

# Contribution to Understanding the Distribution of the Species *Campanula austroadriatica* D. Lakušić & Kovačić in Bosnia and Herzegovina

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## Abstract

The paper offers an overview of the distribution of the endemic species *Campanula austroadriatica* D. Lakušić & Kovačić in Bosnia and Herzegovina, based on the revision of herbarium specimens from the herbarium of the National Museum in Sarajevo (SARA), literature data, and our own field research. Additionally, a brief morphological description and photographs of the species are provided. The species *Campanula austroadriatica* D. Lakušić & Kovačić is present in Bosnia and Herzegovina in 23 localities spread over 13 UTM squares, all localities are located within the Mediterranean biogeographical region.

**Keywords:** *Campanula austroadriatica* D. Lakušić & Kovačić, endemic species, distribution, habitat, Bosnia and Herzegovina.

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## 1. Introduction

The genus *Campanula* is the largest genus of the Campanulaceae family (Park et al., 2006). However, when it comes to the number of species and lower taxonomic categories, there is considerable disagreement, with estimates ranging from 350 to 450 species (Ančev, 1994; Lammers, 2007). These species are distributed from the Arctic and temperate zones of the Northern Hemisphere to the south to Eastern Africa, Southern Asia, and Northern Mexico. Presently, there are around 200 species of the genus *Campanula* in Europe (Fedorov and Kovanda, 1976). New species are constantly being described (Kovanda, 1999), and based on research, some change status (Lakušić and Conti, 2004). On the Balkan Peninsula, over 100 species and subspecies have been recorded (Fedorov and Kovanda, 1976; Kovačić, 2004; Škondrić et al., 2014), with a significant proportion being endemics (Kovačić, 2004; Škondrić et al., 2014). This is why the Balkan Peninsula is designated as one of the centers of diversity for the genus. In the past decade, several new species have been described in the Balkan Peninsula: *Campanula austroadriatica* D. Lakušić & Kovačić (Lakušić et al., 2013); *C. skanderbegii* Bogdanović, Brullo & D. Lakušić (Bogdanović et al., 2014a); *C. teutana* Bogdanović & Brullo (Bogdanović et al., 2014b); and *C. aureliana* Bogdanović, Rešetnik, Brullo & Shuka (Bogdanović et al., 2015).

According to the Flora of Bosnia and Herzegovina (Beck-Mannagetta et al., 1983), the genus *Campanula* is represented by 24 species from two sections: sect. *Campanula* and sect. *Rapunculus* Dumort. Abadžić and Šilić (1990) later supplemented this list with two more species for the territory of Bosnia and Herzegovina (*Campanula waldsteiniana* Schult. and *C. thyrsoides* L.), and Šoljan (2001) added another two species (*Campanula spicata* L. and *C. trichocalycina* Ten.). In the meantime, new species have been described for Bosnia and Herzegovina (Maslo and Boškailo, 2015) and certain changes in names have been made. Authors Lakušić et al. (2013) conducted a detailed phylogenetic study of the *Campanula pyramidalis* L. complex by analyzing molecular data obtained by sequencing nuclear internal transcribed spacers (ITS) and three non-coding chloroplast regions (*psbA-trnH*, *psbZ-trnfM*, *trnG-trnS*). The results of this study indicate the existence of three different groups of populations in the form of three well-supported phylogenetic branches in phylogenetic networks and trees. Specifically, the existence of a new species (*Campanula austroadriatica* D. Lakušić & Kovačić, sp. nov.) south of the Neretva River valley was noted. A herbarium specimen from the University of Belgrade Herbarium (BEOU) No. 31510 collected in the Risan locality, Boka Kotorska, Montenegro, was designated as the holotype of this species. *Campanula austroadriatica* is described as a long-lived plant with a densely interwoven rhizome from which several erect stems with numerous flowers emerge. The lower part of

the stem becomes woody. The leaves are serrated, somewhat fleshy, and the teeth have glandular edges. Basal leaves are ovate-heart-shaped to ovate-lanceolate. The upper leaves are sessile and taper towards the base. The widely bell-shaped flowers are almost sessile, clustered in a long inflorescence 30-100(-120) cm long. The corolla is bell-shaped, purple to light bluish-purple, usually with dark blue in the center, composed of five fused petals. There are five stamens. The fruit is a capsule with many small seeds, 0.9-1.0 x 0.4-0.5 mm in diameter. This species has been recorded in the following countries: Croatia (Nikolić, 2019), B&H (Maslo and Boškailo, 2015), Montenegro (Lakušić et al., 2013), and Albania (Barina et al., 2018).

