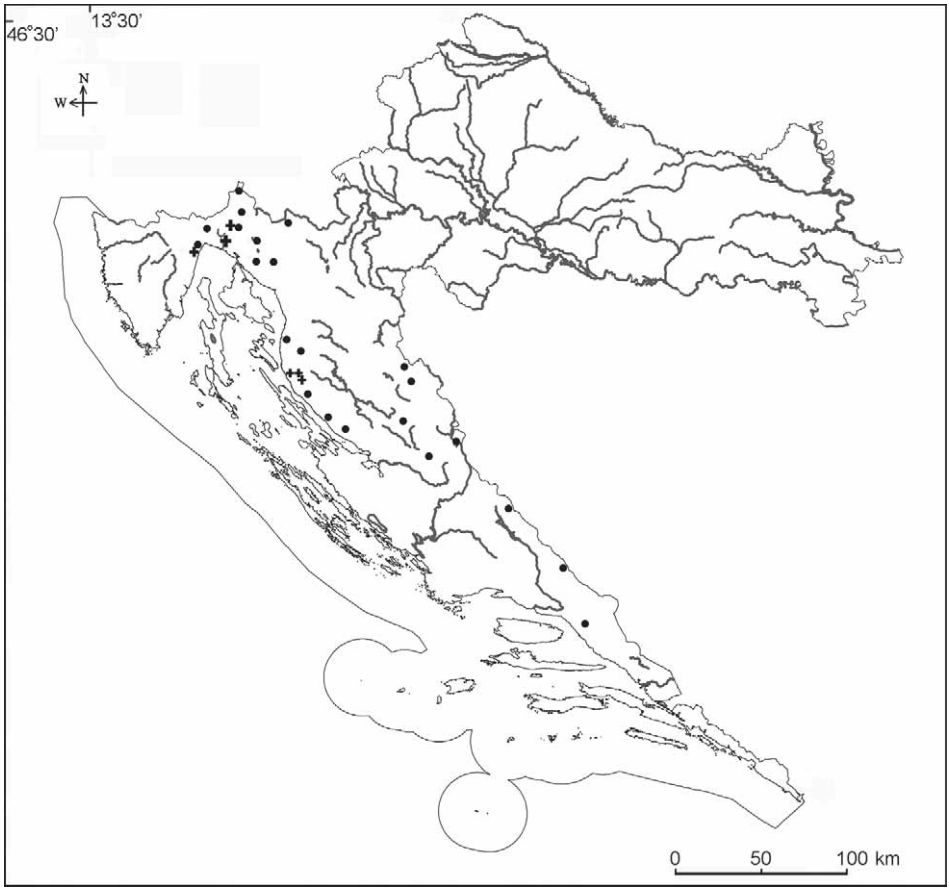

Fig. 1. Distribution of *Berberis croatica* Horvat in Croatia: points – MARTINIS (1994); crosses – new finding localities.

whitebeam (*Sorbus aria* (L.) Crantz), European hop hornbeam (*Ostrya carpinifolia*) and common juniper (*Juniperus communis* L.). Nearby vegetation belongs to the association *Homogyno sylvestris-Fagetum sylvaticae* (Ht. 1938) Borh. 1963. On this locality, plants of common juniper overcrowd the Croatian barberry and it would be useful to reduce its number.

Six new localities of the Croatian barberry were registered in the hinterland mountains of town Rijeka:

Krežala above Kamenjak

On the stone peak at 840 m a.s.l. there is a small, isolated population of the Croatian barberry. Plants are 30–40 cm high and cover 2–3 m^2 of stone and grass area. Population of the Croatian barberry is surrounded by *Carici-Centaureetum rupestris* Ht. 1931 grassland and European hop hornbeam. The Croatian barberry grows together with hairy cotoneaster (*Cotoneaster nebrodensis* (Guss.) K. Koch) and alpine daphne (*Daphne alpina* L.).

Mali Platak

On a stone ridge exposed to the strong winds and about 600 m from the settlement Mali Platak there is another locality of the Croatian barberry. One group of plants is situated on the top of the stone ridge at 1060 m a.s.l. Several other groups of plants are located on the south facing slopes. Each group of plants covers area of a few square meters. Plants grow from fissures in limestone and are surrounded by grassland of *Sesleria tenuifolia* Schrad. Among the plants of the Croatian barberry several plants of karst buckthorn (*Rhamnus saxatilis* Jacq.) and alpine daphne are growing.

Treska above Mali Platak

The stone ridge Treska (1234 m) is situated about 1 km from the cottage settlement Mali Platak. At approximately 1190 m a.s.l., on S and SE exposed sites several shrubs of Croatian barberry can be found. On this scarcely vegetated location *B. croatica* plants grow from fissures in limestone. The nearby forest vegetation belongs to the association *Calamagrosti-Abietetum* Ht. 1950.

