

NEW DATA ON THE DISTRIBUTION OF *ADENOPHORA LILIIFOLIA* (L.) A. DC. (CAMPANULACEAE) IN SERBIA

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Due to habitat loss or changes in management, populations of *Adenophora liliifolia* (L.) A. DC. in Europe are increasingly endangered. Therefore, this plant has the status of an endangered or extremely endangered species in most European countries. It is defined as a “target species” or a “species of European concern” whose conservation requires designation of special areas of conservation. *A. liliifolia* is a rare plant species on the Balkan Peninsula, found only in the Western Balkans: in Bosnia and Herzegovina, Montenegro, Croatia, and Serbia. In Serbia, it is believed to have disappeared from its western region, specifically in the Derвента canyon and Grlac on Mount Tara. However, it is in good condition at its only known site in the Ibar river gorge in southwestern Serbia. During the revision of the herbarium material in the BEOU herbarium, a specimen of *Adenophora liliifolia* was discovered. It was collected in the Lim gorge near Gostun. Field research conducted in that area revealed a population of this species in an atypical habitat, next to the main road to Montenegro, in the vicinity of Brodarevo. The search for new sites of this internationally important species in the Lim Gorge, from Gostun and Brodarevo, and further to Ustibar, will continue in the coming period.

Key words: *Adenophora liliifolia*, Balkan Peninsula, endangered species, new record

INTRODUCTION

The genus *Adenophora* Fisch. comprises more than 60 species (65 according to Lammers 2007a, 67 according to Govaerts 1995), having centre of its distribution in East and South-east Asia. Although many infrageneric taxa have been described, no modern attempt at classification has yet clarified the taxonomy of this genus (Vaculná 2022). Most of the species are distributed in East Asia, and only two in Europe (Govaerts 1995, Lamers 2007b, Castroviejo *et al.* 2010). The representatives of the genus are perennial herbs, often with large tuberous roots, cauline leaves rarely opposite or verticillate, and small to medium-sized flowers with campanulate purple or blue, rarely white corollas (Lamers 2007b).

Two representatives of the genus *Adenophora* occur in Europe, endemic Crimean *Adenophora taurica* (Sukaczew) Juz. and widely distributed but rare European-South Siberian *Adenophora liliifolia* (L.) A. DC. (Castroviejo *et al.* 2010). There are different opinions about the origin of *A. liliifolia* in Europe. According to Vaculná (2022) it probably represents a relic of the late glacial and early Holocene, while according to Stevanović & Lakušić (1999) it is a Tertiary relict. The distribution range of the species extends from southwestern Siberia and the Ural Mountains in the east to Western Europe, where the populations are highly fragmented. Its range extends further south to northern Italy and the western Balkans (Meusel & Jäger 1992, Milanović & Stevanović 2009, Castroviejo *et al.* 2010, Prausova *et al.* 2016). A typical habitat of *A. liliifolia* is the coppice. It grows in small populations in the lowlands in remnants of former light oak forests, their ecotones and adjacent meadows. At higher altitudes it grows on the rocky outcrops in beech forests and in parts of riparian forests that receive plenty of sunlight (Vaculná 2022 and the references therein). *Adenophora liliifolia* is considered an endangered or critically endangered species in most countries where it occurs. Population numbers in Central Europe are gradually declining, mainly due to changes in habitat management and the loss of suitable habitats. That is why it is defined as a “target species”, or “species of European concern” that requires specific conservation concern (Ozinga *et al.* 2005).

On the Balkan Peninsula, *A. liliifolia* is found in Croatia, Bosnia and Herzegovina, Montenegro and Serbia (Milanović & Stevanović 2009, Castroviejo *et al.* 2010). It inhabits stony-gravel and shady banks of mountain rivers, mainly within thermo-mesophilous forests of the *Orno-Ostryon* alliance, but also the mesophilous streamside formations of *Alnus glutinosa* (Milanović & Stupar 2017), wet meadows of the alliance *Molinion*, beside hilly-mountainous rivers, and rarely mountainous peat-bogs. It also grows on calcareous canyon rocks above the water (Stevanović & Lakušić 1999).

A single known locality in Serbia (Ibar gorge near Ribariće) represents the southernmost point of the species' distribution in Europe and the easternmost in the Balkans. It is included in the Red Data Book of Flora of Serbia 1 as critically endangered species (Stevanović & Lakušić 1999). It is also listed in the Rulebook on the proclamation and protection of strictly protected and protected wild species of plants, animals and fungi in Serbia as strictly protected species (OFFICIAL GAZETTE RS 2010–2011), and in Annex II of the Directive on the conservation of natural habitats and wild fauna and flora (Habitat Directive, Council of the European Communities 1992).

