

## NEW LOCALITIES OF *BERBERIS CROATICA* HORVAT AND *TEUCRIUM ARDUINI* L. IN THE CROATIAN DINARIC MOUNTAINS

DARIO KREMER<sup>1\*</sup>, GORDAN LUKAČ<sup>2</sup>, MARKO RANDIĆ<sup>3</sup>, IRENA KRUŠIĆ<sup>4</sup>,  
IVAN KOSALEC<sup>1</sup> & MIRKO RUŠIĆ<sup>5</sup>

<sup>1</sup>Faculty of Pharmacy and Biochemistry, University of Zagreb, Schrottova 39,  
HR-10000 Zagreb, Croatia

<sup>2</sup>Public Institution Paklenica National Park, F. Tuđmana 14A, HR-23244 Starigrad Paklenica, Croatia

<sup>3</sup>Priroda Public Institution, Grivica 4, HR-51000 Rijeka, Croatia

<sup>4</sup>Public Institution Northern Velebit National Park, Krasno 96, HR-53274 Krasno, Croatia

<sup>5</sup>Faculty of Sciences, University of Split, Teslina 12, HR-21000 Split, Croatia

Kremer, D., Lukač, G., Randić, M., Krušić, I., Kosalec, I. & Rušić, M.: New localities of *Berberis croatica* Horvat and *Teucrium arduini* L. in the Croatian Dinaric mountains. *Nat. Croat.*, Vol. 23, No. 1, 147–162, 2014, Zagreb.

New localities of the endemic species *Berberis croatica* Horvat and *Teucrium arduini* L. in the north-western and central Dinaric Mountains in Croatia are listed in this paper. *Berberis croatica* was found in the hinterland mountains of the city of Rijeka, in Gorski kotar (Mt Drgomalj), and on Mt Velebit and Mt Kamešnica. *Teucrium arduini* was observed in new localities on Mt Velebit, Mt Visoka, Bili Brig near Sinj, Mt Kamešnica, in Cetina River Canyon, on Mt Biokovo, and Brač Island. Information about new sites of *B. croatica* and *T. arduini* will be of help in future research of these endemic species, which is essential in ensuring their protection.

**Key words:** *Berberis croatica*, *Teucrium arduini*, Dinaric Mountains

Kremer, D., Lukač, G., Randić, M., Krušić, I., Kosalec, I. & Rušić, M.: Novi lokaliteti vrsta *Berberis croatica* Horvat i *Teucrium arduini* L. na području Dinarida u Hrvatskoj. *Nat. Croat.*, Vol. 23, No. 1, 147–162, 2014, Zagreb.

U radu su navedeni novi, do sada neobjavljeni lokaliteti dviju endemičnih vrsta, hrvatske žutike (*Berberis croatica* Horvat) i Arduinova dubačca (*Teucrium arduini* L.) na području Dinarida u Hrvatskoj. Novi lokaliteti hrvatske žutike zabilježeni su na planinama u zaleđu grada Rijeke, u Gorskom kotaru (Drgomalj), na Velebitu i na Kamešnici. Arduinov dubačac pronađen je na novim lokalitetima na Velebitu, na planini Visoka, na Bilom Brigu u blizini Sinja, Kamešnici, u kanjonu rijeke Cetine, na Biokovu te na otoku Braču. Podaci o novim lokalitetima hrvatske žutike i Arduinova dubačca predstavljaju značajan doprinos budućim istraživanjima ovih vrsta, koja su potrebna za njihovu adekvatnu zaštitu, kao i za očuvanje biološke raznolikosti u Republici Hrvatskoj.

**Ključne riječi:** *Berberis croatica*, *Teucrium arduini*, Dinarske planine

### INTRODUCTION

*Berberis croatica* Horvat (*Berberidaceae*) is a deciduous, erect shrub which grows at the upper limit of the wooded zone in Croatia, Bosnia and Herzegovina, Montenegro, and

\* Corresponding author, e-mail: dkremer@pharma.hr

Macedonia at altitudes ranging from 840 to 1700 m a.s.l. (KUŠAN, 1969; TRINAJSTIĆ, 1973; MARTINIS, 1994; ŠILIĆ, 1996; 2005; KREMER *et al.*, 2008). In Croatia it is distributed on Mt Učka, Mt Obruč, in Gorski kotar (Mt Risnjak, Mt Viševica, Mt Bjelolasica, Čabar, Prezid, Vrbovsko), on Mt Lička Plješivica, Mt Velebit, Mt Dinara, Mt Biokovo, and Mt Sniježnica (DEGEN, 1938: 151; KUŠAN, 1969; MARTINIS, 1994; KREMER *et al.*, 2008; 2011; NIKOLIĆ (*ed.*), 2013). Today, however, the presence of *B. croatica* on Mt Risnjak has not been confirmed (KREMER *et al.*, 2008).

*Teucrium arduini* L. (*Lamiaceae*) is a semi-woody plant with erect or ascending stems and small whitish flowers. It grows in crevices of carbonate rocks from the Istrian Peninsula in Croatia to northern Albania at altitudes ranging from sea level up to 1600 m a.s.l. (ŠILIĆ, 1990; LAKUŠIĆ *et al.*, 2007). In Croatia it could be found on Mt Učka, Mt Velebit, Mt Dinara, Mt Tovarnica (southern section of Mt Kamešnica), Mt Kozjak, Mt Mosor, Mt Visošnica, Mt Omiška Dinara, Mt Biokovo, Pelješac Peninsula, Brač Island, Mt Srđ near Dubrovnik, Cavtat, and Mt Sniježnica (DEGEN, 1938: 583; KUŠAN, 1956; PLAZIBAT, 2002; KREMER *et al.*, 2011; NIKOLIĆ (*ed.*), 2013).

The aim of this paper is to present new localities of the endemic Illyrian-Balkan species *B. croatica* and *T. arduini* in the north-western and central Dinaric Mountains in Croatia. Both species are statutorily strictly protected species in Croatia (ANONYMOUS, 2013). Additionally, *T. arduini* is noted as a data deficient species. Any information concerning the localities of these two species, especially of *T. arduini*, helps to broaden our knowledge of their range and population numbers, and environmental conditions. These investigations could help in putting in place monitoring schemes, developing plans for managing protected areas and ecological networks, for *in situ* and *ex situ* conservation, and future re-evaluations of the Croatian Red Book of Vascular Plants and NATURA 2000-documents.

## MATERIALS AND METHODS

The new localities of *Berberis croatica* and *Teucrium arduini* were discovered during several field trips undertaken from April 2005 to July 2013. Standard keys (TUTIN & WOOD, 1972; TRINAJSTIĆ, 1973) for identification were used. NIKOLIĆ (*ed.*) (2013) were employed for species nomenclature. Each locality was described via the data on altitude and location obtained using Garmin eTrex Vista HCx and Gauss-Krüger coordinates system. A list of prevailing species which grow inside and on the border of the investigated populations was added. Additionally, habitat type according to the National Habitat Classification (ANONYMOUS, 2009) was given.

Voucher specimens were deposited in the Fran Kušan Herbarium, Department of Pharmaceutical Botany with the Fran Kušan Pharmaceutical Botanical Garden, Faculty of Pharmacy and Biochemistry, University of Zagreb, Croatia.

## RESULTS AND DISCUSSION

Tab. 1 displays a total of 47 new localities of *Berberis croatica* and *Teucrium arduini* in the north-western and central Dinaric Mountains in Croatia.

### Localities of *Berberis croatica*

New localities of *Berberis croatica* were found in the mountainous hinterland of the city of Rijeka, in Gorski kotar, and on Mt Velebit and Mt Kamešnica.

Tab. 1. Newly found localities of *Berberis croatica* and *Teucrium arduini* in Dinarids in Croatia.

