Fritillaria (Liliaceae) in Serbia: distribution, habitats and some taxonomic notes

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Abstract. Notes on the distribution, taxonomy and ecology are presented for the following *Fritillaria* species in Serbia: *F. gussichiae*, *F. macedonica, F. meleagris* subsp. *meleagris*, *F. messanensis* subsp. *gracilis,* and *F. montana*. Nomenclature and taxonomy of *F. montana* are particularly discussed. Furthermore, certain ecological features (habitat, altitudinal and substrate preferences) are outlined for each *Fritillaria* taxon on the basis of field research, herbarium and literature data.

Key words: distribution, ecology, *Fritillaria*, Serbia, taxonomy

Introduction

The genus *Fritillaria* L. (*Liliaceae*) comprises bulbous perennials occurring in the temperate regions of the Northern Hemisphere, from China, Japan and Central Asia, through the Mediterranean region, Europe and N America. According to Rønsted & al. (2005), this genus is represented by 100 species, while Kamari & Phitos (2006) reported 145 species. The largest number of taxa has been found in Turkey (38), China (30), Greece (24), and California (18) (Rix 1998; Kamari & Phitos 2006).

The East Mediterranean region is a diversity center for the genus *Fritillaria*, but its primary evolutionary center is probably in Iran, where taxa from different subgenera from Central Asia, the Mediterranean region and the Caucasus meet (Rønsted & al. 2005). Thus, in N Iran, a comparatively small number of species (17, including four subspecies) represent four different subgenera (*Fritillaria*, *Petilium* Engl., *Theresia* (C. Koch) Engl. and *Rhinopetalum* (Fisch. ex Alexander) Engl. (Rechinger 1990)

In the Balkans, the largest number of species has been found in Greece, where 24 species and five subspecies were recorded (Kamari & Phitos 2006). The authors concluded that Greece represents a secondary evolutionary centre for the subgenus *Fritillaria*. In other parts of the Balkans, a comparatively small number of *Fritillaria* taxa were recorded. In Turkey and the East Aegean islands, 38 species were recorded, whereas only two species were reported for European Turkey (Başak 1991).

The following numbers of taxa at the rank of species and subspecies have been recorded in the Balkan countries:

Bulgaria: six native species (Yanev 1964);

Republic of Macedonia: six native species (Bornmüller 1928; Micevski 1978; Matevski *pers. comm.*);

Albania: five species with six subspecies (Vangjeli 2000);

Serbia: five taxa (Diklić 1975; Amidžić & al. 1998);

Montenegro: three species, of which two taxa are doubtful (Rohlena 1942; Pulević 2005);

Bosnia and Herzegovina: three species (Beck 1903);

Croatia: three species with four subspecies (Nikolić 2006);

Slovenia: two native species (Martinčič & al. 1999);

Romania: two native species (Zahariadi 1966; Corneanu & Popescu 1981).

On the Balkan Peninsula, the number of *Fritillaria* taxa evidently increases from the north to the southeast.

The aim of this study is to present the currently known distribution of five taxa of the genus *Fritillaria* in Serbia and also to elucidate certain morphological, taxonomical and nomenclature problems of the genus in this part of the Balkans. Also, ecological features of each *Fritillaria* species in Serbia, including substrate preferences, altitudinal range and habitat types are presented.

Material and methods

The present study of the genus *Fritillaria* in Serbia is based on field observations and plant material collected in most of the regions of Serbia proper and Vojvodina. All relevant literature was also checked for additional information on the distribution patterns of five *Fritillaria* species. Dried material was determined and/or revised from the collections of the Belgrade University Herbarium (BEOU) and the Herbarium of the Natural History Museum, Belgrade (BEO). Species distribution in Serbia is presented on UTM maps (10×10 km^2 grid).

Results and discussion

According to recent literature data, five native taxa of the genus *Fritillaria* were recorded in Serbia: *F. gussichiae*, *F. macedonica*., *F. meleagris* subsp. *meleagris*, *F. messanensis* subsp. *gracilis,* and *F. montana* (Diklić 1975; Amidžić & al. 1998). All species belong to subgenus *Fritillaria,* section *Fritillaria,* and are divided into two series: ser. *Alternifoliae* A. Los. (*F. montana*, *F. macedonica*, *F. meleagris*) and ser. *Trichostylae* Boiss. (*F. messanensis*, *F. gussichiae*). The species from subgenus *Fritillaria* have a chromosome number *2n* = 24, except for *F. montana* and *F. ruthenica* Wikström, which have *2n* = 18 (Kamari & Phitos 2006).

1. *Fritillaria gussichiae* (Degen & Dörfl.) Rix (Fig. 6a)

Syn. *F. graeca* auct. non Boiss. & Spruner; *F. graeca* Boiss. & Spruner var. *gussichiae* Degen & Dörfl.

General distribution. It is a Balkan endemic, distributed in N Greece, Albania, Republic of Macedonia, S Serbia, and SW Bulgaria. It is included in *Red Data Book of the PR Bulgaria* (Velchev 1984 sub. *F. graeca*) in the Rare (R) species category. Formerly, it was considered a variety of *F. graeca*, but according to Kamari (1991b), it is closer to *F. pontica* Wahlenb., from which it differs in the narrower wings of the capsules and in the amplexicaul lower leaves. The shape and colour of the flowers is distinctive (see Fig. 6a) and *F. gussichiae* appears to be a well-defined species.

Floristic element. Mediterranean-Submeditteranean/E Submediterranean/ Balkan (N-C Scardo-Pindhian-SW Moesian)

Distribution in Serbia. The species was mostly cited under the name *F. graeca,* or *F. graeca* var. *gussichiae* for the region of S Serbia. It was recorded in Mt Kozjak: Prohor Pčinjski Monastery, EM-78 (Ranđelović & Stamenković 1985; Nikolić & al. 1986), Mt Krstilovica, EN-71 (Fritsch 1909; Diklić 1975), Mt Pljačkovica, EN-71 (Diklić 1975), Preobraženje village near Vranje, EN-82 (Fritsch 1909; Ničić 1893, 1894), Sobina village near Vranje, EN-71 (Ničić 1894), and Mt Rujan, EM-67, EM-68, EM 69 (Ranđelović & Stamenković 1984, 1985, 1986; Nikolić & al. 1986).

