

***SERAPIAS BERGONII* E. G. CAMUS (ORCHIDACEAE):
A NEW GENUS AND SPECIES IN THE FLORA OF SERBIA**

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Serapias bergonii E. G. Camus (Orchidaceae) was recorded as a new species in the flora of Serbia. In addition, *Serapias* L. is a new genus for the flora of Serbia. The species was found on Mt. Rujan (Southern Serbia) in 2014 and on Mt. Seličevica (Eastern Serbia) in 2019. It inhabits dry, shrubby habitats, forest glades, and the edges of oak forests. This study presents data on morphology, distribution, ecological and biological preferences and population size of the newly recorded species. The distribution map, created within the 10 × 10 sq. km UTM grid system, shows two records of *S. bergonii* in Serbia. The IUCN threat status of this taxon in Serbia was assessed as Critically Endangered.

Key words: *Serapias bergonii*, Orchidaceae, Balkan Peninsula, Serbia, threatened status

INTRODUCTION

Serapias L. (Orchidaceae) is a genus of essentially Mediterranean distribution, although some species reach the western parts of the Atlantic coast (El Mokni *et al.* 2021). Its range extends from the Azores and the Canaries in the west to the Caucasus in the east and north as far as Brittany (Šegota *et al.* 2018). However, its center of distribution encompasses the Mediterranean region from southern France and Corsica to southern Italy and Greece, including the Greek islands (Bellusci *et al.* 2010, Pellegrino *et al.* 2015). In addition, several *Serapias* taxa have been recorded in the British Isles, but their native status is probably uncertain (Lang 1997).

The species of the genus *Serapias* have been traditionally divided into two sections, *S. sect. Serapias* and *S. sect. Bilamellaria* Schlechter 1923 (Baumann & Künkel 1989). Further division of the species within the sect. *Bilamellaria* is based on petal width, with three apparent subsections: *Platypetalae*, *Mediopetalae* and *Stenopetalae* (Lorenz 2001).

However, considering the recent phenetic studies, all *Serapias* taxa may be divided into two main morphological groups separated by values of epichile width (Venhuis *et al.* 2007). The phylogenetic analysis based on chloroplast genome has also divided all *Serapias* taxa into two main groups and each of them into two smaller ones in turn (Bellusci *et al.* 2008). There is no complete agreement on *Serapias* taxonomy, mainly because of lack of clear morphological differences, particularly in flower structure, which is quite uniform among species (Sardaro *et al.* 2012). The absence of distinctive vegetative traits and the continuous variation in floral size make it difficult to delineate and identify all currently recognized taxa (Bellusci *et al.* 2010). Almost all species appear to hybridize readily with each other and with species of *Anacamptis* Rich., *Dactylorhiza* Neck. ex Nevski, and *Orchis* Tourn. ex L. in nature, while there is an artificial hybrid with *Ophrys* L. (Moore 1980, Govaerts 2024).

According to the World Checklist of Vascular Plants (Govaerts 2024), the genus *Serapias* consists of 17 species and 3 subspecies. Within the Balkan Peninsula, there used to be seven known taxa: *S. bergonii* E. G. Camus, *S. cordigera* L., *S. lingua* L., *S. orientalis* (Greuter) H. Baumann & Künkele, *S. parviflora* Parl., *S. politisii* Renz and *S. vomeracea* (Burm.f.) Briq. According to Djordjević *et al.* (2018), no taxa of this genus were recorded in Serbia before this study.

The present study reports the first record of *S. bergonii* E. G. Camus in Serbia. At the same time, the genus *Serapias* L. is also a new genus for the flora of Serbia.

MATERIAL AND METHODS

Data on presence, morphology, distribution, habitat preferences and population size of *S. bergonii* were collected during the floristic studies of southern and eastern regions of Serbia in period 2014–2024. Identification of collected plant material was performed according to Delforge (1994), Lorenz (2001) and Pellegrino *et al.* (2005). The morphological descriptions of genus and species were based on literature sources (Moore 1980, Joseph 2001, Pellegrino *et al.* 2005, Saez *et al.* 2005, Tsiftsis & Tsiripidis 2015, Deniz 2018, Domozetski 2024). Plant material was preserved and stored at the Herbarium of the Faculty of Sciences and Mathematics, Department of Biology and Ecology, University of Niš (HMN), with acquisition numbers given in the parentheses after the distribution records. Nomenclature followed the World Checklist of Vascular Plants (Govaerts 2024).