Loc. no.	Taxon	x coordinate	y coordinate	Altitude (m)	Habitat type according to National habitat classification (NHC)	Date	Author
1	<i>B. croatica</i>	5466225	5030881	1320	D.2. Subalpine scrub	2011.08.14.	M. Randić
2	<i>B. croatica</i>	5463678	5032194	1180	D.2. Subalpine scrub	2013.06.29.	M. Randić
3	<i>B. croatica</i>	5471412	5022600	1085	D.2. Subalpine scrub	2013.08.13.	M. Randić
4	<i>B. croatica</i>	5483636	5035406	850	B.1.3.2. Mountain rocks of Gorski kotar	2010.09.12.	M. Randić
5	<i>B. croatica</i>	5499347	4960230	1522	D.2. Subalpine scrub	2011.08.06.	D. Kremer
6	<i>B. croatica</i>	5499480	4958301	1612	D.2. Subalpine scrub	2011.08.06.	D. Kremer
7	<i>B. croatica</i>	5499403	4957471	1586	D.2. Subalpine scrub	2011.08.06.	D. Kremer
8	<i>B. croatica</i>	5498699	4960798	1543	D.2. Subalpine scrub	2011.08.20.	I. Krušić, D. Kremer
9	<i>B. croatica</i>	5498381	4960441	1495	D.2. Subalpine scrub	2011.08.20.	I. Krušić, D. Kremer
10	<i>B. croatica</i>	5500190	4958276	1607	D.2. Subalpine scrub	2011.08.21.	I. Krušić, D. Kremer
11	<i>B. croatica</i>	5499896	4956012	1590	D.2. Subalpine scrub	2011.08.04.	I. Krušić, D. Kremer
12	<i>B. croatica</i>	5499971	4955963	1568	D.2. Subalpine scrub	2011.08.04.	I. Krušić, D. Kremer
13	<i>B. croatica</i>	5503880	4945198	1440	D.2. Subalpine scrub	2011.08.27.	I. Kosalec, D. Kremer
14	<i>B. croatica</i>	5647635	4842547	1043	E.3.5.6 As. <i>Sesleria autumnalis</i> - <i>Ostryetum</i> Ht. et H-ić in Ht. 1950	2011.08.17.	M. Ruščić, D. Kremer
15	<i>B. croatica</i>	5646763	4843614	1225	D.2. Subalpine scrub	2011.08.17.	M. Ruščić, D. Kremer
16	<i>B. croatica</i>	5648826	4843204	1284	D.2. Subalpine scrub	2013.07.19.	M. Ruščić, D. Kremer
17	<i>T. arduini</i>	5538465	4911314	503	B.1. Not overgrown and poor overgrown rocks	2005.04.28.	G. Lukač
18	<i>T. arduini</i>	5540899	4907977	677	B.1. Not overgrown and poor overgrown rocks	2005.05.20.	G. Lukač
19	<i>T. arduini</i>	5540173	4907721	705	B.1. Not overgrown and poor overgrown rocks	2005.05.30.	G. Lukač
20	<i>T. arduini</i>	5536183	4908133	701	B.1. Not overgrown and poor overgrown rocks	2005.05.21.	G. Lukač
21	<i>T. arduini</i>	5535873	4909023	552	B.1. Not overgrown and poor overgrown rocks	2005.05.21.	G. Lukač
22	<i>T. arduini</i>	5535394	4910122	647	B.1. Not overgrown and poor overgrown rocks	2005.05.21.	G. Lukač
23	<i>T. arduini</i>	5536653	4909688	702	B.1. Not overgrown and poor overgrown rocks	2005.04.28.	G. Lukač

24	<i>T. arduini</i>	5535063	4911521	946	B.1. Not overgrown and poor overgrown rocks	2008.06.11.	G. Lukač
25	<i>T. arduini</i>	5534538	4911562	806	B.1. Not overgrown and poor overgrown rocks	2007.07.01.	G. Lukač
26	<i>T. arduini</i>	5533226	4911360	848	B.1. Not overgrown and poor overgrown rocks	2007.07.01.	G. Lukač
27	<i>T. arduini</i>	5630449	4838201	782	B.1.3. Alpine-Carpathian-Balkan limestone rocks	2008.08.09.	M. Rušćić
28	<i>T. arduini</i>	5642482	4849409	963	C.3.5.2.3. As. <i>Bromo-Seslerietum interruptae</i> Trinajstić 1965	2011.08.18.	M. Rušćić, D. Kremer
29	<i>T. arduini</i>	5645040	4841132	668	E.3.5.2. <i>Saturejoni subspicatae</i> H-ić 1975	2011.08.17.	M. Rušćić, D. Kremer
30	<i>T. arduini</i>	5646973	4842180	922	B.1.3. Alpine-Carpathian-Balkan limestone rocks	2011.08.17.	M. Rušćić, D. Kremer
31	<i>T. arduini</i>	5647635	4842547	1043	E.3.5.6. As. <i>Seslerio autumnalis-Ostryetum</i> Ht. et H-ić in Ht. 1950	2011.08.17.	M. Rušćić, D. Kremer
32	<i>T. arduini</i>	5647433	4842909	1113	E.3.5.6. As. <i>Seslerio autumnalis-Ostryetum</i> Ht. et H-ić in Ht. 1950	2011.08.17.	M. Rušćić, D. Kremer
33	<i>T. arduini</i>	5647386	4843012	1125	E.3.5.6. As. <i>Seslerio autumnalis-Ostryetum</i> Ht. et H-ić in Ht. 1950	2011.08.17.	M. Rušćić, D. Kremer
34	<i>T. arduini</i>	5647212	4843257	1153	E.3.5.6. As. <i>Seslerio autumnalis-Ostryetum</i> Ht. et H-ić in Ht. 1950	2011.08.17.	M. Rušćić, D. Kremer
35	<i>T. arduini</i>	5646763	4843614	1225	C.4.1. Mountain stony grasslands	2011.08.17.	M. Rušćić, D. Kremer
36	<i>T. arduini</i>	5646598	4843917	1304	C.4.1. Mountain stony grasslands	2011.08.17.	M. Rušćić, D. Kremer
37	<i>T. arduini</i>	5648465	4842905	1192	C.4.1. Mountain stony grasslands	2013.07.19.	M. Rušćić, D. Kremer
38	<i>T. arduini</i>	5648676	4843087	1245	C.4.1. Mountain stony grasslands	2013.07.19.	M. Rušćić, D. Kremer
39	<i>T. arduini</i>	5654877	4836320	1041	D.2. Subalpine scrub	2011.08.18.	M. Rušćić, D. Kremer
40	<i>T. arduini</i>	5654985	4835903	1093	C.3.5.2.3. As. <i>Bromo-Seslerietum interruptae</i> Trinajstić 1965	2011.08.18.	M. Rušćić, D. Kremer
41	<i>T. arduini</i>	5654990	4835557	1119	C.4.1. Mountain stony grasslands	2011.08.18.	M. Rušćić, D. Kremer
42	<i>T. arduini</i>	5652115	4813858	270	B.1.4.2. Dalmatian limestone rocks	2011.09.11.	M. Rušćić
43	<i>T. arduini</i>	5653143	4811483	173	B.1.4.2. Dalmatian limestone rocks	2010.06.21.	M. Rušćić
44	<i>T. arduini</i>	5661877	4803129	422	B.1.4.2.3. As. <i>Campanulo-Mollketium petrcae</i> H-ić 1962	2009.07.15	M. Rušćić
45	<i>T. arduini</i>	5662767	4802978	728	B.1.4.2.4. As. <i>Inulo-Centauretum cuspidatae</i> Trinajstić (1980) 1987.	2009.07.15	M. Rušćić
46	<i>T. arduini</i>	5662577	4803965	1340	B.1.4. Tyrrhenian – Adriatic limestone rock	2009.07.15	M. Rušćić
47	<i>T. arduini</i>	5629223	4799188	417	E.8.1.7. Forest of Dalmatian black pine and holm oak	2008.08.17.	M. Rušćić

Note: Loc. no. – Locality number (according to the order in text)

### 1. *Jasenovica*

Jasenovica (1328 m a.s.l.) is a forested mountainous ridge located above the winter resort Platak. *Berberis croatica* was found several dozen meters from the top, on the site exposed to the southeast. Several dozen plants grow from the fissures and humus pockets in the limestone and cover an area of 25 m<sup>2</sup> in a forest clearing. The plants are 30–120 cm high and in good condition. The stand is surrounded by subalpine beech forest. Plant species that grow together with *B. croatica* are *Rhamnus fallax* Boiss., *Lonicera alpigena* L., *Rubus idaeus* L., *Urtica dioica* L., *Mercurialis perennis* L., *Aegopodium podagraria* L., *Geranium robertianum* L., *Moehringia muscosa* L., *Allium* sp., *Peltaria alliacea* Jacq., *Cyclamen purpurascens* Mill., *Campanula trachelium* L., *Mycelis muralis* (L.) Dumort., *Scrophularia heterophylla* Willd., *Poa nemoralis* L., *Cardamine impatiens* L., *Lathyrus pratensis* L.