Note: records for Metohija region – Mt Koprivnik near Peć, DN-31, DN-32 (Grebenščikov 1943; Diklić 1975; Amidžić & Panjković 2003) and Mt Šara – Jažinacko Lake cirque, DM-96 (Amidžić & Belij 1996; Petkovski & al. 1996) are most probably incorrect and refer to another species. There are no herbarium specimens, either in BEO or in BEOU to confirm these citations. A record from Prokletije Mts probably refers to *F. messanensis* subsp. *gracilis,* whereas one from Mts Šara may represent *F. macedonica*.

New floristic records in Serbia. S Serbia: Preševo: Miratovac village, EM-57, ass. *Orno-Quercetum pubescentis*, serpentinite, 500 m, leg. *B. Zlatković, V.*

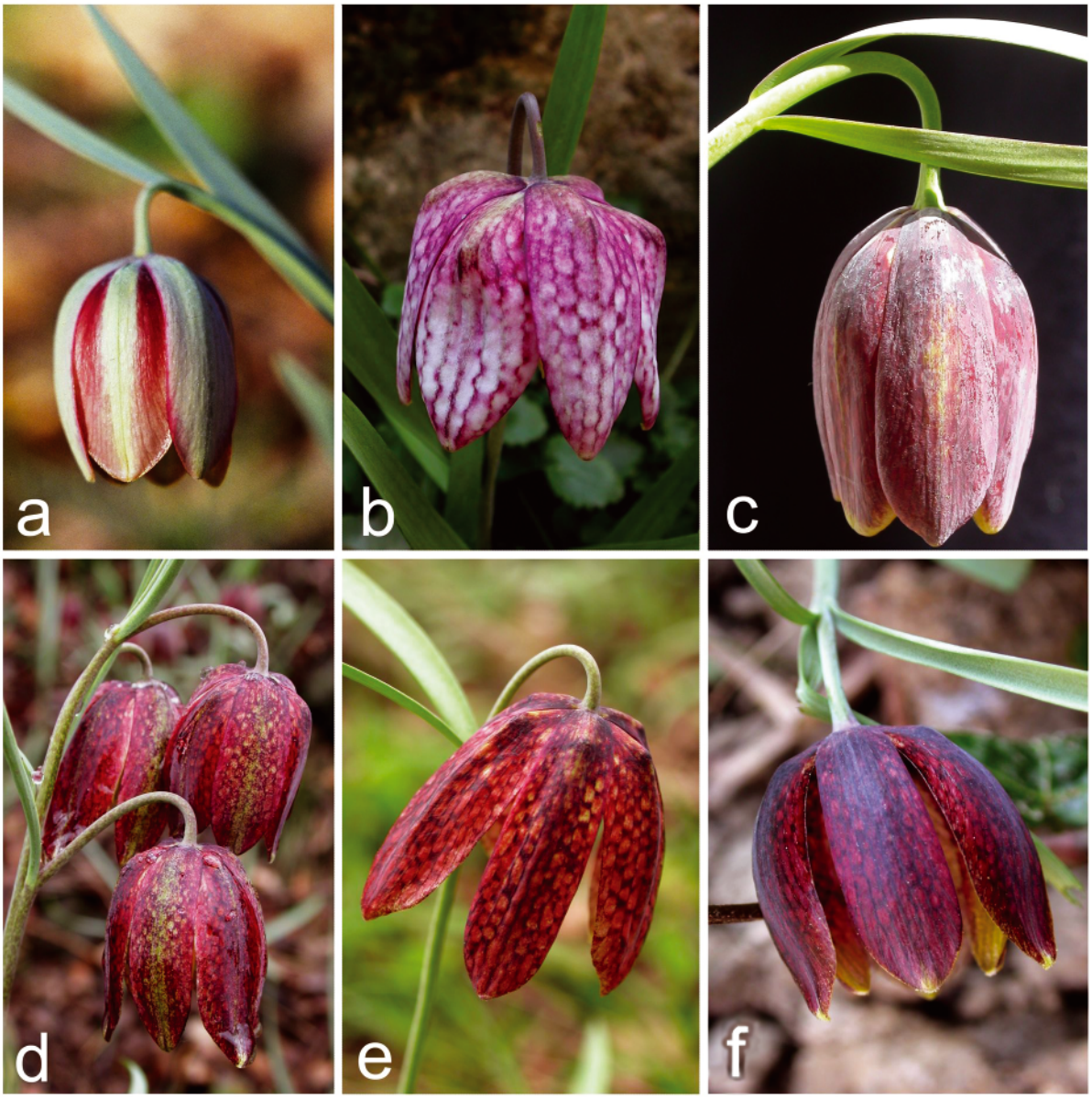

Fig. 6. *Fritillaria* species with flowers:
a – *F. gussichiae* (S Serbia, in the vicinity of Prohor Pčinjski Monastery, photo B. Zlatković);
b – *F. meleagris* (C Serbia, Kraljevo: in the surroundings of Grdica village, photo S. Vukojičić);
c – *F. messanensis* (Montenegro, Boka Kotorska bay, Luštica peninsula, photo D. Lakušić);
d – *F. montana* (W Serbia, in the surroundings of Gornji Milanovac, Brđanska gorge, serpentinite, photo S. Vukojičić);
e – "*F. degeniana*" (Banta, Deliblatska Sands, photo S Vukojičić);
f – "*F. degeniana*"- NE Serbia, between Ram and Zatonje, near the Danube River, photo S. Vukojičić).

Ranđelović & *D. Jović,* 08.05.2003, (BEO 16153); Bujanovac: in the surroundings of Lučane village, EN-50, EM-59, leg. *V. Nikolić,* 03.01.1967, det. *N. Diklić*, sub. *F. graeca* var. *gussichiae* (BEO 39667); Vladičin Han: Balinovce village, EN-83, leg. *Anonymous*, sub. *F. graeca* var. *gussichiae* (BEOU) (Fig. 1).

