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The genus *Orchis* Tourn. ex L. and its related genera in the Zenica-Doboj Canton (Bosnia and Herzegovina): diversity, distribution and conservation

Original Article

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Abstract:
This paper represents the results of the distribution study focused on the genera *Anacamptis*, *Neotinea*, *Orchis* and related species belonging to Orchidaceae family. The investigation was conducted in the Zenica-Doboj Canton, during the period of four years (2016-2019). The presence of 12 species and two subspecies was noticed. All of the populations turned out to be very vulnerable, consisting of a reduced number of individuals. The most endangered populations are *Orchis militaris*, *O. pallens* and *O. spitzelii*.

Key words:
Orchidaceae, Anacamptis, Neotinea, Orchis

Apstract:
Rod Orchis Tourn. ex L. i njemu srodni rodovi u Zeničko-dobojskom kantonu (Bosna i Hercegovina): diverzitet, rasprostranjenje i konzervacija
U vom radu su dati rezultati istraživanja distribucije vrsta iz rodova *Anacamptis, Neotinea* i *Orchis* iz familije Orchidaceae na području Zeničko-Dobojskog kantona u periodu od 2016. do 2019. godine. Utvrđeno je prisustvo 12 vrsta i dve podvrste. Populacije svih vrsta su izrazito malobrojne, što ih čini veoma ugroženim. Najugroženije su populacije vrsta *Orchis militaris, O. pallens* i *O. spitzelii*.

Ključne reči:
Orchidaceae, Anacamptis, Neotinea, Orchis

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Introduction

The genus *Orchis* belongs to Orchidaceae family (Chase, 2005; Stroh, 2016), the family with the highest diversity, which comprises about 28,000 species sorted in 736 genera (Christenhusz & Byng, 2016). The genus is affiliated to the subtribus Orchidinae, the tribus Orchideae and the subfamily Orchidoideae. Moreover, the rest of the genera from the central part of the Balkan Peninsula - *Anacamptis*, *Dactylorhiza*, *Gymnadenia*, *Herminium*, *Himantoglossum*, *Neotinea*, *Ophrys*, *Platanthera*, *Pseudorchis* and *Traunsteinera* (Djordjevic, 2018) – are having the same taxonomic status. According to the Flora Europaea (Soó, 1980), the genus *Orchis* also included some species, recently relocated within the *Anacamptis* and *Neotinea* genera, as a consequence of phylogenetic analysis, based on nuclear ITS sequences (Bateman et al., 1997).

In Bosnia and Herzegovina, the Orchidaceae family is represented by 23 genera and 69 species (Šilić, 2008) – among them, 8 species belong to the genus *Orchis* (*O. italica*, *O. mascula*, *O. militaris*, *O. pallens*, *O. provincialis*, *O. purpurea*, *O. simia* and *O. spitzelii*), 5 to the genus *Anacamptis* (*A. pyramidalis*, *A. coriophora*, *A. morio*, *A, laxiflora* and *A. palustris*) and 2 to the genus *Neotinea* (*N. tridentata* and *N. ustullata*) (Back Managetta, 1903; Šoljan