MATERIALS AND METHODS

The investigations were conducted using recent field studies, analysis of herbarium material deposited at BEOU, and literature data. The occurrence of species in the field was recorded using a GPS device (Garmin GPS Map 64s). All other distribution data were georeferenced in the OziExplorer 3.95 4s program. Voucher specimens are deposited in the Herbarium of the Institute of Botany and Botanical Garden “Jevremovac”, Faculty of Biology, University of Belgrade (BEOU). The nomenclature of taxa mentioned in the text is in accordance with EURO+MED Plantbase. The distribution map was created using QGIS software version 3.20, and the coordinates are provided in the World Geodetic System 84 (WGS84) format.

RESULTS – DISTRIBUTION IN SERBIA

The first report on the occurrence of *A. liliifolia* in Serbia was published by Pančić (1874) and refers to population from canyon of the Derventa river on the Tara Mt. („u Podrinju idući Derventi“, sub. *Campanula alpini* L.). He collected the herbarium material much earlier, namely in 1866 (sub. *Campanula liliifolia* L.), in the Grlac canyon (canyon of Neveljski stream) in the same area of the Tara Mountain. In the following years he visited the area again and collected further herbarium materials in both the Derventa and Grlac canyons, where other researchers also collected specimens. However, both populations became extinct due to the construction of an hydroaccumulation lake in the Drina canyon, which destroyed natural habitats near the mouths of the Neveljski stream and Derventa river. The only extant population in the single till now known site in the gorge of Ibar river near Ribariće spreads more or less continuously over a length of c. 10 kilometers, predominantly between Ribariće and Batrage (surrounding of Prometanj). It is estimated to consist of more than 2000 reproductive individuals (Stevanović & Lakušić 1999). Recent field studies have shown

that the population in the Ibar gorge still persist within previously known range. During field study in 2020, few known localities of this species were visited, and it was estimated that the population consists of about 500 individuals. Although this last estimate differs from earlier one, it is assumed that the population is still large and in good condition.

According to previous authors, the occurrence of this species in Serbia could be expected both in the non-flooded part of the Drina canyon and in the gorge of Lim river (Stevanović & Lakušić 1999).

During the revision of the herbarium material deposited at BEOU (acronym according to Thiers 2024), the material determined as “*Campnula secundiflora?*”, which was collected near the border with Montenegro in the Lim gorge near Gostun, was re-examined and revised as *A. liliifolia*. The label of the specimen did not contain enough data to reliably reconstruct the exact location. Since the Lim gorge has been explored in recent decades and the main road connecting Serbia and Montenegro passes through this area, which is frequently used by botanists researching the flora of the Balkans, it was surprising that no one had discovered specimens of this species here before. This was the reason to conduct field research to determine whether this species really occurs in the gorge of Lim river, as earlier authors had assumed (Stevanović & Lakušić 1999).

With fieldwork conducted in August 2023, the presence of the species in gorge of Lim river was confirmed. The population was found beside the main road (Fig. 1), on the edge of the neighboring forest habitat.

The newly recorded population is on atypical habitat and consists of ca. 10–15 individuals on 30 m². This habitat on the roadside can be characterized as advanced successional stage of *Tussilaginetum farfarae* community type (habitat with recently disturbed soil), where species growing in adjacent forests (*Orno-Ostryon* and *Alnion glutinosae*) and fringe vegetation are colonizing the area. *Adenophora liliifolia* was recorded together with *Acer pseudoplatanus*, *Alnus glutinosa* (L.) Gaertn., *Arabis procurrens* Waldst. & Kit., *Arrhenatherum elatius* (L.) J. Presl & C. Presl, *Aruncus dioicus* (Walter) Fernald, *Brachypodium sylvaticum* (Huds.) P. Beauv., *Carlina vulgaris* L., *Cicerbita muralis* (L.) Wallr., *Clematis vitalba* L., *Clinopodium menthifolium* (Host) Stace, *Cotinus coggygria* Scop., *Daucus carota* L., *Eupatorium cannabinum* L., *Galium pseudoaristatum* Schur, *Gentiana asclepiadea* L., *Hippocrepis emerus* (L.) Lassen, *Holcus lanatus* L., *Hypericum perforatum* L., *Lathyrus vernus* (L.) Bernh., *Lembotropis nigricans* (L.) Griseb., *Lolium perenne* L., *Origanum vulgare* L., *Ostrya carpinifolia* Scop., *Pastinaca sativa* L., *Pimpinella saxifraga* L., *Poa nemoralis* L., *Solidago virgaurea* L., *Stachys recta* L., *Tussilago farfara* L., *Veronica austriaca* subsp. *teucrium* (L.) D. A. Webb, etc. Consi-