Habitat and ecology. The species grows in various types of thermophilous habitats. In Bulgaria, it inhabits xerophilous pastures and rocky grounds, as well as forests and scrub formations at altitudes from 300 m to 1320 m; only in the Rila Mts it reaches 1800 m (Yanev 1964). In S Serbia, it is recorded in thermophilous oak forests (ass. *Quercetum frainetto-cerris*, ass. *Orno-Quercetum pubescentis*, ass. *Quercetum montanum* subass. *carpinetosum orientalis*) and scrub communities on siliceous, serpentinite, granite, and limestone bed-

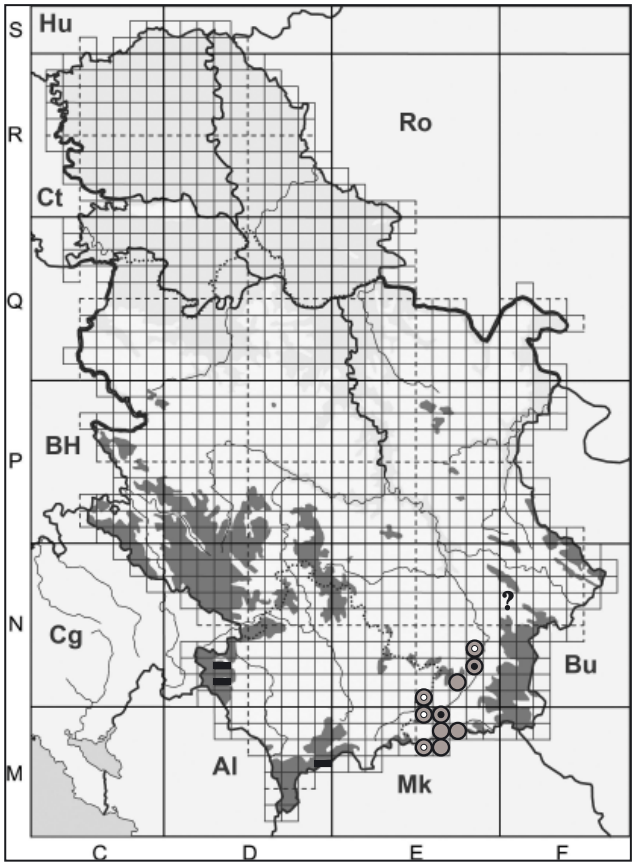

Fig. 1. Distribution of the species *F. gussichiae* in Serbia. Indication of localities: grey circle-white center – new chorological data; grey circle-black center – literature data; grey circle – both literature and herbarium data; **?** – doubtful; ▬ – erroneous.

rocks, at altitudes between 450 m and 800 m. On Mt Rujan, it grows in a steppe-like formation of ass. *Festuco-Chrysopogonetum grylli* forming particular subass. *fritillarietosum* (Ranđelović & Stamenković 1984).

2. *F. macedonica* Bornm.

General distribution. This Scardo-Pindhian local endemic plant was described from Mt Jablanica (*locus classicus*) in SW Macedonia (Bornmüller 1923). It is also distributed in E & C Albania: Gurabardhe, Jablanice, Mal me Gropa, Golloborde, Klenje and Mali i Zebes (Vangjeli & al. 1994), and in SW Serbia in the Metohija region (Amidžić & al. 1998). In Albania, it is included in the *Red Book of Threatened and Rare Plants Species* (Vangjeli & al. 1994) in the Rare (R) species category. Furthermore, the species is included in the *Red Data Book of the Flora of Serbia* (Amidžić & Krivošej 1999) in the Critically Endangered (CR) category.

This taxon belongs to the aggregate of *F. montana* and its closest relative may be *F. epirotica* Turrill ex Rix, a high-altitude serpentine endemic from NW Greece. Floristic element: Central-South European mountains/South European mountains/Balkan mountains (N Scardo-Pindhian mountain).

Distribution in Serbia. This high-mountain species was recently found in Mt Šara – Bistrica Peak and Jažince cirque – DM-96 (Amidžić & Krivošej 1998; Amidžić & al. 1998), the locality representing the northernmost limit of the distribution of the species.

New floristic record in Serbia. Metohija: Mts Šara: Gine Vode – Mekuš Bor – Careve Livade – DM-96, EM-06, ass. *Juniperus nana-Bruckenthalia spiculifolia*, silicate, 1900 m, (leg. *Stevanović, V*. 7441, 24.06.1997 (BEOU) (Fig. 2).

Habitat and ecology. In the Republic of Macedonia (Mt Jablanica – *locus classicus*) this species inhabits high-mountain pastures and rocky places, at altitudes from 1600 m to 1800 m. According to Amidžić and Krivošej (1999), it grows on flat or gently sloping terrains, on humid-rich siliceous soils on granite and granodiorite bedrocks, within a brushwood association of *Juniperus nana-Bruckenthalia spiculifolia*. It can be found at altitudes between 1900 m and 2250 m.

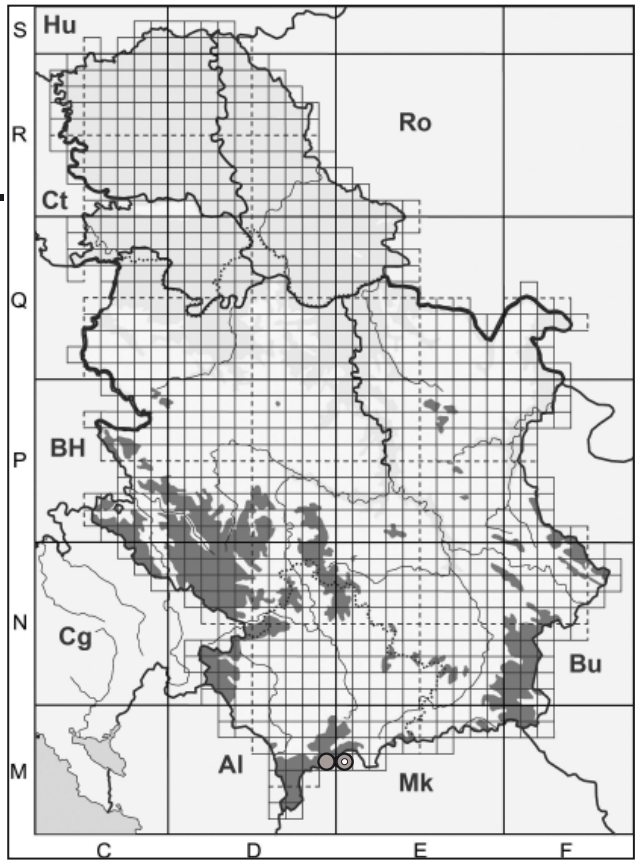

Fig. 2. Distribution of the species *F. macedonica* in Serbia (indication of localities as in Fig. 1).