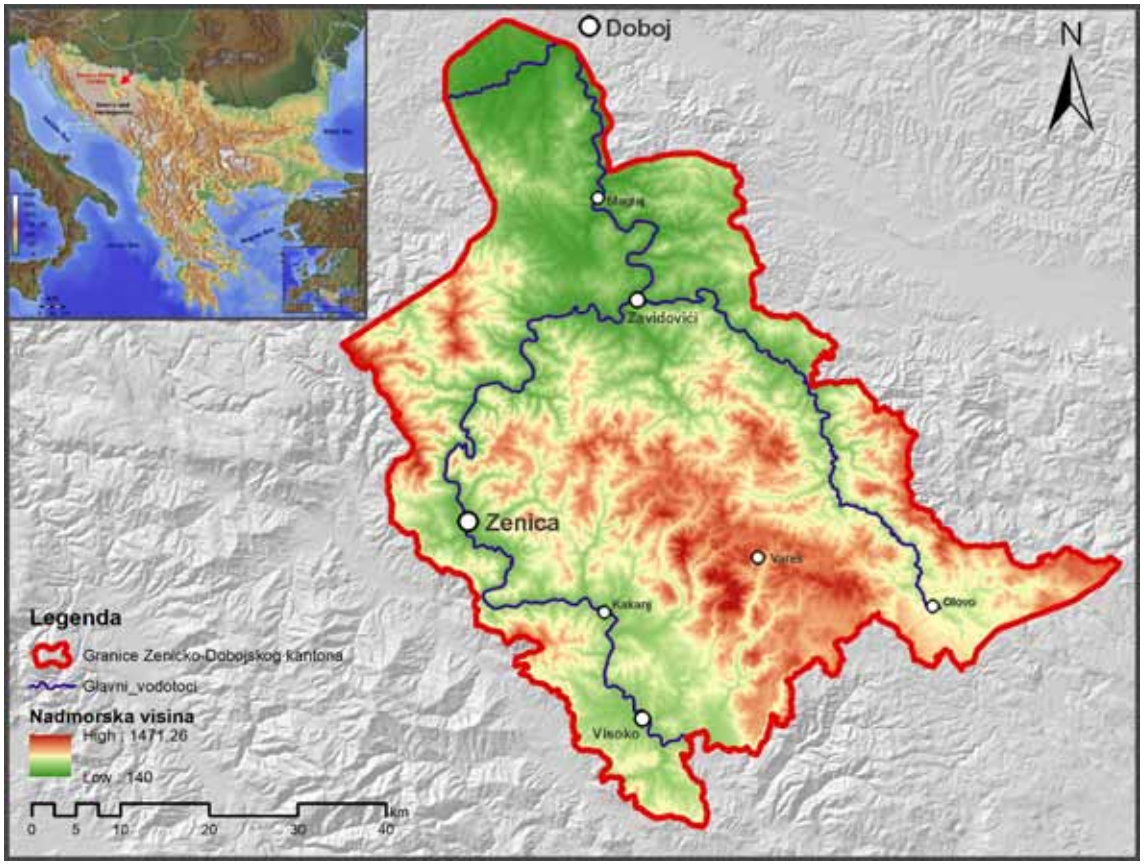

Fig. 1. Geographical position of investigated area

et al., 2014; Bucalo, 2015). "The Red List of Flora of the Federation of Bosnia and Herzegovina" (Đug et al., 2013) contains 4 species from the previously mentioned genera: *Orchis purpurea*, *O. simia*, *O. spitzelii* and *Anacamptis pyramidalis*. The same species can be found in "The Red List of Flora of Bosnia and Herzegovina" Šilić (1996). "The Red List of Flora and Fauna of Republika Srpska" (http://www.nasljedje.org/docs/crvenalista/Vascular_Flore.pdf), is highlighting the importance of the orchid flora, comprising all of the species from the mentioned genera.

The orchid flora of the Zenica-Doboj Canton, hadn't been investigated previously. The data about their distribution are seriously restricted; on the one hand, most of the literature data, including 11 species from the genera *Orchis*, *Anacamptis* and *Neotinea*, date from the second half of the 19th and the first half of the 20th century (Kummer & Sendtner, 1849; Fiala, 1896, Protic , 1898, Beck Mannagetta, 1903; Maly, 1908; Plavsic, 1940); on the other hand, more recent data have been reduced to individual citations (Ritter-Studnička, 1970; Abadžić, 2012; Šabanović & Bektić, 2017).

The morphological similarity, followed by the phylogenetic status of the genera *Orchis*, *Anacamptis* and *Neotinea*, as well as the fact that species from the genera *Anacamptis* (with *A. pyramidalis* as an exception) and *Neotinea* are even nowadays represented as the members of the genus *Orchis* (Šoljan et al., 2014) in Bosnia and Herzegovina, are indicating the need of the thorough investigation. Hence, the aim of this paper was to determine the diversity of all three genera in the area of Zenica-Doboj Canton, to show the distribution and condition of their populations and to point out the need for conservation of habitats as the only way of preserving populations.

Material and Methods

Study area

The study was focused on the Zenica-Doboj Canton (Fig. 1), the territory located in the central part of Bosnia and Herzegovina, more precisely, Bosna River Basin. It covers an area of 3345 km^2, between 17°44'38'' and 18°50'11'' longitude, and 43°54'13'' and 44°43'41'' latitude. It is a distinctly mountainous area, with a huge geomorphological diversity and altitudes ranging from 160 to 1472 m. The relief is characterized by three specific areas: Usore River valley with its plains and hilly areas in the north, hilly-mountainous terrain in the central part and hilly relief in the south. The central area is

the largest, extending between the rivers of Bosnia and Krivaya and consisting of the mountain massifs Ravan planina, Konjuh, Smolin, Zvijezda and Čemerska planina. The highest mountain peak of Karasanovina (1472 m asl) is located on Zvijezda Mountain (Goletić, ed. 2016). From the aspect of the geological substrates, the study area is quite diverse, including silicates, carbonates (Goletić, ed. 2016) and, in particular, serpentinite (Ritter-Studnička, 1930). The entire area is characterized by a large number of river flows belonging to the Bosna River Basin. The lowland and hilly parts of the canton are characterized by a continental to a temperate continental climate, while with the altitude increases, the influence of the mountain climate is getting more pronounced (Goletić, ed. 2016).

In a domain of phytogeography, Zenica-Doboj Canton belongs to the Illyrian subregion of the Central European region and Holarctic floristic kingdom (Horvat et al., 1974). This area is characterized by high diversity of flora, including endemic species, e.g. *Daphne blagayana, Hesperis dinarica, Viola beckiana, Euphorbia gregersenii, E. montenegrina, Dianthus croaticus* and others. Many plant species are declared as endangered, such as *Halacsya sendtneri, Notolaena maranthe, Eranthis hiemalis*, *Kitaibela vitifolia* and others. The orchid species contained in this study are included in the group of highly sensitive species.

This area is characterised by the pronounced vegetation diversity as well, unfortunately enormously degraded due to the anthropogenic factor. On the banks of rivers and streams riparian gallery forests (classis *Alno glutinosae-Populetea albae* P. Fukarek et Fabijanić 1968) have been developed. The mountain belt is overgrown with the oak-hornbeam and mesic oak forests (ordo *Carpinetalia betuli* P. Fukarek 1968). The climatogenic vegetation of this area is represented with the sessile oak and the common hornbeam forest (*Querco-Carpinetum illyricum* Ht. et al. 1974), whereas the sessile oak forests (*Quercetum montanum* Čer. et Jov. 1968) prefer thermophilic habitats. Forest vegetation of the mountain belt is seriously degraded, giving a place to the mountain grasslands as a secondary type of vegetation. Above this belt, at higher altitudes, beech forests (*Fagetum illyricum* Ht. 1938) gradually turn into mixed deciduous and coniferous forests (*Abieti-Fagetum illyricum* Ht. 1938). Coniferous spruce forests (*Piceetum illyricum montanum* Ht. 1950) are growing on the small areas of the mountains Zvijezda and Ravna planina (Horvat et al. 1974, Fukarek, Jovanović, ed., 1983). In surrounding of Vareš, forests with peat moss and spruce (*Sphagno-Piceetum montanum* Stefanović 1964) *are* developed in the depressions of the mountain belt (Barudanović et al., 2019). Black pine forests (*Erico-Pinetum nigrae serpentinicum* Stef. 1962) and other communities preferring serpentinite represent a special feature to the vegetation (Ritter-Studnička, 1970a).

