Two neglected species of the genus *Geranium* L. (Geraniaceae) in the vascular flora of Bosnia and Herzegovina

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Abstract

This paper represents a survey of the distribution of two poorly documented *Geranium* species in Bosnia and Herzegovina and Croatia (*G. bohemicum* and *G. divaricatum*) based on a revision of herbarium material from SARA, CNHM, ZA, ZAHO and ZAGR collections, literature data and field observations. In addition, a short morphological description and photographs of these species are presented. Special attention was given to the IUCN categories of these species.

Keywords: Distribution, *Geranium bohemicum, Geranium divaricatum*, rare species

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Sažetak

Ovaj rad predstavlja pregled rasprostranjenosti dviju slabo dokumentiranih vrsta roda *Geranium* (*G. bohemicum* i *G. divaricatum*) u Bosni i Hercegovini i Hrvatskoj na temelju revizije herbarijskog materijala iz herbarijskih zbirki SARA, CNHM, ZA, ZAHO i ZAGR, literaturnih podataka i terenskih opažanja. Dodatno je prikazan kratki morfološki opis i fotografije ovih vrsta. Posebna pozornost posvećena je IUCN kategorijama navedenih vrsta.

Ključne riječi: *Geranium bohemicum, Geranium divaricatum*, rasprostranjenost, rijetke vrste

Introduction

Geranium L. (Geraniaceae Juss.) is a genus of about 400 species, distributed throughout most of the world (Aedo et al. 1998a), represented by 86 species in the Euro-Mediterranean region (Aedo 2009). Approximately 20 species of the genus *Geranium* are mentioned in the flora of Bosnia and Herzegovina (Beck-Mannagetta 1920), while 26 taxa of the genus are present in Croatian flora (Nikolić 2005-onwards). Some species in Bosnia and Herzegovina, as well as in Croatia, such as *G. bohemicum* and *G. divaricatum* are very rare with a limited distribution. For these species, there are mostly old findings from the literature, while the current state of their distribution is quite unknown (Beck-Mannagetta 1920, Nikolić 2005-onwards).

Geranium bohemicum L. (Fig. 1) is a summer or winter annual with erect, leafy stems which can reach a height of 60 cm. Both stalks and leaves have glandular hairs. Leaves are 2-6 cm wide, divided 75% of the radius into 5 to 7 lobes. Peduncles are longer than the subtending leaves. The flowers are bright violet, with 9-12 mm long, aristate sepals and 8-9 mm long, emarginate petals. The stigma is white. Seeds are finely reticulate, brownish. Detailed description of the taxon can be found in Aedo (2023).

G. bohemicum belongs to the Eurasian floral element and its native distribution range is Europe to Caucasus. The species grows in open areas, usually on recently burned sites, between 20 and 1800 m (Aedo et al. 2007). Up to date, *G. bohemicum* was reported in the Balkans in Albania (Barina et al. 2018), Bosnia and Herzegovina (Malý 1904), Bulgaria (Petrova & Kozhuharov 1979), Croatia (Hayek 1927; Nikolić 2005-onwards), Greece (Dimopoulos et al. 2013), Montenegro (Hayek 1927, Rohlena 1942), North Macedonia (Aedo et al. 2007) and Serbia (Janković 1973).

G. bohemicum is a fire prone species that establishes after forest fires and is found almost exclusively on burnt lands. Its seed is covered with a shell which is impermeable to water and which is dependent on heat for germination (Risberg & Granström 2015). It is an annual plant with a long-lived seed bank which remains viable over long time periods (Milberg 1994). In this way, the species is well adapted to occasional natural forest fires, without which the seeds of the species cannot germinate. In this way, the species appears in some areas after a long period of time, which explains the scattered distribution and temporal disappearance of the species in some localities (Aedo et al. 2007).