Distribution of the studied taxa within the territory of Serbia was determined and mapped in UTM grid system (10 × 10 sq. km, UTM Zone 34T) (Lampinen 2001).

The types of habitats where *S. bergonii* was recorded during the study were then aligned with the *Rulebook on criteria for determining the habitat types, on habitat types, vulnerable, endangered, rare, and habitat types of priority for protection and safety measures for their conservation* („Sl. Glasnik RS“, No. 35/2010). Abundance values for *S. bergonii* were determined on the basis of direct counting of the total number of flowering individuals. Methodology according to IUCN Red List Categories and Criteria (2012) and Niketić (2020) was applied in order to assess the threat status of *S. bergonii* in Serbia.

RESULTS AND DISCUSSION

Morphological characteristics

Serapias L., Sp. Pl.: 949 (1753).

Perennial herbaceous, autotrophic geophyte with 2 to 5 ovoid to globose entire tubers. Stems erect, simple, cylindrical, smooth, green, sometimes with reddish spots at the base, glabrous, without stolons. Leaves are gathered in a rosette at the base of the plant, narrow, canaliculate, acute, entire, usually shiny and folded into gutters. Bracts are usually colored; they are folded, larger than the ovary and often exceeding the flower. Flowers are grouped in a few-flowered spike, generally large, without a spur. The outer perianth consists of three sepals, ovate-lanceolate, acute,

and partially connate. Sepals are united and fused with two linear-lanceolate, acuminate upper petals to form a closed pointed helmet (galea), highly characteristic of the genus *Serapias*. The labellum (third petal), which emerges from the helmet, is trilobed, in the shape of a hanging tongue. Labellum large, more or less villose, constricted into a basal hypochile, with two indistinct lateral lobes and a prominent, pendent epichile. The two glabrous lateral lobes of the hypochile are folded upwards and largely fit into the helmet, which gives the helmet its tubular shape, which plays an important role in pollination within the genus. In addition, at the base of the hypochile, there is an excrescence generally characteristic of a species of *Serapias*, which may take different forms: a simple callus or two more or less parallel lamellae. Fruit capsule, erect, oblong. Flat seeds, reticulate, with interlaces elongated, brownish ochre.

Serapias bergonii E. G. Camus, in E. G. Camus, P. Bergon & A. A. Camus., Monogr. Orchid.: 61 (1908).

= *S. laxiflora* Chaub., J. B. G. Bory & L. A. Chaubard, Nouv. Fl. Pélop.: 62 (1838) ≡ *S. vomeracea* subsp. *laxiflora* (Soó) Gözl & H. R. Reinhard, Orchidee (Hamburg) 28: 114 (1977) ≡ *S. cordigera* subsp. *laxiflora* (Soó) H. Sund., Europ. Medit. Orchid., ed. 3: 39 (1980).

= *S. hellenica* Renz, Repert. Spec. Nov. Regni Veg. 25: 230 (1928).

= *Serapias bergonii* subsp. *cilentana* Presser, J. Eur. Orch. 39: 95 (2007) ≡ *S. bergonii* f. *cilentana* (Presser) P. Delforge, Naturalistes Belges 88: 248 (2007) ≡ *S. cilentana* (Presser) Presser, J. Eur. Orch. 44: 620 (2012).