Field work

The diversity and geographical distribution of the taxa from the genera *Orchis, Anacamptis* and *Neotinea* were investigated in the period from 2016 to 2019. GPS and UTM (10×10 km) coordinates are determined for each population. Population status was defined by counting flowering and non-flowering individuals in the square areas 50×50 m. At the same time, potential factors in taxa endangerment have been reported.

The collected floristic material was deposited in the Museum „Visoko" in the Visoko city. Considering the high degree of threatened taxa, a rich photo-documenting material was created in order to avoid the collection of the plant material. Photographs are also stored in the museum.

Data collection and analysis

In addition to the field data, literature and herbarium data (SARA - Herbarium of the National Museum of Bosnia and Herzegovina) were included.

The identification of the taxa was performed by using keys from modern literature (Soó, 1980; Delforge, 2006). The nomenclature of the taxa is consistent with The Euro+Med PlantBase (http://ww2.bgbm.org/EuroPlusMed/results.asp).

The distribution of the taxa is shown on the grid map and zone s4T with squares of 10×10 km, based on the Universal Transverse Mercator (UTM) projection (Lampinen, 2001). The different types of the data are presented as follows: the white dot - the field data, the black dot - the literature data, the black-white dot - the field and literature data, and the grey dot - the herbarium data.

The affiliation to an appropriate chorological type and floral element was determined on the basis of its geographical range. The determination of the chorological type is based on the coincidence of the geographical range with the corresponding phytochoria (Stevanović, 1992). The abbreviations of the chorological type, as defined in Ranđelović, Zlatković (2010) and Đorđević (2018), are given as listed: EA - Eurasian, CE - Central European, MSM - Mediterranean-Sub-Mediterranean and SEM - South European Mountainous. The floral elements were determined according to Meusel (Meusel et al., 1965) modified by Stevanović (1992).

The endangerment of the taxa wase based on the IUCN criteria. The IUCN categories are presented as follows: CR - critically endangered, EN - endangered, VU - vulnerable and LC - least