Geranium divaricatum Ehrh. (syn. *Geranium winterlii* Roth, *Geranium bohemicum* Krock.) (Fig. 2). is a widely branched annual, 20-50 cm tall with long eglandular hairs and short glandular and eglandular hairs. Dimensions of basal leaves in rosettes are 3-7 × 3-8 cm, divided for 75-85% of the radius into 3-5 shortly pinnatifid lobes with obtuse segments. Upper leaves are opposite, palmatifid with rhombic-oblong segments. Pedicels are shortly glandular-pubescent, deflexed in fruit. Sepals are shortly mucronate. Petals are 5-7 mm, equaling the sepals, emarginate, bright purple. Mericarps are pubescent, transversely ridged above, beakless when ripe. Detailed description of the taxon can be found in Aedo (2023).

G. divaricatum belongs to Pontic-South-Siberian floral element (Pignatti 1982) and its native distribution range is Europe, Central Asia, China, and the Indian subcontinent. It grows mostly on waste places, stony dry slopes, field margins, and shady wood borders, between 0 and 2100 m (Aedo et al. 1998b). Up to date, *G. divaricatum* was reported in the Balkans in Albania (Barina et al. 2018), Bosnia and Herzegovina (Hofmann 1882), Bulgaria (Petrova & Kozhuharov 1979), Croatia (Nikolić 2005-onwards), Greece (Dimopoulos et al. 2013), North Macedonia (Micevski 2005), Serbia (Janković 1973) and Turkey (Davis 1967).

Material and methods

The study was carried through field expeditions in Central Bosnia conducted between 2015 and 2022, analysis of herbarium material deposited at SARA, CNHM, ZA, ZAHO and ZAGR (Thiers 2023), as well as literature data. Digital photographs were taken in the field. The nomenclature follows Aedo (2009-onwards). The distribution of the species in Bosnia and Herzegovina is shown on the map using standard UTM grid 10 × 10 km (Fig. 2). A list of all localities representing the distribution of *G. bohemicum* and *G. divaricatum* in Bosnia and Herzegovina is given in Table 1. with WGS1984 coordinates. The presence and distribution of both species in neighbouring Croatia has also been discussed. The IUCN guidelines were used for the classification of taxa into IUCN categories (IUCN 2012).

Results and discussion

Geranium bohemicum

The occurrence of *G. bohemicum* in the flora of Bosnia and Herzegovina was firstly noted by Malý (1904) in the area of Igman Mt. near Ilidža. Although known from several localities mentioned in older botanical literature (Malý 1904, 1908, 1910, 1912, 1928, 1933, 1938; Beck-Mannagetta 1920), findings of *G. bohemicum* in Bosnia and Herzegovina in the last 80 years have been very rare (Ritter-Studnička 1970). In the Herbarium of the National Museum of Bosnia and Herzegovina (SARA), nine specimens of *G. bohemicum* were stored. Eight specimens were collected by Malý, mostly in the mountainous areas around Sarajevo, between 1901 and 1931. One specimen was collected by Ritter-Studnička on serpentine substrates near Konjuh Mt. in 1959. On the other hand, three specimens were deposited in the ZA herbarium, but they were all collected in the mountains of central Bosnia by Malý between 1908 and 1926 (Tab. 1). During the field research in Central Bosnia conducted between 2015 and 2022, six new localities of *G. bohemicum* were recorded. This species was found on serpentines on the slopes of the Konjuh Mountain as well as near the towns of Vareš, Olovo and Zavidovići (Tab. 1) mostly on recently burned sites (Fig. 1). Its altitude range varies here between 291 and 1150 m.

According to all known data, we could conclude that *G. bohemicum* has scattered distribution in the central (mountainous) part of Bosnia and Herzegovina. This species is known only from sixteen UTM quadrants in Bosnia and Herzegovina (Fig. 3). Considering the low number of individuals and small extent occurrence *G. bohemicum* should be treated as a data deficient (DD) species in the flora of Bosnia and Herzegovina.

Figure 1. *Geranium bohemicum* on the slopes of Konjuh Mt.: habitus (1a), flower and fruit (1b) (Photos Š. Šarić).