Perennial plant, stems of up to 40 cm tall, with two ovoid tubers. There are 5–9 narrowly lanceolate leaves up the stem, 5–18 cm long; uppermost 1–3, bract-like. Bracts are of a similar color to the flowers, with darker veins, 18–55 mm long and 7.8–11.9 mm wide, longer than the ovaries. The inflorescence is lax, 8–10 cm long, with (2)3–12(20) reddish flowers. Sepals are lanceolate, 15.4–19.2 mm long and 3–5 mm wide. Upper petals are orbicular (eyedrop) in shape, 13–18 mm long and 2.6–4.5 mm wide. The labellum is 3-lobed, tongue-shaped, 18–35 mm long; the lateral lobes of the hypochile are folded upwards and fit into the helmet. Hypochile 10–13 mm × 11–15 mm, pale-colored in the center, with short hairs and two parallel linear ridges at the base; lateral lobes blackish-purple. Epichile lanceolate, (10)12–18(20) mm long and 4–7.5 mm wide, turned backwards and positioned almost parallel to the helmet. Ovary 10–19 mm long, straight; column slender; connective part beak-like, beak 3–5 mm long. Pollinia are greenish (Fig. 1). Flowering period: V–VI; fructification: VI. Pollination by insects. Dispersion method is anemochory. Less often, it also reproduces vegetatively, via tubercidia. Initial or partial mycoheterotroph.

