

# On the distribution and conservation status of some rare orchid taxa (Orchidaceae) in Bosnia and Herzegovina (Western Balkans)

Đorđije Milanović<sup>1</sup>, Vladimir Stupar<sup>1</sup>, Elvedin Šabanović<sup>2</sup>, Vladan Djordjević<sup>3</sup>, Jugoslav Brujić<sup>1</sup>, Aldin Boškailo<sup>4</sup> & Vladimir Randelović<sup>5</sup>

**Key words:** Dinaric Alps, *Himantoglossum*, IUCN conservation status, phytogeography, *Serapias*, Western Balkans.

**Ključne besede:** Dinarske Alpe, *Himantoglossum*, IUCN ohranitveni status, fitogeografija, *Serapias*, Zahodni Balkan.

Corresponding author:  
Đorđije Milanović  
E-mail:  
djordjije.milanovic@sf.unibl.org

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## Abstract

Albeit rich in a number of taxa, flora of Orchidaceae in Bosnia and Herzegovina has not been sufficiently studied. The paper presents distribution of ten rare and threatened orchid taxa in the territory of Bosnia and Herzegovina. *Serapias bergonii* and *Himantoglossum calcaratum* subsp. *rumelicum* are new for Bosnia and Herzegovina, while for other studied taxa (*Serapias parviflora*, *Serapias vomeracea*, *Himantoglossum adriaticum*, *H. calcaratum* subsp. *calcaratum*, *Gymnadenia frivaldii*, *Pseudorchis albida*, *Orchis quadripunctata*, *Cypripedium calceolus*) in addition to field investigation, checking and revision of herbarium material, as well as literature sources were also used for supplementing distribution data. The distribution maps of these taxa in Bosnia and Herzegovina are created on a 10 km × 10 km MGRS grid system. Based on the IUCN Red List criteria, the threat status in Bosnia and Herzegovina was assessed for all studied taxa. Data concerning their habitat preferences and population size are also provided.

## Izvleček

Čeprav je družina Orchidaceae v Bosni in Hercegovini vrstno bogata še ni dovolj preučena. V članku predstavljamo razširjenost desetih redkih in ogroženih orhidej na območju Bosne in Hercegovine. *Serapias bergonii* in *Himantoglossum calcaratum* subsp. *rumelicum* sta novi za Bosno in Hercegovino, za druge preučevane taksone (*Serapias parviflora*, *Serapias vomeracea*, *Himantoglossum adriaticum*, *H. calcaratum* subsp. *calcaratum*, *Gymnadenia frivaldii*, *Pseudorchis albida*, *Orchis quadripunctata*, *Cypripedium calceolus*) pa smo s terenskimi raziskavami, preverjanjem in revizijo herbarijskega materiala in literarnih virov dopolnili podatke o razširjenosti. Karte razširjenosti teh taksonov v Bosni in Hercegovini smo prikazali na mrežnem MGRS sistemu 10 km × 10 km. Na osnovi kriterijev Rdečega seznama IUCN smo ocenili ogroženost vseh preučevanih taksonov v Bosni in Hercegovini. Prikazali smo tudi podatke o rastiščnih potrebah in velikosti populacij.

1 University of Banja Luka, Faculty of Forestry, Banja Luka, Bosnia and Herzegovina.

2 University of Tuzla, Faculty of Natural Sciences and Mathematics, Tuzla, Bosnia and Herzegovina.

3 University of Belgrade, Faculty of Biology, Institute of Botany and Botanical Garden „Jevremovac“, Belgrade, Serbia.

4 University „Džemal Bijedić“ in Mostar, Teachers Faculty, Mostar, Bosnia and Herzegovina.

5 University of Niš, Faculty of Natural Sciences and Mathematics, Niš, Serbia.

## Introduction

The family of orchids (Orchidaceae) has always attracted special attention among botanists, owing to the variety, size, and beauty of their flowers, their very specific way of life and reproduction, and their extraordinary diversity of species. As a consequence of their very small size and lack of nutrients, orchid seeds cannot germinate independently, as is the case with most other flowering plants, but must enter into a complex symbiotic relationship with certain fungal species (Arditti, 1967). Because mycorrhizal development is conditioned by a very narrow range of specific soil properties, many orchid species are closely tied to particular habitats and have a very limited ecological niche (IUCN/SSC Orchid Specialist Group, 1996). The development of a new individual from seed can take up to 10 years, which in turn can lead to infrequent occurrence of specimens at the same microsite, as well as a large variation in the number of individuals in a population from year to year (Rasmussen, 1995). Furthermore, many orchid species have very specific pollinators with limited geographical ranges to which they have adapted the structure of their flowers and with which their range is causally related (Schiestl & Schlüter, 2009). As a result, a large number of orchids are considered rare and endangered in many countries and protected by international legal provisions (CITES, 1975; Council of the European Communities, 1992).

Given all these features, a large number of botanists specializing in the taxonomy and ecology of orchids described a large number of taxa, especially in the last 30–40 years. For example, in the mid-1980s, about 19,000 species were known (Atwood, 1986; Dressler, 2005), while today the number of described orchid species has reached about 28,000 (Christenhusz & Byng, 2016). According to some updated comprehensive analyses, the family counts 27,135 species (Zotz, 2013), although these data should be taken with caution, as a considerable number of new taxa are described each year. Such big numbers, with up to 730–880 genera described (Chase et al., 2015; Givnish et al., 2016), make the family Orchidaceae one of the largest families of vascular plants on earth. Orchidologists believe that there is still a large number of undescribed species, especially in unexplored parts of tropical rainforests.

The European continent is inhabited by considerably smaller number of taxa of exclusively terrestrial orchids (Dressler, 1981), as the climate is unsuitable for the development of epiphytes. Albeit, the interest of European botanists in the study of orchids does not lag behind the world trends. This is evidenced by more than 30 professional associations devoted exclusively to this family and no less than 21 journals devoted exclusively to orchids (ac-

ording to <https://www.europeanorchidcouncil.eu/>). The result of a very narrow understanding of the species by some orchidologists is the estimate that about 600 species and subspecies grow in Europe (Kreutz, 2004), although Kreutz himself states that "*so many new taxa (species, subspecies, varieties and forms) have been described that even the most orchid specialists have totally lost track of them*". The same author also points out that the concept of subspecies is almost abandoned and that many authors describe new taxa exclusively at species level (e.g. Delforge, 2006) and raise most of the previously described infraspecific taxa to species level. Such an approach makes it impossible for botanists to trace relationships between taxa that are morphologically very similar and group them into aggregates or macrospecies, which would greatly facilitate the identification process and reduce the possibility of misidentifications. As a consequence, some authors now consider that the approach to the taxonomy of the orchid family requires a thorough critical review and revision (Kreutz, 2004) according to modern methods, in which taxa should be grouped into (macro)species, meaning that many described species have to be splitted into infraspecific taxonomic units. A similar approach is taken in the current version of the Euro+Med (2006+) database, which tries to create some kind of consensus. According to this database, 221 species from 31 genera occur in Europe and the Mediterranean countries, of which 177 subspecies are described within 44 species, with numerous lower infraspecific taxa.

Botanists are mainly concerned with the taxonomy of the genus *Ophrys*, which comprises ca. 200 microspecies, with a tendency for this number to increase to 250. The most important diagnostic characters are the pigmentation of the corolla, the shape of the markings and the color of the lip, and the size of the flower, which vary between flowers of the same individual and even more between individuals of the same population. The situation is similar in the genus *Epipactis*, where the number of described taxa is somewhat smaller. For Croatia, for example, 150 orchid taxa up to subspecies are listed (Kranjčev, 2004), of which 69 are from the genus *Ophrys* and 21 from the genus *Epipactis*. Similarly, for the area of Greece, about 100 species of the genus *Ophrys* are listed (Antonopoulos & Tsiftsis, 2017), which is more than three times the number of species accepted in the Euro+Med database. To add to the confusion, there are no comprehensive and reliable identification keys, which further complicates the problem of identifying the mentioned orchids.

As opposed to European and world trends, knowledge of this group of vascular plants in BiH is far from being good. The last comprehensive list of orchids of Bosnia and Herzegovina (BiH) dates from 1904 (Beck-Mannag-

etta, 1904) and lists 56 species, so it is not necessary to point out that this list is taxonomically outdated. Later reports only give the assessments of the number of taxa. Thus, Šoljan et al. (2006) and Redžić et al. (2009) speculate about 69 orchid species (with 35 subspecies and 7 hybrids), Šilić (2008) and Šoljan et al. (2014b) mention about 80 species and subspecies. On the bright side, several papers contributing to the knowledge of orchids in BiH have been published recently (Šabanović et al., 2019, 2020; Šoljan et al., 2014b, 2014a), while several more list new orchid taxa for BiH: *Dactylorhiza fuchsii* (Druce) Soó (Šoljan et al., 2014a), *Epipactis muelleri* Godfery (Takács et al. in Raab-Straube & Raus 2014), *Himantoglossum adriaticum* H. Baumann (Milanović et al., 2015b), *Serapias vomeracea* (Burm. F.) Briq. (Maslo & Boškailo, 2018), *Serapias parviflora* Parl. (Milanović, 2019) and *Epipactis helleborine* subsp. *orbicularis* (K. Richt.) E. Kleinn. (Šabanović & Djordjević in Tomović et al. 2021), with the confirmation of *Liparis loeselii* (L.) Rich. (Đ. Milanović, 2012), which was considered extinct on the territory of BiH and the Balkan Peninsula.

This paper's aims were:

- to make a revision of the genera *Serapias* and *Himantoglossum* for the territory of BiH in order to clarify which taxa certainly occur in Bosnia and Herzegovina;
- to complete the distribution range of some rare orchid species, which were previously known only from a few localities in BiH: *Gymnadenia frivaldii*, *Pseudorchis albida*, *Orchis quadripunctata* and *Cypripedium calceolus*;
- assess the threat status of each of the studied species according to the IUCN categories and criteria (IUCN Species Survival Commission, 2012b, 2012a).

## Material and methods

The research was conducted in the field on the territory of BiH in the period 2010–2020. In addition to the field survey, the distribution data were supplemented by checking and revision of herbarium material deposited in the Herbarium of the National Museum of Bosnia and Herzegovina (SARA), in the Herbarium of the Faculty of Forestry of the University of Banja Luka (SF) and in the private collections of Đ. Milanović (ĐM) and E. Šabanović (ES) as well as by literature sources. Since herbarium material is often insufficient for orchid identification, photographs of plant habit and macrophotographs of floral parts were taken in the field, indicating the herbarium voucher to which they refer. In the case of the genus *Serapias*, processing of the herbarium material required reparation (resuscitation) of floral parts in boiling water in order to make morphometric measurements of organs important for taxon determination.

It should be mentioned that, in some cases, the revision of the herbarium material could not be carried out, especially in the case of the genus *Himantoglossum* from the National Museum Herbarium (SARA), as some vouchers under the same numbering contain several specimens collected from different localities. Moreover, they differ morphologically and are characterized by transitional values of their diagnostic parameters, so that it was not possible to determine which specimen belongs to which locality or to which taxa they refer. All these questionable data are marked with a "?" sign (Figure 4), indicating that further population-level studies on live specimens are required, and listed in Appendix 2b.