The only record in Croatia is that of Hayek (1927), but without citing any localities, which was also reported by Nikolić (1996), about half a century later, but this record was never confirmed afterwards. This species should be listed as dubious taxon in Croatia because there are no other records of the taxon reported from the country, which was also evident by the absence of voucher specimens kept in Croatian herbariums (CNHM, ZA, ZAHO and ZAGR). New field research is necessary to confirm the eventual presence of this species in Croatia.

Geranium divaricatum

The oldest record from Bosnia and Herzegovina is from the Banja Luka area (Hofmann 1882). Subsequently, the species was recorded only in two locations in Bosnia and Herzegovina: Bileća (Vandas 1888) and the Varda Mountain near Rudo (Malý 1908). After more than a century, these records have only historical value (Fig. 4, Tab. 1).

During field research in central Bosnia in June 2022, the species was recorded in a new locality. About a dozen individuals have been recorded near Olovski krševi (Tab. 1, Fig. 2). The population was found near town of Olovo, on rocky places at an altitudinal range of 572 m a.s.l. At that locality *G. divaricatum* was accompanied by *Acer campestre* L., *Acer monspessulanum* L., *Allium sphaerocephalon* L., *Campanula rapunculus* L., *Carpinus betulus* L., *Cerastium rectum* Friv., *Corydalis ochroleuca* Koch., *Corylus avellana* L., *Erysimum cuspidatum* (M. Bieb.) DC., *Geranium molle* L., *Smyrnium perfoliatum* L. and *Viola tricolor* subsp. *alpestris* (Ging.) Ces.

Considering the low number of individuals and small extent occurrence (Fig. 4) *G. divaricatum* should be treated as a data deficient (DD) species in the flora of Bosnia and Herzegovina.

The species was firstly recorded for Croatia by Schlosser & Vukotinović (1869) for the area of Čerević in Slavonia, which was part of Croatia during the 19th century, but today is in Srijem (Vojvodina, Serbia). On the other hand, first herbarium specimen was collected near Rasinja and Cvetkovec in Podravina, by Schlosser in the end of the 19th century (ZA). The first modern reference in the literature for the area of Croatia refers to the locality Đurđevački pijesci in Podravina (Kušt 2001). Only recently, the species was also recorded in the area of central Dalmatia (Mekinić et al. 2013, Hršak et al. 2023).

According to Nikolić (2005-onwards), the species has recently been recorded in several other localities in Dalmatia (for distribution map, see Nikolić 2005-onwards). Since there is a high probability of misidentification and confusion with other species, especially with *G. dissectum* L., this data still needs to be checked, especially since there is no herbarium material stored in Croatian collections (CNHM, ZA, ZAHO and ZAGR). Until then, the species should be treated as data deficient (DD) in Croatia.