Vela Pliš

Vela Pliš (1141 m) is located near Gornje Jelenje Pass. On the mild, south facing slope a small, dense population of the Croatian barberry covers an area of 2–3 m^2. Plants of the Croatian barberry are up to 60 cm high and vigorous. The slope is overgrown with grass and dotted with shrubs of bigleaf willow (*Salix appendiculata* Vill.) and redleaf rose (*Rosa glauca* Pourr.).

Medlužine

In the forest region Medlužine, about 750 m far from Vela Pliš there is a rocky, grassy ridge, which is exposed to strong winds. On the peak (1070 m a.s.l.) one can find isolated population of the Croatian barberry, which covers area of about 10 m^2. Plants grow from fissures in the limestone and are surrounded by grassland formed by *Sesleria tenuifolia*. Among the plants of the Croatian barberry grow hairy cotoneaster, alpine daphne, illyrian savory *Satureja subspicata* Bartl. ex Vis., dwarf sedge (*Carex humilis* Leyss.), *Allium ericetorum* Thore, St Bernard's lily (*Anthericum ramosum* L.). The nearby forest vegetation belongs to the association *Seslerio autumnalis-Fagetum sylvaticae* (Ht. 1950) M. Wraber 1960.

Međuvrhi between Snježnik and Guslica

This locality of Croatian barberry is situated in the sub-mountainous region of the peak of Međuvrhi in the Snježnik massif at 1400 m a.s.l. Plants of the Croatian barberry are growing on a limestone bedrock, on a SW slope. Plants are on average 80 cm high, vigorous and are growing together with bigleaf willow, mountain juniper (*Juniperus communis* ssp. *alpina* (Sm.) Čelak), alpine currant (*Ribes alpinum* L.), great maple (*Acer pseudoplatanus* L.), *Aconitum lycoctonum* L., *Carduus carduelis* Ten., *Hypericum richeri* Vill., *Myrrhis odorata* (L.) Scop. Nearby vegetation belongs to the association *Homogyno sylvestris-Fagetum sylvaticae* (Ht. 1938) Borh. 1963.

On Mt Velebit, the Croatian barberry was found at four new localities. Two of them are in the northern and two in the central part of the mountain range.

Rossijev kuk

A population of the Croatian barberry is located below the peak named Rossijev kuk (1615 m a.s.l.) in the northern part of Mt Velebit. Plants grow beside the trail called Premužićeva staza, 5–10 minutes from the climbers' shelter Rossijeva koliba (1580 m a.s.l.). Plants of the Croatian barberry cover an area of about 3 m^2 and are surrounded (except beside Premužićeva staza) by European mountain pine (*Pinus mugo* Turra). Plants are up to 65 cm high and vigorous. One plant of the Croatian barberry was also found on the rock beside Premužićeva staza near the Varnjača snow pit.

Obli vrh

Obli vrh (1515 m a.s.l.) is situated in the southeastern part of northern section of Mt. Velebit, not far away from the famous Veliki Kozjak peak. Plants of *B. croatica* could be found on the peak, spread among the limestone rocks on the dominantly S and SW exposed sites. Plants of the Croatian barberry are vital, 15–65 cm high and among them shrubs of mountain juniper and karst buckthorn are growing.

Buljma

Buljma peak (1421 m a.s.l.) is situated in the central part of Mt Velebit, about 25 minutes by foot from the climbers' lodge called Alan. Plants are to be found on the south-exposed slope, a few hundred meters from the peak. This habitat is almost continuously exposed to the strong winds and is poorly vegetated. Plants of the Croatian barberry, 12–27 cm high and in poor health grow from the fissures in limestone. This is the most endangered new locality of the Croatian barberry. Plant species that grow nearby are: common bearberry (*Arctostaphylos uva-ursi* (L.) Spreng), common cotoneaster (*Cotoneaster integerrimus* Medik.), *Satureja subspicata*.

Šatorina

Šatorina (1634 m a.s.l.) is the highest peak in the central part of Mt Velebit. A locality of the Croatian barberry is situated on the west-exposed slope, about ten minutes from the peak and beside the trail in the direction of Dokozina plan. Plants of the Croatian barberry cover an area of 4–5 m^2. Among the other plant species the most noticeable are the European mountain pine, mountain juniper and *Eryngium alpinum* L. Plants of the Croatian barberry are 15–60 cm high and vigorous.

Newly found populations of the Croatian barberry are small and isolated. They commonly exist on poor soils and they are exposed to strong winds. The most endangered new locality is Buljma where the plants of the Croatian barberry are in poor health and damaged by hikers.

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