All sites reported in the literature and the herbarium material were georeferenced using the QGIS software package, while the coordinates of the new sites were recorded in the field using a GPS device. All records of the species studied are presented as follows: Locality with coordinates in the WGS84 coordinate system, MGRS (Military Grid Reference System) 10x10 km square, habitat type (if available), material (herbarium and literature data and an observation on live specimens), date of collection (herbarium), observations or publications (literature data), name of the legator, elevation and population size if observed in the field or derived from literature or herbarium data. In most cases, the material refers to the herbarium material studied, to which the corresponding literature data (if available) were added, while in the absence of a herbarium voucher, only the literature reference, i.e. the date of observation, was given. The localities for a given taxon were listed beginning with the new (with the word "locality" bolded) or most recent records from the field. This was followed by literature references and information on herbarium specimens collected at other localities (arranged spatially from west to east). In order to get an insight into the distribution area of the studied species on the territory of Bosnia and Herzegovina, all localities were presented on 10x10 km MGRS maps (Figure 6; Figure 11).

Species of the genus *Serapias* were determined according to Delforge (2006), while for the genus *Himantoglossum* we used a description of diagnostic characters given by Molnár et al. (2012). Other species discussed were determined using Flora Europaea (Tutin et al., 2001), as their taxonomic status has not changed significantly and there were no taxonomic novelties after the publication of this edition. The nomenclature is consistent with the updated version of the Euro+Med database (Euro+Med 2006+), except for the taxon *Himantoglossum calcaratum* subsp. *rumelicum*, whose valid name was published only recently (Niketić et al., 2018). Threat assessment was performed according to the IUCN methodology (IUCN Species Survival Commission, 2012b, 2012a).

## Results and discussion

### Genus *Serapias* L.

The taxonomy of the genus *Serapias* has changed considerably in the last 40 years or so. For example, the number of species is now almost 10 times higher than in the 1980s, when only three species of this genus were thought to occur in Europe. In the middle of the first decade of the 21<sup>st</sup> century, the genus underwent a major revision and has grown to 26–27 species in Europe, mostly distributed in the Mediterranean region (Delforge, 2006; Venhuis et al., 2007), while some other taxa, mainly from Italy and Spain, were described later (Euro+Med, 2006+). So far, only two species of the genus *Serapias* have been recorded in Bosnia and Herzegovina: *S. vomeracea* (Burm. F.) Briq. near Počitelj in the valley of the Neretva River (Maslo & Boškailo, 2018) and *S. parviflora* Parl. on the Klek Peninsula near Neum (Milanović, 2019). The literature for BiH also mentions *Serapias lingua* L. from the Sutorina area (Beck-Mannagetta, 1903), which is now part of the territory of Montenegro. There were no specimens of the genus *Serapias* in the herbarium of SARA, older than the recently inserted vouchers (Milanović, 2019). A specimen of *S. vomeracea* from the Počitelj area, which was deposited in the collection of Aldin Boškailo, has since been lost, so this taxon remains questionable for the territory of BiH (Appendix 2a; Figure 6).

Based on new field research conducted in the Mediterranean and sub-Mediterranean areas of Bosnia and Herzegovina, in addition to the already mentioned *Serapias vomeracea*, the occurrence of two other taxa of the genus *Serapias* has been recorded for BiH:

**1. *Serapias parviflora* Parl.** (Figure 1, Figure 3a) – recorded at the locality of Tanko sedlo on the Klek Peninsula (Milanović, 2019) (Appendix 1a). This is the only locality of this species in BiH with a population size of less than 20 adult individuals. As its habitat is threatened by succession into the surrounding maquis, we propose the status of critically endangered species for the area of BiH.

Estimated regional conservation status in Bosnia and Herzegovina: Critically Endangered – CR D.

**2. *Serapias bergonii* E. G. Camus** (Figure 2) (syn. *Serapias vomeracea* subsp. *laxiflora* (Soó) Gözl & R. Reinhard) – **new species for BiH** found in two different localities: near Moševići in the hinterland of Neum and Crno brdo near Hutovo blato (Appendix 1b). In both localities, the species counts less than 50 adult individuals and is assessed as critically endangered for BiH.

However, it should be emphasised that there are many potential habitats for this orchid species in the Mediterranean and sub-Mediterranean areas of BiH, so it could be expected to occur in other localities as well.

Based on available data, the regional conservation status in BiH is estimated to be: Critically Endangered – CR D.

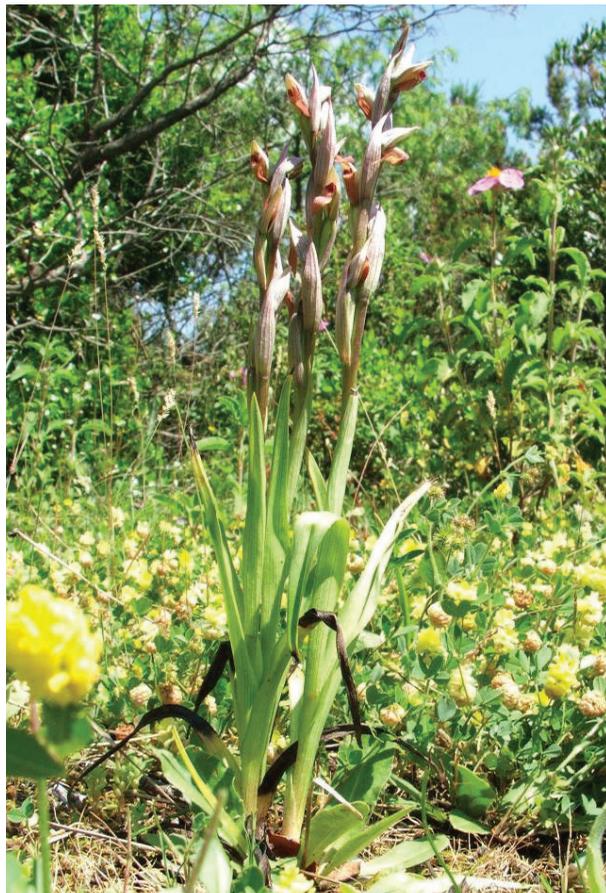
The species of the genus *Serapias* are morphologically very similar, so the identification, which requires measurement of the width and length of the flower segments, should be made on fully developed flowers from several individuals within the population. *Serapias parviflora* is characterized by a small epichile (Table 1), erect flowers (especially in the juvenile phase), an elongated base of the petals (elongated drop shape) and yellow pollinia (Delforge, 2006; Tsiftsis & Antonopoulos, 2017), which separates it from the *S. vomeracea* group. In addition, two nearly parallel to slightly divergent ridges are visible at the tip of the hypochile, which separates this species from the related *S. lingua*. *Serapias bergonii* is much more variable, often growing in the same localities and in sympatry with the closely related *S. vomeracea*, forming mixed populations with which it additionally interbreeds (Delforge, 2006; Tsiftsis & Antonopoulos, 2017), making identification even more complicated. The main characteristic of the species lies in the slightly smaller dimensions of all its organs compared to the related *S. vomeracea*, with dichotomous keys generally indicating differences in the width of the epichile (Table 1). In addition, *S. bergonii* has a glabrous epichile and bracts that are at most twice as long as the calyx, whereas in *S. vomeracea* the epichile is hairy and the bracts are more than twice as long as the calyx (tending to be almost three times as long) (Delforge, 2006).

Although our collected specimens show some morphometric features at the limits of variation of individual characters, they still correspond more to the species *S. bergonii* than *S. vomeracea*. For example, the bracts are

**Table 1:** Morphometric diagnostic characteristics of three similar species of the genus *Serapias* (according to Delforge 2006).

**Tabela 1:** Morfometrične značilnosti treh podobnih vrst rodu *Serapias* (po Delforge 2006).

Species / morphological characters	Epichile width [mm]	Epichile length [mm]	Length x width of corolla [mm]	Shape of the corolla base
<i>Serapias parviflora</i>	3–5	(5–) 6–10 (–13)	13–16 × 3–4	elongated
<i>Serapias bergonii</i>	4–7.5	(10–) 12–18 (–20)	19–27.5 × 2–4.5	rounded
<i>Serapias vomeracea</i>	8–13	18–30	19–27.5 × 4–8.5	rounded



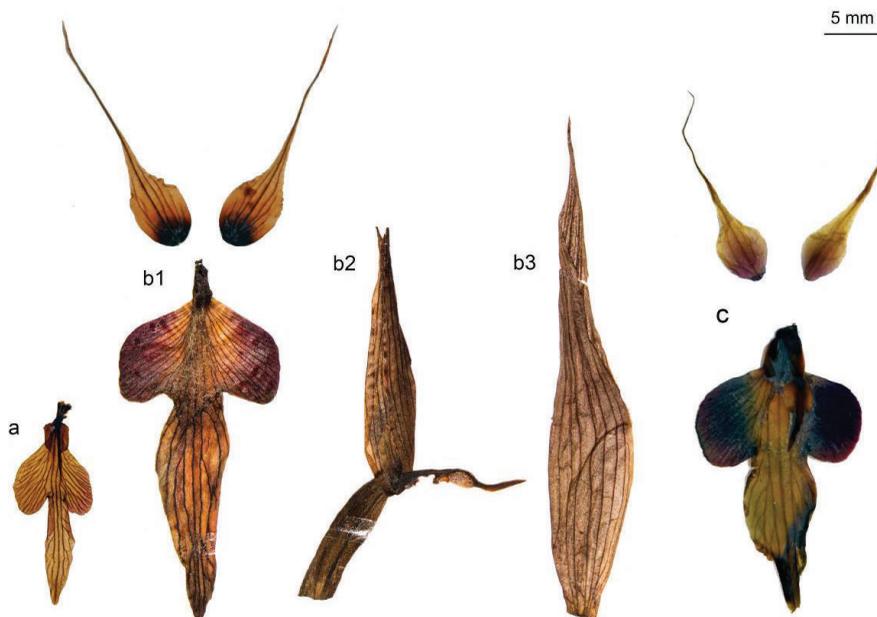
**Figure 1:** *Serapias parviflora* on Klek Peninsula (Đ. Milanović 09. 05. 2010).

**Slika 1:** *Serapias parviflora* na polotoku Klek (Đ. Milanović 09. 05. 2010).



**Figure 2:** *Serapias bergonii* from Crno brdo (E. Šabanović 05.05.2020).

**Slika 2:** *Serapias bergonii* z Crnega brda (E. Šabanović 05.05.2020).



**Figure 3:** Comparative view of flowers of *Serapias* species repaired from the herbarium: a – *Serapias parviflora* from Klek peninsula (lip); b – *Serapias bergonii* near Moševići (flower details): b1 – lip and petals; b2 – ovary with a hood; b3 – belonging bract; c – *Serapias bergonii* from Crno brdo by Hutovo (lip with petals) (© Đ. Milanović).