3. *F. meleagris* L. subsp. *meleagris* (Fig. 6b)

General distribution. This species has a wide distribution range, encompassing Great Britain, France, Netherlands, Germany, Switzerland, Austria, Hungary, Slovakia, Czech Republic, Poland, Italy, Slovenia, Croatia, Bosnia and Herzegovina, Montenegro (questionable), Serbia, Romania, and the Russian Federation (*Western* & *Central* parts). It is introduced in Denmark, Finland, Norway, Sweden, and in the Baltic region. In Europe, *F. meleagris* is divided into subsp. *meleagris* and subsp. *burnatii* (Planchon) Rix; the latter is distributed in the S & SW Alps (Rix 1980). Floristic element: Central European.

Note: In Bulgaria, the vicarious species *F. meleagroides* Patrin ex Schult. f. was reported to inhabit wet meadows in the western parts of the country (surroundings of Sofia region, Dragomansko Marsh, Bozhourishte and Novi Han villages). All localities are close to the Serbian-Bulgarian border. Since it is very rare, threatened and already extinct in some localities (in the vicinity of Bozhourishte), it is included in the *Red Data Book of the PR Bulgaria* (Velchev 1984) in the Endangered (E) species category. This species is also distributed in the Russian Federation (European part and W Siberia), and Central Asia. Bearing in mind that similar habitats (wet meadows on carstic muds) also exist in E Serbia (in the surroundings of Odorovce and Smilovci villages near Pirot, and Krupac village near Dimitrovgrad), it seems very likely that *F. melagrioides* might be also found there.

Distribution in Serbia. Distribution of this species in Serbia is well known. It was found in NW Serbia**:** in the surroundings of Šabac, CQ-95 (Pančić 1874; Bobić 1900), the surroundings of Valjevo, DQ-10 (Lindtner 1960); and Pomoravlje region – near Ljubičevo EQ-13 (Pančić 1874) and Babušinac villages, EQ-14 (Lindtner 1960). It was also recorded in Šumadija region**:** in the surroundings of Smederevska Palanka, DQ-80, DQ-90, DQ-91 (Jovanović & Dunjić 1951; Lindtner 1960), the surroundings of Obrenovac, DQ-33, DQ4, DQ-44 (Gajić 1965; Lindtner 1960) and the surroundings of Lazarevac DQ-41, DQ-42 (Lindtner 1960); and in Banat region – Deliblatska Sands (without exact citation of locality): in wet places – FQ-06 (Stojanović 1983). However, some favorable habitats of the species (hygromesophilous forests and meadows) in the bordering area of Deliblatska Sands, facing the Danube and Karas rivers, have to be checked out in the field. If the latter citation is confirmed, the locality in Deliblatska Sands would represent the northernmost record of the species range in Serbia.

New floristic records in Serbia. Šumadija: Lazarevac, Kolubara river valley, DQ 31, in a hygrophilous oak forest (leg. *Sigunov, A.* 39668, 08.04.1973, det. *Diklić, N.*(BEO); Mladenovac: in the surroundings of Markovac (Međulužje village), DQ-71 (leg. *Anonymous* 11040, (BEOU); C Serbia**:** Kraljevo: in the surroundings of Grdica village, DP-74, in a hygrophilous shadow forest near a stream, 190 m (leg. *Ljaljević-Grbić, M.*, 25.03.2000, det. *Vukojičić, S.*, (BEOU) (Fig. 3).

Habitat and ecology. In the former countries of Yugoslavia (Slovenia, Croatia, and Bosnia and Herzegovina) this plant inhabits alluvial lowlands, wet submontane oak forests and wet meadows (Martinčič & al. 1999; Schlosser & Vukotinović 1876; Beck 1903). In Serbia, the plant grows in hygromesophilous meadows and in lowland oak forests (remnants of *Quercus robur* and *Fraxinus angustifolia* forests) belonging to ass. *Querceto-Fraxinetum serbicum mixtum* and *Querco-Carpinetum* (*Q. robur* and *Carpinus betulus* forests), at altitudes between 100–250 m. A comparison of the current status of *F. meleagris* populations and their state in Serbia with their status 50 years ago shows that the populations have decreased to an extent at which they might be considered endangered.

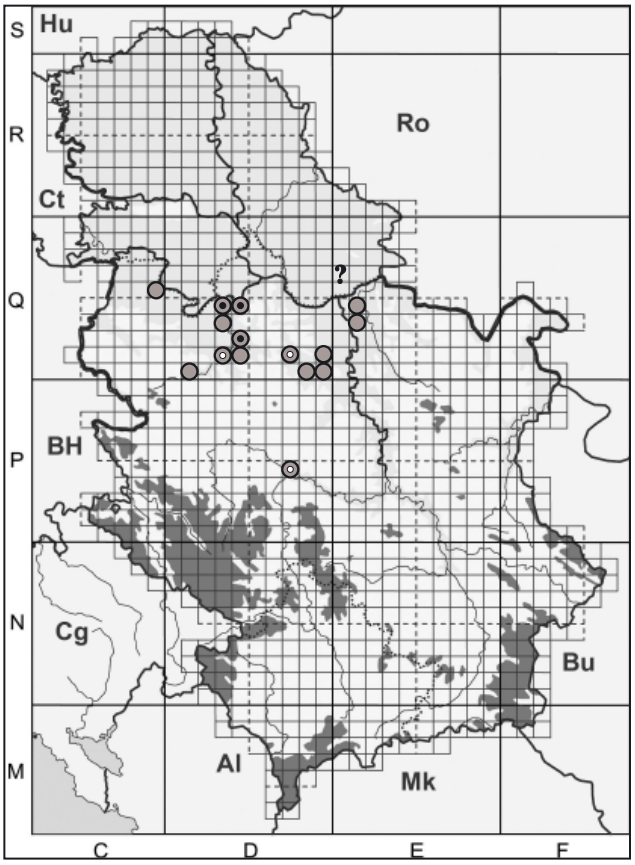

Fig. 3. Distribution of the species *F. meleagris* subsp. *meleagris* in Serbia (indication of localities as in Fig. 1).

4. *F. messanensis* Rafin. subsp. *gracilis* (Ebel) Rix
(Fig. 6c)

Syn. *F. gracilis* (Ebel) Asch. & Graebn.; *F. neglecta* Parl.; *Lilium gracile* Ebel

General distribution. *F. messanensis* was described from Italy (Sicily, Messina – *locus classicus*). Its distribution comprises Italy (Sicily and Calabria) and the Balkan Peninsula. The species is divided into subsp. *messanensis* and subsp. *gracilis* (Ebel) Rix; the latter was originally described as *F. gracilis* from Montenegro (Mt Sutorman – *locus classicus*). Floristic element: Mediteranan-Submediteranean/C. Submediterranaean/Illyrian Submediterranean.