### 2. *Primorski Klek*

Primorski Klek (1214 m a.s.l.) is a peak situated near the better known peak Crni vrh (1335 m a.s.l.) in the eastern section of the Mt Obruč group. About 25 plants of *B. croatica* grow on the pass between two huge rocks surrounded on one side by beech forest. The pass is covered with grassland dominated by narrow-leaved moor grass (*Sesleria juncifolia* Suffren s.l.). *Berberis* shrubs are partly desiccated, stunted, and did not fructify in the year of investigation. Plant species that grow together with *B. croatica* are *Ribes alpinum* L., *Cotoneaster integerrimus* Medik., *Fagus sylvatica* L., *Festuca* L. sp., *Melica uniflora* Retz., *Sorbus aria* (L.) Crantz, *Cyclamen purpurascens*, *Thalictrum minus* L., *Asperula* sp., *Rosa* sp., *Rosa spinosissima* L., *Galium lucidum* All., *Lotus corniculatus* L., *Lonicera alpigena*, *Anemone nemorosa* L., *Satureja subspicata* Vis., *Ligusticum lucidum* Mill., *Vicia cracca* L., *Gentiana lutea* L. subsp. *symphyandra* (Murb.) Hayek, *Centaurea triumfetti* All., *Peltaria alliacea*, *Convallaria majalis* L., *Salix appendiculata* Vill., *Carex humilis* Leyss.

### 3. *Tuhobić*

Tuhobić (1106 m a.s.l.) is a mountain which was rather extensively investigated by several florists. But *B. croatica* has not been observed there before. Several dozen plants formed mutually aggregated groups growing from the fissures in the limestone (1085 m a.s.l.) on a site exposed to the northeast. The rocky, grassy clearing stand of *B. croatica* is surrounded by beech forest. Plants of *B. croatica* are 20–80 cm high and grow together with *Viburnum lantana* (L.) Spreng, *Sorbus aria*, *S. aucuparia* L., *Lonicera xylosteum* L., *Daphne alpina* L., *Rubus saxatilis* L., *Lathyrus pratensis*, *Scrophularia heterophylla*, *Valeriana tripteris* L., *Galium lucidum*, *Saxifraga paniculata* Mill. subsp. *paniculata*, *Satureja subspicata*, *Athamanta* sp., *Euphrasia illyrica* Wettst., *Knautia* sp., *Bromus* sp., *Pimpinella* sp.

### 4. *Vidikovac above Hajdova hiža cave*

A few plants of *B. croatica* were found on the locality Vidikovac (850 m a.s.l.) which is located on the northern slopes of Drgomalj, above Mala Belica valley (Kupa River basin). Plants of *B. croatica* grow at the edge of escarpment above the cave Hajdova hiža. They are up to one meter high, vigorous and with good fructification. They cover an area of several square meters inside the underwood at the edge of limestone rock overgrown with *Sesleria tenuifolia* Schrad. subsp. *kalnikensis* (Jav.) Deyl. The rocks are encompassed with forest of beech and silver fir. Plant species that grow together with *B. croatica* are *Viburnum lantana*, *Rosa pendulina* L., *Lonicera xylosteum*, *Rhamnus cathartica* L., *Cardaminopsis arenosa* (L.) Hayek, *Galium album* Mill., *Acer pseudoplatanus* L., *Cyclamen purpurascens*, *Cirsium erisithales* (Jacq.) Scop., *Abies alba* Mill., *Fagus sylvatica*.

### 5. Premužičeva staza 1

Premužičeva staza [trail] is the best known trail on Mt Velebit. On the left side of the trail (in the direction of the Alan mountain hut), two kilometers from the beginning of Premužičeva staza near the Zavižan – Balinovac – Velika Kosa Botanical Reserve (Sjeverni Velebit National Park) there is an unnamed rock with several plants of *B. croatica*. They are up to 40 cm high and grow from the fissures in limestone exposed to the south. Plant species that grow together with *B. croatica* are *Pinus mugo* Turra, *Fagus sylvatica*, *Picea abies* (L.) H. Karst., *Juniperus communis* L. subsp. *alpina* (Sm.) Čelak, *Rosa pendulina*, *Sorbus chamaemespilus* (L.) Crantz, *S. aucuparia*, *Salix appendiculata*, *Lonicera alpigena*, *L. caerulea* L. subsp. *borbasiana* (Kuntze) E. May., *Amelanchier ovalis* Medik., *Sambucus racemosa* L., *Cotoneaster integerrimus*, *C. nebrodensis* (Guss.) K. Koch, *Rubus idaeus*, *Solanum dulcamara* L., *Micromeria thymifolia* (Scop.) Fritsch, *Cirsium erisithales*, *Gentiana lutea* subsp. *symphyandra*, *Prenanthes purpurea* L., *Achillea clavinae* L., *Lamium galeobdolon* (L.) L., *Epilobium angustifolium* L., *Hypericum* sp., *Adenostyles* sp.

### 6. Premužičeva staza 2

On the left side of the trail (in the direction of the Alan mountain hut), about 4.1 km from the beginning of Premužičeva staza there is another new locality of *B. croatica*. About ten plants of *B. croatica* grow from the fissures in limestone, covering a continuous area of about 8 m<sup>2</sup>. Plants are up to 50 cm high and grow on the site exposed to the southwest together with *Juniperus communis* subsp. *alpina*, *Genista radiata* (L.) Scop., *Rosa pendulina*.

### 7. Premužičeva staza 3

The new locality of *B. croatica* is on the left side of the trail (in the direction of the Alan mountain hut), about 5.6 km from the beginning of Premužičeva staza. On the site where the trail turns into steps, there are a few huge rocks. Several plants of *B. croatica* grow on rock exposed to the south. They are up to 40 cm high and grow together with *Picea abies* trees, *Pinus mugo*, *Rosa pendulina*, *Salix appendiculata*, *Micromeria croatica* (Pers.) Schott, *Stachys recta* L., *Achillea clavinae*, *Campanula waldsteiniana* Schult., *Buphtalmum salicifolium* L., *Vincetoxicum hirundinaria* Medik., *Gentiana lutea* subsp. *symphyandra*, *Globularia meridionalis* (Podp.) Schwarz, *Carlina acaulis* L., *Cerinth glabra* Mill., *Solidago virgaurea* L., *Mercurialis perennis*, *Convallaria majalis*, *Adenostyles* sp., *Hypericum* sp.

### 8. Smrčeve doline 1

Smrčeve doline is a great complex of old *Picea abies* forest located in the northern section of Mt Velebit. Several plants of *B. croatica* grow on the top of an unnamed rock exposed to the southeast. Plants are up to 35 cm high and cover an area of about two square meters. Plant species that grow together with *B. croatica* are *Picea abies*, *Salix appendiculata*, *Juniperus communis* subsp. *alpina*, *J. sabina* L., *Rosa pendulina*, *Rhamnus saxatilis*, *Rubus idaeus*, *Gentiana lutea* subsp. *symphyandra*, *G. asclepiadea* L., *Buphtalmum salicifolium*, *Achillea clavinae*, *Campanula waldsteiniana*, *Melampyrum nemorosum* L., *Cirsium erisithales*, *Asplenium trichomanes* L., *Viola* sp.

### 9. Smrčeve doline 2

Another locality of *B. croatica* was found on an unnamed rocky peak located several hundred meters from the locality Smrčeve doline 1. A few plants of *B. croatica* grow on the top of the peak exposed to the southeast. Plants are up to 30 cm high covering an



area of about one square meter. Plant species that grow together with *B. croatica* are *Picea abies*, *Abies alba*, *Salix appendiculata*, *Juniperus communis* subsp. *alpina*, *Lonicera caerulea* subsp. *borbasiana*, *Sambucus racemosa*, *Sorbus aucuparia*, *Gentiana lutea* subsp. *symphyandra*, *Cotoneaster integerrimus*, *Achillea clavinae*.

#### 10. Unnamed peak nearby Vratarski kuk

Vratarski kuk (1676 m a.s.l.) is a well-known peak in the northern section of Mt Velebit. A new locality of *B. croatica* was found on an unnamed peak located 15 minutes on foot after crossing Vratarsko sedlo – Škrbine drage. A few plants of *B. croatica* grow near the trail in the direction of Vratarski kuk. Plants are up to 30 cm high and grow on the sites exposed to the southeast and southwest together with *Juniperus communis* subsp. *alpina*, *Pinus mugo*, *Salix appendiculata*, *Picea abies*, *Rosa pendulina*, *Cotoneaster integerrimus*, *Daphne alpina*, *Achillea clavinae*, *Gentiana lutea* subsp. *symphyandra*, *Carlina acaulis*.