**Slika 3:** Primerjava cvetov vrst rodu *Serapias* iz herbarija: a – *Serapias parviflora* z polotoka Klek (medena ustna); b – *Serapias bergonii* pri Moševićih (podrobnosti cveta): b1 – medena ustna in venčni listi; b2 – plodnica s čelado; b3 – pripadajoči ovršni list; c – *Serapias bergonii* z lokacije Crno brdo pri Hutovu (medena ustna z venčnimi listi) (© Đ. Milanović).

usually at most twice as long as the sepals, there are no hairs on the epichilium or they are sparse and short, the dimensions of the epichilium are 6–7 mm × 13–21 mm and those of the corollas are 17–22 × 4–5 mm, suggesting that they are almost entirely consistent with the range of variation of *S. bergonii*, while they are outside the range of variation of *S. vomeracea*. Moreover, this new locality of the species in the Mediterranean part of Bosnia and Herzegovina fits the eastern Mediterranean distribution of the species (Tsiftsis & Antonopoulos, 2017), which, along with the known localities from the Dalmatian coast (Kranjčev, 2005), extend along the eastern Adriatic Sea to Istria (Rottensteiner et al., 2020).

### Genus *Himantoglossum* Spreng.

The species of the genus *Himantoglossum* are among the tallest and most unusual of European orchids, owing to the very long mid lobe of the lip. Older botanical references mention two species for the western and central Balkans: *Himantoglossum* (*Loroglossum*) *hircinum* and *H. caprinum*. The description of the species *Himantoglossum adriaticum* (Baumann, 1978) and its first records from Slovenia (Ravnik, 2002), Croatia (Molnár et al., 2012) and Bosnia and Herzegovina (Milanović et al., 2015b; Bódis et al., 2018) added another taxon to this genus in this part of the Balkans. The Mediterranean species *H. robertianum*, recently recorded from Bosnia and Herzegovina (Zelenika, 2012) (Appendix 1f; Figure 6), has traditionally been placed in the genus *Barlia* because of its different flowers. As we do not have accurate data on the only known population of this species in BiH, it was not the subject of this study.

Only recently it was shown that all records of *Himantoglossum caprinum* from the Balkan Peninsula and the rest of Europe are related to the species *H. jankae* (Molnár et al., 2012), which is distributed from southern Slovakia through Hungary, Romania, Croatia, Serbia, Montenegro, Bulgaria, Greece (including Crete) to northwestern and northern Turkey (Djordjević et al., 2018; Molnár et al., 2012), while the typical *H. caprinum* is endemic to Crimea, based on the original description of this taxon. In addition to *H. jankae*, the endemic *H. calcaratum* with a significantly longer spur also occurs in the Western Balkans, a taxon mentioned under the name *H. hircinum*  $\beta$  *calcaratum* in the Flora of BiH (Beck-Mannagetta, 1904). Based on morphometric and molecular analysis of all taxa of the genus *Himantoglossum* (Bateman et al., 2017), the species *H. jankae* was subordinated to the subspecies level within the species *H. calcaratum*. Respecting the rule of precedence according to the Plant Nomenclature Code, it was recently re-

named *H. calcaratum* subsp. *rumelicum* (H. Baumann & R. Lorenz) Niketić & Djordjević (Niketić et al., 2018). According to Bateman et al. (2017), *H. hircinum* does not grow east of Italy, Austria and Germany (see Fig. 5 in Bateman et al., 2017).

Following the discovery of *H. adriaticum* from Ostrovica in Albania (Barina et al., 2005) and from the vicinity of Bosanski Petrovac in western BiH (Milanović et al., 2015b), the range of this species has expanded significantly to the east. This changes the picture of the range delimitation provided by Bateman et al. (2017) and makes the area where three taxa (*H. adriaticum*, *H. calcaratum* subsp. *calcaratum* and *H. calcaratum* subsp. *rumelicum*) potentially overlap much larger. Under these circumstances, it remains questionable to which taxa the numerous literature and herbarium records for *H. hircinum* and *H. caprinum* from Bosnia and Herzegovina refer. Field research in northwestern Bosnia (near Banja Luka) and a review of available herbarium collections (SARA, ĐM, SF) show that there are three taxa of the genus *Himantoglossum* in Bosnia and Herzegovina:

**3. *Himantoglossum adriaticum*** H. Baumann (Figure 4a, 5a) – in addition to the known locality from Suvaja near Bosanski Petrovac (Milanović et al., 2015b), an inspection of the SARA herbarium revealed that the species also occurs near Banja Luka (Appendix 1c), where it was collected by Hofmann in 1879. Although our research in this area did not confirm the species, this record suggests that the range of *H. adriaticum* in northwestern Bosnia overlaps with the range of *H. calcaratum* subsp. *rumelicum*. As the species was first recorded in Bosnia and Herzegovina several years ago (Milanović et al., 2015b), its threat status was not assessed in the Red List of the Federation of Bosnia and Herzegovina (Đug et al., 2013). However, we suggest that it should be placed under strict protection throughout the territory of BiH, as it is listed in Annex 2 of the EU Habitats Directive (Council of the European Communities, 1992), and all its sites should be included in the future European ecological network Natura 2000.

Although the only known and confirmed population from Suvaja near Bosanski Petrovac is numerous (about 200 adults were counted in 2011), its habitat is endangered, as the former pastures where it grows are in succession towards the thermophilous forests. Considering the distribution and ecology of the species, its range is potentially larger in Bosnia and Herzegovina, but since it has not been found elsewhere in Bosnia and Herzegovina since then, it should be considered a critically endangered species.

Estimated regional conservation status in Bosnia and Herzegovina: Critically Endangered – CR C2a(ii)b.

**4. *Himantoglossum calcaratum*** (G. Beck) Schltr. subsp. *calcaratum* (Figure 4c, 5c) – has been confirmed by recent field research and revision of herbarium material in the upper reaches of the Drina River and its tributaries (Appendix 1d; Figure 6), while in the Bosna River Basin and the middle reaches of the Drina River it occurs in transitional forms to *H. calcaratum* subsp. *rumelicum* (Appendix 2b; Figure 6). Until the taxonomic status of the populations from the Bosna River valley and the middle course of the Drina is clarified, there is not yet enough data to adequately assess the threat status of this taxon for the BiH territory (DD). Moreover, it is classified as a vulnerable species in the Red List of the Federation of BiH (VU) (Đug et al., 2013), while in the Republic of Srpska it enjoys the status of a strictly protected species (*Uredba o Strogo Zaštićenim i Zaštićenim Divljim Vrstama*, 2020).

**5. *Himantoglossum calcaratum*** (G. Beck) Schltr. subsp. *rumelicum* (Somlyay, Kreutz & Óvári) Niketić & Djordjević (syn. *Himantoglossum jankae* Somlyay, Kreutz & Óvári, *H. calcaratum* subsp. *jankae* (Somlyay, Kreutz & Óvári) Bateman, Molnár & Sramkó, *H. caprinum* auct. mult.) (Figure 4b, 5b) – **new species for Bosnia and Herzegovina**. Individuals typical for this taxon are distributed in the northwestern and northern parts of BiH (Appendix 1c), while specimens from southern and central Bosnia and eastern Herzegovina show a transitional character to the type subspecies (Appendix 2b; Figure 6). For the same reasons as for the previous taxon, the proposed category for threat status is DD (Data Deficient). It should be placed under strict protection throughout Bosnia and Herzegovina, as it is listed in Annex 2 of the EU Habitats Directive under the name *Himantoglossum caprinum* (Council of the European Communities, 1992), and all its sites should be included in the future European ecological network Natura 2000.

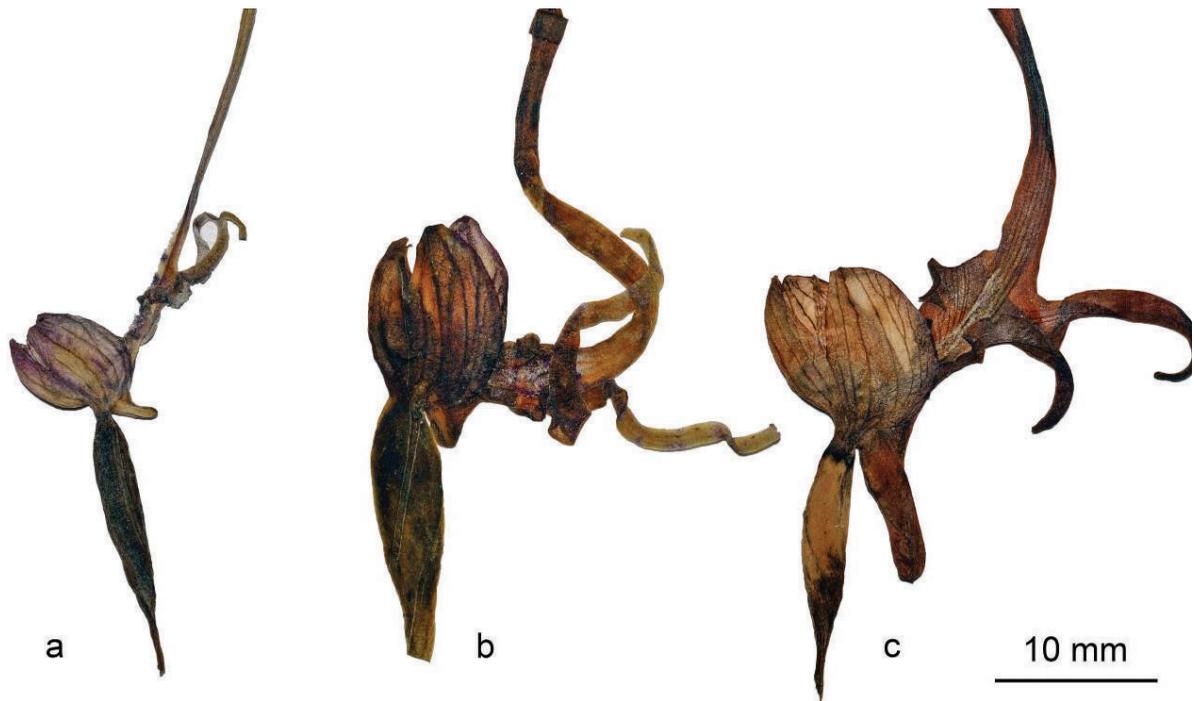
The delimitation of the distribution range of individual taxa of genus *Himantoglossum* in the territory of Bosnia and Herzegovina remains an open question that requires a systematic study of living material. Older literature data list only two species (*H. caprinum*, *H. hircinum*), none of which grows in BiH. As the existing taxa have a similar ecology and their areas in BiH at least partially overlap, it is not possible to conclude to which of them numerous literature data for *H. caprinum* and *H. hircinum* (in the absence of herbarium material) correspond (Appendix 2b1).