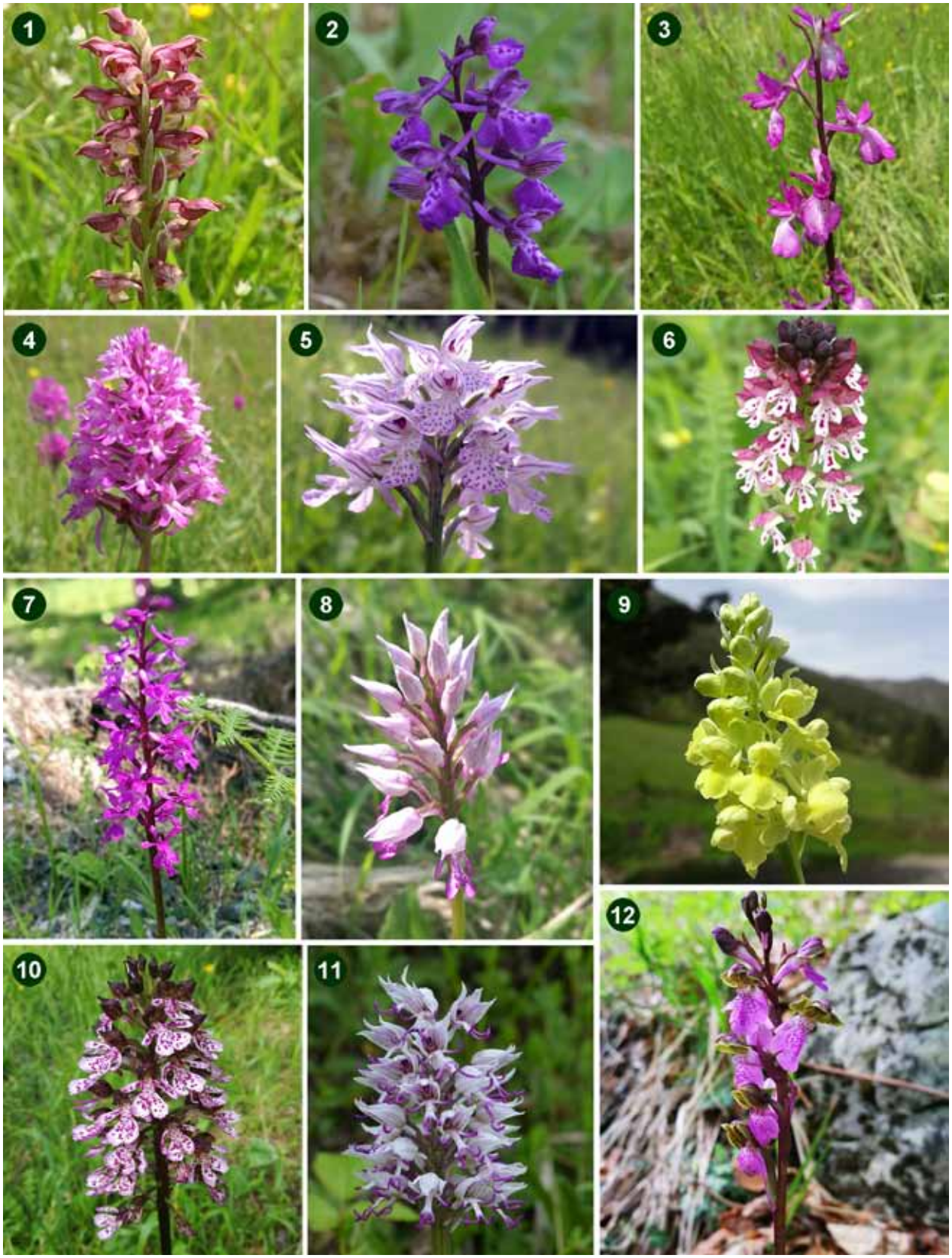

Fig. 2. Investigated species: 1. *Anacamptis coriophora*, 2. *A. morio*, 3. *A. palustris*, 4. *A. pyramidalis*, 5. *Neotinea tridentata*, 6. *N. ustulata*, 7. *Orchis mascula*, 8. *O. militaris*, 9. *O. pallens*, 11. *O. purpurea*, 11. *O. simia*, 12. *O. spitzelii*

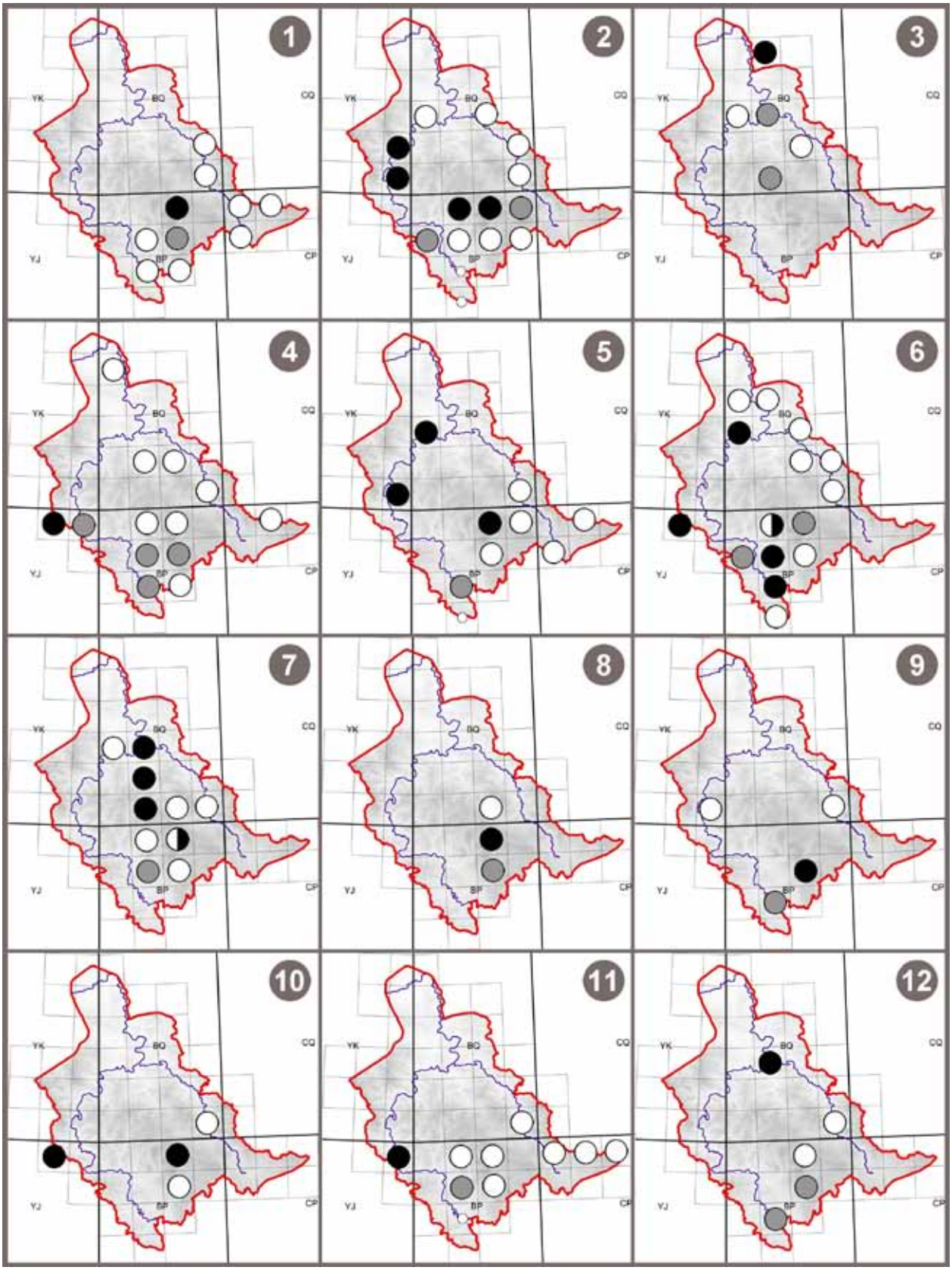

Fig. 3. Distribution of investigated species: 1. *Anacamptis coriophora*, 2. *A. morio*, 3. *A. palustris*, 4. *A. pyramidalis*, 5. *Neotinea tridentata*, 6. *N. ustulata*, 7. *Orchis mascula*, 8. *O. militaris*, 9. *O. pallens*, 11. *O. purpurea*, 11. *O. simia*, 12. *O. spitzelii*

concern. Relative frequency, as defined in Vuković et al. (2011), was given as listed: a - abundant, f - frequent, r - rare, rr - extremely rare.