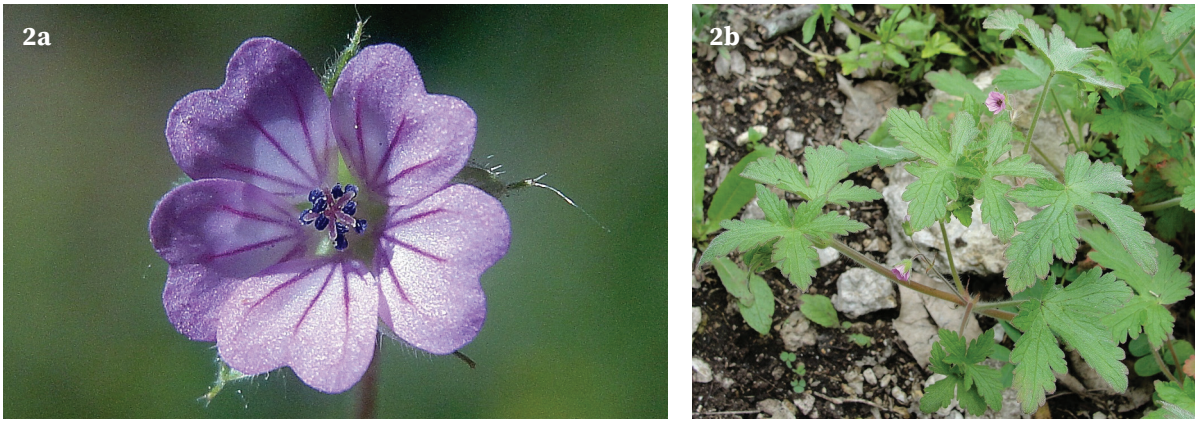

Figure 2. *Geranium divaricatum* in Olovski krševi: habitus (2a), flower (2b) (Photos Š. Šarić).

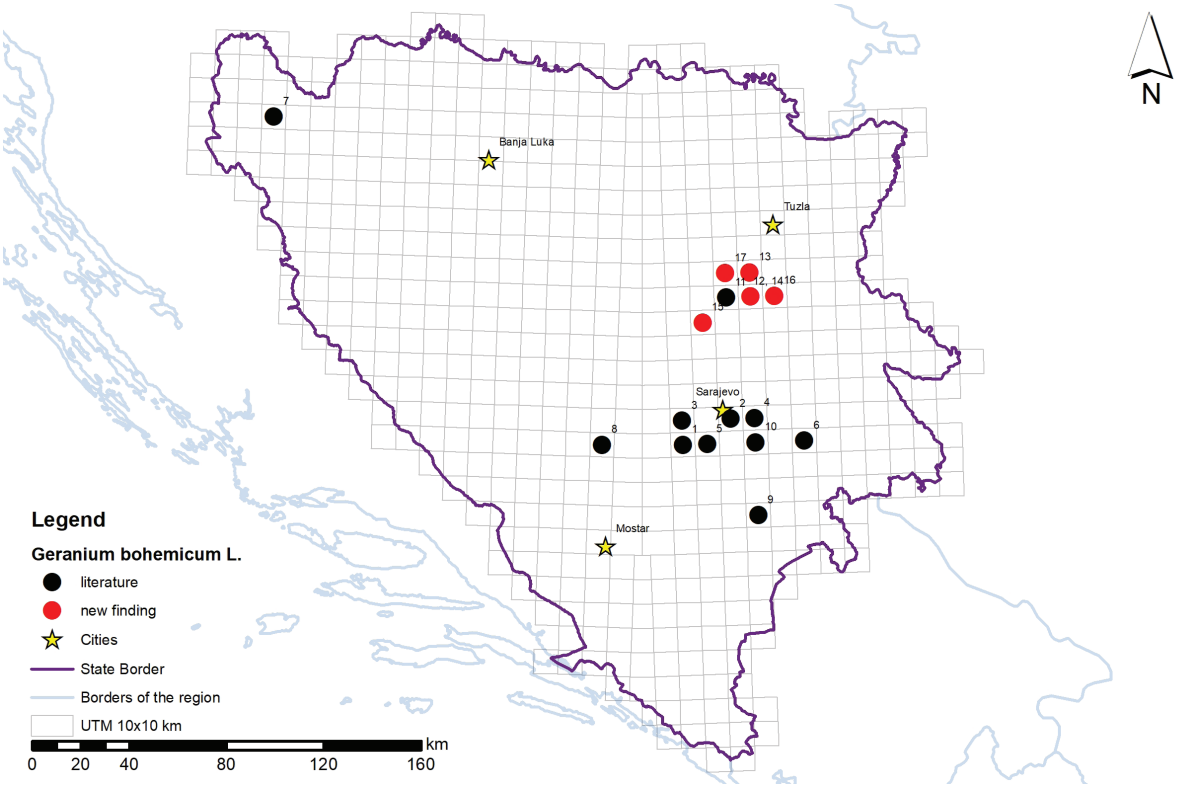

Figure 3. The distribution of *Geranium bohemicum* in Bosnia and Herzegovina. Black circles – old records, red circles – new records. Numbers correspond to localities in Table 1.