In the Balkans, *F. messanensis* s.l. was recorded along the north and central parts of the Dalmatian coast in Croatia (Nikolić 2006), Bosnia and Herzegovina (Beck 1903), and Montenegro (Rohlena 1942). In the continental parts of the Balkans, it was found in SW Serbia (Diklić 1975), Montenegro and N Albania (Baldaccii 1901, sub. *F. neglecta*; Hayek 1917, 1924; Jávorka 1926; Vangjeli 2000). There is an intriguing record from the southern part of R Macedonia (Mt Bigla, near Gopeš) published by Bornmüller (1928), who reported it as new to Macedonia under the name *F. neglecta*. The record needs to be checked out in the field.

There is certain confusion concerning the presence of *F. messanensis* s.l. in Croatia. In the Flora Croatica Database (Nikolić 2006), both subspecies are listed for this territory and their distribution maps are presented. Furthermore, *F. messanensis* subsp. *gracilis* is included in the *Red Book of Vascular Flora of Croatia* (Mihelj 2005). Despite these facts, Kamari & Phitos (2006) considered that the specimens from Croatia do not belong to this species, without indicating what taxon it might be. In the *Flora Albania* (Vangjeli 2000) both subspecies are listed again, and *F. messanensis* subsp. *gracilis* is also included in the *Red Book of Threatened and Rare Plants Species* (Vangjeli & al. 1994) in the Endangered (E) species category. Still, Kamari & Phitos (2006) maintain that only subsp. *gracilis* is distributed in Albania. Obviously, much is still uncertain about the distribution of the two subspecies on the Balkan Peninsula, and all literature records need to be checked in the field.

After reviewing a large number of floristic papers (Diklić 1975; Rix 1980; Mihelj 2005; Kamari & Phitos 2006), we have noticed that differential characters presented in many keys for differentiation of these two subspecies are not well defined. Probably, this is one of the main causes of incorrect identification of these taxa, which has resulted from insufficient knowledge of their distribution patterns on the Balkan Peninsula. Due to certain chorological and taxonomical confusion in differentiation between subsp. *messanensis* and subsp. *gracilis,* their status in the Balkans is still unresolved.

After comparing herbarium specimens of subsp. *messanensis* from Sicily (Messina – *locus classicus*) and subsp. *gracilis* from Serbia, and after reviewing numerous publications concerning these taxa, we have concluded that only subsp. *gracilis* grows in Serbia. This plant is in the List of Internationaly Important Species in Serbia (Stevanović & al. 1995).

Distribution in Serbia. There are only few literature records on the distribution of *F. messanensis* subsp. *gracilis* in Serbia. Several records refer to the bordering mountains between Serbia and Albania: Mt Paštrik, DM-67 (Hayek 1924) and Mt Koritnik, DM5, DM6 (Jávorka 1926; Markgraf 1932). Rudski (1949) recorded this taxon in Prokletije Mts – Krš Bogotija above Kaličane village and Vrelski Potok stream – DN-43, DN-53, but he actually published it under the name *F. montana*. In the *Flora of Serbia* (Diklić 1975), this mistake was corrected after revision of the herbarium specimens deposited in BEO. The plant was also recorded in Mt Žljeb, DN-33 (Diklić 1975).

Note: A literature record of the presence of *F. messanensis* subsp. *gracilis* in Bistrica river gorge near Prizren, DM 87 (Nikolić & al. 1986) seems doubtful and might refer to *F. montana*. Further field investigations are needed, owing to lack of herbarium specimens. In addition, the presence of *F. montana* (Diklić 1975) in Prokletije Mts – Mt Nedžinat, DN-22 has been proven incorrect, since it was checked and revised (as *F. messanensis* subsp. *gracilis*) in a herbarium specimen deposited in BEO. Also, the record of *F. gussichiae* in Mt Koprivnik near Peć, DN-31, DN-32 (Grebenščikov 1943; Diklić 1975) seems to be incorrect and probably relates to *F. messanensis* subsp. *gracilis*.

New floristic record in Serbia. Metohija: Prokletije Mts – Mt Streočke (Krš Čalis), DN-31, in ass. *Pinetum heldreichii*, on limestone, 1400 m (leg. *Niketić, M.* 23.08.1997 (BEO); Peć (Rugovska gorge), DN 32, leg. *Rudski, I.*, 27.04.1937, det. *Diklić, N.* sub. *F. tenella* (BEO) (Fig. 4).

Habitat and ecology. *Fritillaria messanensis* s.l. inhabits various habitats in the Balkans: from Submediterranean forests and scrub communities along the Adriatic coast of Dalmatia and Montenegro, to high-mountain pastures and rocky grounds in the Dinaric Alps facing the Adriatic. It prefers limestone, occasionally ophiolitic geological substrate. In Greece, it occupies stony places

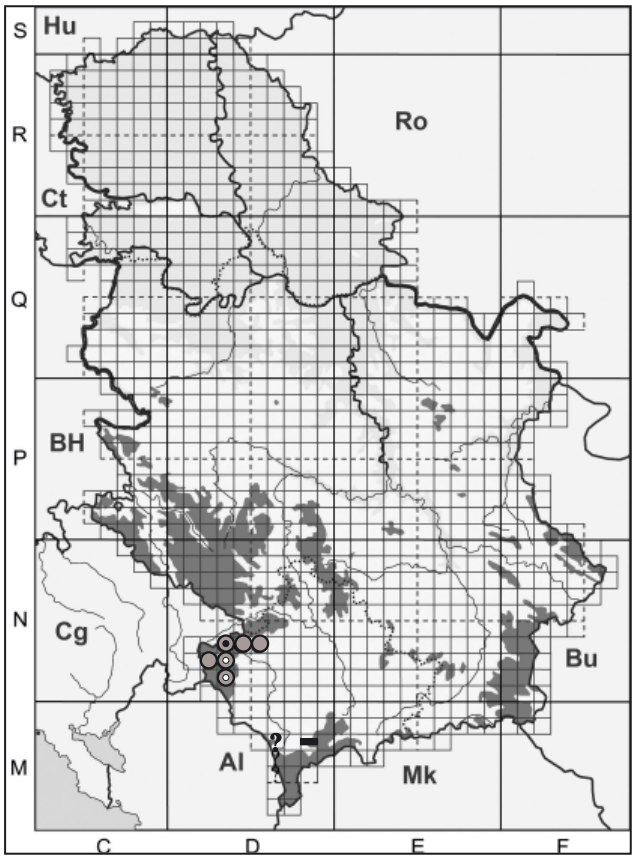

Fig. 4. Distribution of the species *F. messanensis* subsp. *gracilis* in Serbia (indication of localities as in Fig. 1).