The species and subspecies with the corresponding data (chorological type, IUCN category, relative frequency, localities and habitats - if available) are presented alphabetically in the list as follows:

Name of species

Chorological type/floral element
IUCN category/abundance

Distribution:

Literature and herbarium data: locality, altitude, UTM 10×10, habitat (Reference or *Collector,* dd.mm.yyyy, Herbarium).

Field data: locality, altitude, UTM 10x10, habitat (*Collector,* DD.MM.YYYY).

Results

The presence of 12 orchid species and 2 subspecies from genera *Anacamptis* (4 species, 1 subspecies), *Neotinea* (2 species) and *Orchis* (6 species, 1 subspecies) has been identified in the Zenica-Doboj canton.

List of species

***Anacamptis coriophora* (L.) R. M. Bateman, Pridgeon & M. W. Chase (Fig. 2-1)**

EA/Central European-Mediterranean-Sub-Mediterranean-Southwest Asian

VU/f (small populations, only the population near village Porječani is more than 10 individuals)

Distribution (Fig. 3-1):

Literature and herbarium data: oko Vareša, BP89 (Protić, 1898); oko Vareša, BP89 (Beck, 1903); Pajtov Han, BP88 (*Plavšić*, 11/6/1940, SARA).

Field data: Stipin Han, 350 m, BQ91, mesophilous grassland (*Šabanović*, 10/5/2018); Prhinje, 465 m, BP77, hygrophilous grassland by the mining pit lake (*Šabanović*, 27/5/2018); Visočica, 690 m, BP77, mesophilous grassland from alliance *Arrhenatherion elatius* (*Šabanović*, 27/5/2018); Porječani, 445 m, BP78, mesophilous grassland from alliance *Arrhenatherion elatius* (Šabanović, 3/6/2019); Jelaške, BQ90 (*Šarić*, 14/5/2016; 17/5/2018); Milankovići, CP09 (*Šarić*, 6/6/2016); Smailbegovići, Breza, BP87 (*Šarić*, 29/5/2018); Drecelj, Olovo, CP19 (*Šarić*, 8/6/2017); Ajdinovići, CP08, (*Šarić*, 30/6/2017).

***Anacamptis morio* (L.) R.M.Bateman, Pridgeon & M.V.Chase (Fig. 2-2)**

EA/European-Mediterranean-West Asian

Lc/a

Distribution (Fig 3-2):

Literature and herbarium data: Borovica, BP79; Vranduk, YK30 (Kummer & Sendtner, 1849); in grassland around Pobrin han, BP89 (Protić, 1898); around Vranduk, YK30; between Žepče and Golubinje, YK31; near Visoko, BP77; near Vareš, BP89 (Beck, 1903); Kruškovica, BP99 (*Plavšić*, 19/6/1940, SARA); Kondžilo, BP68 (*Plavšić*, 9/6/1939, SARA); Visočica, BP77 (*Plavšić*, 25/6/1939, SARA).

Field data: Sokolina, 870 m, BQ90, mesophilous pasture in a belt of mixed deciduous and coniferous forests of the *Abieti-Fagion* type (*Šabanović, Ranđelović, Šarić*, 30/4/2018); Župa-Jelaške, 585 m, BQ90, mesophilous grassland (*Šabanović, Ranđelović, Šarić*, 30/4/2018); Visočica, 670 m, 685 m, BP77, mesophilous grassland (*Šabanović*, 13/5/2018); Visočica, 640 m, BP77, mesophilous grassland from alliance *Arrhenatherion elatius* (*Šabanović*, 11/5/2018); Visočica, 710 m, BP77, dry grassland *Festuco-Brometea* type (*Šabanović*, 11/5/2018); Visočica, 790 m, BP77, mesophilous grassland from alliance *Arrhenatherion elatius* (*Šabanović*, 11/5/2018); Dvor, 585 m, BP76, mesophilous grassland (*Šabanović*, 9/5/2018); Ribnica, 350 m, BQ91, mesophilous grassland from alliance *Arrhenatherion elatius* (*Šabanović*, 12/5/2018); Pogar, 1055 m, BP89, mesophilous pasture (*Šabanović*, 12/5/2018); Gorani, 635 m, BP77, thermophilic rocky meadows (*Šabanović*, 13/5/2018); Dvor, 515 m, BP76, mesophilous grassland (*Šabanović*, 17/5/2018); Porječani, 445 m, BP78, mesophilous grassland from alliance *Arrhenatherion elatius* (*Šabanović*, 3/6/2019); Karići, 1190 m, BP98 (*Šabanović*, 18/5/2019); Žepče, 220 m, BQ62, mesophilous grassland from alliance *Molinion caeruleae* (*Šabanović*, 25/5/2019); Perun, 1330 m, BP88, mesophilous pasture (*Šabanović*, 9/6/2019); Brezik, Zavidovići, BQ82 (*Šarić*, 21/4/2016); Jelaške, BQ90 (*Šarić*, 21/4/2016; 25/4/2018); Dištica, Zavidovići, BQ90 (*Šarić*, 27/4/2018); Bukov dol, BQ90 (*Šarić*, 29/5/2019).

***Anacamptis palustris* (Jacq.) R.M. Bateman, Pridgeon & M.W. Chase (Fig. 2-3)**

EA/Atlantic-European-Euxinian-Caucasian-Pontian-Irano-Turian

VU/r (population near Lupoglav is very rich and counts over 500 individuals, while other populations are with few individuals)

Distribution (Fig 3-3):

Literature and herbarium data: između Trbuka i Maglaja, (Beck, 1903); Tajan, BQ70 (*Maly*, 22/5/1898; 24/6/1906; 21/5/1908; 30/5/1912;

29/6/1912); Tajan, BQ70 (*Maly*, 6/6/1921, SARA); Ljeskovica, BQ72 (*Maly*, 29/5/1930, SARA); Klek-Zavidovići, BQ72 (*Fiala*, 16/6/1892, SARA).