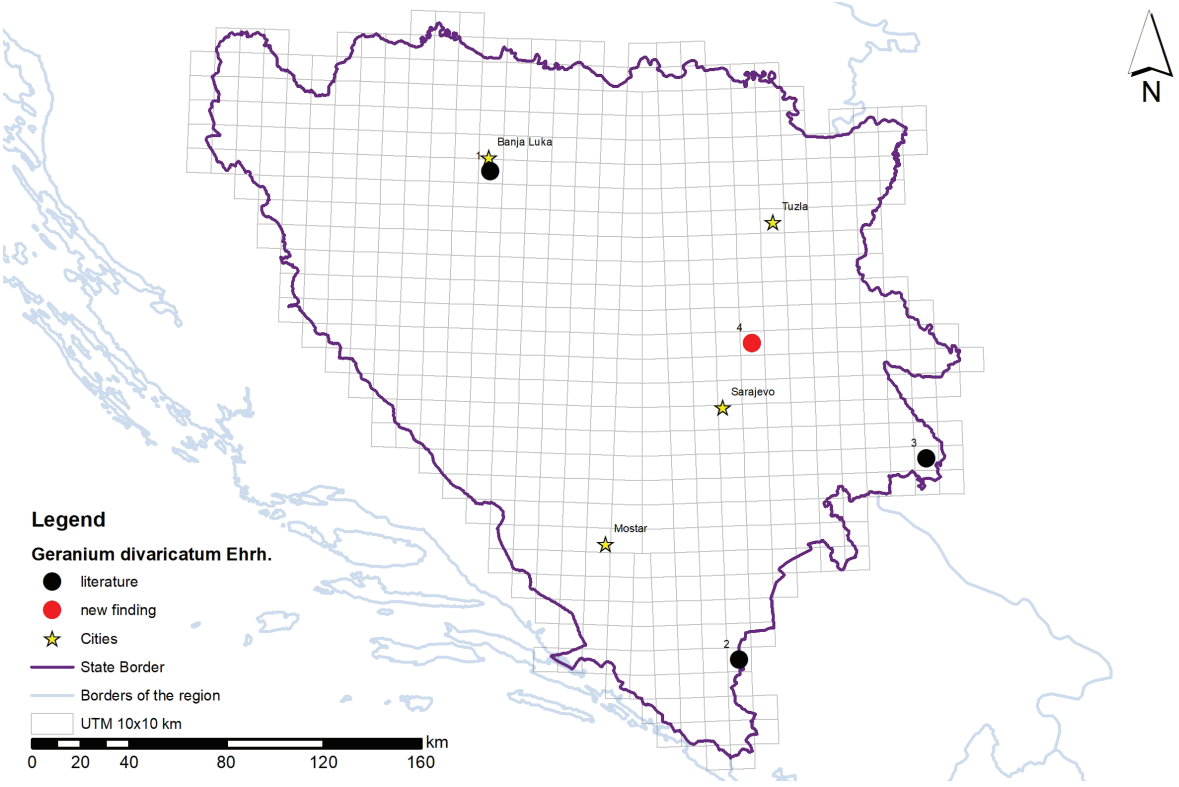

Figure 4. The distribution of *Geranium divaricatum* in Bosnia and Herzegovina. Black circles – old records, red circles – new records. Numbers correspond to localities in Table 1.

Table 1. Georeferenced data on the distribution of *Geranium bohemicum* and *G. divaricatum* in Bosnia and Herzegovina (new records are marked in bold). Numbers in brackets indicate the position on the map in Figure 2.