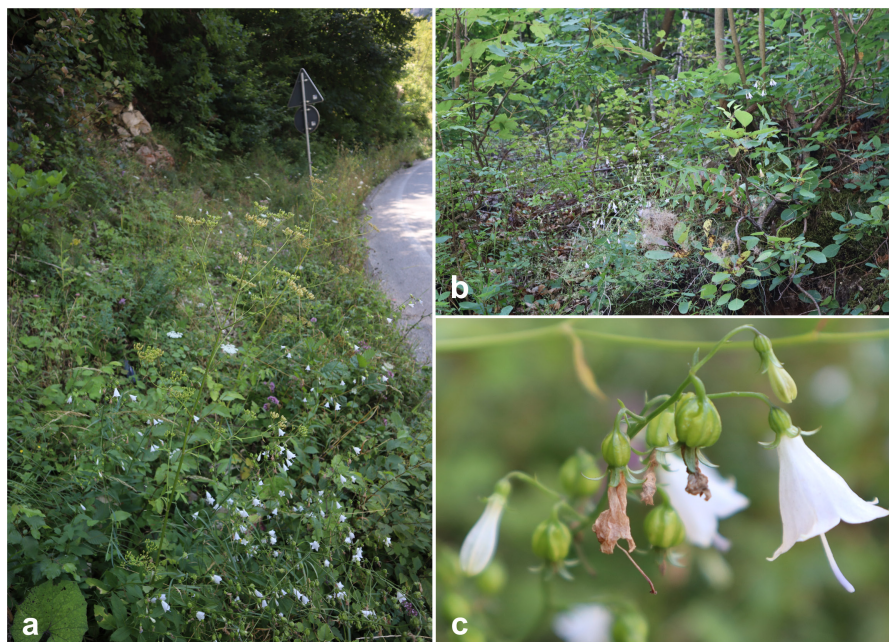


Fig. 1. – a-b) Habitat of the newly found population; c) detail of the inflorescence.

dering the ecology of the species, larger populations could occur on the banks of the Lim.

Based on all available sources (literature data, herbarium specimens and field observations), we provide chorological data and distribution map of *A. liliifolia* in Serbia (Fig. 2).

Chorological data:

WESTERN SERBIA, **Mt. Tara** (extinct): canyon of the Derventa river (Pančić, J. BEOU 9388, 07.1875); „u Podrinju idući Derventi“ (sub. *Campanula alpini*, Pančić, J. 1874); canyon Grlac (sub. *Campanula liliifolia*, Pančić, J. BEOU 9459, 07.1866.; Pančić, J. BEOU 9393, 9403, 07.1876; Jurišić, Ž. BEOU s.n., 30.08.1887).

SOUTH-WESTERN SERBIA, **Ibar gorge**: sub *Campanula* sp. (Preljević, N. BEOU 445); Ribariće, Prometanj: tall herbs, beside the river (Lakušić, D. & Preljević, N. BEOU 8639, 04.07.1998); screes and rocky grounds, sub. *Campanula versicolor*, (Preljević, N. NP 84); beside river in Ibar gorge (Preljević *et al.* 2013); northwestern part of Mokra Gora Mt, Prometanj (Radak *et al.* 2016); 42.9604786 N, 20.4317146 E, 743 m, on the rocks (Stevanoski, I., Kuzmanović, N., Preljević, N. *field obs., photo documentation*, 30.07.2020); Dužice: 42.9517272 N, 20.4233456 E, 732 m, on the rocks (Stevanoski, I., Kuzmanović, N., Preljević, N., *field obs., photo*

documentation, 30.07.2020); Batrage: rocks above the water, 42.9331668 N, 20.3985214 E, 813 m, limestone (Kuzmanović, N., Stevanoski, I., Preljević, N. BEOU 54640, 30.07.2020); 42.9517272 N, 20.4233456 E, 766 m, rocks above the water, limestone (Kuzmanović, N., Stevanoski, I., Preljević, N. BEOU 54639, 30.07.2020)