***A. palustris* subsp. *elegans* (Heuff.) R.M. Bateman, Pridgeon & M.W. Chase**

Distribution (Fig. 3-3):

Field data: Stošnica, 260 m, BQ81, swamp meadow (*Šabanović*, 30/5/2018); Lupoglav, 230 m, BQ62, swamp meadow (*Šabanović*, 4/6/2019); Stošnica, BQ81 (*Šarić*, 12/5/2016; 29/5/2018); Žepče, BQ62 (*Šarić*, 5/6/2019); Vozuća, BQ81 (*Šarić*, 2/6/2016).

***Anacamptis pyramidalis* (L.) Richard (Fig. 2-4)**

MSM/Mediterranean-Sub-Mediterranean-Central European-Pontian-Euxinian-Caucasian-Iranian

VU/f (populations are with few individuals)

Distribution (Fig. 3-4):

Literature and herbarium data: in grasslands near Pobrin han, BP89 (Protić, 1898); between Tolović and Zenica, YJ29; near Vareš, BP89 (Beck, 1903); Raspotočje, YJ39 (*Ritter*, 26/6/1939, SARA); Sutjeska, BP78 (*Plavšić*, 5/7/1939, SARA); Visoko, BP77 (*Laschnigg*, 28/5/1930, SARA); Dabravine, BP88 (*Maly*, 8/6/1930, SARA); Kula Banjer, BP77 (*Maly*, 8/6/1930, SARA); Vardište, BP88 (*Bjelčić*, 24/6/1907, SARA).

Field data: Kula Banjer, 570 m, BP77, thermophilic shrub (*Šabanović*, 23/5/2018); Prhinje, 510 m, 520 m, 530 m, BP77, thermophilic shrub and grassland (*Šabanović*, 27/5/2018); Porječani, 560 m, BP78, mesophilous grassland (*Šabanović*, 1/6/2018); Lipnica, 1210 m, BP79, mesophilous pasture (*Šabanović*, 15/7/2018); Bajrići, Maglaj, 300 m, BQ64 (*Šabanović*, 25/5/2019); Klupe-Stog Zavidovići, BQ81 (*Šarić*, 1/6/2016, serpentin); Potoci near Vareš, BP89 (*Šarić*, 28/7/2016); Lovnica, Zavidovići, BQ71 (*Šarić*, 11/6/2016); Magulica, BQ90 (*Šarić*, 13/6/2016); Ćude, Olovo, CP19 (*Šarić*, 8/6/2017); Smailbegovići, Breza, BP87 (*Šarić*, 27/5/2018).

***Neotinea tridentata* (Scop.) R.M. Bateman, Pridgeon & M.V. Chase (Fig. 2-5)**

MSM/Mediterranean-Sub-Mediterranean-Central European-Euxinian-Caucasian-Pontian

EN/f (populations are with few individuals, a number rarely exceeding 10 individuals)

Distribution (Fig. 3-5):

Literature and herbarium data: Osova, BQ62 (Fiala, 1896); around Vranduk, YK30; around Vareš, BP89 (Beck, 1903); on the Mt. Macat near Vradište, BP88 (Maly, 1912); Visoko, BP77 (*Plavšić*, 23.5.1939, SARA).

Field data: Magulica, near the Franciscan church, 830 m, BQ90, by the mountain road (*Šabanović, Ranđelović, Šarić*, 30/4/2018); Dvor, 590 m, BP76, mesophilous grassland (*Šabanović*, 9/5/2018); Visočica, 640 m, 650m, 670m, 680m, BP77, mesophilous grassland (*Šabanović*, 11/5/2018); Visočica, 790 m, BP77, mesophilous to thermophilous grassland (*Šabanović*, 13/5/2018); Gorani, 630 m, BP77, thermophilous rocky grassland (*Šabanović*, 13/5/2018); Prhinje, 530 m, BP77, dry grassland (*Šabanović*, 27/5/2018); Ajdinovići, 870 m, CP08, thermophilous grassland (*Šabanović*, 5/6/2019); Perun, 845 m, BP88, mesophilous grassland (*Šabanović*, 9/6/2019); Perun, 1340 m, BP88, mesophilous pasture (*Šabanović*, 9/6/2019); Ćude near Olovo, CP19 (*Šarić*, 12/5/2016); Crni potok, BP99 (*Šarić*, 19/5/2018); Magulica, BQ90 (*Šarić*, 17/5/2016); Bukov dol, BQ90 (*Šarić*, 29/5/2019).

***Neotinea ustulata* (L.) R.M. Bateman, Pridgeon & M.V. Chase (Fig. 2-6)**

CE/Central European-Pontian-South Sibirian

Lc/f (populations are with few individuals, a number rarely exceeding 10 individuals)

Distribution (3-6):

Literature and herbarium data: Borovica, BP79 (Kummer & Sendtner, 1849); around Osova, BQ62 (Fiala, 1896); near Pobrin han, BP89; on the slopes above Vareš, BP89 (Protić, 1898); between Tolović and Zenica, YJ29; Vareš, BP89; Osova, BQ62 (Beck, 1903); Banjer near Visoko, BP77 (Maly, 1933b); swamp Bistrik, Haljinići, BP78 (Abadžić, 2012); Čatići kod Kaknja, BP68 (*Brandis*, 19/7/1896, SARA); Vranjkovci, BP89 (*Plavšić*, 19/6/1940; 7/7/1940, SARA).

