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A new subspecies of *Cephalaria pastricensis* Dörfl. & Hayek (Dipsacaceae) from North Macedonia

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Abstract – *Cephalaria pastricensis* subsp. *pologensis* Teofilovski (Dipsacaceae), from NW North Macedonia, is reported as a new subspecies to science. It is distinguished from *C. pastricensis* Dörfl. & Hayek subsp. *pastricensis* by its densely, ± patent-subvillous petioles and rachis of the leaves, and the midrib of the lower surface of the leaf lobes (vs. with sparse, short, ± appressed hairs), densely pubescent lower surface of the leaves (vs. with scattered hairs on the nerves), and densely pubescent to subglabrous upper surface of the leaves (vs. glabrous or with scattered hairs on the nerves). The new subspecies is a Macedonian endemic known from small areas in the Šar Mountains (near Brezno village) and Mt. Buković (near Gorna Đonovica village). Its distribution range is geographically distinct from that of *C. pastricensis* subsp. *pastricensis,* which is a Balkan endemic, distributed in Albania, Montenegro, Bosnia and Herzegovina, Kosovo, and Serbia.

Keywords: *Cephalaria pastricensis* subsp. *pologensis,* indumentum, new subspecies, North Macedonia

Introduction

The genus *Cephalaria* Schrader (Dipsacaceae) is distributed from N Africa and S & SE Europe to W China, with some species also occurring in parts of S Africa (Szabó 1940). This author quoted 65 species worldwide while since then, the number of known species has been raised to 94 (Göktürk and Sümbül 2014). With 11 native species, the Balkan Peninsula has a relatively low diversity [compared e.g. to 39 species representing the genus in Turkey (Göktürk and Sümbül 2014)]. In the flora of North Macedonia, the following six native species are known so far: *C. ambrosioides* (Sibth. & Sm.) Roem. & Schult., *C. flava* (Sibth. & Sm.) Szabó, *C. leucantha* (L.) Roem. & Schult., *C. pastricensis* Dörfl. & Hay., *C. transsylvanica* (L.) Roem. & Schult., and C. *uralensis* (Murray) Roem. & Schult. The only adventive species known in North Macedonia as well as in the Balkan Peninsula is the SW Asian *C. syriaca* (L.) Roem. & Schult.

Cephalaria pastricensis is a Balkan endemic, with a dispersed distribution in NE & SE Albania, Montenegro, C, E & S Bosnia and Herzegovina, W Kosovo, C & E Serbia, and NW North Macedonia (Hayek 1921, Szabó 1940, Millaku et al. 2013, Teofilovski 2014, Tomović et al. 2022). Babalonas (1983) reported this species also for NW Greece, however, according to Constantinidis and Phitos (2004) this report actually refers to a species belonging to another section.

In North Macedonia it is a very rare species, discovered relatively recently, in two localities near Brezno village in the Šar Mountains (Teofilovski 2014) [these data were erroneously referenced by Tomović et al. (2022) to "Vladimirov et al. 2014"]. Despite the identified differences in the indumentum between the collected specimens and typical *C. pastricensis*, due to the lack of additional information, they were not taken into consideration in the cited article. In the summer of 2022, during extensive fieldwork in the forest area south of Gostivar (NW North Macedonia), *C. pastricensis* was also recorded in Mt. Buković, with the indumentum of all the observed individuals matching those of the plants from Šar Mountains. The uniform indumentum of the plants from both mountain areas, obviously not matching that of the typical *C. pastricensis*, motivated the author to study the taxonomic position of the recorded populations. The comparative analysis showed that Macedonian populations should be classified as a separate subspecies of *C. pastricensis*.

Materials and methods

During fieldwork conducted in 2012, 2013, and 2022, appropriate parts of representative plants were collected and

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photographed. The collected material was herbarized and stored in the author's private herbarium, in the Herbarium of the Institute of Biology, Faculty of Natural Sciences and Mathematics in Skopje (MKNH), and the Herbarium of the Natural History Museum of the Republic of North Macedonia. Scans of herbarium specimens from the type collection and several other collections of *C. pastricensis* were used as comparative material (details listed in Discussion). Relevant literature related to the taxonomy of the genus *Cephalaria* was used during the morphological study of the collected material (Hayek 1921, Hayek 1928–1931, Szabó 1940, Matthews 1972, Diklić 1973, Ferguson 1976, Pignatti 1982, Kokkini 1991). Diagnosis of the newly described subspecies accompanied by a comparative table of the diagnostic characteristics and relevant photographs is presented. The distribution of the new subspecies is mapped.