#### 11. Unnamed peak nearby Krajačev kuk

Krajačev kuk (1659 m a.s.l.) is a well-known peak located in the northern section of Mt Velebit. According to the Flora Croatica Database (NIKOLIĆ /ed./, 2013), the presence of *B. croatica* on Krajačev kuk has already been observed. An unnamed peak is located on the left side of the trail Premužičeva staza – Krajačev kuk, near the crossing Krajačev kuk – Veliki Lubenovac. A few plants of *B. croatica* grow among the limestone rocks exposed to the southwest together with *Fagus sylvatica*, *Picea abies*, *Pinus mugo*, *Sorbus aria*, *Salix appendiculata*, *Rhamnus fallax*, *Sambucus racemosa*, *Amelanchier ovalis*, *Ribes alpinum*, *Rosa pendulina*, *Rubus idaeus*, *Juniperus communis* subsp. *alpina*, *Daphne mezereum* L., *Clematis alpina* (L.) Mill., *Solanum dulcamara*, *Micromeria croatica*, *M. thymifolia*, *Carlina acaulis*, *Buphtalmum salicifolium*, *Achillea clavinae*, *Scutellaria alpina* L., *Melittis melissophyllum* L., *Heracleum sphondylium* L., *Epilobium angustifolium*, *Gentiana lutea* subsp. *symphyandra*, *Senecio ovatus* (Gottfr. Gaertn., B. Mey. et Scherb.) Willd., *Campanula* sp., *C. waldsteiniana*, *Aquilegia nigricans* Baumg., *Asplenium ruta-muraria* L., *Polystichum lonchitis* (L.) Roth, *Hypericum* sp., *Euphorbia* sp., *Scrophularia* sp.

#### 12. Rock complex opposite to Krajačev kuk

On the right side of the trail to Krajačev kuk (near the crossing Krajačev kuk – Veliki Lubenovac) there is a rock complex. Several plants of *B. croatica* are growing at the beginning of this rock complex. Plants are up to 40 cm high, and grow on the top of the rock together with *Fagus sylvatica*, *Picea abies*, *Daphne mezereum*, *Rosa pendulina*, *Clematis alpina*, *Achillea clavinae*, *Gentiana lutea* subsp. *symphyandra*, *Buphtalmum salicifolium*, *PolYGONATUM odoratum* (Mill.) Druce var. *odoratum*, *Melittis melissophyllum*, *Campanula* sp., *Cirsium erisithales*, *Carlina acaulis*, *Mercurialis perennis*, *Campanula waldsteiniana*.

#### 13. Dokozina plan

Dokozina plan is a small plain located in the central section of Mt Velebit, about one hour and 45 minutes from Šatorina peak (1634 m a.s.l.). The new locality is located on the left side of the trail (in the direction of Šatorina), about 30 minutes from Dokozina plan. A few plants of *B. croatica* are spread among the limestone rocks exposed to the southwest. The plants are up to 40 cm high and grow together with *Fagus sylvatica*, *Acer pseudoplatanus*, *Pinus mugo*, *Juniperus communis* subsp. *alpina*, *Sambucus racemosa*, *Rosa pendulina*, *R. spinosissima*, *Rubus idaeus*, *Clematis alpina*, *Micromeria croatica*, *M. thymifolia*, *Mercurialis perennis*, *Buphtalmum salicifolium*, *Vincetoxicum hirundinaria*, *Senecio ovatus*, *Prenanthes purpurea*, *Aconitum lycoctonum* L. subsp. *vulparia* (Rchb. ex Spreng.) Nyman,

*Lilium carniolicum* Bernh. ex W. D. J. Koch, *Achillea clavенаe*, *Ajuga genevensis* L., *Allium carinatum* L., *Polystichum lonchitis*, *Laserpitium* sp., *Plantago* sp., *Scrophularia* sp.

KREMER *et al.* (2011) observed *B. croatica* in the section of Mt Kamešnica which belongs to Bosnia and Herzegovina. Later, *B. croatica* was found on several localities in the section of Mt Kamešnica belonging to Croatia and these localities are presented herein.

#### 14. Donja Korita – Glavaš 1

The new locality of *B. croatica* was found near the Donja Korita – Glavaš trail, five minutes on foot from the crossing Glavaš – Kamešnica peak. About fifteen plants of *B. croatica* grow from the fissures in limestone covering an area of several square meters. They are up to 1.2 m high, vigorous and grow together with *Teucrium arduini*, *T. montanum* L., *T. chamaedrys* L., *Quercus pubescens* Willd., *Ostrya carpinifolia* Scop., *Fraxinus ornus* L., *Prunus mahaleb* L., *Acer monspessulanum* L., *Rhamnus intermedia* Steud. et Hochst., *Frangula rupestris* (Scop.) Schur, *Satureja montana* L., *S. subspicata*, *Genista sylvestris* Scop. subsp. *dalmatica* (Bartl.) H. Lindb., *Globularia cordifolia* L., *Eryngium amethystinum* L., *Campanula trachelium*, *Petrorhagia saxifraga* (L.) Link, *Brachypodium sylvaticum* (Huds.) P. Beauv., *Filipendula vulgaris* Moench.

#### 15. Below Glavaš

Glavaš (1304 m a.s.l.) is one of the highest peaks in the section of Mt Kamešnica belonging to Croatia. The new locality of *B. croatica* is located about ten minutes on foot from the top. Seven plants of *B. croatica* grow from the fissures in limestone. They are up to 1.5 m high, vigorous and grow together with *Teucrium arduini*, *Ostrya carpinifolia*, *Prunus mahaleb*, *Sorbus aria*, *Rhamnus intermedia*, *Frangula rupestris*, *Amelanchier ovalis*, *Euonymus verrucosus* Scop., *Juniperus communis* subsp. *alpina*, *Satureja montana*, *S. subspicata*, *Dorycnium germanicum*, *Centaurea rupestris* L., *Inula spiraeifolia* L.

#### 16. Donja Korita – Kamešnica

About ten plants of *B. croatica* grow from the fissures in the limestone near the Donja Korita – Kamešnica peak trail (1809 m a.s.l.) in the area called Kitica. They are up to 1.2 m high and vigorous. Plant species that grow together with *B. croatica* are *Rhamnus intermedia*, *Rhamnus fallax*, *Acer campestre* L., *Allium sphaerocephalon* L., *Melica ciliata* L., *Satureja montana*, *Sorbus aria*, *Sedum ochroleucum* Chaix, *Fagus sylvatica*, *Rosa canina* L., *Anthericum ramosum* L., *Thalictrum minus* L., *Lilium martagon* L. var. *cattaniae* Vis., *Mycelis muralis*, *Epilobium angustifolium*, *Atropa bella-donna* L., *Amelanchier ovalis*, *Peltaria alliacea*.

Also, 4–5 plants of *B. croatica* grow from the fissures in small limestone rocks inside grassland dominated by *Sesleria tenuifolia*, about 30 meters from the first habitat. Plant species that grow together with *B. croatica* are *Satureja subspicata*, *Globularia meridionalis*, *Thymus longicaulis* Ronninger, *Veronica austriaca* L. subsp. *jacquinii* (Baumg.) Eb. Fisch., *Teucrium montanum*, *Genista sylvestris* subsp. *dalmatica*, *Ornithogalum umbellatum* L., *Muscari comosum* (L.) Mill., *Dorycnium germanicum*, *Stipa pennata* L., *Amelanchier ovalis*, *Inula spiraeifolia*, *Knautia dalmatica* Beck, *Anthyllis montana* L. subsp. *jacquinii* (A. Kern.) Hayek.

#### Localities of *Teucrium arduini*

New localities of *Teucrium arduini* were found at a few distinct geographical sites: Mt Velebit, Mt Visoka, Bili Brig near the town of Sinj, Mt Kamešnica, Cetina River Canyon, Mt Biokovo, and Brač Island.



*T. arduini* was found on ten new locations in the south section of Mt Velebit. The presence of *T. arduini* in some localities in this area (Velika Paklenica, Borisov dom – Babino jezero, Štutinov dolac, Bojinac, Buželina strana, Razvršje, Mala Paklenica) was observed before by DEGEN (1938: 583), ALEGRO (2004), KREMER *et al.* (2011), and FCD (NIKOLIĆ *ed.*, 2013).

### 17. Mountain hut Paklenica

The mountain hut Paklenica is located near the hiking trail from Velika Paklenica canyon to Vaganski vrh. *Teucrium arduini* grows from the fissures in limestone exposed to the northeast, north and northwest together with petrophilous plant species: *Satureja montana*, *S. subspicata*, *Paronychia kapela* (Hacq.) Kern., *Campanula pyramidalis* L., *Prunus mahaleb*, *Acer monspessulanum*, *Fraxinus ornus*, *Frangula rupestris*, *Amelanchier ovalis*, *Rosa canina*, *Juniperus oxycedrus* L., *Dorycnium germanicum*, *Daphne alpina*, *Fagus sylvatica*.

### 18. Njive Lekine (edge of Mala Paklenica canyon)

Njive Lekine is an area at the right edge of Mala Paklenica canyon. *Teucrium arduini* grows on rocks exposed to the southeast and southwest together with *Salvia officinalis* L., *Eryngium amethystinum*, *Teucrium chamaedrys*, *T. montanum*, *Satureja montana*, *S. subspicata*, *Ruta graveolens* L., *Dorycnium germanicum*, *Fraxinus ornus*, *Prunus mahaleb*, *Sorbus aria*, *Fumana ericoides* (Cav.) Gand., *Ostrya carpinifolia*, *Quercus pubescens*, *Frangula rupestris*, *Cotoneaster nebrodensis*, *Crataegus monogyne* Jacq. var. *transalpina* A. Kern., *Rhamnus intermedia*, *Prunus spinosa*.