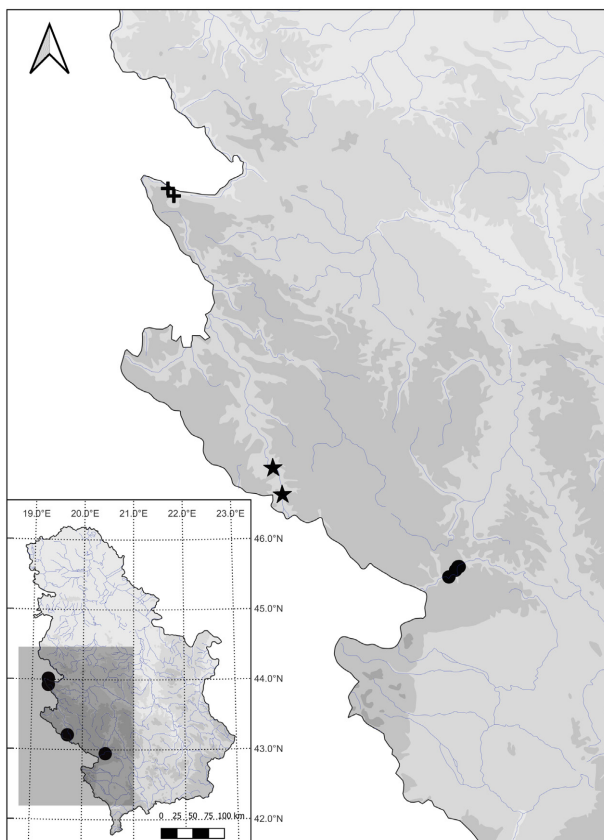


Fig. 2. – Distribution of *Adenophora liliifolia* in Serbia. Cross – extinct populations (canyon of the Derventa river and canyon Grlac), circle – herbarium, literature data and field observations (gorge of the Ibar river), star – new findings (gorge of Lim river). The overview map shows the distribution in Serbia in UTM squares of 10×10 km.

New findings:

Gorge of Lim river: Gostun, sub *Campanula secundiflora?*, close to main road bellow the cliffs, west side of the gorge, 520 m. (leg./det. Lazarević, P. s.n. 23.09.2003., rev. Vukojičić, S. 2020); Brodarevo:

43.224198 N, 19.743269 E, c. 524 m, beside the main road, edge of thermophilous hop hornbeam forest (*Kuzmanović, N.* BEOU 71247, 09.08.2023).

The recent discoveries of new populations of *A. liliifolia* in Bosnia & Herzegovina (Milanović & Stevanović 2009, Ballian & Šarić 2015, Milanović & Stupar 2017) suggest that it may also be more common in Serbia. Especially interesting are the findings in the canyon of river Lim (2–3 km upstream from its confluence with Drina), and on the right bank of river Drina (2 km downstream from the inflow of Lim) (Redžić & Šoljan 1988), which indicate that the area in southwestern Serbia along the Lim from Gostun and Brodarevo to Priboj, and further to Ustibar, needs to be studied more in detail. In addition, the area of the Đalovića gorge, which stretches through Montenegro and Serbia along the Bistrica river (right tributary of the Lim), could be a potential area for further occurrences of this species of European concern.

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НОВИ ПОДАЦИ О РАСПРОСТРАЊЕЊУ *ADENOPHORA LILIIFOLIA* (L.) A. DC. (SAMRANULACEAE) У СРБИЈИ

НЕВЕНА КУЗМАНОВИЋ, ДМИТАР ЛАКУШИЋ, ЕВА КАБАШ,
ПРЕДРАГ ЛАЗАРЕВИЋ, ИВАНА СТЕВАНОСКИ, НЕВЕНА КУЗМАНОВИЋ

Р Е З И М Е

Због губитка станишта или промена у њиховом управљању, популације врсте *Adenophora liliifolia* (L.) A. DC. у Европи су све угрожене. Зато ова биљка има статус угрожене или крајње угрожене врсте у већини европских земаља, и као таква је дефинисана као „циљна врста“, или „врста од европског значаја“ која захтева посебну бригу. На простору Балканског полуострва *A. liliifolia* је ретка и присутна само у земљама западног Балкана (Босна и Херцеговина, Црна Гора, Хрватска и Србија). У Србији се води као ишчезла из њеног западног дела (кањони Дервенте и Грлац на планини Тари), док је у југозападној Србији, на до сада једином познатом локалитету у клисури реке Ибар, у добром стању. Ревизијом хербарског материјала у Хербаријуму *BEOU* пронађен је примерак *Adenophora liliifolia* сакупљен у клисури Лима код Гостуна. Теренским истраживањима тог дела клисуре установљена је популација ове врсте у околини Бродарева, на атипичном станишту, поред магистралног пута ка Црној Гори. Потрага за новим налазиштима ове међународно значајне врсте у клисури Лима, од Гостуна и Бродарева, и даље до Устибара, биће настављена у наредном периоду.