Field data: Jelaške, 500 m, BQ90, ruderal habitat (*Šabanović, Ranđelović, Šarić*, 30/4/2018); Visočica, 640 m, BP77, mesophilous grassland (*Šabanović*, 11/5/2018); Ribnica, 350 m, BQ91, mesophilous grassland (*Šabanović*, 12/5/2018); Visočica, 685 m, BP77, mesophilous grassland (*Šabanović*, 13/5/2018); Ginje, 540 m, BP76, mesophilous grassland (*Šabanović*, 16/5/2018); Lipnica, 840 m, BP79, mesophilous grassland in a belt of mixed deciduous and coniferous forests of the *Abieti-Fagion* type (*Šabanović*, 15/7/2018); Brezik, Zavidovići, 250 m, BQ73, mesophilous grassland (*Šabanović*, 25/5/2019); near Borik resort, Maglaj, 215 m, BQ63, mesophilous grassland (*Šabanović*, 25/5/2019);

Lipnica, 860 m, BP79, mesophilous grassland (*Šabanović*, 26/5/2019); Perun, 1310 m, BP88, mesophilous pastures (*Šabanović*, 9/6/2019); Jelaške, BQ90 (*Šarić*, 21/4/2016; 21/5/2016; 7/5/2017; 13/5/2017; 29/5/2017; 23/4/2018; 28/4/2018; 14/5/2019; 29/5/2019); Ribnica, Zavidovići, BQ91 (*Šarić*, 7/5/2018); Vozuća near Zavidovići, BQ81 (*Šarić*, 14/5/2016).

***Orchis mascula* (L.) L. (Fig. 2-7)**

EA/Mediterranean-Sub-Mediterranean-Central European-Euxinian-Caucasian-Iranian

VU/f (populations are with few individuals, a number rarely exceeding 20 individuals)

Distribution (Fig. 3-7)

Literature and herbarium data: around Pajtov han, BP88 (Protić, 1898); around Vareš, BP89; near Osova, BQ62 (Beck, 1903).

***Orchis mascula* subsp. *speciosa* (Vest) Soo**

Literature and herbarium data: Tajan, 1296 m, BQ70 (Hilda Ritter-Studnička, 1970); Sutjeska, BP78 (*Plavšić*, 19/6/1940, SARA).

Field data: Jelaške 610 m, BQ90, mesophilous grassland (*Šabanović*, 10/5/2018); Duboštica, 770 m, BQ80, mesophilous grassland (*Šabanović*, 12/5/2018); Ponijeri, 1090 m, BP79, mesophilous pasture (*Šabanović*, 20/5/2018); from Ponijeri to Lipnica, 830 m, BP79, mesophilous grassland (*Šabanović*, 26/5/2019); Lipnica, 815 m, BP79, mesophilous grassland (Šabanović, 26/5/2019); Perun, 1436 m, BP88, mesophilous grassland (Šabanović, 9/6/2019); Duboštica, BQ80 (*Šarić*, 19/5/2016; 13/5/2018); Jelaške, BQ90 (*Šarić*, 14/5/2017); Kopališta in Vareš, BP89 (*Šarić*, 23/5/2016); Ponijeri, BP79 (*Šarić*, 28/5/2017).

***Orchis militaris* L. (Fig. 2-8)**

EA/Central European-Caucasian-Pontian-South Sibirian

EN-CR/rr (occurs single or with 2 to 3 individuals)

Distribution (Fig. 3-8)

Literature and herbarium data: near Pobrin han and village Potoci near Vareš, BP89 (Beck, 1903); Vardište, 900 m, BP88 (*Maly*, 30/5/1918, SARA).

Field data: Duboštica, 770 m, BQ80, mesophilous grassland (*Šabanović*, 12/5/2018); Duboštica, BQ80 (*Šarić*, 12/5/2018).

***Orchis pallens* L. (Fig. 2-9)**

CE/Central European-Caucasian-Pontian-Southwest Sibirian

EN-CR/rr (occurs single or with 2 to 3 individuals)

Distribution (Fig. 3-9)

Literature and herbarium data: on the hill Bogoš, BP88 (Protić, 1898); on the hill Bogoš near Vareš, BP88 (Beck, 1903); Visočica, BP77 (*Plavšić*, 8/5/1939, SARA); Vardište, BP88 (*Maly*, 30/5/1911, SARA).

Field data: Jelaške, Stojčići, 600 m, BQ90, roadside (*Šabanović*, 28/04/2019); Vranduk, YK30 (*Šarić*, 29/10/2016); Jelaške, BQ90 (*Šarić*, 29/10/2016; 27/04/2017; 23/4/2018); Stojčići, BQ90 (*Šarić*, 14/5/2019).

***Orchis purpurea* Huds. (Fig.2-10)**

CE/Central European-Mediterranean-Sub-Mediterranean-Caucasian-Pontian

VU/f (small populations)

Distribution (Fig. 3-10)

Literature and herbarium data: oko sela Potoci prema Pobrinom hanu, BP89 (Protić, 1898); between Tolovići and Zenica, YJ29; around Vareš, BP89 (Beck, 1903).