The main goal of this paper is to contribute to the understanding of the distribution of the species *Campanula austroadriatica* D. Lakušić & Kovačić in Bosnia and Herzegovina.

## 2. Material and Methods

Data on the distribution of the species were collected based on available literature sources, analysis of herbarium material, and the authors field research conducted in the period from 2016 to 2022. The determination was made using the key: Nikolić (2019). Nomenclature is harmonized with the Euro+Med PlantBase (2006-2023), the information system for the vascular flora of Europe and the Mediterranean. All collected data were georeferenced using the ArcGIS 10.4 software program. For displaying the distribution of the given species, the UTM grid 10 x 10 km (Lampinen, 2001) was used with the dot method according to Walter and Straka (1970) for a more complete field coverage and ensuring a satisfactory level of exploration and thus objectivity in the representation of distribution status.

## 3. Results

The species *Campanula austroadriatica* D. Lakušić & Kovačić has been separated from the species *Campanula pyramidalis* L. in the territory of B&H (Maslo and Boškailo, 2015), where it is stated, that all findings of *Campanula pyramidalis* L. in Herzegovina are attributed to the species *Campanula austroadriatica* D. Lakušić & Kovačić. The first data on the presence of this species in the territory of B&H are mentioned by Vandas (1909), and then K. Malý (1910) confirmed it at the following locations: around Hrasno, Čapljina, Ravnog, and Zavala-Čvaljina. Autor Đuran in Beck-Mannageta (1983) mentions it for the area of Mountain Žaba near Hutovo. The following data are found after the year 2000, Maslo and Boškailo (2015) mention it for the following locations: Bivolje Polje, Počitelj, and one herbarium specimen is stored in the Herbarium of the National Museum of Bosnia and Herzegovina

(Čapljina: Počitelj, leg. et det. Boškailo, A. & Maslo, S., 22.10.2015, inv. no. 51435., SARA), and Boškailo et al. (2016) confirmed it at the locations: Ravno and near Ljubinj. Through new field research, it has been confirmed at the following locations: Čapljina - Hutovo blato, Neum - Klek, Neum, Klobuk (border crossing), Trebinje - Trebinjsko jezero, Trebinje - Stari Grad, Trebinje - near Donji Čičava, Trebinje - Skočigrm, Trebinje - Strujići, Čapljina - Cerovica, Čapljina - Dretelj, (Figure 1; Figure 2; Table 1).

Table 1: Findings of the species *Campanula austroadiatica* D. Lakušić & Kovačić in Bosnia and Herzegovina

No.	Wider locality	Narrower locality	Habitat	Coordinate	Altitude	Source	Year	UTM
1.	Neum	around Hrasna	-	42,95175 17,91657	335 m	Malý, 1910;	1910	YH36
2.	Čapljina	around Čapljine	fissures in limestone rocks	43,12214 17,72075	35 m	Malý, 1910; Field finding	1910	YH27
3.	Ravno	Ravno	fissures in limestone rocks	42,8792 17,9728	256 m	Malý, 1910; Field finding;	1910	YH45
4.	Ravno	Zavala-Čvaljina	fissures in limestone rocks	42,86832 17,97095	331 m	Malý, 1910; Field finding	1910	YH44
5.	Neum	Mt. Žaba	fissures in limestone rocks	42,95403 17,80015	391 m	Beck-Mannageta, 1983; Field finding	1983	YH26
6.	Čapljina	Bivolje Polje	fissures in vertical limestone rocks	43,15737 17,76030	47 m	Field finding; Maslo et Boškailo, 2015; Maslo in Nikolić, 2023	2015	YH28
7.	Čapljina	Bivolje Polje	fissures in vertical limestone rocks	43,15737 17,76030	47 m	SARA!; Field finding	2015	YH28
8.	Čapljina	Počitelj	fissures in vertical limestone rocks	43,14526 17,73430	34 m	Maslo et Boškailo, 2015; Maslo in Nikolić, 2023; Field finding	2015	YH27
9.	Ravno	Ravno	fissures in limestone rocks	42,89065 17,99765	327 m	Boškailo et al., 2016	2016	YH45