### 19. Jama Vodarica

Jama Vodarica is located inside the borders of the National Park Paklenica. *Teucrium arduini* was found on stones and rocks exposed to the northwest and northeast. Plant species that grow together with *T. arduini* are *Teucrium chamaedrys*, *T. montanum*, *Satureja montana*, *S. subspicata*, *Ruta graveolens*, *Dorycnium germanicum*, *Salvia officinalis*, *Eryngium amethystinum*, *Prunus mahaleb*, *Galium verum* L., *Geranium sanguineum* L., *Carlina corymbosa* L., *Plantago holostium* Scop., *Ostrya carpinifolia*, *Quercus pubescens*, *Frangula rupestris*, *Fraxinus ornus*.

### 20. Pasji klanac

Pasji klanac (793 m a.s.l.) is a peak near the road from Starigrad Paklenica to the famous shrine Veliko Rujno. *Teucrium arduini* grows from the fissures in limestone with southwestern and southeastern exposure together with *Satureja montana*, *S. subspicata*, *Ruta graveolens*, *Dorycnium germanicum*, *Teucrium chamaedrys*, *T. montanum*, *Frangula rupestris*, *Cotoneaster nebrodensis*, *Fraxinus ornus*, *Prunus mahaleb*, *Rhamnus intermedia*, *Amelanchier ovalis*, *Geranium sanguineum*, *Carlina corymbosa*, *Cirsium arvense* (L.) Scop., *Centaurea jacea* L., *Ostrya carpinifolia*, *Quercus pubescens*.

### 21. Županov dolac (or Dolac Županov)

Dolac Županov is an area above Pasji klanac. It is also located near the road from Starigrad Paklenica to Veliko Rujno. The stones and rocks where *T. arduini* grows are exposed to the northwest and northeast. Plant species that grow together with *T. arduini* are *Salvia officinalis*, *Satureja montana*, *S. subspicata*, *Stachys recta*, *Anthyllis vulneraria* L., *Hieracium* sp., *Eryngium amethystinum*, *Achillea millefolium* L., *Thymus serpyllum* L., *Fragaria vesca* L., *Mercurialis perennis*, *Brachypodium sylvaticum*, *Vicia cracca*, *Heracleum sphondylium*, *Ostrya carpinifolia*, *Quercus pubescens*, *Frangula rupestris*.

## 22. Jatara

Jatara is a cave inside the borders of National Park Paklenica. *Teucrium arduini* was found around the cave on rocks exposed to the southwest and southeast. Plant species that grow together with *T. arduini* are *Teucrium montanum*, *Satureja montana*, *S. subspicata*, *Eryngium amethystinum*, *Campanula pyramidalis*, *Ruta graveolens*, *Dorycnium germanicum*, *Prunus mahaleb*, *Acer monspessulanum*, *Fraxinus ornus*, *Ostrya carpinifolia*, *Quercus pubescens*, *Cornus mas* L., *Frangula rupestris*, *Cotoneaster nebrodensis*, *Crataegus monogyna* var. *transalpina*, *Rhamnus intermedia*, *Prunus spinosa*.

## 23. Ramići

Ramići is a settlement nearby the Paklenica mountain hut. *T. arduini* was found on rocks near the hiking trail. It grows from the fissures in limestone exposed to the northwest and northeast together with *Fumana ericoides*, *Dorycnium germanicum*, *Satureja montana*, *S. subspicata*, *Teucrium montanum*, *Eryngium amethystinum*, *Carlina corymbosa*, *Genista sylvestris* subsp. *dalmatica*, *Koeleria splendens* C. Presl, *Hieracium* sp., *Globularia cordifolia*, *Frangula rupestris*, *Cotoneaster nebrodensis*, *Crataegus monogyna* var. *transalpina*, *Rhamnus intermedia*, *Ostrya carpinifolia*, *Quercus pubescens*, *Fraxinus ornus*.

## 24. Bilig

Bilig is a small peak inside the borders of Paklenica National Park. *Teucrium arduini* grows in the fissures of limestone together with *Tulipa sylvestris* L., *Globularia cordifolia*, *Cotoneaster nebrodensis*, *Amelanchier ovalis*, *Ostrya carpinifolia*. It forms a stabile population on the northwestern exposure.

## 25. Modrin dolac

Modrin dolac is an area near the hiking trail from Veliki Vaganac to Veliko Rujno. *Teucrium arduini* was found on stones exposed to the southwest and southeast, and surrounded by shrubby vegetation. Plant species that grow together with *T. arduini* are *Ostrya carpinifolia*, *Fraxinus ornus*, *Quercus pubescens*, *Dorycnium germanicum*, *Satureja montana*, *S. subspicata*, *Salvia officinalis*, *Fumana ericoides*, *Teucrium montanum*, *Eryngium amethystinum*, *Carlina corymbosa*, *Genista sylvestris* subsp. *dalmatica*, *Teucrium chamaedrys*, *Sesleria autumnalis* (Scop.) F. W. Schultz, *Globularia cordifolia*, *Frangula rupestris*, *Cotoneaster nebrodensis*, *Crataegus monogyna* var. *transalpina*, *Rhamnus intermedia*.

## 26. Jagin kuk

Jagin kuk (1001 a.s.l.) is a small peak below Bojinac. *Teucrium arduini* was found on stones and rocks exposed to the northwest and northeast. Plant species that grow together with *T. arduini* are *Globularia cordifolia*, *Genista sylvestris* subsp. *dalmatica*, *Teucrium chamaedrys*, *Frangula rupestris*, *Cotoneaster nebrodensis*.

*Teucrium arduini* was also found in the mountainous hinterland of central Dalmatia.

## 27. Mt Visoka

Mt Visoka (890 m a.s.l.) is located between the settlement of Dicmo and the town of Sinj. *T. arduini* grows from the fissures of limestones exposed to the southeast and forms a stabile population composed of a quite large number of plants. Plant species that grow together with *T. arduini* are *Quercus pubescens*, *Asplenium ceterach* L., *Satureja montana*, *Rubus ulmifolius* Schott., *Cornus mas*, *Juniperus oxycedrus*, *Prunus mahaleb*, *Acer monspessulanum*, *Fraxinus ornus*, *Rhamnus intermedius*, *Campanula pyramidalis*, *Thymus longicaulis*,

*Teucrium chamaedrys*, *Rubus discolor* Weihe et Ness., *Frangula rupestris*, *Achillea millefolium*, *Aethionema saxatile* (L.) R. Br., *Sedum acre* L., *Bupleurum veronense* Turra, *Dryopteris pallida* (Bory) C. Chr. ex Maire et Petitmengin, *Lonicera etrusca* Santi, *Cotinus coggygria* Scop., *Potentilla australis* Krašan, *Sedum ochroleucum*, *Brachypodium* sp.

### 28. Vaganj (Bili Brig near Sinj)

*Teucrium arduini* was found in the area Vaganj, in the interborder area between Croatia and Bosnia and Herzegovina. Plants of *T. arduini* grow in the fissures of limestone exposed to the southeast and south together with *Fraxinus ornus*, *Prunus mahaleb*, *Sorbus aria*, *Fumana ericoides*, *Ostrya carpinifolia*, *Quercus pubescens*, *Frangula rupestris*, *Cotoneaster nebrodensis*, *Crataegus monogyna* var. *transalpina*, *Rhamnus intermedia*, *Dorycnium germanicum*, *Chamaecytisus hirsutus* (L.) Link, *Satureja montana*, *S. subspicata*, *Teucrium montanum*, *Eryngium amethystinum*, *Carlina corymbosa*, *Genista sylvestris* subsp. *dalmatica*, *Koeleria splendens*, *Galium rubrum*, *Plantago holosteum*, *Pseudolysimachion spicatum* (L.) Opiz, *Hieracium* sp., *Globularia cordifolia*.

PLAZIBAT (2002) observed *T. arduini* at the localities Orlovača and Gorčina (Mt Tovarnica area) in the southern section of the Mt Kamešnica complex. KREMER *et al.* (2012) mentioned the presence of *T. arduini* on Mt Kamešnica in a section that belongs to Bosnia and Herzegovina. However, the presence of *T. arduini* in other parts of Mt Kamešnica which belong to Croatia was not known until these investigations. Thirteen new localities of *T. arduini* in the section of Mt Kamešnica which belongs to Croatia are listed in this paper. Ten of them are located in the central section of Mt Kamešnica (above the settlement Donja Korita) while two of them are located in the southern section (Mt Tovarnica above the settlement of Voštane).