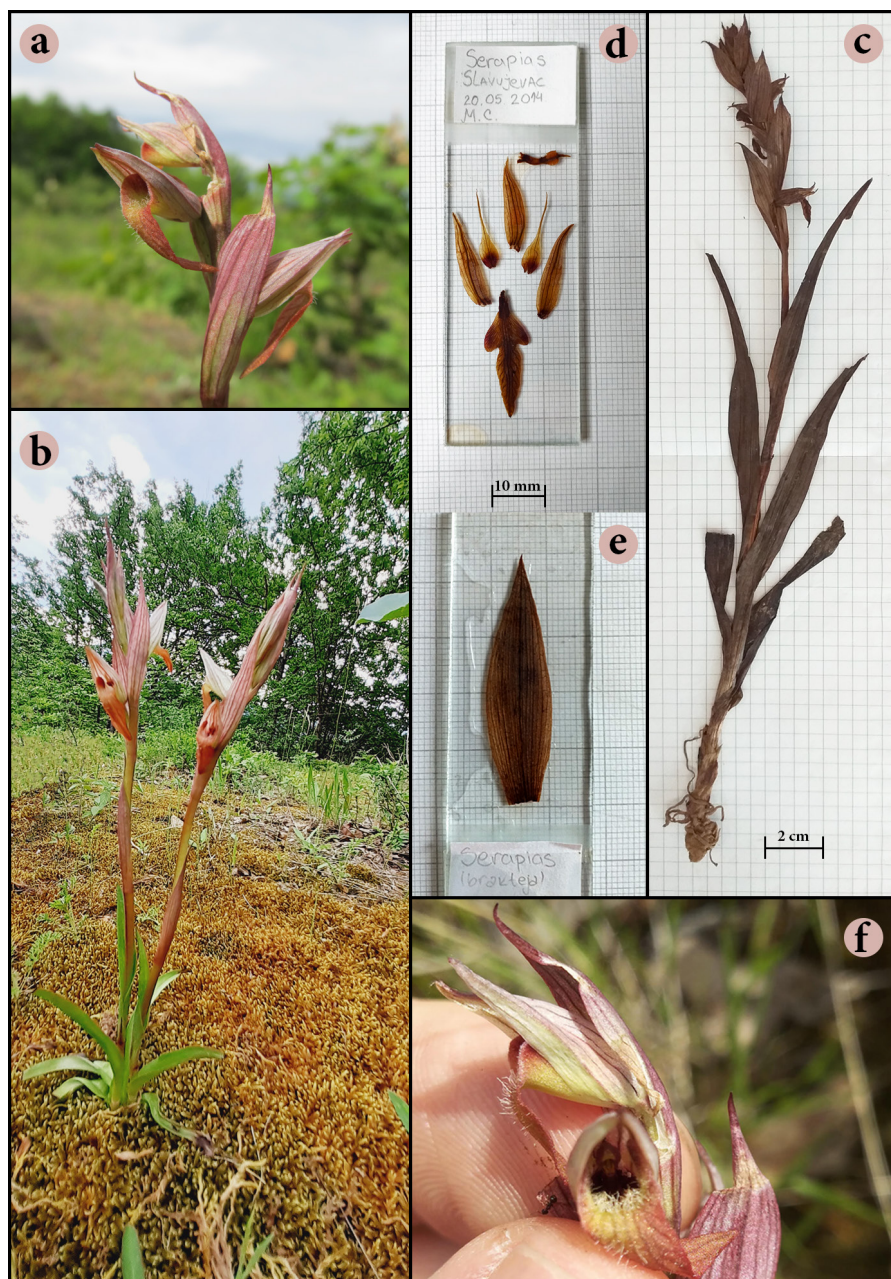


Fig. 1. – *Serapias bergonii* E. G. Camus a) inflorescence; b) habitus; c) specimen; d) dissected flower; e) bract; f) flowers [photo B. Zlatković (a), S. Bogosavljević (b, f), M. Simić (c, d, e)].

Taxonomic relationships

Serapias bergonii is an entity originally described by Camus (1908) under the name *S. vomeracea* (N. L. Burm.) Briq. subsp. *laxiflora* (Soò) Gözl & Reinhard after a discovery made on the Greek island Corfu close to the Potamos (Lorenz 2001). It belongs to sect. *Bilamellaria* and subsect. *Stenopetalae* (Lorenz, 2001). The taxonomically closest species, *S. parviflora* and *S. politisii*, with which *S. bergonii* occasionally grows in sympatry, belong to the same subsection. At the same time, *S. bergonii* hybridizes with species from all subsections of the section *Bilamellaria*, but also with *S. lingua*, a representative of the section *Serapias* (Govaerts 2024).

In appearance, *S. bergonii* is comparatively similar to *S. parviflora*, *S. politisii* and *S. vomeracea*. According to Pellegrino *et al.* (2005), one significantly different floral trait was length of the epichile, which is longer than those of *S. parviflora* and *S. politisii*. Another characteristic that differentiates *S. vomeracea* and *S. bergonii* from the other two species is shape of petals, which are orbicular at the base in the first pair (*S. vomeracea* group) and elongated drop-shaped at the base in *S. parviflora* and *S. politisii* (*S. parviflora* group) (Dellforce 1994). According to Lorenz (2001), *S. parviflora* and *S. bergonii* differ in shape of petals and length of epichile (7–10 mm in *S. parviflora* and 10–16 mm in *S. bergonii*), while both species differ from *S. vomeracea* in width of petals (width of petals 3–5 mm in *S. parviflora* and *S. bergonii* and 5–7 mm in *S. vomeracea*). It should be noted that *S. bergonii* and *S. vomeracea* often grow together in the same locality and in sympatry, where they form mixed populations, so their identification is even more complicated (Milanović *et al.* 2022, Domozetski 2024). In general, the dimensions of all organs in *S. bergonii* are slightly smaller than in *S. vomeracea*, with a significant difference in the length and width of the epichile, which is most often used in dichotomous keys. The shape of the labellum is the best guide to identification, with particular reference to the relative proportions of the hypochile and the epichile, the size and shape of the lateral lobes of the hypochile, the presence of hairs on the labellum, and the shape of the callus or calli (small protuberances at the base of the hypochile) (Lang 1997).

Biological characteristics

In general, *Serapias* species produce no nectar reward but attract insects that use the floral tube to rest or sleep as a draft-free hiding place under bad or rainy weather conditions, or for thermoregulation. Insects entering the floral tube encounter two guiding ridges at the base of the labellum. Pollination occurs when insects carrying pollinia visit another flower and deposit pollen on the stigma (Pellegrino *et al.* 2005).

In *S. bergonii*, unusual trichomes with domelike protuberances and striate surface were observed on the medial region of the labellum, in addition to the typical trichomes on the lateral region. These unusual trichomes may also secrete some compounds and have an osmophore function. Thus, *Serapias* species also have deceptive pollination strategies (Süngü Şeker *et al.* 2016).