No.	Wider locality	Narrower locality	Habitat	Coordinate	Altitude	Source	Year	UTM
10.	Ljubinje	at Ljubinja	fissures in limestone rocks	42,92485 18,05620	573 m	Boškailo et al., 2016	2016	BN65
11.	Čapljina	Hutovo	fissures in limestone rocks	42,96708 17,79961	457 m	Field finding; Bukvić et al., 2020; Maslo in Nikolić, 2023;	2016	YH27
12.	Neum	Klek	fissures in limestone rocks	42,91230 17,62297	46 m	Field finding; Maslo in Nikolić, 2023	2016	YH15
13.	Neum	Neum	fissures in limestone rocks	42,92955 17,61008	51 m	Field finding	2016	YH15
14.	Trebinje	Klobuk (border crossing)	fissures in limestone rocks	42,71121 18,55403	854 m	Field finding	2016	BN93
15.	Trebinje	Trebinjsko jezero	fissures in limestone rocks	42,70336 18,39035	309 m	Field finding	2016	BN83
16.	Trebinje	Stari Grad	fissures in limestone rocks	42,71009 18,35116	274 m	Field finding	2016	BN83
17.	Trebinje	at Donjeg Čičava	fissures in limestone rocks	42,67095 18,34900	420 m	Field finding	2016	BN82
18.	Trebinje	Skočigrm	fissures in limestone rocks	42,68735 18,51973	427 m	Field finding	2016	BN92
19.	Trebinje	Strujići	fissures in limestone rocks	42,88998 17,99336	268 m	Field finding	2016	YH45
20.	Čapljina	Cerovica	fissures in limestone rocks	42,98161 17,79928	349 m	Field finding	2020	YH26
21.	Čapljina	Dretelj	fissures in limestone rocks	43,13108 17,72248	51 m	Field finding	2022	YH27
22.	Ravno	Orahov Do	fissures in limestone rocks	42,82767 17,92851	343 m	Field finding	2022	YH34
23	Ravno	Čvaljina	fissures in limestone rocks	42,868731 17,970421	354 m	Field finding	2022	YH45