### 29. Donja Korita

Several plants of *T. arduini* were found on the left side (in the direction of Donja Korita) of the gravel road near the settlement Donja Korita. They grow on stones with southeasterly exposure and surrounded by shrubby vegetation. Plant species that grow together with *T. arduini* are *Ostrya carpinifolia*, *Fraxinus ornus*, *Carpinus orientalis* Mill., *Quercus pubescens*, *Acer monspessulanum*, *Rhamnus intermedia*, *Genista sylvestris* subsp. *dalmatica*, *Satureja montana*, *S. subspicata*, *Globularia cordifolia*, *Carlina corymbosa*, *Silene vulgaris* (Moench) Garcke, *Acinos arvensis* (Lam.) Dandy, *Melica ciliata*, *Koeleria splendens*, *Aethionema saxatile*, *Brachypodium pinnatum*, *Centaurea* sp.

### 30. Blatački brig

Blatački brig is a rock complex located on the left side (in the direction of Glavaš peak) of the hiking trail Donja Korita – Glavaš. Plants of *T. arduini* were most abundant in the eastern section of Blatački brig. They grow from the fissures in limestone with a southern – southwestern exposure. Plant species that grow together with *T. arduini* are *Daphne alpina*, *Prunus mahaleb*, *Ostrya carpinifolia*, *Fraxinus ornus*, *Acer monspessulanum*, *Amelanchier ovalis*, *Lonicera etrusca*, *Euonymus verrucosus*, *Teucrium montanum*, *Satureja montana*, *S. subspicata*, *Eryngium amethystinum*, *Lilium martagon* var. *cattaniae*, *Hieracium* sp., *Euphorbia fragifera* Jan, *Inula verbascifolia* (Willd.) Hausskn., *Carlina corymbosa*, *Cephalaria leucantha* (L.) Schrad. ex Roem. et Schult., *Centaurea rupestris*, *Globularia cordifolia*.

### 31. Donja Korita – Glavaš 1

A description of this locality is given above (see locality number 14: Donja Korita – Glavaš 1).

### 32. Donja Korita – Glavaš 2

Several plants of *T. arduini* were found on stones near the trail Donja Korita – Glavaš. They grow from the fissures in limestone with a southern exposure. Plant species that grow together with *T. arduini* are *Prunus mahaleb*, *Acer obtusatum* Waldst. et Kit. ex Willd., *Ostrya carpinifolia*, *Fraxinus ornus*, *Rosa canina*, *Frangula rupestris*, *Amelanchier ovalis*, *Crataegus monogyna* var. *transalpina*, *Euonymus verrucosus*, *Sorbus aria*, *Rhamnus intermedia*, *Fragaria vesca*, *Mercurialis perennis*, *Brachypodium sylvaticum*, *Arabis hirsuta* (L.) Scop., *Mycelis muralis*, *Thalictrum minus*.

### 33. Donja Korita – Glavaš 3

Several dozen plants of *T. arduini* were also found near the trail Donja Korita – Glavaš. *T. arduini* grows on the rocks with a southeastern – southwestern exposure. Plant species that grow together with *T. arduini* are *Fagus sylvatica*, *Prunus mahaleb*, *Acer monspessulanum*, *Fraxinus ornus*, *Populus tremula* L., *Sorbus aria*, *Crataegus monogyna* var. *transalpina*, *Rhamnus fallax*, *Ribes alpinum*, *Rubus caesius* L., *Satureja montana*, *Mycelis muralis*, *Brachypodium sylvaticum*, *Vicia cracca*, *Sesleria autumnalis*, *Heracleum sphondylium*, *Epilobium angustifolium*.

### 34. Donja Korita – Glavaš 4

Another locality with several dozen plants of *T. arduini* was also found near the Donja Korita – Glavaš trail. *T. arduini* grows on the rocks with a southeastern – southwestern exposure. Plant species that grow together with *T. arduini* are *Prunus mahaleb*, *Acer monspessulanum*, *Fraxinus ornus*, *Fagus sylvatica*, *Sorbus aria*, *Crataegus monogyna* var. *transalpina*, *Frangula rupestris*, *Rhamnus intermedia*, *Satureja montana*, *Rubus caesius*, *Cotoneaster integerrimus*, *Lonicera etrusca*, *Dorycnium germanicum*, *Chamaecytisus hirsutus*, *Sesleria autumnalis*, *Atropa bella-donna*, *Geranium robertianum*, *Epilobium angustifolium*, *Vincetoxicum hirundinaria*, *Hieracium pilosella* L., *Achillea millefolium*, *Thymus serpyllum*, *Allium senescens* L., *Sonchus oleraceus* L., *Melica ciliata*.

### 35. Below Glavaš

A description of this locality is given above (see locality number 15: Below Glavaš).

### 36. Glavaš peak

Several plants of *T. arduini* were also noticed on the top of Glavaš peak. They grow among stones with a southern exposure together with *Amelanchier ovalis*, *Cerastium grandiflorum* Waldst. et Kit., *Cotoneaster integerrimus*, *Daphne alpina*, *Euphorbia fragifera*, *Frangula rupestris*, *Juniperus communis* subsp. *alpina*, *Ostrya carpinifolia*, *Populus tremula*, *Prunus mahaleb*, *Rhamnus saxatilis*, *Ribes alpinum*, *Rosa pendulina*, *Ruta graveolens*, *Satureja montana*, *S. subspicata*, *Sempervivum tectorum* L., *Sorbus aria*, *Teucrium montanum*.

### 37. Donja Korita – Kamešnica peak 1

Several plants of *T. arduini* grow in the fissures in limestone near the trail Donja Korita – Kamešnica peak in the area called Kitica. Plant species that grow together with *T. arduini* are *Arabis hirsuta*, *A. turrata* L., *Verbascum nigrum* L., *Amelanchier ovalis*, *Dorycnium germanicum*, *Fraxinus ornus*, *Rhamnus fallax*, *Fagus sylvatica*, *Epilobium angustifolium*, *Teucrium chamaedrys*, *Frangula rupestris*, *Melica ciliata*, *Sorbus aria*, *Prunus mahaleb*, *Rosa canina*, *Galium* sp., *Crataegus monogyna* var. *transalpina*, *Cerastium grandiflorum*, *Campanula pyramidalis*, *Rhamnus intermedia*, *Allium sphaerocephalon*, *Cotoneaster integerrimus*, *Cotoneaster nebrodensis*, *Brachypodium sylvaticum*, *Satureja montana*, *Globularia meridionalis*, *Arenaria serpyllifolia* L., *Genista sylvestris* subsp. *dalmatica*.

### 38. Donja Korita – Kamešnica peak 2

*Teucrium arduini* was also found at another locality near the Donja Korita – Kamešnica peak trail in the area called Kitica. Plants of *T. arduini* grow from the fissures in the limestone together with *Fagus sylvatica*, *Crataegus monogyna* var. *transalpina*, *Teucrium montanum*, *Aethionema saxatile*, *Frangula rupestris*, *Sedum ochroleucum*, *Epilobium angustifolium*, *Rhamnus fallax*, *Rhamnus intermedia*, *Verbascum nigrum*, *Acinos arvensis*, *Melica ciliata*, *Arabis hirsuta*, *Inula conyzae* (Griess.) Meikle, *Epilobium angustifolium*, *Cirsium eriophorum* (L.) Scop., *Filipendula vulgaris*, *Allium flavum* L., *Dorycnium germanicum*, *Veronica austriaca* subsp. *jacquinii*, *Galium verum*.

### 39. Unnamed peak 1 (Mt Tovarnica, Mt Kamešnica)

Unnamed peak 1 is the nearest peak on the right side (in the direction of Bosnia and Herzegovina) of the gravel road leading from the settlement of Voštane to Bosnia and Herzegovina. A great number of *T. arduini* plants grow from the fissures in limestone rocks with a southeastern – southwestern exposure. Plant species that grow together with *T. arduini* are *Ostrya carpinifolia*, *Prunus mahaleb*, *Acer monspessulanum*, *Fagus sylvatica*, *Sorbus aria*, *Cornus mas*, *Corylus avellana* L., *Euonymus verrucosus*, *Hedera helix* L., *Frangula rupestris*, *Amelanchier ovalis*, *Rosa canina*, *Juniperus oxycedrus*, *Cotoneaster nebrodensis*, *C. integerrimus*, *Rhamnus intermedia*, *R. saxatilis*, *Daphne alpina*, *Satureja montana*, *Dorycnium germanicum*, *Lilium martagon*, *Geranium sanguineum*, *Carlina corymbosa*, *Succisella petteri* (J. Kern. et Murb.) Beck, *Seseli montanum* L., *Campanula cervicaria* L., *Teucrium chamaedrys*, *Sesleria autumnalis*.