However, certain patterns can be observed in the transitional areas. The upper part of the catchment of the Drina and its tributaries is absolutely dominated by specimens that usually have a very long spur and belong to *H. calcaratum* subsp. *calcaratum*. The studied specimens from the upper reaches of the Bosna River and its tributaries (especially from the vicinity of Sarajevo and Travnik, where most of the specimens in the herbarium SARA come from) show a transitional character to *H. calcaratum* subsp. *rumelicum*. In this part of Bosnia, there is probably overlap in the range of these two otherwise very similar and related taxa with questionable taxonomic status. Further north, west, and also south and northeast, the study specimens have a relatively shorter spur which fits more to the description of *H. calcaratum* subsp. *rumelicum*, which completely replaces the typical subspecies in the north and northwest of the country. The spur is very short in some specimens (about 3–4 mm), while in others it reaches up to 8 (–9) mm, but never more. A large number of specimens from the herbarium SARA show a transitional character between *H. calcaratum* subsp. *calcaratum* and *H. calcaratum* subsp. *rumelicum*, while different specimens from the same locality show considerable differences in the length of the spur, so that they could not be determined with certainty at this point (Appendix 2b2).

On the other hand, in the west and southwest of Bosnia, the area of *H. calcaratum* subsp. *rumelicum* overlaps with the area of *H. adriaticum*, which is also confirmed from the surroundings of Banja Luka. However, it can be concluded that *H. adriaticum* is to be expected in the sub-Mediterranean area, while it does not penetrate deeper into the eastern, continental part of Bosnia and Herzegovina (where it is replaced by *H. calcaratum* subsp. *rumelicum*). Both taxa are expected to occur in northwestern Bosnia.

In view of the above, all questionable literature data (Appendix 2b1) and herbarium specimens with transitional features (Appendix 2b2) have been marked with "?" on the map of localities in BiH (Figure 6), in order to highlight localities where field research is needed to delineate the range of taxa of the genus *Himantoglossum* on the territory of BiH.

The analyzed material from Bosnia and Herzegovina indicates that the species *Himantoglossum adriaticum* has very stable morphological characteristics and that it can be easily distinguished from the other two taxa by significantly smaller dimensions of all floral parts (Figure 4a). The spur is usually pale, almost whitish, very short in relation to the length of the ovary (about 1/6–1/5) up to 4 mm long. The situation in *H. calcaratum* subsp. *calcaratum* and *H. calcaratum* subsp. *rumelicum* is markedly different and more complicated. Analysis of the herbari-



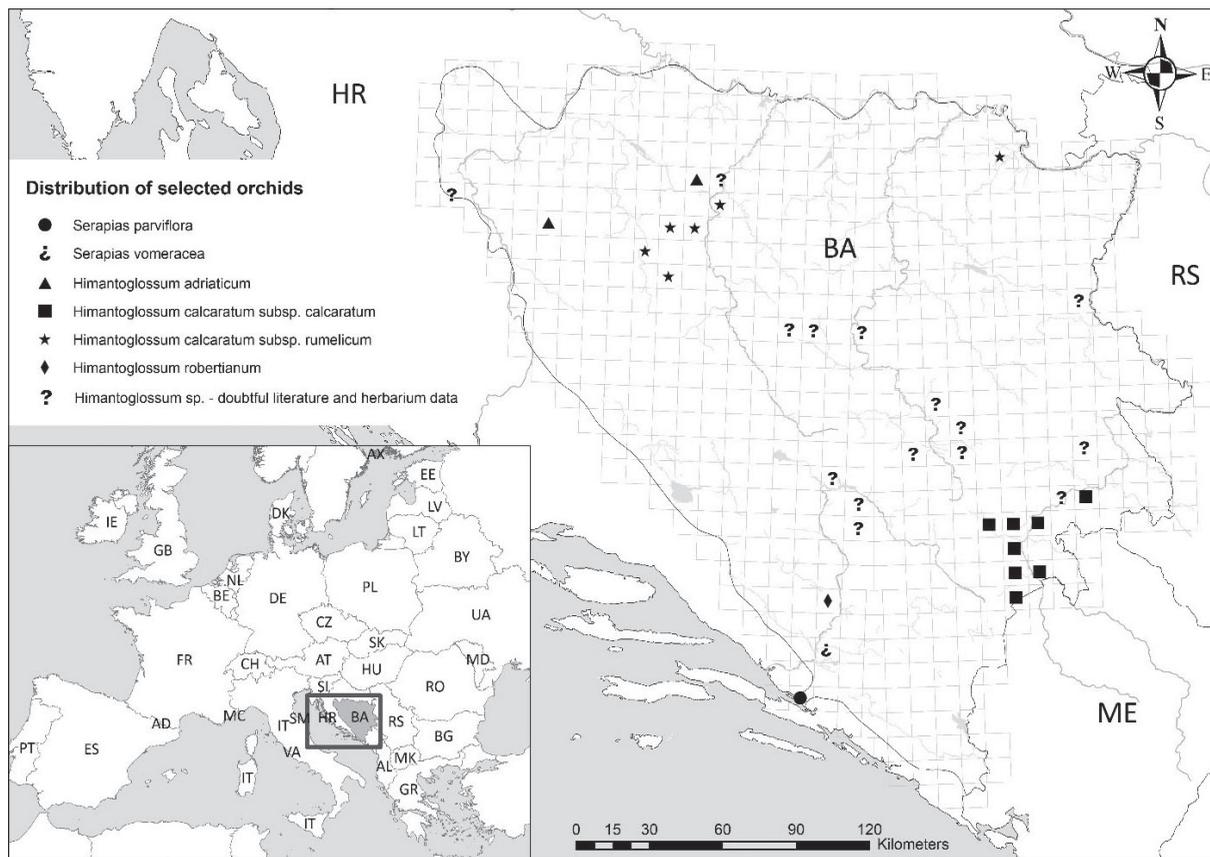
**Figure 4:** Comparative view of flowers of genus *Himantoglossum* (from herbarium): a – *Himantoglossum adriaticum* from Suvaja near Bosanski Petrovac; b – *Himantoglossum calcaratum* subsp. *rumelicum* from Bukvalek near Banja Luka; c – *Himantoglossum calcaratum* subsp. *calcaratum* from Belen in Drine River valley between Foča and Tjentište (© Đ. Milanović).

**Slika 4:** Primerjava cvetov vrst rodu *Himantoglossum* (iz herbarija): a – *Himantoglossum adriaticum* z Suvaje pri Bosanskom Petrovcu; b – *Himantoglossum calcaratum* subsp. *rumelicum* z Bukvaleka pri Banji Lukci; c – *Himantoglossum calcaratum* subsp. *calcaratum* z Belena v dolini reke Drine med Fočo in Tjentištem (© Đ. Milanović).



**Figure 5:** Inflorescences of genus *Himantoglossum* in BiH: a – *H. adriaticum* from Suvaja 27. 06. 2011., b – *H. calcaratum* subsp. *rumelicum* from Bukvalek near Banja Luka 04. 07. 2017.; c – *H. calcaratum* subsp. *calcaratum* beneath Stajkovac at Vijogor 10.07.2011. (© Đ. Milanović and J. Brujić).

**Slika 5:** Socvetja rodu *Himantoglossum* v BiH: a – *H. adriaticum* z Suvaje 27. 06. 2011., b – *H. calcaratum* subsp. *rumelicum* z Bukvaleka pri Banji Lukci 04.07.2017.; c – *H. calcaratum* subsp. *calcaratum* pod Stajkovcem na Vijogoru 10. 07. 2011. (© Đ. Milanović in J. Brujić).



**Figure 6:** Distribution of the species *Serapias parviflora* and species of the genus *Himantoglossum* in Bosnia and Herzegovina with revised as well as questionable data.

**Figure 6:** Razširjenost vrste *Serapias parviflora* in vrst rodu *Himantoglossum* v Bosni in Hercegovini z revidiranimi in vprašljivimi podatki.

um material suggests that the length of the spur is not a reliable characteristic for the identification of these two taxa (Tsiftsis, 2016). Specimens from the upper catchment of the Drina River regularly have long spurs (Figure 4c), while specimens from the western part of BiH regularly have shorter spurs (rarely up to 8.5 mm long) (Figure 4a). However, in the Bosna River basin, in the same populations, there are specimens with short spurs (5–7 mm), but also those whose spurs are significantly longer (8–10 mm), which makes identification from herbarium material unreliable. Therefore, it is fully justified to place the taxon *H. jankae* at the level of the subspecies of *H. calcaratum*, i.e. *H. calcaratum* subsp. *rumelicum*, the populations being apparently mixed in the areas where their ranges overlap. In typically developed specimens of *H. calcaratum* subsp. *rumelicum*, the spur was found to have a conical shape and to taper properly into a rounded apex, which is often not the case in *H. calcaratum* subsp. *calcaratum*. Here the spur is often somewhat expanded at the apex or at least cylindrical in the middle part (Figures 4b-c and 5b-c). Furthermore, in *H. calcaratum* subsp.

*rumelicum* the spur reaches at most half of the ovary (in full flower), whereas in the typical subspecies it is usually longer than half of the ovary.

### Other rare species

**6. *Gymnadenia frivaldii*** Hampe ex Griseb. (syn. *Leucorchis frivaldii* (Hampe ex Griseb.) Schltr.; *Pseudorchis frivaldii* (Hampe ex Griseb.) P. F. Hunt) (Figure 7) – was found in Konjsko polje on the Ljubišna Mt. in eastern Bosnia (Figure 11), which is only the second reported locality of this species for the BiH area (Appendix 1g). Considering the fact that we did not confirm the occurrence of the species at the other known locality (on the Maglić Mt.), while on Konjsko polje only about 20 adult individuals were found, the species can be considered critically endangered for the territory of BiH.

Estimated regional conservation status in Bosnia and Herzegovina: Critically Endangered – CR B1ab(iii,iv)+2ab(iii,iv); D.

*Gymnadenia frivaldii* is a subendemic species of the Balkan Peninsula with a center of distribution in the mountains of the southeastern Dinaric Alps and the mountains of the Scardo-Pindhian province, with a disjunction in the southeastern Carpathians (Bartók et al., 2016; Lakušić & Grgić, 1971). The optimal conditions this species founds in the Balkan peatlands of the *Narthecion scardici* Lakušić alliance, for which it is considered a characteristic species (Lakušić, 1970), while in western Serbia it is recorded in the communities of the alliance of *Caricion fuscae* Koch (Djordjević et al., 2020). According to some authors, it also occurs in the snow-bed vegetation of the Dinaric Mountains (Lakušić & Grgić, 1971).

The first and only record of this species from the territory of Bosnia and Herzegovina refers to the slopes of Maglić Mt. above Prijedor at 2200–2300 m a.s.l. in grasslands of the subalpine region (Bjelčić et al., 1969). Although in this reference it was noted that the species was collected by Č. Šilić, there is no voucher of this taxon col-

lected on the slopes of Maglić in the available herbaria. It is possible that the specimen was deposited in the collection of the Biological Institute, which was burned in the fire in the last war (1992–1996). As there are no springs or fens in this area, but the habitats are rather rocky and steep-sloped subalpine and alpine grasslands, snow-beds in sinkholes, cliffs and crevices, the record of this species is quite questionable. Systematic studies of the flora and vegetation of the Maglić Mt. for more than 15 years have not confirmed the presence of this orchid. On the other hand, the species *Pseudorchis albida*, a species similar to *G. frivaldii* especially in the fruiting stage, is found in this area, which suggests potential misidentification. Therefore, the record for Maglić Mt. was marked as questionable on the map (Figure 11) with the symbol "?".