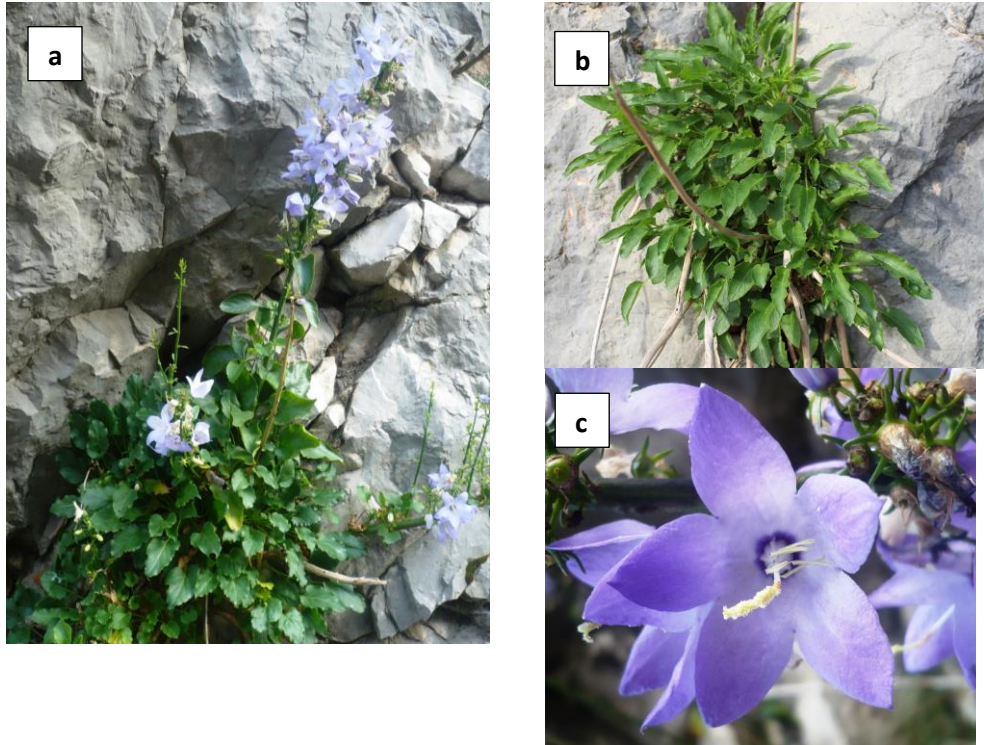


Figure 1: *Campanula austroadriatica* D. Lakušić & Kovačić: a) habitat of the species in the area of Klobuk near Trebinje; b) leaves; c) blossom (photo: Boškailo, A.)

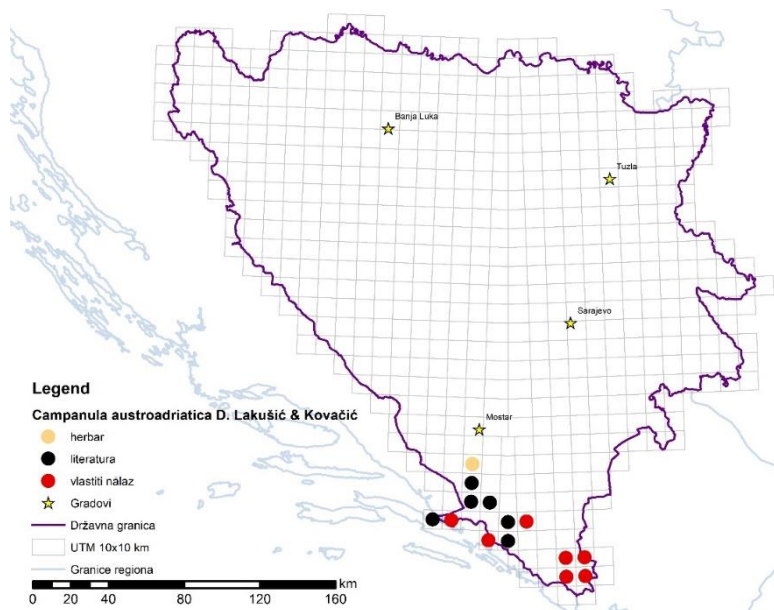


Figure 1: Distribution of the species *Campanula austroadriatica* D. Lakušić & Kovačić in Bosnia and Herzegovina

Based on the current analysis of available herbarium, literature data, and authors field research in B&H, 23 findings have been recorded in 13 UTM squares (Table 1; Figure 2). Populations of *Campanula austroadriatica* can be found within the vegetation of rock crevices (*Asplenietea rupestris*), and less often within the vegetation of sedges (*Drypetea spinose*), on limestone, on altitudes from 0 to 1.000 m. In urban habitats they can be found on old walls and fortresses (Lakušić et al., 2013).

Based on the provided map, it is evident that all findings are from the Mediterranean biogeographical region (European Environment Agency, 2002). Considering the fact that the species *C. pyramidalis* L. is listed on the Red List of protected species of flora and fauna of Republika Srpska (Anonymus, 2012) and on the Red List of the Federation of Bosnia and Herzegovina (Đug et al., 2013) under the category NT - Nearly threatened species, it is evident that the data from this study will represent a significant basis for assessing the threatened status of this species when creating the future Red List of Bosnia and Herzegovina.

#### 4. Conclusions

The species *Campanula austroadriatica* D. Lakušić & Kovačić is present in Bosnia and Herzegovina across 23 distinct locations spread across 13 UTM squares, all situated within the Mediterranean biogeographical region. This species exhibits a preference for inhabiting cracks found within limestone rocks. The information highlights the importance of ongoing monitoring efforts, as there remains a significant likelihood of identifying additional locations where this species thrives within the Mediterranean biogeographical region. Such monitoring is crucial for understanding the distribution, ecology, and conservation needs of *Campanula austroadriatica* in Bosnia and Herzegovina.

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