### 40. Unnamed peak 2 (Mt Tovarnica, Mt Kamešnica)

Unnamed peak 2 is the second peak in the row of several peaks located on the right side (in the direction of Bosnia and Herzegovina) of the gravel road leading from Voštane to Bosnia and Herzegovina. Plants of *T. arduini* grow from the fissures in the limestone with a southeastern and southern exposure. Plant species that grow together with *T. arduini* are *Sesleria tenuifolia*, *Satureja montana*, *Satureja subspicata*, *Prunus mahaleb*, *Carlina corymbosa*, *Ostrya carpinifolia*, *Cotoneaster integerrimus*, *C. nebrodensis*, *Daphne alpina*, *Dorycnium germanicum*, *Fraxinus ornus*, *Melica ciliata*, *Seseli montanum*, *Frangula rupestris*, *Teucrium montanum*, *Amelanchier ovalis*, *Succisella petteri*, *Carlina acaulis*, *Plantago holostemum*, *Inula spiraeifolia*, *Inula ensifolia* L., *Knautia dalmatica*, *Centaurea rupestris*, *Teucrium chamaedrys*, *Lonicera etrusca*, *Thalictrum minus*, *Lilium martagon*, *Cephalaria leucantha*, *Sorbus aria*, *Genista sylvestris* subsp. *dalmatica*, *Scorzonera austriaca* Willd. subsp. *austriaca*, *Allium senescens*, *Mercurialis perennis*, *Echinops ritro* L., *Cornus mas*, *Anthericum ramosum*.

### 41. Križ (Mt Tovarnica, Mt Kamešnica)

*Teucrium arduini* was found several dozen meters below the top of Križ peak (1133 m a.s.l.). It grows from the fissures in the limestone with a southeastern exposure. Plant species that grow together with *T. arduini* are *Ostrya carpinifolia*, *Prunus mahaleb*, *Fagus sylvatica*, *Fraxinus ornus*, *Acer monspessulanum*, *Amelanchier ovalis*, *Euonymus verrucosus*, *Crataegus monogyna* var. *transalpina*, *Frangula rupestris*, *Rhamnus saxatilis*, *Daphne alpina*, *Rosa canina*, *Satureja montana*, *S. subspicata*, *Stachys recta*, *Anthyllis vulneraria*, *Hieracium* sp., *Eryngium amethystinum*.

### 42. Cetina River Canyon

*Teucrium arduini* was observed south of the spot where the bridge of the Zagreb – Split motorway crosses Cetina River Canyon. It grows from the fissures in the limestone to-



gether with *Acer monspessulanum*, *Ostrya carpinifolia*, *Carpinus orientalis*, *Quercus pubescens*, *Pistacia terebinthus* L., *Paliurus spina-christi* Mill., *Prunus mahaleb*, *Fraxinus ornus*, *Cornus mas*, *Phillyrea media*, *Ficus carica* L., *Euonymus verrucosus*, *Rhamnus intermedia*, *Colutea arborescens* L., *Coronilla emerus* L. subsp. *emeroides* Boiss et Spruner, *Clematis vitalba* L., *C. flammula* L., *Satureja montana*, *Asparagus acutifolius* L., *Ruscus aculeatus* L., *All-yssooides utriculata* (L.) Med., *Campanula pyramidalis*, *Portenschlagiella ramosissima* (Port.) Tutin, *Peltaria alliacea*, *Arabis turrita*, *A. verna* (L.) R. Br., *Petrorhagia saxifraga*, *Inula verbascifolia*, *Sedum dasyphyllum* L., *Brachypodium pinnatum*, *Melica ciliata*, *Asplenium ceterach*.

#### 43. Gubavica (Zadvarje)

Gubavica is a cascade in the Cetina River Canyon located near a storage lake for the Kraljevac hydro-electric station. *Teucrium arduini* was found in the fissures of limestone rocks with a western exposure. Plant species that grow together with *T. arduini* are *Acer monspessulanum*, *Fraxinus ornus*, *Prunus mahaleb*, *Pistacia terebinthus*, *Paliurus spina-christi*, *Rhamnus intermedia*, *Colutea arborescens*, *Coronilla emerus* subsp. *emeroides*, *Hedera helix*, *Clematis vitalba*, *C. flammula*, *Satureja montana*, *Ruscus aculeatus*, *Arabis turrita*, *Cyclamen repandum* Sibth. et Sm., *Viola odorata*, *Inula verbascifolia*, *Portenschlagiella ramosissima*, *Petrorhagia saxifraga*, *Campanula pyramidalis*, *Sedum dasyphyllum*, *Brachypodium pinnatum*, *Melica ciliata*, *Asplenium ceterach*.

#### 44. Bast – Sv. Ilija 1 (Mt Biokovo)

Sv. Ilija (1642 m a.s.l.) is one of the best-known peaks on Mt Biokovo. *Teucrium arduini* was found near the trail from the Bast settlement to Sv. Ilija peak. It grows from the fissures in limestone exposed to the southwest. Plant species that grow together with *T. arduini* are *Ostrya carpinifolia*, *Fraxinus ornus*, *Quercus pubescens*, *Pinus nigra* Arnold subsp. *dalmatica* (Vis.) Franco, *Prunus prostrata* Labill., *Pyrus amygdaliformis* Vill., *Drypis spinosa*, *Linaria parviflora* (Jacq.) Hall., *Helictotrichon convolutum* (C. Presl) Henrard, *Alyssum murale* Waldst. et Kit., *Centaurea spinosociliata* Seenus subsp. *spinosociliata*, *Tanacetum cinerariifolium* (Trevir.) Sch. Bip., *Helichrysum italicum* (Roth) D. Don, *Satureja subspicata*, *Salvia officinalis*, *Thalictrum minus*, *Centaureum tenuifolium* (Hoffm. et Link.) Fritsch, *Asplenium trichomanes*, *A. ceterach*, *A. ruta muraria*, *Inula verbascifolia*, *Verbascum macrum* Ten., *Campanula portenschlagiana* Schult., *Arabis verna*, *Ruta divaricata* Ten., *Aegilops neglecta* Req. ex Bertol., *Onosma echioides* L., *Globularia cordifolia*, *Hieracium waldsteinii* Tsch., *Euphorbia myrsinites* L., *E. spinosa* L., *Argyrolobium zanonii* (Turra) P. W. Ball, *Carduus micropterus* (Borbás) Teyber subsp. *micropterus*, *Thymus longicaulis*, *T. striatus* Vahl, *Edraianthus tenuifolius* (Waldst. et Kit.) A. DC., *Erica manipuliflora* Salisb.

#### 45. Bast – Sv. Ilija 2 (Mt Biokovo)

Another locality of *T. arduini* was also found near the trail from the Bast settlement to Sv. Ilija peak. It grows from the fissures in the limestone and on scree exposed to the southwest. Plant species that grow together with *T. arduini* are *Sesleria robusta*, *Geranium purpureum*, *G. robertianum*, *Teucrium chamaedrys*, *Crataegus monogyna*, *Geranium lucidum*, *Arenaria gracilis* W. K., *Sedum dasyphyllum*, *Frangula rupestris*, *Quercus ilex* L., *Senecio rupestris* W. K., *Cardamine hirsuta* L., *C. carnosa* W. K., *C. maritima* Port. ex DC., *Seseli tomentosum* Vis., *Hieracium waldsteinii*, *Dryopteris pallida*, *Daphne alpina*, *Sedum ochroleucum*, *Rubus ulmifolius*, *Acer monspessulanum*, *Leontodon crispus* Vill., *Calamagrostis varia* (Schrad.) Host, *Portenschlagiella ramosissima*, *Opoanax chironium* (L.) W. D. J. Koch., *Rumex acetosa* L., *R. scutatus* L., *Moltkia petraea* (Tratt.) Gris., *Drypis spinosa*, *Ostrya carpinifolia*, *Cerastium grandiflorum*.



#### 46. Osičine hunting lodge (Mt Biokovo)

*Teucrium arduini* was found nearby the Osičine hunting lodge and near the trail from Bast to Sv. Ilija peak. It grows from the fissures in limestone exposed to the southwest and forms a vigorous population. Plant species that grow together with *T. arduini* are *Daphne alpina*, *Anthyllis montana* subsp. *jacquinii*, *Saxifraga rotundifolia* L., *Edraianthus pumilio* (Port.) A. DC., *Biscutella laevigata* L., *Jurinea mollis* (L.) Rchb., *Peltaria alliacea*, *Scrophularia peregrina*, *Astragalus gremlii* Burn., *Helianthemum salicifolium* (L.) Mill., *Dorycnium germanicum*, *Arabis hirsuta*, *Veronica austriaca* subsp. *jacquinii*, *Draba lasiocarpa* Rochel, *Coronilla emerus* subsp. *emeroides*, *Lilium martagon*, *Armeria canescens* (Host) Boiss. in DC., *Astragalus vesicarius* L. subsp. *carniolicus* (A. Kern.) Chater, *Luzula multiflora* (Retz.) Lej., *Saxifraga paniculata*, *Valeriana tripteris*, *Malcolmia orsiniana* (Ten.) Ten.