General distribution

The range of *S. bergonii* is centered in the Eastern part of the Mediterranean, where it was recorded in Greece, including almost entire Eastern Aegean archipelago (Tsiftsis & Tsiripidis 2015), Albania (Rakaj *et al.* 2013), Anatolia, Crete, Cyprus, Italy (Calabria, Apulia, Campania, Molise, Sicily), Malta, Türkiye (Mifsud 2010) and Bulgaria (Domozetski 2024). On the Balkan Peninsula, this species has also been recorded in Croatia (Kranjčev 2004), Bosnia and Herzegovina (Milanović *et al.* 2022), and Montenegro (Hadžiablahović 2010).

Distribution in Serbia

Southern Serbia: Mt. Rujan: Slavujevac village (Amedan), [MGRS 34T EM68], silicate, 580 m, 20.05.2014, coll. M. Simić, det. B. Zlatković (HMN 18764); **Eastern Serbia: Mt. Seličevica:** Grkinja village (Draškovac), [MGRS 34T EN88], silicate, 418 m, 26.05.2019, S. Bogosavljević, N. Stojanović (field obs.); 27.05.2019, S. Bogosavljević, B. Zlatković (field obs.); 01.06.2019, S. Bogosavljević, M. Bogosavljević (field obs.); 16.11.2019, S. Bogosavljević, M. Bogosavljević (field obs.); 17.05.2020, coll. S. Bogosavljević, M. Bogosavljević (HMN 18765); 02.06.2020, S. Bogosavljević, M. Bogosavljević (field obs.); 23.05.2021, S. Bogosavljević, M. Bogosavljević (field obs.); 05.06.2022, S. Bogosavljević (field obs.); 21.05.2023, S. Bogosavljević (field obs.); 05.05.2024, S. Bogosavljević (field obs.) (Fig. 2).

Habitat and ecology

As a Mediterranean-submediterranean species, *S. bergonii* prefers grasslands, forest openings, phrygana and shrublands at altitudes up to 900 m a.s.l. (Tsiftsis & Tsiripidis 2015). In Serbia, it inhabits peripheral parts of forests and shrubby habitats created by degradation of thermophilic oak forests, within the class *Quercus-Fagetalia* Br.-Bl. & Vlieger 1937, on siliceous geological substrate at the altitude of 418 to 580 m a.s.l. In accordance with the national classification of habitat types („Sl. Glasnik RS“ No. 35 / 2010), this species was recorded within the following habitat types: A2.11 Hungarian (*Quercus frainetto*) and Turkey Oak (*Quercus cerris*) forests A2.21;