On the other hand, *Gymnadenia frivaldii* was found in full bloom in its typical fen habitat of Konjsko polje on the Ljubišnja Mt. in full flower (Figure 7). It is very rare in this area and was found in only one place. Konjsko



**Figure 7:** *Gymnadenia frivaldii* from fens of Konjsko polje (Đ. Milanović 03. 07. 2020.)

**Slika 7:** *Gymnadenia frivaldii* z barij na Konjskem polju (Đ. Milanović 03. 07. 2020.)



**Figure 8:** *Pseudorchis albida* in high elevations of Maglić Mt. (Đ. Milanović 28. 07. 2013.)

**Slika 8:** *Pseudorchis albida* na viškim legah na Magliću (Đ. Milanović 28. 07. 2013.)

polje is becoming an increasingly popular tourist destination, which is still relatively well preserved, as it is far from the administrative centers of Foča (BiH) and Pljevlja (Montenegro) with more than 40 km of poor macadam roads. However, with the planned opening of new modern roads for the construction of lead and zinc mines, this situation may soon change. All the more it is necessary to put these peatlands under protection and help them to remain in their original state.

**7. *Pseudorchis albida* (L.) Á. Löve & D. Löve (syn. *Gymnadenia albida* (L.) Rich., *Leucorchis albida* (L.) E. Mey.)** (Figure 8) – previously recorded only on the mountains of Jahorina and Vranica (Appendix 1h), with the new record from the top of Maglič Mt., from where it was probably erroneously reported as *Gymnadenia frivaldii* by Bjelčić et al. (1969). This mountain orchid inhabits the subalpine and alpine belts of our highest mountains and represents a glacial relict in the flora of BiH. It occurs on prominent grassy ridges and snow-beds of the highest peaks of our mountains, where it occurs solitary and quite rare. In the Republic of Srpska, the species is strictly protected (*Uredba o Strogo Zaštićenim i Zaštićenim Divljim Vrstama*, 2020), while in the Federation of BiH it is neither protected nor has the threat status category in the Red List (Đug et al., 2013). Considering the fact that the species is known from only five sites so far (three of them on the Vranica Mt.) and that its range is relatively small (the extent of occurrence (EOO) is 1512.62 km<sup>2</sup>), as well as the fact that the species occurs irregularly and sporadically in habitats threatened by natural succession due to the lack of management, it can be considered endangered for the territory of BiH. Rare localities where this plant occurs suggest that it should also be protected in all its habitats in the Federation of Bosnia and Herzegovina.

Estimated regional conservation status in Bosnia and Herzegovina: Endangered – EN B1ab(iii)+2ab(iii).

**8. *Orchis quadripunctata* Cirillo ex.Ten. (syn. *O. bipunctata* Raf.)** (Figure 9) – was first mentioned in BiH by Malý (1904) from the foothills of the Bjelašnica Mt. near Trebinje at about 800 m a.s.l. Besides this locality, the species was also found on the slopes of Hum near Mostar (Janchen, 1906; Sagorski, 1911), near Međugorje and above Kravice waterfall (Zelenika, 2012), which represent all known localities on the territory of BiH. However, the recent study of flora and vegetation in and around Neum has shown that this species is not rare in the eumediterranean part of BiH, where it inhabits more open habitats: sparsely vegetated com-

munities of Mediterranean junipers, edges of maquis, while it is particularly common in rocky former Mediterranean pastures, which are in various stages of secondary succession, as well as in sites where there have been recent fires of lower intensity. The species may also occur at other similar sites in the vicinity of Neum, but probably also at other sites in the sub-Mediterranean region with a stronger influence of the Mediterranean climate. However, sites favorable for this species are in a state of secondary succession towards pseudomaquis and maquis after the abandonment of cattle grazing and browsing. As the species has been recorded in a total of nine sites, five of which are near Neum (Appendix 1i), it has a limited distribution on the territory of Bosnia and Herzegovina (EOO is 13876 km<sup>2</sup>) and its habitats are in succession, this orchid can be considered endangered on the territory of Bosnia and Herzegovina.

Estimated regional conservation status in Bosnia and Herzegovina: Vulnerable – VU B1ab(iii) +2ab(iii).



**Figure 9:** *Orchis quadripunctata* at fire site on Debeli brijeg (Đ. Milanović 21.04.2018.)

**Slika 9:** *Orchis quadripunctata* na požarištu na Debelem brijegu (Đ. Milanović 21.04.2018.)

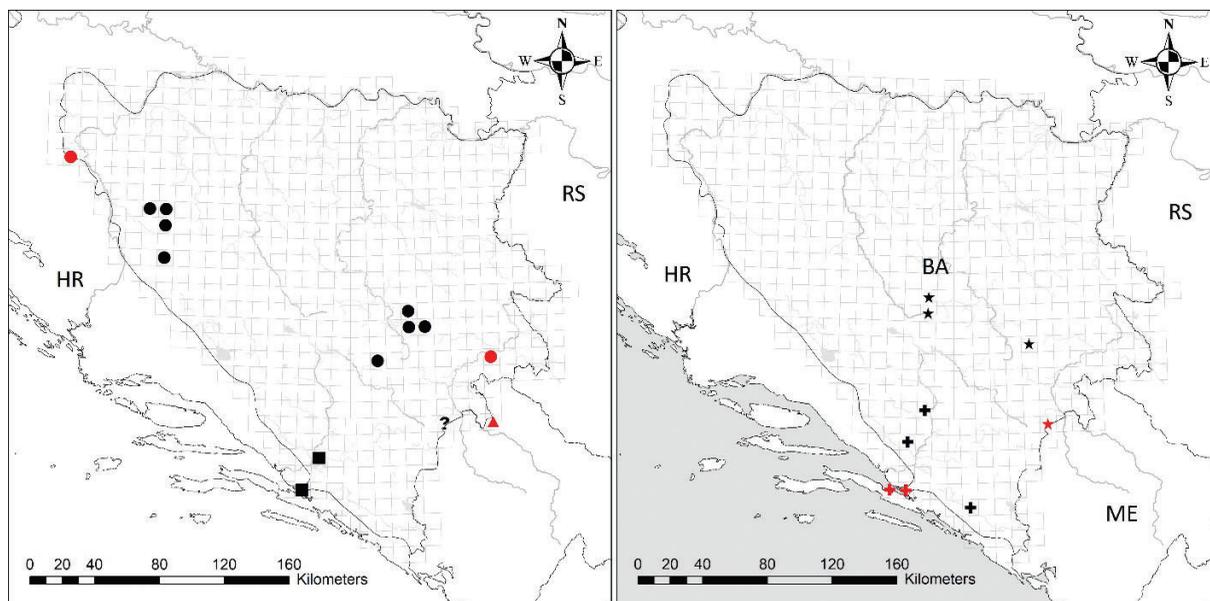
9. *Cypripedium calceolus* L. (Figure 10) – is a rare species throughout its range and is listed in Annex II of the European Union Habitats Directive (Council of the European Communities, 1992). It is known from several sites in Bosnia and Herzegovina (Appendix 1j). Recent surveys of its populations in the Sarajevo area have not confirmed this rare orchid at any of the known sites. Some authors express concern that it has completely disappeared from these localities (Šoljan et al., 2014a, 2014b). However, new localities of this species have been found in well-preserved forest complexes in the mountains of western and eastern Bosnia (Plješevica and Vijogor near Čajniče), mainly on a dolomite bedrock where this plant probably has the optimum for its development in BiH.

In the Republic of Srpska it has the status of a strictly protected plant species (*Uredba o Strogo Zaštićenim i Zaštićenim Divljim Vrstama*, 2020), which is in line with the recommendations of the EU Habitats Directive (Council of the European Communities, 1992), as the species is listed in Annex 2 of the EU Habitats Directive and all its sites should be included in the future European ecological network Natura 2000. It should have the



Figure 10: *Cypripedium calceolus* on slopes of Žestikovac at Plješevica Mt. (K. Dejanović 01. 06. 2017)

Slika 10: *Cypripedium calceolus* na pobočjih Žestikovac na Plješevici (K. Dejanović 01. 06. 2017)



Distribution of selected orchids in BiH

● *Cypripedium calceolus* ? ▲ *Gymnadenia frivaldi* ■ *Serapias bergonii* + *Orchis quadripunctata* ★ *Pseudorchis albida*

Figure 11: Distribution of studied species in Bosnia and Herzegovina. New sites are marked red.

Slika 11: Razširjenost proučavanih vrst v Bosni in Hercegovini. Nove lokacije so označene rdeče.

same protection status in the Federation of BiH, where this species is currently considered critically endangered (CR) (Đug et al., 2013). This orchid was often collected for the beauty of its flowers by uninformed mountaineers and nature lovers, and therefore has probably disappeared from all accessible and frequently visited sites. According to the IUCN criteria (IUCN Species Survival Commission, 2012b), this orchid can be considered an endangered species on the territory of BiH, given the number (only the populations in Plješevica and Klekovača mountains count more than 300 adult specimens), mutual distance and isolation of its populations (EEO is 7405 km<sup>2</sup>).

Estimated regional conservation status in Bosnia and Herzegovina: Vulnerable – VU B1ab(iv)+2ab(iv); C2(i).

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## Appendix 1

Distribution of studied orchid taxa in Bosnia and Herzegovina. New localities are bolded.

### a. *Serapias parviflora* Parl. (Figure 1, Figure 3a).

**Locality:** Tanko sedlo on Klek Peninsula near Neum (17.589051°E, 42.919900°N; MGRS YH15); **Habitat type:** fragment of ruderalized therophytic Mediterranean grasslands on the edge of macchia *Fraxino ornio-Quercetum ilicis* Horvatić (1956) 1958. **Material:** ĐM 23/07–20/001; ŠF 254/2011; correspondent literature data – Milanović (2019), without precise locality. **Date:** 09.05.2010. **Legator:** Đ. Milanović, V. Stupar i J. Brujić. **Elevation:** 61 m. **Population size:** less than 20 adult individuals.

### b. *Serapias bergonii* E. G. Camus (Figure 2) (syn. *Serapias vomeracea* subsp. *laxiflora* (Soó) Gözl & R. Reinhard).

**Locality:** south of Gradina near Mošević in the hinterland of Neum (17.684728°E, 42.932991°N; MGRS YH15) (Figure 3b). **Habitat type:** moist trampled semi-ruderalized Mediterranean grasslands along the watering hole. **Date:** 10.05.2010. **Private herbarium** Đ. Milanović: 23/07–20/002. **Legator:** Đ. Milanović, V. Stupar and J. Brujić. **Elevation:** 250 m. **Population size:** less than 30 adult individuals.

**Locality:** Crno brdo near Škrčko lake (Hutovo blato) (17.743758°E, 43.083323°N; MGRS YH27) (Figure 3c). **Habitat type:** submediterranean rocky grasslands and sparse stands of *Paliurus spina-christi*. **Date:** 05.05.2020. **Herbarium:** SARA 52241, as *S. parviflora* Parl. – det. E. Šabanović and A. Boškailo. **Legatori:** E. Šabanović and A. Boškailo. **Elevation:** 11 m. **Population size:** less than 20 adult individuals.