#### 47. Between Nerežišće and Vidova gora (Brač Island)

On the way from the settlement of Nerežišće to Vidova gora there is a small hill covered with *Pinus nigra* subsp. *dalmatica* forest. *Teucrium arduini* grow on a rock and gravel geological base. Plant species that grow together with *T. arduini* are *Fraxinus ornus*, *Quercus ilex*, *Frangula rupestris*, *Salvia officinalis*, *Aurinia sinuata* (L.) Griseb., *Inula verbas-cifolia*, *Euphorbia spinosa*, *Juniperus oxycedrus*, *Lonicera etrusca*, *Helichrysum italicum*.

In conclusion, 16 new localities of *B. croatica* and 31 new localities of *T. arduini* have been described in the Dinaric Mountains in Croatia. The majority of populations of *B. croatica* are formed from a small number of plants. Exceptions were the localities Jase-novica and Tuhobić in the mountainous hinterland of the town of Rijeka. On the other hand, the majority of *T. arduini* populations are formed from a greater number of plants. The afforestation of habitats by natural forest vegetation represents the greatest threat to populations of both species. These investigations will help for *in situ* and *ex situ* conservation of both species, and in future re-evaluations of the Croatian Red Book of Vascular Plants and NATURA 2000-documents. Additionally, investigations of Kamešnica Mountain have helped to broaden our knowledge of flora of this mountain in the light of the possible establishment of Kamešnica Nature Park.

#### ACKNOWLEDGEMENTS

This work was supported by the Ministry of Science, Education and Sports of the Republic of Croatia (project no. 006–0000000–3178).

Received September 13, 2013

#### REFERENCES

- ALEGRO, A., 2004: Plant world of NP "Paklenica" (In Croatian). In: LUKAČ, G. (eds.), Paklenički zbornik: Simpozij povodom 55. godišnjice NP "Paklenica", Vol. 2., Uprava NP "Paklenica", Starigrad-Paklenica, p. 35–54.
- ANONYMOUS, 2009: Habitat types in Croatia (National habitat classification – NKS) (In Croatian). OFFICIAL GAZETTE (OG) 119/09, 21–52.
- ANONYMOUS, 2013: Pravilnik o strogo zaštićenim vrstama (Ordinance of strictly protected species) (In Croatian). OFFICIAL GAZETTE (OG) 144/13, 7–84.
- DEGEN, A., 1938: Flora Velebitica. Vol. 2, p. 151–152; vol. 2, p. 583. Verlag der Ungar. Akademie der Wissenschaften, Budapest.
- KREMER, D., RANDIĆ, M., KOSALEC & KARLOVIĆ, K., 2008: New localities of *Berberis croatica* Horvat in Croatia. Acta Botanica Croatica 67, 237–244.

- KREMER, D., RANDIĆ, M., KOSALEC, I., BRKLJAČIĆ, A., LUKAČ, G., KRUŠIĆ, I., BALLIAN, D., BOGUNIĆ, F. & KARLOVIĆ, K., 2011: New localities of three subendemic species in the Dinaric Alps. *Acta Botanica Croatica* **70**, 289–300.
- KREMER, D., STABENTHEINER, E., JURISIĆ GRUBEŠIĆ, R., OBERLÄNDER, A., VLADIMIR-KNEŽEVIĆ, S., KOSALEC, I. & BALLIAN, D., 2012: Morphological and chemotaxonomic researches of *Teucrium arduini* L. in Croatia and Bosnia and Herzegovina. *Plant Biosystems* **146**, 402–412.
- KUŠAN, F., 1956: Composition and distribution of vegetation on Mt Kamešnica (1849 m) (In Croatian). *Godišnjak Biološkog instituta u Sarajevu* **9**, 3–26.
- KUŠAN, F., 1969: New barberry (*Berberis*) species in Croatian flora (In Croatian). *Acta Botanica Croatica* **28**, 423–434.
- LAKUŠIĆ, B., LAKUŠIĆ, D., SLAVKOVSKA, V., STEVANOVIĆ, V. & STEVANOVIĆ, B., 2007: Morpho-anatomical differentiation of the Balkan endemic species *Teucrium arduini* L. (*Lamiaceae*). *Archives of Biological Sciences* **59**, 369–381.
- MARTINIS, Z., 1994: *Berberis croatica* (Horvat) Kušan (In Croatian). In: ŠUGAR, I. (eds.), Red Data Book of plant species of Republic of Croatia. Ministarstvo graditeljstva i zaštite okoliša, Zavod za zaštitu prirode, Zagreb. p. 63–65.
- NIKOLIĆ, T. (ed.), 2013: Flora Croatica Database. Department of Botany, Faculty of Science, University of Zagreb. (<http://hirc.botanic.hr/fcd>). Prirodoslovno-matematički fakultet, Sveučilište u Zagrebu. [Last access: September 5, 2013]
- PLAZIBAT, M., 2002: A contribution to the flora of Tigarica in southern Croatia. *Natura Croatica* **11**, 53–75.
- ŠILIC, Č., 1990: Endemic plants (In Bosnian). IP Svjetlost, Sarajevo, Beograd. p. 113.
- ŠILIC, Č., 1996: List of plant species (*Pteridophyta* and *Spermatophyta*) for red book of Bosnia and Herzegovina. *Glasnik Zemaljskog muzeja Bosne i Hercegovine, Sarajevo*. p. 323–367.
- ŠILIC, Č., 2005: Atlas of woody plants (trees and shrubs) of Bosnia and Herzegovina (In Croatian). Matična Hrvatska Ogranak Čitluk and Franjevačka kuća Masna Luka, Čitluk. p. 160.
- TRINAJSTIĆ, I., 1973: *Berberis* L. (In Croatian). In: TRINAJSTIĆ, I. (eds.), *Analička flora Jugoslavije* **1**, 377–381.
- TUTIN, T. G., WOOD, D., 1972: *Teucrium* L. In: HEYWOOD, V. H., BURGESS, N. A., MOORE, D. M., VALENTINE, D. H., WALTERS, S. M. & WEBB, D. A. (eds.): *Flora Europaea*, Vol. 3, *Diapensiaceae* to *Myoporaceae*, Cambridge University Press, Cambridge. p. 129–135.

## SAŽETAK

### Novi lokaliteti vrsta *Berberis croatica* Horvat i *Teucrium arduini* L. na području sjeverozapadnih Dinarida

D. Kremer, G. Lukač, M. Randić, I. Krušić, I. Kosalec & M. Ruščić

Na području sjeverozapadnih i središnjih Dinarida u Hrvatskoj zabilježeni su u razdoblju od svibnja 2006. do srpnja 2013. godine novi, do sada u literaturi nezabilježeni lokaliteti dviju subendemičnih, razmjerno rijetkih, floristički zanimljivih i u Republici Hrvatskoj strogo zaštićenih biljnih vrsta: hrvatske žutike (*Berberis croatica* Horvat) i Arduinova dubačca (*Teucrium arduini* L.). Novi lokaliteti hrvatske žutike zabilježeni su na planinama u zaleđu grada Rijeke, Gorskom kotaru (Drgomalj), na Velebitu i Kamešnici. Arduinov dubačac utvrđen je na novim lokalitetima na Velebitu, na planini Visoka, na Bilom Brigu u blizini Sinja, Kamešnici, u kanjonu rijeke Cetine, na Biokovu te na otoku Braču. Podaci o novim lokalitetima hrvatske žutike i Arduinova dubačca predstavljaju značajan doprinos poznavanju rasprostranjenosti ovih dviju vrsta, brojnosti njihovih populacija, kao i ekološkim uvjetima u kojima rastu. S obzirom da vrste *B. croatica* i *T. arduini* nisu na adekvatan način valorizirane u Crvenoj knjizi vaskularne flore Hrvatske, prikupljeni podaci pomoći će prilikom njene skorašnje revizije. Na ovaj način stvaraju se i adekvatni preduvjeti za *in situ* i *ex situ* zaštitu ovih dviju vrsta. Istraživanja na planini Kamešnici predstavljaju doprinos poznavanju biljnog svijeta ove planine u svjetlu njenog mogućeg proglašenja parkom prirode.