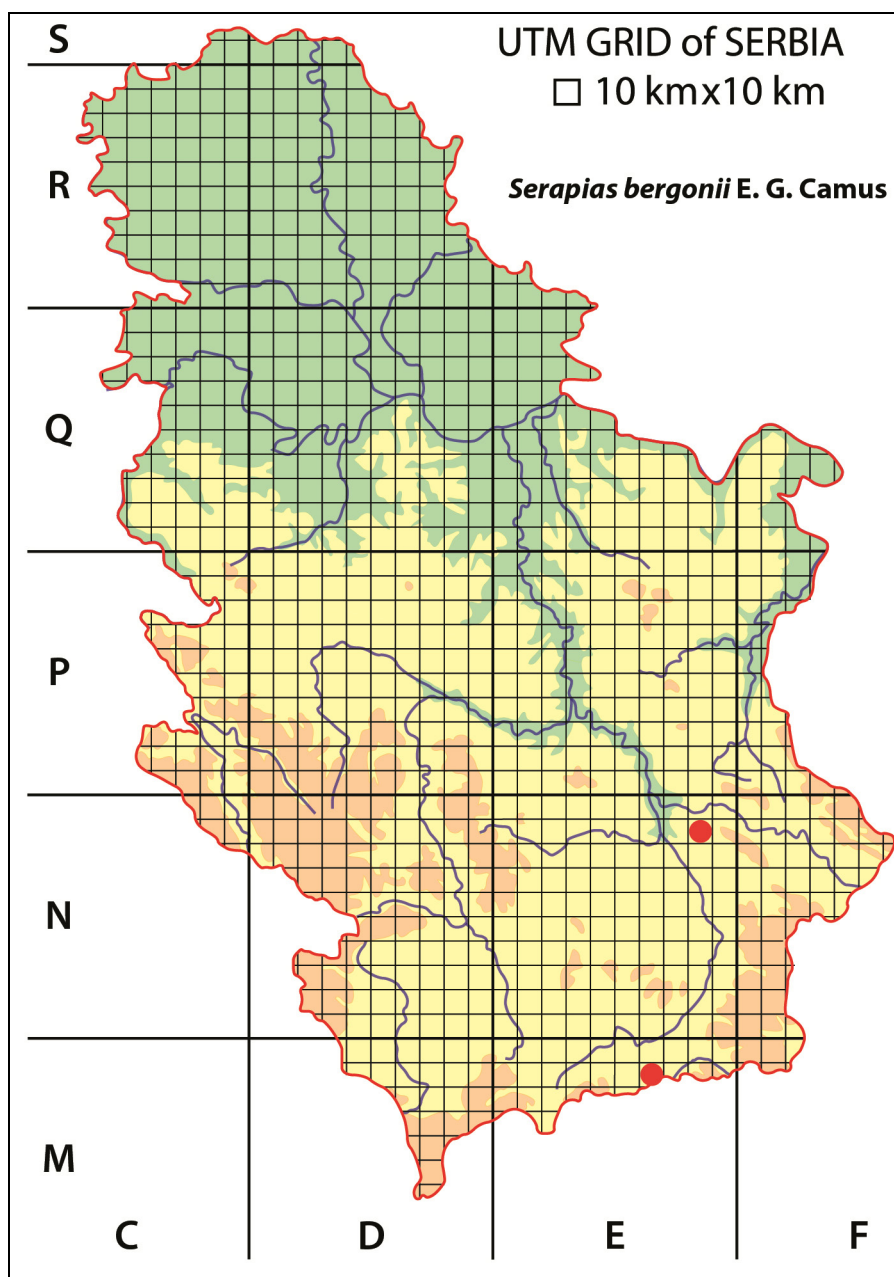


Fig. 2. – Distribution of *Serapias bergonii* E. G. Camus in Serbia.

Downy Oak forests (*Quercus pubescens*); B2.1 Xerophilous shrublands. Under the national classification, downy oak forests are already considered a particularly significant, fragile type of habitat within the territory of Serbia. In the habitats of *S. bergonii* in Serbia, the following plant species

are the characteristic and most common ones: *Quercus cerris* L., *Q. pubescens* Willd., *Q. frainetto* Ten., *Carpinus orientalis* Mill., *Crataegus monogyna* Jacq., *Fraxinus ornus* L., *Pyrus spinosa* Forssk., *Chamaecytisus austriacus* (L.) Link, *Spiranthes spiralis* (L.) Chevall., *Cerastium semidecandrum* L., *Myosotis arvensis* (L.) Hill, *Parentucellia latifolia* (L.) Caruel, *Festuca muralis* Kunth, *Prunella laciniata* (L.) L., *Achillea nobilis* subsp. *neilreichii* (A. Kern.) Velen., *Pilosella bauhini* (Schult.) Arv.-Touv., *P. officinarum* F. W. Schultz & Sch. Bip., *Potentilla neglecta* Baumg., *Cynosurus echinatus* L., *Clinopodium vulgare* L., *Sanguisorba minor* Scop., *Plantago lanceolata* L., *Rumex acetosella* L. and several species of moss (Musci spp.).



Fig. 3. – Habitat of *Serapias bergonii* E. G. Camus in Mt. Seličevica (photo S. Bogosavljević).

Chromosome number

According to D'Emérico *et al.* (2000), the chromosome number is $2n = 36$, which is confirmed by more recent study of Turco *et al.* (2023). There are 8 metacentric, 24 submetacentric and 4 subtelocentric chromosomes (Turco *et al.* 2023).