### c. *Himantoglossum adriaticum* H. Baumann

**Locality:** Suvaja near Bosanski Petrovac (16.324167°E, 44.650731°N; MGRS XK04). **Habitat type:** road cuts and grasslands in succession. **Material:** ĐM 23/07–11/001; correspondent literature data – Milanović et al. (2015), Bódis et al. (2018) dry and mesophilic grasslands or open woodlands and is restricted to a small region along the Adriatic coast and within Central and South-eastern Europe. We compiled phytosociological relevés (n = 84). **Date:** 27.06.2011. **Legator:** Đ. Milanović and V. Stupar. **Elevation:** 680 m. **Population size:** over 200 flowering individuals.

**Locality:** NW of Banja Luka, in the hills to the right of the road leading to the Bronzani Majdan (17.128248°E, 44.80062°N; MGRS XK66). **Material:** SARA 06703, as *H. hircinum*. **Date:** June 1879; **Legator:** F. Hofmann; corresponding literature data: Hofmann (1882) as *H. hircinum*; later in Beck-Mannagetta (1904), as *Loroglossum hircinum*. **Note:** The specimen in the SARA herbarium is characterized by small flowers and very

short spurs which completely corresponds to the species *H. adriaticum*.

**d. *Himantoglossum calcaratum*** (G. Beck) Schltr. subsp. *calcaratum* (Figure 5c, 6c)

**Locality:** Sink hole in Bistrica River canyon near Miljevina (Foča municipality) (18.657667°E, 43.519222°N; MGRS CP12). **Habitat type:** the edge of a forest of hophornbeam and downy oak. **Material:** ĐM 23/07-11/004. **Date:** 12.07.2010. **Legator:** Đ. Milanović. **Elevation:** 530 m. **Population size:** about 10 adult individuals.

**Locality:** Beleni in Drina River valley (Foča municipality) (18.760112°E, 43.417609°N; MGRS CP10). **Habitat type:** road cuts and oriental hornbeam scrub. **Material:** ĐM 23/07-11/003. **Date:** 21.07.2009. **Legator:** Đ. Milanović. **Elevation:** 620 m. **Population size:** less than 30 adult individuals.

**Locality:** Međuriječje near Čajniče (19.091208°E, 43.651476°N; MGRS CP43). **Habitat type:** edge of abandoned pastures. **Material:** observation on living specimens. **Date:** 10.07.2011. **Elevation:** 570 m. **Population size:** less than 30 adult individuals.

**Locality:** Tuhalji at Izbišno in the Bistrica River valley near Foča (18.5947°E, 43.53378°N; MGRS CP02). **Material:** Literature data – Izbišno (Fekete et al., 2017). **Elevation:** 671 m. **Note:** in the same reference, locality Kosatica in BiH is mentioned, which actually is located on the territory of Serbia (also confirmed by the coordinates).

**Locality:** near Suha in the valley of the river Sutjeska (18.65694°E, 43.30805°N; MGRS CN19). **Material:** Literature data – originally Sutjeska 2 (Fekete et al., 2017). **Elevation:** 710 m. **Note:** this locality is situated near the aforementioned locality.

**Locality:** near Suha in the valley of the river Sutjeska at the slopes of Maglič Mt. (18.660599°E, 43.309437°N; MGRS CN19). **Habitat type:** among shrubs. **Material:** Literature data – Beck-Mannagetta (1887), as *Aceras caprina* var. *A. calcarata*; Beck-Mannagetta (1904), as *Loroglossum caprinum*  $\beta$  *calcaratum*. **Elevation:** 700 m. **Note:** this locality lies close to previous localities. Furthermore, material from the Sutjeska valley was studied in the systematic revision of the genus (Bateman et al., 2017) so it can be concluded that this is a type subspecies.

**Locality:** Popov most near Tjentište (Foča municipality) (18.711452°E, 43.376948°N; MGRS CP10). **Material:** SARA 06689, as *Aceras caprina* var. *calcarata*, det. F. Fiala; as *Loroglossum calcaratum*, det. Nelson E. 30.03.1968. **Date:** 06.07.1894. **Legator:** F. Fiala.

**Locality:** Baljevo polje in Bistrica River valley near Foča (18.73627°E, 43.49652°N and 18.73721°E, 43.49625°N; MGRS CP11). **Material:** Literature data – Sutjeska (Fekete et al., 2017). **Elevation:** 426 and 434 m. **Note:** two very close localities were mistakenly

named Sutjeska in the literature, but there are coordinates based on which locality was determined more precisely

**Locality:** near Trbušće in Drina River valley (Foča municipality) (18.742766°E, 43.465827°N; MGRS CP 11). **Habitat type:** among shrubs. **Material:** SARA 06688, as *Aceras caprina* var. *calcarata*, det. F. Fiala; as *Loroglossum calcaratum*, det. E. Nelson 30.03.1968. **Date:** 06.07.1894. **Legator:** F. Fiala.

**Locality:** Čelikovo polje between Foča and Bastasi in Drina River valley (18.782514°E, 43.402014°N; MGRS CP20). **Material:** Literature data – Beck-Mannagetta (1904), as *Loroglossum caprinum*  $\beta$  *calcaratum*. **Note:** this locality lies very close to the previous one, so it is likely related to the same taxon.

**Locality:** between Foča and Ustikolina (18.792085°E, 43.545284°N; MGRS CP22). **Habitat type:** on the roadside. **Material:** SARA 06691, as *H. caprinum*, det. Loschnigg V.; as *Loroglossum calcaratum*, det. Nelson E. 30.03.1968. **Date:** 06.07.1929. **Legator:** V. Loschnigg.

**Locality:** Bastasi in Drina River valley (18.79632°E, 43.37621°N; MGRS CP20). **Material:** Literature data – Sutjeska (Fekete et al., 2017). **Elevation:** 516 m. **Note:** Locality was mistakenly named Sutjeska in the literature, but according to coordinates we were able to determine the locality more precisely.

**Locality:** Hum near Ščepan polje in Drina River Valley (18.84427°E, 43.34911°N; MGRS CP20). **Material:** Literature data – Hum (Fekete et al., 2017). **Elevation:** 454 m.

**e. *Himantoglossum calcaratum*** (G. Beck) Schltr. subsp. *rumelicum* (Somlyay, Kreutz & Óvári) Niketić & Djordjević (syn. *Himantoglossum jankae* Somlyay, Kreutz & Óvári, *H. calcaratum* subsp. *jankae* (Somlyay, Kreutz & Óvári) Bateman, Molnár & Sramkó, *H. caprinum* auct. mult.)

**Locality:** Veliko brdo above Stričići on Manjača Mt. (16.98999°E, 44.627442°N; MGRS XK54). **Habitat type:** succession of grasslands and sparse shrub with common juniper and other deciduous shrubs. **Material:** observation on living specimens. **Date:** 15.07.2016. **Elevation:** 800 m. **Population size:** about 50 adult individuals.

**Locality:** Prisjek near Dobrnja on Manjača Mt. (17.006138°E, 44.643635°N; MGRS XK54). **Habitat type:** succession of grasslands and sparse scrub with common juniper and other deciduous shrubs. **Material:** observation on living specimens. **Date:** 04.07.2017. and 13.07.2014. **Elevation:** 690 m. **Population size:** an extremely large population with several hundred flowering individuals.

**Locality:** slopes of Kik near Gornja Kola (Manjača Mt.) (17.068706°E, 44.680214°N; MGRS XK64). **Habitat type:** thermophilous forests of sessile oak and oriental

hornbeam. *Material*: observation on living specimens. *Date*: 24.06.2013. *Elevation*: 500 m. *Note*: this locality corresponds to literature data for Kola (Manjača Mt.) (Stupar et al., 2011, as *H. hircinum* subsp. *calcaratum*). *Population size*: less than 20 adult individuals.

**Locality**: at Balabanov točak in Bukvalem near Banja Luka (17.144928°E, 44.733464°N; MGRS XK75). *Habitat type*: grassy habitats along the road. *Material*: ĐM 23/07–11/002; ŠF 151/2011. *Date*: 01.06.2011. *Legator*: V. Stupar. *Elevation*: 290 m. *Population size*: only two adult individuals.

**Locality**: at Ljubinska Mt. near Zableće (16.819658°E, 44.520169°N; MGRS XK43) *Material*: literature data – Formanek, 1890, as *Aceras caprina* var. *calcarata*; later in Beck-Mannagetta (1904) as *Loroglossum caprinum* β *calcaratum*; also Vandas (1909) as *Aceras caprina* var. *calcarata*. *Note*: this locality lies near (about 7 km by air) the aforementioned localities, which indicates that this literature records also corresponds to *Himantoglossum calcaratum* subsp. *rumelicum*.

**Locality**: Gornja Previja near Dragoraj (16.898961°E, 44.485778°N; MGRS XK52). *Habitat type*: road cut. *Material*: observation on living specimens. *Date*: 13.07.2014 *Elevation*: 740 m. *Note*: Some specimens' flowers were completely white. At this Locality (Dragoraj by the road from Ključ to Varcar Vakuf (Mrkonjić grad)) the species was recorded by Schiller (1903) as *Himantoglossum hircinum*; later mentioned by Beck-Mannagetta (1904) as *Loroglossum hircinum*.

**Locality**: Donji Žabar near Gradačac (18.645971°E, 44.944811°N; MGRS CQ17). *Material*: SARA 06594, as *H. hircinum* det. O. Reiser; as *H. caprinum* det. K. Maly; kao *Loroglossum calcaratum* det. Nelson 30.03.1968. *Date*: 29.06.1911. *Legator*: O. Reiser. *Note*: specimen very robust, with a spur about 6 mm long.

**f. *Himantoglossum robertianum*** (Loisel.) P. Delforge (syn. *Orchis longibracteata* Biv.; *Barlia robertiana* (Loisel.) Greuter):

**Locality**: Čitluk (not far from the entrance to the town) (17.716696°E, 43.261066°N; MGRS YH29). *Habitat type*: ancient Mediterranean woodland composed mainly of pine trees. *Material*: Literature data – (Zelenika, 2012).

**g. *Gymnadenia frivaldi*** Hampe ex Griseb. (syn. *Leucorchis frivaldii* (Hampe ex Griseb.) Schltr.; *Pseudorchis frivaldii* (Hampe ex Griseb.) P. F. Hunt)

**Locality**: Konjsko polje at Ljubišnja Mt. (19.063906°E, 43.309662°N; MGRS CN49). *Habitat type*: alkaline fens along intermittent streams. *Material*: ĐM 23/07-09/001. *Date*: 03.07.2020. *Legator*: Đ. Milanović. *Population size*: less than 20 adult individuals.

**Locality**: above Prijedor at Maglić Mt. (18.732684°E, 43.283147°N; MGRS CN19). *Habitat type*: meadows and pastures of the subalpine region. *Material*: Litera-

ture data – Bjelčić et al. (1969). *Elevation*: 2200–2300 m. *Note*: questionable record – probably reported mistakenly instead of *Pseudorchis albida*.