Results

***Cephalaria pastricensis* subsp. *pologensis* Teofilovski, subsp. nov.**

Diagnosis: *Cephalaria pastricensis* subsp. *pologensis* Teofilovski, subsp. nov. differs from *C. pastricensis* Dörfl. & Hayek subsp. *pastricensis* by its densely, ± patent-subvillous petioles and rachis of the leaves, and the midrib of the lower surface of the leaf lobes (vs. with sparse, short, ± appressed hairs), densely pubescent lower surface of the leaves (vs. with scattered hairs on the nerves), and densely to sparsely pubescent upper surface of the leaves (or subglabrous in upper cauline ones) (vs. glabrous or with scattered hairs on the nerves) (Tab. 1, Fig. 1 and Fig. 2)

Holotype: North Macedonia, Mt. Buković, 2.2 km SW of Gorna Đonovica village, forest clearing in the zone of a mixed forest of *Ostrya carpinifolia* Scop. and *Fagua sylvatica* L., limestone, 1250 m, 41.690475 N, 20.892805 E, 10.8.2022, leg. & det. A. Teofilovski (MKNH).

Isotype: herb. A. Teofilovski.

Other examined collections: North Macedonia, Šar Mountains, 4.5 km NW of Brezno village, roadside in the zone of beech forest, siliceous substrate, 1460 m, 42.111214 N, 20.993406 E, 20.7.2012, leg. & det. A. Teofilovski (herb. A. Teofilovski) (Teofilovski 2014, sub *C. pastricensis*); North Macedonia, Šar Mountains, 1.8 km NW of Brezno village, pastures and shrubby places, siliceous substrate, 1570–1590 m a.s.l., 42.092039 N 21.017495 E, 5.8.2013, leg. & det. A.

Fig. 1. *Cephalaria pastricensis* subsp. *pologensis*: A – holotype (MKNH), B-D – details from the holotype. B – rachis of the basal cauline leaf, C – abaxial surface of the basal cauline leaf, D – abaxial surface of a middle cauline leaf, E – detail from the adaxial surface of a basal cauline leaf of a plant from the type locality. Scale bars = 3 mm (Photo: A. Teofilovski).

Tab. 1. Morphological differences between *Cephalaria pastricensis* subsp. *pologensis* Teofilovski, subsp. nov. and *C. pastricensis* Dörfl. & Hayek subsp. *pastricensis*.

	Cephalaria pastricensis subsp. *pologensis* (Fig. 1 and Fig. 3)	*C. pastricensis* subsp. *pastricensis* (Fig. 2)
Petioles, rachis of the leaves, and the midrib of the lower surface of the leaf lobes	densely, ± patently subvillous	with sparse, short, ± appressed hairs
Lower surface of the leaves	densely pubescent	with scattered hairs on the nerves
Upper surface of the leaves	densely to sparsely pubescent (or subglabrous in upper cauline ones)	glabrous or with scattered hairs on the nerves
Distribution	North Macedonia (Šar Mountains, Mt. Bukovič)	Albania, Montenegro, Kosovo, Serbia, Bosnia and Herzegovina

Teofilovski (herb. A. Teofilovski; Herbarium of the Natural History Museum of the Republic of North Macedonia) (Teofilovski 2014, sub *C. pastricensis*); North Macedonia, Bukovič Mt., 2.4 km SW of Gorna Đonovica village, mixed forest of *Acer obtusatum* Willd. and *Quercus cerris* L., limestone, 1285 m a.s.l., 41.688651 N, 20.896195 E, 10.8.2022, photo. A. Teofilovski; North Macedonia, Bukovič Mt., 1.3 km S of Gorna Đonovica village, forest margin, limestone, 1035 m a.s.l., 41.697198 N, 20.906883 E, 10.8.2022, leg. & det. A. Teofilovski (herb. A. Teofilovski).