under a dense scrub canopy, woodlands, and occasionally clearings of *Pinus* or *Fagus* forests, usually on calcareous substrate (Kamari & Phitos 2006). It grows on limestone and serpentinite rocks and pastures in Albania, reaching altitudes as high as 1800 m (Jávorka 1926). In Serbia, *F. gracilis* grows on high-mountain limestone rocks, rocky grounds and pastures in the Prokletije Mts, at an altitude above 1300 m. Some significant differences in the species habitats, ranging from warm Submediterranean to cold high-mountain, require further detailed taxonomic and molecular investigations of *F. gracilis* populations in the Dinaric Alps.

5. *F. montana* Hoppe (Figs 6d-f)

Syn. *F. orientalis* auct. non Adams; *F. tenella* auct non M. Bieb.; *F. degeniana* H. Wagner; *F. intermedia* N. Terracc.; *F. liburnica* B. Lengyel, *F. pollinensis* N. Terracc.

General distribution. The distribution pattern of *F. montana* includes SE France, Austria (Tyrol), Italy, Slovenia, Croatia, Bosnia and Herzegovina, Montenegro (doubtful but not unexpected), Serbia, Bulgaria, Republic of Macedonia, Albania, Greece, Hungary, Romania, and the Russian Federation (European part only) (Zahariadi 1966; Rix 1980). It is included in the *Red Data Book of the PR Bulgaria* (Velchev 1984 sub. *F. orientalis* Adams) in the Rare (R) species category. Floristic element (aggregate): C-E Mediterranean-Submediterranean – Pontic/ C-E Submediterranean-W-C Pontic.

There has been a long-standing confusion in botanical literature concerning the nomenclature of this taxon. *Fritillaria montana* was described from Italy, in the vicinity of Trieste in 1832, *F. orientalis* and *F. tenella* M. Bieb from the Caucasus in 1805 and 1808, respectively, while *F. degeniana* was found in 1906 in Serbia – Vojvodina (Deliblatska Sands, Banat region – *locus classicus*).

The first attempt to differentiate *F. montana* and *F. orientalis* was done in the *Flora of the USSR*, including indications of differential characters between these two taxa (Lozina-Lozinskaja 1935). The two species are geographically separated in the USSR, i.e.: *F. montana* grows in the European part (Central Dniepr region, i.e. Podolie), while *F. orientalis* is limited to the Caucasus, including the slopes of the mountain massif in Armenia and Georgia. Subsequently, more differential characters were added in the process (Zahariadi 1966). Finally, Kamari (1991a, b) differentiated *F. montana* from *F. orientalis*, considering that *F. montana* is distributed in S & SW Europe (including Greece), while *F. orientalis* is restricted to the Caucasus region. The following table contains a survey of the differential characters which distinguish these two species (Table 1).

Table 1. Differential characters between *F. orientalis* and *F. montana* according to literature data (Lozina-Lozinskaja 1935; Zahariadi 1966; Kamari 1991).

Fritillaria orientalis	*Fritillaria montana*
ser. *Trichostylae*	**ser. *Alternifoliae***
bulbs conspicuously longer than wide	bulbs not conspicuously longer than wide
always alternate leaves	leaves mostly opposite
always 1-flowered	1-many (–6) flowered
narrowly campanulate flowers	± broadly campanulate flowers
larger and fewer tessellations	smaller and more intensive tessellations
inner perigon leaves rapidly attenuate, broadly rotundate	inner perigon leaves gradually attenuate, acuminate
distance between 3 middle nerves of inner perigon leaves 4–5 mm	distance between 3 middle nerves of inner perigon leaves 1–1.5 (2) mm
ovate-lanceolate nectaries	linear nectaries
capsule 6-lobate	capsule 3-lobate
Pontic-oriental element, locally distributed in the Caucasus	Central-Easteuropaean submediterranean-westpontic element
$2n = 24$	$2n = 18$

Nevertheless, in *Flora Europaea* only *F. orientalis* was treated as a valid name since it was believed to be conspecific with *F. montana*, while all other names were considered to be synonyms (Rix 1980). This approach was accepted by almost all authors in the relevant regional *Floras*, e.g. by Martinčić & al. (1999), Vangjeli (2000), Nikolić (2006), etc.

It is important to note that all three (four) taxa have been described from the bordering sites of the entire range of the *F. montana* group. Therefore, a large variability of morphological characters among these marginal populations might be expected.

It is interesting to note that both *F. degeniana* and *F. montana* were accepted as good and separate taxa only in the *Flora of Hungary* (Jávorka 1924) and in the *Flora of Serbia* (Diklić 1975). Probably, this attitude was based on the publication of Wagner (1906), who described *F. degeniana* from Deliblatska Sands and presented a detailed comparative survey of the morphological characters both for *F. degeniana* and *F. tenella* (= *F. montana*).

Distribution in Serbia. There are many herbarium (BEOU, BEO) and literature data on the presence of *F. montana* (sub. *F. degeniana*) in the Banat region: Deliblatska Sands, DQ-98, EQ7, EQ8 (Broz 1951; Kuzmanović 1998; Sigunov 1970; Diklić 1975; Stjepanović-Veseličić 1953, 1979; Stojanović 1983). This species is also cited (in some cases as subnomen *F. tenella*) for Šumadija region**:** in the surroundings of Gornji Milanovac – Brđanska gorge, DP-57 (Fritsch 1909) and Mt Rudnik, DP 68 (Gajić 1961); NE Serbia**:** Mt Greben, EQ-91, EQ-92 (Pančić 1874; Nikolić & al. 1986); Đerdap gorge – Mt Veliki Štrbac, FQ-03 (Savić & al. 1995); W Serbia**:** Mt Ovčar, DP-36 (Pančić 1856, 1874; Nikolić & al. 1986), and Mt Zlatibor, CP-93, CP-94 (Urošević 1949; Jovanović & al. 1992); C Serbia**:** Mt Goč, DP-91 (Katić 1896); SE Serbia: Bosilegrad: – Mt Rudina, FN-20 (Avramović & al. 2006). For the territory of Kosovo region there is only one literature source from Mt Novo Brdo near Gnjilane, EN-31 (Rexhepi 1975), and for Metohija region this species was cited by Diklić (1975) for Mt Koritnik near Peć, DM 65, DM-66, and Mts Šara (Mt Ošljak), DM-86 (Krivošej 1997).

