Botanica SERBICA 37 (2): (2013) 173-181

Original Scientific Paper

Novelties for vascular flora of Bosnia and Herzegovina

Đorđije Milanović*, Vladimir Stupar and Jugoslav Brujić

Faculty of Forestry, University of Banja Luka, Stepe Stepanovića 75a, 78000 Banja Luka, Bosnia and Herzegovina

ABSTRACT: In this paper six new species for flora of Bosnia and Hercegovina are presented: *Homogyne sylvestris* Cass, *Gagea spathacea* (Hayne) Salisb., *Leucojum vernum* L., *Carex disticha* Huds., *Carex alba* Scop. and *Carex michelii* Host. For each species the locality, habitat characteristics, distribution in BiH and estimated threatened status according to IUCN criteria and categories are given. These records contributed to knowledge of the distribution ranges of those species in Bosnia and Herzegovina and the Balkan Peninsula.

Key words: Floristic novelties, distribution, threatened status, Bosnia and Herzegovina.

Received 28 June 2013 Revision accepted 31 August 2013

UDK 581.96(497.6)

INTRODUCTION

During recent years of investigating the flora and vegetation of Bosnia and Herzegovina, many threatened and rare plant taxa in Bosnia and Herzegovina have been registered. Investigations were conducted in western, northwest and northern parts of the country, mainly in Bosnian karst fields (Livanjsko and Glamočko polje), Plješevica Mt, termophilous oak forests around Bosanski Petrovac and Drvar and the wider area of Lijevče field, from Banja Luka to Gradiška.

After comprehensively studying the available literature data and herbarium material from these regions, it was concluded that six of those species are new for flora of Bosnia and Herzegovina: *Homogyne sylvestris* Cass., *Gagea spathacea* (Hayne) Salisb., *Leucojum vernum* L., *Carex disticha* Huds., *Carex alba* Scop. and *Carex michelii* Host. *Carex disticha* was collected during earlier investigations by Ritter-Studnička (Herbarium SARA), but this record was never published. The new records have importance for contributing to our knowledge of the flora of Bosnia and Herzegovina and the wider region, as well as for compiling the Red list of vascular plants in the country.

MATERIAL AND METHODS

During the last few years, abundant herbarium material from the regions described above was collected and stored in the Private Herbarium of Đorđije Milanović and the Herbarium of the Forestry faculty, University in Banja Luka. In addition to this, material from the Herbarium of the State Museum of Bosnia and Herzegovina was studied.

The plants are presented according to phylogenetic order (Cronquist 1981) and identified according to Flora Europaea (Tutin 1976; Chater 1980; Richardson 1980; Webb 1980) and other relevant references (Tomović & Niketić 2005; Jovanović *et al.* 2009). The exact locality with WGS84 coordinates, locality characteristics, plant community, date of collecting, collectors, origin of the material, main morphological and habitat characteristics, distribution and estimated Red List category according to IUCN criteria and categories (IUCN 2001) were given or calculated for each of the treated species. Their distribution is shown for Bosnia and Herzegovina on the maps with a 10x10km^2 UTM grid, with the exception of *Gagea spathacea*, which is displayed for the Balkan Peninsula area with the same grid. The borders of the

*correspondence: djolebota@gmail.com

Balkans are given according to Turrill's line (Turrill 1929).

RESULTS AND DISCUSSION

1. ***Homogyne sylvestris*** Cass. (fam. **Compositae**)

BiH: Plješevica Mt, everywhere around Skočajska draga locality in the forest *Carici albae-Fagetum* M. Moor 1952, dolomite, 530 m a.s.l., 23. 05. 2010., 44° 45' 14" N, 15° 50' 24" E, *coll. Milanović Đ., Stupar V., Brujić J. & Nikić D.,* Milanović Đ. Private Herbarium 19c/01-293, Herb. Fac. Silv.

BiH: Plješevica Mt, Greda between Crni vrh and Opaliti vrh, ass. *Omphalodo-Fagetum* (Tregubov) Marinček et al. 1993, limestone, 1210 m a.s.l., 23. 05. 2010., 44° 46' 52" N, 15° 47' 34" E, *coll. Brujić J., Milanović Đ., Stupar V. & Nikić D.,* Herb. Fac. Silv.

Description: Stems 10-40 cm, often branched, with glandular arachnoid indumentums above. Basal leaves 3-7 cm, with 5-9 shallow lobes; each lobe with usually 3 mucronate teeth, sparsely and shortly hairy on the veins beneath, thin; lower cauline leaves usually petiolate. Involucre 10-12 mm. 2n=58 (Tutin 1976). In the past it was often confused with *Homogyne alpina*, especially in the vegetative stage. Thus Rohlena (1942) was suspected in Pančić's record from Komovi Mt in Montenegro, while Fukarek's record from Maglić Mt in Bosnia (Fukarek & Stefanović 1958) is certainly wrong.