**h. *Pseudorchis albida*** (L.) Á. Löve & D. Löve (syn. *Gymnadenia albida* (L.) Rich., *Leucorchis albida* (L.) E. Mey.) (Figure 9)

**Locality**: Bosnian side of the top of Maglić Mt. (18.733742°E, 43.282666°N; MGRS CN19). *Habitat type*: alpine mountain ridge grasslands *Elyno-Edraianthetum alpini* Lakušić 1970 and snow-beds of *Salicetum retusae kitaibelianae* Lakušić 1970. *Material*: ĐM 23/07-19/001. *Date*: 28.07.2013. *Legator*: Đ. Milanović.

**Locality**: Vranica (17.750914°E, 43.948861°N; MGRS YJ26). *Material*: SARA 06792 as *Gymnadenia albida* det. G. Beck; correspondent literature data – common at Vranica Mt. (Beck-Mannagetta, 1904). *Date*: 11.07.1892. *Legator*: G. Beck.

**Locality**: on meadows of Panja beneath Okrugljača at Vranica Mt. (17.794504°E, 43.96628°N; MGRS YJ27). *Habitat type*: ass. *Nardetum strictae*. *Material*: SARA 06794 as *Leucorchis albida*, det. Č. Šilić. *Date*: 01.07.1965. *Legator*: Č. Šilić. *Elevation*: 1400 m.

**Locality**: Sjekira at Vranica Mt. (17.803393°E, 43.92969°N; MGRS YJ26). *Material*: SARA 06791 as *Gymnadenia albida* det. E. Brandis. *Date*: 15.07.1892. *Legator*: E. Brandis.

**Locality**: Gola Jahorina (18.571132°E, 43.714211°N; MGRS CP04). *Habitat type*: mountain grasslands. *Material*: SARA 06793, as *Leucorchis albida*, det. K. Maly; corresponding literature data – „auf alpinen Triften der Gola Jahorina“, as *Gymnadenia albida* (Malý, 1935); Gola Jahorina (Šoljan et al., 2014b). *Date*: 22.07.1935. *Legator*: K. Maly. *Elevation*: 1800 m.

**i. *Orchis quadripunctata*** Cirillo ex Ten. (syn. *O. bipunctata* Raf.) (Figure 10)

**Locality**: above village Opuće on Klek Peninsula (17.56497°E, 42.9289°N; MGRS YH05). *Habitat type*: maquis with Mediterranean junipers on former pastures. *Material*: observation on living specimens. *Date*: 22.04.2018. *Elevation*: 60 m.

**Locality**: Jazine on Klek Peninsula near Neum (17.625414°E, 42.911862°N; MGRS YH15). *Habitat type*: Mediterranean rocky areas in the holm oak zone. *Material*: ĐM 23/07-17/001; ŠF 147/2010. det. Đ. Milanović. *Date*: 09.05.2010. *Legator*: Đ. Milanović, J. Brujić, V. Stupar. *Elevation*: 50 m.

**Locality**: southern slopes of Ćurilo on Klek Peninsula (17.628127°E, 42.903744°N; MGRS YH15). *Habitat type*: maquis with Mediterranean junipers on former pastures. *Material*: observation on living specimens. *Date*: 21.04.2018. *Elevation*: 60 m.

**Locality**: Debeli brijeg above Kamenica near Neum (17.638846°E, 42.904745°N; MGRS YH15). *Habitat type*: a recent fire site in the holm oak zone. *Material*:

observation on living specimens. *Date*: 21.04.2018. *Elevation*: 110 m.

**Locality**: Vranjevo selo above Neum (17.64305°E, 42.925132°N; MGRS YH15). *Habitat type*: succession of former Mediterranean pastures towards holm oak maquis. *Material*: observation on living specimens. *Date*: 10.05.2010. *Elevation*: 135 m.

**Locality**: a hill near the village of Miletina close to Međugorje (17.649926°E, 43.187285°N; MGRS YH18). *Material*: Literature data – Zelenika (Zelenika, 2012).

**Locality**: a hill above the Kravice waterfalls (17.612721°E, 43.157289°N; MGRS YH18). Literature data – (Zelenika, 2012).

**Locality**: northern slopes of Hum near Mostar (17.810243°E, 43.334588°N; MGRS BN64). *Material*: Literature data - Janchen (1906); Sagorski (1911), as *O. quadripunctatus* f. *obscurus*. *Elevation*: 150–200 m.

**Locality**: Bjelašnica Mt. near Trebinje (18.146252°E, 42.819994°N; MGRS YJ20). *Material*: SARA 06455, as *O. quadripunctatus* det. K. Maly. *Legator*: J. Čavek; SARA 06456, as *O. quadripunctatus* var. *obscurus*, det. K. Maly; correspondent literature data – Bjelašnica Mt. near Trebinje (Malý, 1904). *Legator*: O. Reiser. *Elevation*: 800 m.

**j. *Cypripedium calceolus* L.**

**Locality**: Majoruša at Plješevica Mt. (15.813044°E, 44.740197°N; MGRS WK65). *Habitat type*: mesoneutrophilous beech forests (*Aremonio-Fagion*) on dolomite. *Material*: Observation on living specimens (Kata Dejanović). *Date*: 01.06.2017. *Elevation*: about 1100 m.

**Locality**: Žestikova žljeba at Plješevica Mt. (15.825675°E, 44.730228°N; MGRS WK65). *Habitat type*: mesoneutrophilous beech forests (*Aremonio-Fagion*) on dolomite. *Material*: Observation on living specimens (Kata Dejanović). *Date*: 01.06.2017. *Elevation*: about 1000 m.

**Locality**: Stajkovac beneath Vijogor (Čajniče municipality) (19.124427°E, 43.651494°N; MGRS CP43). *Habitat type*: mesoneutrophilous beech forests (*Aremonio-Fagion*) on dolomite. *Material*: ĐM 23/07-04/002. *Date*: 29.08.2018. *Legator*: Đ. Milanović. *Population size*: about 20 adult individuals.

**Locality**: On the ascent from Drinić on Klekovača along the road to Kuzmanova vodica (16.499812°E, 44.465353°N; MGRS XK12). *Material*: SARA 06335 det. F. Fiala; corresponding literature data – Fiala (1889); later in Beck-Mannagetta (1904); Šilić (2008); Drešković et al. (2011); Milanović et al. (2015). *Date*: 15.08.1891. *Legator*: F. Fiala. *Elevation*: 900 m.

**Locality**: near Ajzerov bunar at Klekovača Mt. (16.548059°E, 44.432787°N; MGRS XK22). *Habitat type*: mesoneutrophilous beech forests (*Aremonio-Fa-*

*gion*) on dolomite. *Material*: ĐM 23/07-04/001; corresponding literature data – Milanović et al. (2015a). *Date*: 11.06.2009. *Legator*: Đ. Milanović and J. Brujić. *Population size*: about 150 adult individuals.

**Locality**: forest south of the Preodac village beneath Šator Mt. (16.589763°E, 44.192231°N; MGRS XJ29). *Material*: Literature data – Handel-Mazzetti et al. (1905). *Elevation*: 950 m.

**Locality**: Mlinski potok at Šator Mt. (16.593269°E, 44.17873°N; MGRS XJ29). *Material*: Literature data – Handel-Mazzetti et al. (1905). *Elevation*: 1050 m.

**Locality**: near Potoci at Klekovača Mt. (near the railway station) (16.622676°E, 44.39491°N; MGRS XK21). *Material*: SARA 06331 det. E. Brandis; corresponding literature data – Šilić (2008). *Date*: 06.07.1893. *Legator*: E. Brandis. *Note*: our research has confirmed the presence of the species at this locality.

**Locality**: 3 km upstream of Krupac in the Rakitnica River canyon (right tributary of Neretva River) (18.163674°E, 43.616009°N; MGRS BP73). *Material*: SARA 06336 det. Č. Šilić; corresponding literature data – Šilić (2008). *Date*: 08.05.1966. *Legator*: Č. Šilić.

**Locality**: Bukovik by Sarajevo near Skakavac waterfalls (18.448035°E, 43.941448°N; MGRS BP96). *Habitat type*: hophornbeam forest. *Material*: SARA 06332 det. Č. Šilić; corresponding literature data – Šilić (2008); Šoljan et al. (2014a, 2014b). *Date*: 05.07.1966. *Legator*: Č. Šilić. *Elevation*: 1350 m.

**Locality**: under Dovlići on Trebević Mt. (18.481814°E, 43.832219°N; MGRS BP95). *Material*: Literature data – Protić (1908). *Note*: only one individual was found.

**Locality**: Stari grad near Sarajevo (probably Lipovac?) (18.49766°E, 43.835422°N; MGRS BP95). *Material*: SARA 06334 det. F. Fiala; corresponding literature data – Beck-Mannagetta (1904); Šilić (2008); Drešković et al. (2011); Šoljan et al. (2014a). *Date*: May 1892. *Legator*: F. Fiala.

**Locality**: near Orlovača in the Paljanska Miljacka River gorge (18.50912°E, 43.824059°N; MGRS CP05). *Material*: SARA 06333 det. K. Maly; corresponding literature data – Šilić (2008); Šoljan et al. (2014a). *Date*: 03.06.1906. *Legator*: K. Maly.

## Appendix 2

Indeterminate vouchers and literature citations for genus *Serapias* and *Himantoglossum*:

### a. *Serapias*

*Locality*: Počitelj (17.731414°E, 43.136487°N; MGRS YH27). *Material*: Literature data – Maslo & Boškailo (Maslo & Boškailo, 2018).

### b. *Himantoglossum*

#### 1. Literature data:

*Locality*: south of Zvornik (19.108398°E, 44.360156°N; MGRS CQ41). *Habitat type*: rocky slopes towards the river Drina on limestone. *Material*: Literature data – Wettstein in Fritsch (1909) as *H. hircinum* var. *calcaratum* with mark „leg. Wettstein: July 1890“. *Note*: it can be presumed that there was a herbarium specimen that was not available to us.

*Locality*: Vranduk near Zenica (17.903747°E, 44.293402°N; MGRS YK30). *Material*: Literature data – Degen in Beck-Mannagetta (1904), as *H. hircinum*; Šabanović et al. (2020) – without locality name, only a map.

*Locality*: Goražde (18.986976°E, 43.680134°N; MGRS CP33). *Material*: Literature data – Griebel (2008) as *H. caprinum* ssp. *calcaratum*. *Note*: in the mentioned reference there is only an insufficiently clear photograph from 28.06.1984. taken by the author and wrongly assigned to Montenegro. There is a photograph from the vicinity of Goražde (Faruk Bogunić) with spurs shorter than the ovary, and although these specimens lie in the distribution range of *H. calcaratum* subsp. *calcaratum* we could not attribute them with certainty to this taxon.

*Locality*: on the hill above Budžak near Banjaluka (17.188837°E, 44.804082°N; MGRS XK76). *Material*: Literature data – Conrath (1887) as *H. hircinum*; later in Beck-Mannagetta (1904) as *Loroglossum hircinum*.