Population size and area of occupancy in Serbia

Only a single individual of *S. bergonii* was recorded at the locality in South Serbia, on Mt. Rujan, although the site was visited several times after

2014 when the species was first discovered. At the locality on Mt. Seličevica in Eastern Serbia, another location where only a single specimen of this species was ever found, monitoring was carried out from 2019 to 2024. Vegetative propagation through tuberidia was observed during the years of 2023 and 2024. Up to now, field research has not confirmed existence of any other subpopulations or the spread of individuals outside the known localities in Eastern and Southern Serbia. The total population size falls within the range of fewer than 50 mature individuals.

Estimated threatened status in Serbia

Serapias bergonii is protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora, Appendix II (CITES), together with all other members of the family Orchidaceae. According to IUCN (2012) and Niketić (2020), the threat status of *S. bergonii* in Serbia is estimated as Critically Endangered – **CR C2a(i); D**. The area of occupancy (AOO) is extremely small and is estimated at only 8 km² because the species is known only from two sites within 2 UTM squares. The estimated decrease for the next 10 years is 2–10%, while due to the small number of individuals, it is also in danger of regional extinction. The most significant factors endangering *S. bergonii* in Serbia are the following: collection of plants and fungi, which primarily refers to the collection of orchid species, grassland management including overgrazing and mowing, use of biological resources, human interventions and habitat usurpation, accumulation of garbage and solid waste, as well as other forms of habitat changes or destruction. One of the potential endangerment factors is the spread of invasive plant species, above all *Erigeron sumatrensis* Retz., a species that has shown significant invasive potential in Serbia in recent decades (Bogoslavjević & Zlatković 2018). Its spread was also recorded in a wider range of natural habitats, including forest fragments and clearings in oak and beech forests (Niketić *et al.* 2020), and it was registered in that type of habitats near the site on Mt. Seličevica.

CONCLUSIONS

Serapias bergonii represents a new species for the Flora of Serbia, while *Serapias* is also a new genus. The presence of the species was recorded in two localities in eastern and southern Serbia. Based on the present level of knowledge, the locality at Seličevica in eastern Serbia represents the northernmost distribution point of this species within the Balkan Peninsula. Using the IUCN (2012) criteria, we estimated the threat status of this species in Serbia as Critically Endangered. The species should

be included in the Red Data Book of the Flora of Serbia and the official list of strictly protected species in Serbia according to national legislation. It is necessary to strictly protect both localities and habitats of this species. *Ex situ* protection of the species is also proposed, which implies its cultivation in botanical gardens and propagation in *in vitro* systems, that is, the collection and preservation of its seeds in a seed bank.

Additional research is needed on the existence of the new individuals, the distribution of the species and the trend of changes in the number of individuals of *S. bergonii* in Serbia. In addition to the measures already taken to monitor the abundance, it is necessary to establish long-term monitoring of the population. Activities for the conservation and preservation of the mentioned species include the development of tangible management plans for its population and habitats. Special attention should be paid to the reproductive success of the species, i.e. the presence of pollinators and mycorrhizal fungi in its habitat.

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***SERAPIAS BERGONII* E. G. CAMUS (ORCHIDACEAE): НОВ РОД И НОВА ВРСТА У ФЛОРИ СРБИЈЕ**

СТЕФАН БОГОСАВЉЕВИЋ, МИЛИЦА СИМИЋ, БОЈАН ЗЛАТКОВИЋ

РЕЗИМЕ

Serapias bergonii E. G. Camus (Orchidaceae) забележен је као нова врста у флори Србије. Такође, *Serapias* L. представља нови род за флору Србије. Врста је пронађена на планини Рујан (јужна Србија) 2014. и на планини Селичевица (источна Србија) 2019. године. Настањује суве травњаке на ободу храстових шума, шумске чистине и жбуновита станишта. Приказани су подаци о морфологији, распрострањењу, станишту, екологији, периоду цветања, начину опрашивања и величини популације новорегистроване врсте. Мапа распрострањености ове врсте у Србији приказана је на UTM мрежном систему $10\text{ km} \times 10\text{ km}$, при чему је њено присуство забележено у два квадрата. Међутим, реална површина коју у природи настањује ова изузетно ретка врста је далеко мања и износи мање од 8 km^2 . IUCN статус угрожености врсте *S. bergonii* у Србији оцењен је као критично угрожен (*Critically Endangered*).