Field data: Kamensko, 915 m, BQ90, in mixed deciduous and coniferous forests of the *Abieti-Fagion* type (*Šabanović, Ranđelović, Šarić*, 30/4/2018); Perun, 990 m, BP88, in mixed deciduous and coniferous forests of the *Abieti-Fagion* type (*Šabanović*, 9/6/2019); Kamensko, BQ90 (*Šarić*, 29/5/2017); Sokolina, BQ90 (*Šarić*, 17/5/2016); Jelaške, BQ90 (*Šarić*, 14/5/2019).

***Orchis simia* Lam. (Fig. 2-11)**

MSM/Mediterranean-Sub-Mediterranean-Caucasian-Crimean

VU/f (small populations)

Distribution (Fig. 3-11)

Literature and herbarium data: kod Zenice, YJ39 (*Beck*, 1903); oko Vareša, BP89 (*Beck*, 1903); oko Vareša, BP89 (*Protić*, 1898); Visočica, BP77 (Plavšić, 8/5/1939, SARA); Sutjeska, BP78 (Plavšić, 22/5/1940, SARA).

Field data: Visočica, 660 m, BP77, forest *Carpino-Quercetum petreae*, roadside (*Šabanović*, 11/5/2018); Pobrin Han, 1105 m, BP89, coniferous forests, roadside (*Šabanović*, 12/5/2018); Gorani, 630 m, BP77, forest *Carpino-Quercetum petreae*, roadside (*Šabanović*, 13/5/2018); Lipnica, 820 m, BP79, mesophilous grassland (*Šabanović*, 26/5/2019); Bobovac, 780 m, BP89, mesophilous grassland (*Šabanović*, 8/6/2019); road from Dabravine to Kariće, 660 m, BP88, roadside (*Šabanović*, 18/05/2019); Boganovići, Ćude, CP19 (*Šarić*, 12/5/2018); Bukov dol near Olovo, BQ90 (*Šarić*, 28/4/2018; 29/5/2019); Milankovići, CP09 (*Šarić*,

21/5/2017); Jelaške, BQ90 (*Šarić*, 17/5/2018); Žeravice, Olovo, CP29 (*Šarić*, 6/6/2016).

***Orchis spitzelii* Saut. ex W.D.J.Koch. (Fig. 2-12)**

SEM/Pyrenean-Alpine-Apennine-Dinaric-Balkan-Carpathian-Anatolian

EN-CR/rr (occurs single or with 2 to 3 individuals)

Distribution (Fig. 3-12)

Literature and herbarium data: Zavidovići (Ritter Studnička, 1970); Visočica, BP77 (*Goul*, 30/4/1936, SARA); Vardište, 900 m. BP88 (*Maly*, 30/5/1911, SARA).

Field data: Kamensko, 900 m, BQ90, šume bukve, jele i smrče (*Šabanović, Ranđelović, Šarić*, 30/4/2018); Vareš, BP89 (*Šarić*, 13/5/2016); Sokolina, Kamensko, BQ90 (*Šarić*, 1/5/2018).

Discussion

The study revealed the presence of 12 species and one subspecies of the genera *Anacamptis*, *Neotinea* and *Orchis*. Compared to the data available in the literature (Protic, 1898; Back Mannagetta, 1903 and other), one of the subspecies found, *Anacamptis palustris* ssp. *elegans*, is new to the Zenica-Doboj Canton. Additionally, after the close check of the all potential localities listed in the literature sources, the presence of *Orchis mascula*, described as the type species for this area, has not been confirmed. Since the type species wasn't recorded in the neighboring Sarajevo Canton, but its mentioned subspecies under the name *Orchis ovalis* (Šoljan et al, 2014), it's almost certain that subspecies *O. mascula* ssp. *speciosa* (which has been found in several localities) is the only one growing in the investigated region.

Compared to the neighboring Sarajevo Canton (Šoljan et al., 2014), it's just the subspecies *Anacamptis morio* ssp. *picta* (Loisel.) Jacquet & Scappat that is lacking. On the other hand, the study area is characterized by the species that are not recorded in Sarajevo Canton, including *Anacamptis palustris*, *Orchis militaris* and *O. spitzelii*.

The wild orchids are protected by CITES Convention (Appendice II), which is implying the additional importance of this study. Considering the species diversity in the investigated region as well, the necessity to propose the continuous monitoring system of all the recorded populations (including the remaining genera from the Orchidaceae family throughout the canton) is obvious.

According to the IUCN Red List of Threatened Species, *Anacamptis palustris* categorized as the Least Concern (LC) represents the only one globally threatened species among all the others included in this study. *A. coriophora*, *A. pyramidalis*, *Neotinea tridentata*, *Orchis mascula*, *O. militaris*, *O. pallens*, *O. purpurea* and *O. simia* are having the same status at the European level. *Anacamptis morio* and *Orchis spitzelii* are categorized as Near Threatened (NT) species in Europe.

The proper conservation mechanism of the investigated genera is still lacking from the territory of Bosnia and Herzegovina. More precisely, "The Red List of Flora of Bosnia and Herzegovina" (Đug et al., 2013) contains only 4 species of these genera: *Orchis spitzelii* as Critically Endangered (CR), *Orchis purpurea* and *O. simia* as Vulnerable (VU) and *Anacamptis pyramidalis* with the Near Threatened (NT) status. The same species were mentioned by Šilić (1996) in his list of plant species for the Red Book of Bosnia and Herzegovina, but all defined as Vulnerable (VU). Surprisingly, both of these lists do not contain *Anacamptis palustris* (present on The IUCN Red List of Threatened Species as global endangered) and all the species from the European Red List. Consequently, The Red List of Flora of Bosnia and Herzegovina requires a thorough revision in order to ensure the adequate red list categories and criteria for all the representatives of the *Orchidaceae* family, followed by defining measures for their conservation.

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