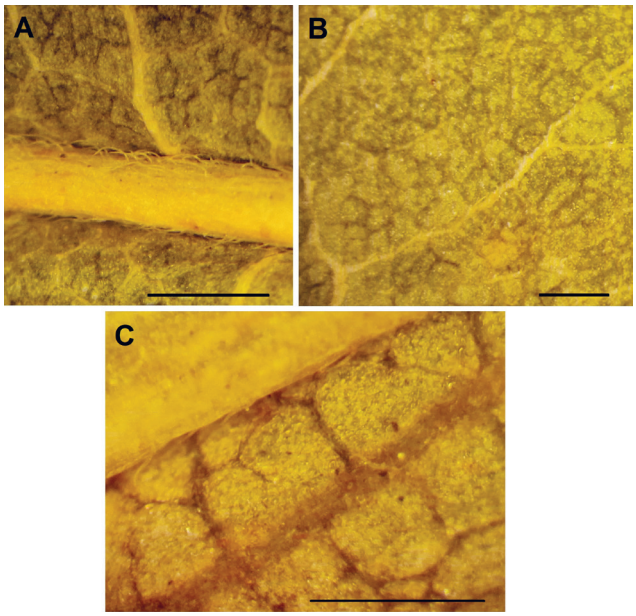

Fig. 2. *Cephalaria. pastricensis* subsp. *pastricensis*: A-B – details of the abaxial surface of a basal cauline leaf (Mt. Prokletije, Kosovo) (23367, BEO), C – detail of the abaxial surface of a middle cauline leaf (Mt. Suva Planina, Serbia). Scale bars = 1 mm (BEO) (Photo: M. Niketić).

Distribution: According to present knowledge, *C. pastricensis* subsp. *pologensis* is endemic to the valley of Polog (NW North Macedonia), occurring in two small areas – one in the Šar Mountains (near Brezno village) and the other on Mt. Bukovič (near Gorna Đonovica village) (Fig. 3). The distance between the two areas is ca. 47 km.

Habitats: The ecological preferences of *C. pastricensis* subsp. *pologensis* seem to be similar to those of *C. pastricensis* subsp. *pastricensis* reported in the literature and recorded in the available herbarium sheets. It grows in open and sparse forest habitats in the zone of mesic and meso-thermophytic forests, at an altitude of between 1036 and 1590 m a.s.l. It is indifferent as regards geological substrate, growing on both silicate (in the Šar Mountains) and limestone (on Mt. Bukovič).

Size of the population and threats: Despite the author's extensive fieldwork over many years in the valley of Polog, so far only 11 individuals were observed in Šar Mountains and ca. 60 individuals on Mt. Bukovič. The recorded populations are apparently highly endangered due to the frequent occurrence of wildfires and forest management activities in the areas.

Etymology: The epithet of the new subspecies refers to the valley of Polog, in which it is distributed.

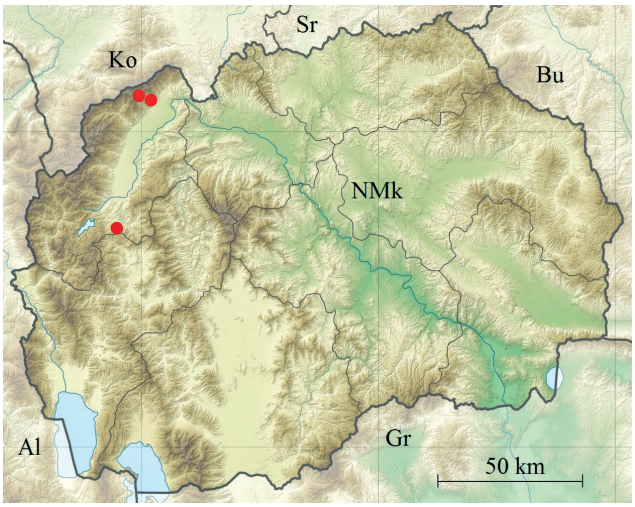

Fig. 3. Distribution of *Cephalaria pastricensis* subsp. *pologensis* in North Macedonia (red dots). Abbreviations: Al – Albania, Bu – Bulgaria, Gr – Greece, Ko – Kosovo, NMk – North Macedonia, Sr – Serbia.

Discussion

Cephalaria pastricensis is a robust, perennial species classified within Sect. *Atrocephala* Szabó and the monotypic Ser. *Rupestris* Szabó (Szabó 1940). It is described from the subalpine zone of the Albanian part of Mt. Paštrik (NE Albania) (Hayek 1921), with the following description provided in the protologue:

"*Perennis fere 2 cm alta. Caulis erectus glaber superne ramosus. Folia dilute viridia non nitentia*, *in pagina inferiore ad nervos minute puberula caeterum glabra*, 5-6-*jugo pinnatisecta segmentis oblongo-lanceolatis logitudine latitudinem* 6-7-*plo superante sensim acutatis anguste serratis*, *basi ad rhachim usque ad foliolum proximum anguste decurrentibus*, *summis late decurrentibus*, *terminali lateralibus subbreviore*; *infima longe caulina breviter petiolata*, *summa tantum* 3-*juga*. *Pedunculi elongati glaberrimi*, *lateralibus supra medium bracteolarum parvarum lanceolatarum pare*, *in quorum axilla capitula rudimentaria sessilia oriuntur*, *instructa*. *Capitula globosa plusquam 3 cm longa et lata*. *Bracteae nigricantes* 4–5 mm *longae triangulares breviter cuspidato-acuminatae hamato-recurvae extus dense sericeo-pilosae*. *Corolla* 10–12 mm *longa ochroleuca extus sericeo pilosa*."

The comparative morphological study showed that the newly described *C. pastricensis* subsp. *pologensis* differs from the typical *C. pastricensis* by the type and much higher density of the indumentum of the pedicels and leaves (Tab. 1, Fig. 1 and Fig. 2). These characteristics are rather uniform in the recorded populations, with none of the collected individuals or ca 30 examined in the field matching or approaching *C. pastricensis* subsp. *pastricensis*.

Besides the morphological differences, the recognition of the new subspecies is also justified by its apparently allopatric distribution in regard to *C. pastricensis* subsp. *pastricensis*. The closest known distance (c. 40 km) between localities of the two subspecies is the one between the type locality of *C. pastricensis* subsp. *pastricensis* (Mt. Paštrik, NW Albania) and the localities of *C. pastricensis* subsp. *pologensis* in the Šar Mountains. There are also no indications that plants approaching or matching *C. pastricensis* subsp. *pologensis* occur within the range of *C. pastricensis* subsp. *pastricensis*, as most of the chorological data for *C. pastricensis* s.l. (Hayek 1921, Hayek 1928–1931, Szabó 1940, Diklić 1973, Ferguson 1976) are accompanied by a morphological description strictly matching the typical *C. pastricensis*. In this context, of particular importance is the information provided by Szabó (1940) in his valuable monography of the genus *Cephalaria*, who quoted 11 checked by himself herbarium collections from Bosnia (Stolac, Višegrad, Silvolje, Čemerno), Herzegovina (Kokorje, sources of the Neretva River, Gacko), and Serbia (Ozren, Kopasnik, Biljanica, Ostra Čuka – Aleksinac). It should be mentioned in support of this author's opinion that the indumentum of all specimens in the following herbarium collections of *C. pastricensis* is typical for subsp. *pastricensis*:

– NE Albania, "District Hasi. Gerrolhalden an then südhängen des Paštrik, ca. 1800 m, nº 917," leg. I. Dörfler, 26.7.1918, 109004709, 109004710, 109004712, (B) (type collection);

– NE Albania, "Bergwiesen am westabhang des Paštrik", leg. H. Zerny, 13. July, 1918, 0047629 (GB);

– W Kosovo, Prokletije Mt., "*In rupestribus calcareis supra* pg. Lipa", leg. P. Černjavski, I. Rudski, V. Lindtner, det. P. Černjavski, 1.8.1933", 23367 (BEO) (Fig. 2A, B);

– W Kosovo, "m. Žljeb, u bukovoj šumi pored puta Stubice – Savine Vode" leg. P. Černjavski, I. Rudski, V. Lindtner, det. P. Černjavski, 3.8.1933, 23368, 23369, 23370, 23371 (BEO);

– SE Serbia, "Mt. Suva Planina, Golemo Stražište, Debalac", leg. M. Niketić, 17.8.2003. (BEO) (Fig. 2 C).

However, the infraspecific affiliation of the populations reported from SE Albania (Barina et al. 2017) needs to be checked. They represent the southernmost points in the distributional range of *C. pastricensis* s.l., situated significantly closer to the localities of *C. pastricensis* subsp. *pologensis* than those of *C. pastricensis* subsp. *pastricensis*.

Due to the indumentum of the leaves and pedicels *C. pastricensis* subsp. *pologensis* is reminiscent of *C. alpina* (L.) Roem. & Schult., distributed in SW & C Alps, Jura, and N Appennini. However, it differs at least by the following morphological characteristics that clearly classify it within *C. pastricensis*: intermediate setae of the involucels distinctly shorter than the longer ones (vs. slightly shorter), usually narrower shape of the lobes of the leaves (oblong-lanceolate to lanceolate vs. elliptic to oblong-lanceolate), and receptacular scales appressed sericeous (vs. patently villous).

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