Note: literature records on the presence of *F. montana* (Diklić 1975) in the Prokletije Mts (Mt Nedžinat), DN-22 are incorrect, and actually relate to *F. messanensis* subsp. *gracilis*, which was confirmed by the herbarium specimen (BEO). On the other hand, the presence of *F. messanensis* subsp. *gracilis* in Prizrenska Bistrica river gorge, DM-87, published by Nikolić & al. (1986), is most probably also incorrect and actually refers to *F. montana* (see comment above on *F. messanensis* subsp. *gracilis*).

New floristic records in Serbia. Banat: Deliblatska Sands: near Deliblato village, EQ-06, on sandy ground (leg. *Jurišić, J.* 28175, sub. *F. degeniana*, 08.05.1922 (BEO); Mt Vršačke: Kula, EQ-29, ass. *Orno-Quercetum petreae*, silicate, 350–400 m, leg. *Zlatković, B., Vukov, D.* 16078, 06.1998 (BEOU); NE Serbia: Đerdapska gorge: Pecka Bara, above Ploče, FQ-04, 590 m, leg. *Dinić, A*. 39674, 29.04.1967, det. *Diklić, N*. sub. *F. tenella* (BEO); between Ram and Zatonje: near the Danube River, EQ-26, ass. *Rusco-Carpinetum*, limestone, 80 m, leg. *Stevanović, V., Lakušić, D., Vukojičić, S., Tomović, G.* 19373, sub. *F. orientalis*, 11.04.2005 (BEOU); W Serbia: Užice: Sinjevac village, DP-05, *in saxosis*, leg. *Urošević, K.* 28157, 04.1911, det. *Jurišić, Ž.* (BEO, BEOU); the Đetinja river gorge, CP-95, ass. *Orno-Ostryetum*, in rocky places, on limestone, 450–600 m, leg. *Zlatković, B.* 16077, 05.2001 (BEOU); SW Serbia: Prijepolje, Mileševska river gorge, CP-90, ass. *Ostryo-Carpinetum*, in rocky places, on limestone, 700 m, leg. *Stevanović, V., Niketić, M. Tomović, G.* & *Vukojičić, S.* 20800, 29.04.2006 (BEOU, BEO); C Serbia: Raška, between Matovići and Trnava, DN-69, ass. *Carpinetum orientale*, serpentinite, 500 m, leg. *Vukojičić, S.* & *Niketić, M.* 7052, sub. *F. montana*, 21.08.1997 (BEOU, BEO); Kosovo: Priština, in the surroundings of Gračaničko Lake, Skakavac hill, EN-11, ass. *Quercetum pubescenti-cerris*, serpentinite, 700–750 m, *Krivošej, Z.*, 05.1995 (pers. comm.); Kosovska Mitrovica: near Kamenica village, DN-86, ass. *Quercetum pubescents*, serpentinite, 500 m, *Krivošej, Z.*, 05.2005, pers. comm.); Metohija: Peć, Mt Gubavac, DN-32, DN-42, ass. *Orno-Quercetum petreae serpentinicum* subass. *forsythietosum*, serpentinite, 1000 m, leg. *Niketić, M.*, sub. *F. orientalis*, 04.09.1997 (BEO); Mts Šara: between Tumbe and Gradski Kamen, DM-74, alliance *Onobrychido-Festucion*, limestone, 1550–1700 m, leg. *Stevanović, V.* & *Lakušić, D.* 2359/91, sub. *Fritillaria*, 30.09.1991 (BEOU) (Fig. 5).

Habitat and ecology. In Greece, this species inhabits scrub communities or rocky places in openings of deciduous and *Fagus* forests, at altitudes from 1000 m to 1800 m, on ophiolitic or limestone substrate (Kamari 1991a), while in Albania, it grows in montane and subalpine regions, at altitudes between 600 m and

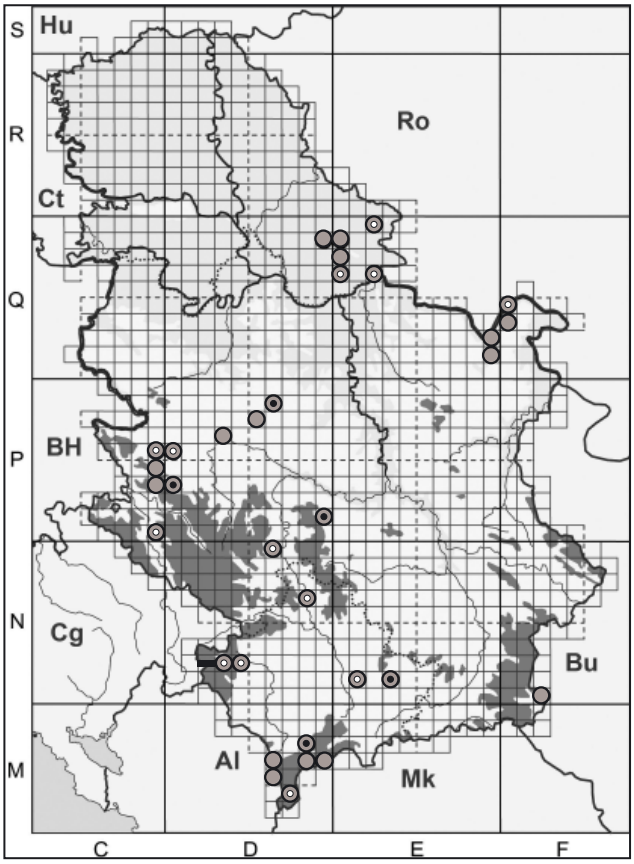

Fig. 5. Distribution of the species *F. montana* in Serbia (indication of localities as in Fig. 1).

1400 m, also on serpentinite and limestone (Jávorka 1926; Košanin 1939). In R Macedonia, it was recorded at a lower altitude, in the Skopska Crna Gora region (about 300 m), reaching a higher altitude in Mt Jablanica (1900 m). *F. montana* mainly grows on a serpentinite geological substrate, but it was also recorded in sands, silicate and limestone ground habitats in Serbia. This plant occurs in various types of plant communities, at altitudes from 80 m to 1700 m (Table 2).