Taxon	Locality, observer/collector, date, herbarium collection number	WGS coordinates	Altitude	UTM quadrant
G. bohemicum	Igman Mt. Malo Polje, leg. Balealović 14.07.1901 (SARA 21882), Malý 1904	43°46'10"N, 18°14'53"E	1200 m	BP74
G. bohemicum	Trebević Mt., Studeno brdo, leg. Malý 09.07.1905 (SARA 21885), Beck-Mannagetta 1920	43°49'39"N, 18°26'45"E	1400 m	BP95
G. bohemicum	Igman Mt., Golo brdo, leg. Malý 22.06.1905 (SARA 21886), Malý 1908	43°47'27"N, 18°15'52"E	1248 m	BP75
G. bohemicum	Bare near Pale, leg. Malý 25.08.1907 (SARA 21884), Beck-Mannagetta 1920, Aedo & al 2007	43°48'07"N, 18°33'31"E	960 m	CP05
G. bohemicum	Igman Mt. Hrastnički stan-Veliko polje, leg. Malý 20.07.1908 (SARA 21887)Malý 22.07.1908 (ZA)	43°45'52"N, 18°17'29"E	1400 m	BP84
G. bohemicum	Melac Mt.near Banja Stijena, leg. Malý 26.06.1910 (SARA 21889: SARA 21890; ZA), Malý 1910	43°45'38"N, 18°52'21"E	900 m	CP24
G. bohemicum	Velika Gomila near Krupa, Una River, Beck-Mannagetta 1920	43°53'24"N, 16°04'08"E	700 m	WK87
G. bohemicum	Bokševica Mt. near Ostrožac, leg. Malý 11.07. 1926 (SARA 21883; ZA), Malý 1928	43°43'27"N, 17°46'16"E	1300 m	YJ24
G. bohemicum	Stabrovača Mt. near Jeleč, leg. Malý 08.07.1931 (SARA 21888), Malý 1933	43°28'42"N, 18°34'19"E	1390 m	CP01
G. bohemicum	Ravna Mt. near Jahorinski potok Malý 1938	43°46'17"N, 18°37'34"E	1150 m	CP04
G. bohemicum	Konjuh Mt. Modra Ploča, Brezanje, leg. Ritter-Studnička 22.06.1959 (SARA 48989), Ritter-Studnička 1970	44°18'02"N, 18°27'40"E	939 m	BQ90

Taxon	Locality, observer/collector, date, herbarium collection number	WGS coordinates	Altitude	UTM quadrant
G. bohemicum	**Konjuh Mt., Zidine, serpentine. Three flowering individuals; leg Šarić, 15.06.2015 (SARA 53261)**	**44°18'49"N, 18°31'15"E**	**1150 m**	**CQ00**
G. bohemicum	**Konjuh Mt., Župeljeva, serpentine. Five flowering individuals; obs Šarić, 28.07.2019**	**44°17'54"N, 18°31'12"E**	**904 m**	**CQ00**
G. bohemicum	**Konjuh Mt., Ravni Bor, serpentine. Two flowering individuals; obs Šarić, 08.07.2022.**	**44°19'08"N, 18°30'27"E**	**1080 m**	**CQ01**
G. bohemicum	**Vareš, Pogar, serpentine. Three flowering individuals; obs Šarić, 10.08.2018**	**44°12'22"N, 18°18'28"E**	**1150 m**	**BP89**
G. bohemicum	**Olovo, Mala Maoča, serpentine. Two flowering individuals; obs Šarić, 07.07.2016**	**44°18'03"N, 18°39'50"E**	**926 m**	**CQ10**
G. bohemicum	**Zavidovići, Ribnica, serpentine. One flowering individual; obs Šarić, 07.07.2016**	**44°21'08"N, 18°23'26"E**	**291 m**	**BQ91**
G. divaricatum	Banja Luka, Hofmann 1882	44°44'49"N, 17°09'38"E	300 m	XK75
G. divaricatum	Bileća, Vandas 1888	42°52'33"N, 18°25'44"E	467 m	BN95
G. divaricatum	Varda Mt. near Rudo, leg Malý 08.06.1908 (SARA 21931), Malý 1912	43°39'04"N, 19°24'12"E	100 m	CP73
G. divaricatum	**Olovski krševi, Olovo, leg Šarić 15.06.2022 (SARA 53267)**	**44°07'36"N, 18°34'29"E**	**572 m**	**CP08**

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