*Locality*: on the slopes of Igman near Blažuj (18.253713°E, 43.836714°N; MGRS BP75). *Habitat type*: in the bushes on the slopes. *Material*: Literature data – Blau (1877), as *Aceras hircinum*; later in Beck-Mannagetta (1887), as *Aceras hircina*; also in Beck-Mannagetta (1904) as *Loroglossum hircinum*.

*Locality*: near Zavalje at Plješevica Mt. (15.832093°E, 44.773303°N; MGRS WK65). *Habitat type*: on a grassy and bushy slope. *Material*: Literature data – Boller (1892), as *Satyrium hircinum*; later in Beck-Mannagetta (1904) as *Loroglossum hircinum*.

*Locality*: along the road from Konjic to Borci on Borošnica (17.977871°E, 43.620492°N; MGRS YJ33); *Material*: Literature data – Degen in Beck-Mannagetta (1904) as *Loroglossum hircinum*.

#### 2. Herbarium material:

Group of localities from the vicinity of Sarajevo:

*Locality*: Koševo near Sarajevo (18.419556°E, 43.879362°N; MGRS BP96). *Material*: SARA 06700 as *H. hircinum* det. Đ. Protić; as *H. caprinum* det. K. Maly; as *Loroglossum calcaratum* det. E. Nelson 30.03.1968; Literature data – Koševo (Šoljan et al., 2014a). *Date*: 03.07.1921. *Legator*: Đ. Protić. *Note*: the specimen has spurs about 8 mm long with long lateral lobes.

*Locality*: Koševo near Sarajevo (18.419556°E, 43.879362°N; MGRS BP96). *Material*: SARA 06683 as *Loroglossum calcaratum* det. K. Maly and E. Nelson 30.03.1968. *Habitat type*: among the bushes. *Elevation*: 600 m. *Date*: 30.07.1902. *Legator*: K. Maly. *Material*: Literature data – the same locality is mentioned in the literature: Malý (1904), as *Loroglossum calcaratum*; later in Beck-Mannagetta (1904). *Note*: the specimen is characterized by rather short spurs (about 6 mm), considerably shorter than the ovary which corresponds more to the taxon *H. calcaratum* subsp. *rumelicum*.

*Locality*: Koševsko brdo near Sarajevo (18.419556°E, 43.879362°N; MGRS BP96). *Material*: SARA 06696 as *H. caprinum* det. K. Maly; det. E. Nelson as *Loroglossum calcaratum* 30.03.1968; Literature data – Koševsko brdo near Sarajevo (Šoljan et al., 2014a). *Habitat type*: on pastures. *Elevation*: 600 m. *Date*: 30.07.1902. *Legator*: K. Maly. *Note*: this specimen, collected on the same day at a spatially close locality as the previous one, is characterized by a significantly longer spur (about 10 mm) which corresponds more to the taxon *H. calcaratum* subsp. *calcaratum*.

*Locality*: on the saddle between Kovačić and Lukavica near Sarajevo (18.395374°E, 43.842261°N; MGRS BP95). *Material*: SARA 06597 as *Aceras caprina* var. *calcarata* det. F. Fiala; det. E. Nelson as *L. calcaratum* 30.03.1068. *Date*: 18.07.1886. *Legator*: F. Fiala. *Literature data*: this locality was mentioned by Fiala (1889), as *Aceras caprina* var. *calcarata*; later in Beck-Mannagetta (1904), as *Loroglossum caprinum* β *calcaratum*). *Note*: spur about 8 mm long.

*Locality*: on the saddle between Kovačić and Lukavica near Sarajevo (18.395374°E, 43.842261°N; MGRS BP95). *Material*: SARA 06684 as *Aceras hircina* det. F. Fiala; det. E. Nelson as *L. calcaratum* 30.03.1068. *Date*: 18.07.1886. *Legator*: F. Fiala. *Literature data*: same as for the previous voucher. *Note*: spur about 8 mm long.

*Locality*: on the saddle between Kovačić and Lukavica near Sarajevo (18.395374°E, 43.842261°N; MGRS BP95). *Material*: SARA 06687 as *Aceras caprina* var. *calcarata* det. V. Čurčić; det. E. Nelson as *L. calcaratum* 30.03.1068. *Date*: 02.07.1893. *Legator*: V. Čurčić. *Note*: spur about 8 mm long.

*Locality*: Ostrog by Stanojevići near Sarajevo (18.42605°E, 43.824767°N; MGRS BP95). *Material*: SARA 06539 as

*Loroglossum caprinum* var. *calcaratum* det. K. Maly; det. E. Nelson as *L. calcaratum* 30.03.1968. *Date*: 10.07.1926.

*Legator*: K. Maly. *Note*: spur about 7 mm long.

*Locality*: Stjenice by Stanojevići near Sarajevo (18.419787°E, 43.822933°N; MGRS BP95). *Material*: SARA 06690 as *Himantoglossum caprinum* det. L. Lazetić; det. E. Nelson as *L. calcaratum* 30.03.1968. *Date*: 03.07.1957. *Legator*: S. Tvrković. *Note*: spur about 8 mm long.

*Locality*: Mrakovo by Ilijaš near Sarajevo (18.282662°E, 43.967048°N; MGRS BP87). *Material*: SARA 06692 as *Loroglossum caprinum* var. *calcaratum* det. K. Maly; det. E. Nelson as *L. calcaratum* 30.03.1968. *Date*: 11.07.1926. *Legator*: K. Maly. *Note*: long spur (about 10 mm) which fits *H. calcaratum* subsp. *calcaratum*.

*Locality*: by Da Riva between Miljacka and Mošćanica near Sarajevo (18.453523°E, 43.857352°N; MGRS BP95). *Material*: SARA 06695 as *Loroglossum caprinum* var. *calcaratum* det. K. Maly; det. E. Nelson as *L. calcaratum* 30.03.1968; *Literature data* – Šoljan et al. (2014a). *Elevation*: 580 m. *Date*: 11.07.1905. *Legator*: K. Maly. *Note*: spur about 9 mm long.

Group of localities from the vicinity of Travnik:

*Locality*: Travnik and the surroundings. *Material*: SARA 06701a i 06701b as *Himantoglossum hircinum* det. E. Brandis; det. E. Nelson as *L. calcaratum* 30.03.1968. *Date*: 27.07.1884 (beneath Bunarbaša – 17.655328°E, 44.230795°N; MGRS YK10); 13.07.1885; 21.07.1892 (at Gostilj – 17.50471°E, 44.285907°N; MGRS YK00). *Legator*: E. Brandis. *Literature data*: Freyn & Brandis (1888) as *Satyrium hircinum*; later Brandis (1890) under the same name; Beck-Mannagetta (1904) as *Loroglossum hircinum*). *Note*: sheets contain several specimens and it can not be said with certainty which one was collected at which locality! The label also states that the species was found by V. Krajinović „near the factory of matches“ (6 specimens) and „in the upper pine grove“ (17 specimens). Among the specimens with long spurs (about 9 mm), one specimen has a shorter and thicker spur (about 6.5 mm).

*Locality*: Travnik and the surroundings. *Material*: SARA 06702a i 06702b as *Himantoglossum hircinum* det. E. Brandis; det. E. Nelson as *L. calcaratum* 30.03.1968. *Date*: 21.07.1884 (beneath Bunarbaša – 17.655328°E, 44.230795°N; MGRS YK10); 13.07.1885; 19.07.1884 (Tarabovac – 17.676212°E, 44.227433°N; MGRS YK10); 13.07.1885. (Ovčarevo – one specimen – 17.61562°E, 44.238081°N; MGRS YK00); 21.07.1892 (at Gostilj – 17.50471°E, 44.285907°N; MGRS YK00). *Legator*: E. Brandis. *Literature data*: same as previous. *Note*: sheets contain several specimens and it can not be said with certainty which one was collected at which locality! The label also states that the species was found by V. Krajinović „near the factory of matches“ (6 speci-

mens) and „in the upper pine grove“ (17 specimens). Among the specimens with a long spurs (about 9 mm) one specimen obviously has a shorter and thicker spur (about 6.5 mm).

*Locality*: Travnik and the surroundings. *Material*: SARA 06703a i 06703b as *Himantoglossum hircinum* det. E. Brandis; det. E. Nelson as *L. calcaratum* 30.03.1968. *Date*: 21.07.1884 (beneath Bunarbaše – 17.655328°E, 44.230795°N; MGRS YK10); 13.07.1885; 19.07.1884 (Tarabovac – 17.676212°E, 44.227433°N; MGRS YK10); 13.07.1885. (Ovčarevo – one specimen – 17.61562°E, 44.238081°N; MGRS YK00); 21.07.1892 (at Gostilju – 17.50471°E, 44.285907°N; MGRS YK00). *Legator*: E. Brandis. *Literature data*: same as previous. *Note*: sheets contain several specimens and it can not be said with certainty which one was collected at which locality! The label also states that the species was found by V. Krajinović „near the factory of matches“ (6 specimens) and „in the upper pine grove“ (17 specimens). Specimens with shorter spurs (about 6 mm) predominate here, which fits *H. calcaratum* subsp. *rumelicum*.

*Locality*: above Ovčarevo near Travnik (17.61562°E, 44.238081°N; MGRS YK00). *Material*: SARA 06699 as *Himantoglossum hircinum* det. J. Freyn; det. K. Maly as *H. caprinum*; det. E. Nelson as *L. calcaratum* 30.03.1968. *Date*: 13.07.1886. *Legator*: J. Freyn. *Note*: spur short (about 6 mm) which fits *H. calcaratum* subsp. *rumelicum*.

*Locality*: Bunarbaša near Travnik (17.655328°E, 44.230795°N; MGRS YK10). *Material*: SARA 06698 as *Satyrium hircinum* det. E. Brandis; det. K. Maly as *H. caprinum*; det. E. Nelson as *L. calcaratum* 30.03.1968. *Date*: 13.07.1886. *Legator*: E. Brandis. *Note*: spur long (about 10 mm) which fits *H. calcaratum* subsp. *calcaratum*.

Other indeterminate vouchers:

*Locality*: Falanovo brdo near Ostrožac (17.817653°E, 43.705431°N; MGRS YJ24). *Material*: Herb. SARA 51266, SARA 51267, SARA 51268, SARA 51269, SARA 51270, SARA 51385, all determined as *H. adriaticum* det. Č. Šilić. *Date*: 16.06.2003. *Note*: so far the only site in Herzegovina based on herbarium material. Some specimens are characterized by rather short spurs (4–5 mm) but large flowers, while spurs in some specimens are relatively long (7–9 mm) which fits the best *H. calcaratum* subsp. *rumelicum*.

*Locality*: entrance to the canyon of river Rakitnica from Rogatica to Mesići (19.010666°E, 43.787053°N; MGRS CP45). *Material*: SARA 06685 and 06686 as *Loroglossum calcarata* det. Đ. Đuran. *Elevation*: 650 m. *Date*: 17.07.1978. *Legator*: Đ. Đuran. *Note*: spur about 7 mm long.