Note: Wagner (1906) and Jávorka (1924) noticed some differences between the populations of *F. degeniana* and *F. tenella* (= *F. montana*). Examination of the specimens collected in the field also confirmed their observations. There is a distinct gradual clinal variability of some morphological features of the specimens from northern to southern parts of Serbia. Plant size, leaves and bracts width and length gradually decrease in specimens from north to southwards. Consequently, the number of stem leaves also decreases. Ripe capsules are always the largest in the specimens of the northern populations, while the individuals from the southern populations (e.g. in Skopska Crna Gora in the Republic of Macedonia) have capsules about half as long as those in the north. Clinal variability of these characters may be caused both by the ecological conditions of the habitat (temperature, moisture, soil type)

Table 2. List of localities, habitats, altitudinal range and geological substrates of *F. montana* in Serbia.

Region	locality	habitat	altitude (m a.s.l.)	substrate
Banat	Deliblatska Sands	ass. *Querco-Tilietum tomentosae*	140–200	sand
Banat	Mt Vršačke Planine (Kula)	ass. *Orno-Quercetum petreae*	350–400	silicate
NE Serbia	Ramsko-Zatonjska Sands	ass. *Rusco-Carpinetum*	80	limestone
NE Serbia	Mt Veliki Štrbac	ass. *Monspessulo-Coryletum colurnae*	700–760	limestone
NE Serbia	Mt Greben	ass. *Syringo-Carpinetum*	500–660	limestone
Šumadija	Gornji Milanovac (Brđanska gorge)	ass. *Carpino orientalis-Quercetum pubescentis*	350	serpentinite
Šumadija	Mt Rudnik	ass. *Fagetum montanum*	1000–1100	silicate
W Serbia	Mt Ovčar	ass. *Ostryo-Fagetum*	986	limestone
W Serbia	Užice (Đetinja river gorge)	ass. *Orno-Ostryetum*	450–600	limestone
W Serbia	Mt Zlatibor (Crni Rzav river gorge)	ass. *Orno-Ostryetum*	750–900	limestone
W Serbia	Mt Zlatibor	ass. *Festuco duriusculae-Euphorbietum glabriflorae*	980–1030	serpentinite
SW Serbia	Prijepolje (Mileševka river gorge)	ass. *Ostryo-Carpinetum*	700	limestone
C Serbia	Raška (Matovići – Trnava)	ass. *Carpinetum orientale*	500	serpentinite
C Serbia	Mt Goč	ass. *Fagetum montanum*	700	serpentinite
SE Serbia	Mt Rudina Planina	ass. *Fritillario-Seslerietum rigidae*	1100	limestone
Kosovo	Mt Novo Brdo near Gnjilane	ass. *Teucrio-Artemisietum camphoratae*	1000–1100	limestone
Kosovo	Priština (surrounding of Gračaničko lake)	ass. *Quercetum pubescenti-cerris*	700–750	serpentinite
Kosovo	Kosovska Mitrovica (near village Kamenica)	ass. *Quercetum pubescentis*	500	serpentinite
Metohija	Mt Gubavac near Peć	ass. *Orno-Quercetum petreae serpentinicum* subass. *forsythietosum*	1000	serpentinite
Metohija	Mts Šar Planina (Tumbe – Gradski Kamen)	alliance *Onobrychido-Festucion*	1550–1700	limestone
Metohija	Mts Šar Planina (Mt Ošljak)	alliance *Onobrychido-Festucion*	1400	limestone

and by the genetic differences among the populations. This assumption could be confirmed by further comparative morphological, cytological, as well as molecular and genetic investigations. Recently, Corneanu & Popescu (1981) presented some morpho-anatomical features (plant size, stem diameter, leaf lenght and width, stem and leaf anatomy) of the populations of *F. montana* from Romania.

Conclusions

1. All literature and herbarium data on the occurrence of *F. graeca* in Serbia refer to *F. gussichiae*. The species is restricted to S & SE Serbia and that region represents the northern limit of the species endemic distribution range in the Balkans.

2. New records from the northern slopes of Mt Šara (Gine Vode-Mekuš Bor-Careve Livade) represent the northernmost limit of the distribution range of the endemic species *F. macedonica*. Furthermore, this new locality is important, given that the species is estimated as Critically Endangered (CR) in Serbia.

3. Several new records of *F. meleagris* in N Serbia correspond to the already known distribution pattern in Serbia. However, a new record from C Serbia (Grdica village near Kraljevo) represents its south-easternmost locality not only in Serbia, but on the whole Balkan Peninsula and in the total species distribution range. Occurrence of the species could be expected in the lowland alluvial *Quercus pedunculiflora* oak forests in the Srem region of Vojvodina province.

4. A new record of *F. messanensis* subsp. *gracilis* in the Prokletije Mts (Mt Streočke Planine – Krš Čalis) represents the easternmost limit of its distribution. At the same time, it is one of the most continental finding of this taxon in the Balkans. However, some literature data on its presence in Mts Koritnik, Paštrik and the surrounding of Prizren (at the foothills of Mt Šara) need to be checked out in the field.

5. The taxonomic status of some populations of the *F. montana* complex needs to be confirmed by further molecular investigations.

6. The thirteen new localities recorded by our survey have contributed to a relatively large number of literature and herbarium data on the distribution of *F. montana* in Serbia. It is quite possible that this plant is even more frequent in Serbia, given that it was not recorded in NE. & E. Serbia, where suitable habitats exist.

7. It is worth mentioning that there are two parapatric zones of the *Fritillaria* species in Serbia: between *F. montana* and *F. messanensis* subsp. *gracilis* in the Prokletije Mts, where *F. gracilis* inhabits high-mountain limestone habitats at altitudes above 1300 m, while the lower altitudes (Mt Gubavac near Peć) are inhabited by *F. montana*, which grows on limestone and serpentine. In Mt Šara, a parapatric zone between *F. montana* and *F. macedonica* was also recorded. *F. macedonica* grows in the subalpine belt of Mt Šara, above 1900 m, on silicate geological substrata. On the other hand, *F. montana* could be found at the foothills, in gorges and at lower altitudes (up to 1700 m) of this mountain (Prizrenska Bistrica river gorge; between Tumbe and Gradski Kamen; Mt Ošljak). As a rule, it grows only in limestone ground habitats.

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