Distribution: It is distributed in the SE Alps and mountains of the West Balkans, registered from Austria, Italy, Slovenia and Croatia; probably incorrectly cited or confused from Romania and Montenegro; reported in error from Bosnia (Greuter 2006-2009). This species is one of several typical forest plants, with the easternmost point in their main distribution in the Balkan Peninsula on Plješevica Mt, such as: *Hacquetia epipactis, Omphalodes verna*, *Helleborus niger* ssp. *macranthus, Scopolia carniolica, Cardamine chelidonia, Lamium orvala* etc. All of these species are common in Croatian and Slovenian beech, mixed or coniferous forest, but they are very rare in similar habitats in Bosnia. Some of them are still not confirmed for Bosnian territory, although the same Illyrian forest associations are present on Bosnian slopes of Plješevica Mt. The main reason is that Plješevica was not the subject of earlier comprehensive studies and it is natural to assume that these species will be confirmed for Bosnia and Herzegovina in the future. The distribution of *Homogyne discolor* in Bosnia is shown on Figure 1.

Habitat: The species inhabits different types of deciduous, coniferous and mixed forests mainly in montane to subalpine regions, in the zone of beech forests. It is a characteristic element of the Illyrian alliance *Fagion illyricum* Horvat and enters into the composition of many associations (Horvat *et al.* 1974). Around Skočajska draga *Homogyne sylvestris* grows with: *Fagus sylvatica* (tree layer), *Erica carnea, Daphne mezereum* (scrub layer), *Carex alba, Carex ornithopoda, Sesleria autumnalis, Anemone nemorosa, Aposeris foetida, Laserpitium krapfii* etc. (herb layer).

Proposed Red List category: NT (near threatened). The species is on the border of its distribution area on Plješevica Mt. Its populations are stable now, but it could be threatened by inappropriate forest management in the mentioned forest types, which are very rare in Bosnia.

2. ***Gagea spathacea*** (Hayne) Salisb. **(fam. Liliaceae)**

BiH: Cerovljani village nearby Gradiška, ass. *Carpino betuli-Quercetum roboris* Rauš 1973, 04. 04. 2006., 45° 02' 58" N, 17° 12' 30" E, *coll. Đ. Milanović & V. Stupar,* Priv. Herb. of Đ. Milanović 20/11 - 13; Herb. Fac. Silv. (Figure 2)

BiH: Veliko Blaško village nearby Banja Luka city, ass. *Carpino betuli-Quercetum roboris* Rauš 1973, 15. 04. 2010, 44° 52' 24" N, 17° 19' 01" E, *coll. Stupar V., Milanović Đ. & Brujić J.,* Priv. Herb. of Đ. Milanović 20/11 – 75;

BiH: Milosavci village, south of Lijevče field, ass. *Carpino betuli-Quercetum roboris* Rauš 1973, 15. 04. 2010, 44° 53' 19" N, 17° 22' 40" E, *coll. Stupar V., Milanović Đ. & Brujić J.,* Priv. Herb. of Đ. Milanović 20/11 – 76;

Description: Bulbs 2, in a common tunic. Stem glabrous. Basal leaves 2, narrowly linear, fistular; cauline solitary, oblong-lanceolate, glabrous. Flowers 2-4; pedicels glabrous. Perianth segments 10-13 mm, linear-lanceolate, obtuse (Richardson 1980). It is similar to *G. minima* (L.) Ker-Gawler, but they differ in the number of basal leaves (2 in *G. spathacea*, 1 in *G. minima*), in the shape of spatha and in fistular leaves of *G. spathacea*.

Distribution: *Gagea spathacea* is widely distributed in C Europe (from S Sweden southwards to NE France, NW Yugoslavia and E&C Ukraine). It prefers Atlantic climatic conditions and thereby it occurs sporadically and very locally in the southern part of its range: **Croatia**: Kamenik (Marković & Mikulić 1989), Lipovljani village in Posavina (Acceto 1982), at Češko selo near Petrinja in the forest of common oak (Trinajstić 1990); **Serbia**: Pocerina region, Krnić village, surroundings of Valjevo, Divci village (Tomović & Niketić 2005); the town of Arilje, village Milićevo (Tomović *et al.* 2007); **not so rare in E and NE Slovenia**: near Ptuj (Fritsch 1929; Mayer 1952), Krakovski gozd near Kostanjevica, south of Slovenska Bistrica (Acceto 1973), around the village of Macinec to the west of Čakovec in Međimurje (Acceto 1986), a forest complex between the river Pesnica and the village Biš, the upper Ščavnica valley, Mostje to the northeast of Dornava, between the villages of Pacinje and Podvinci, the Trnjavski log, between the villages Žamenci and Mezgrovci (Acceto 1988), near Žitkovci village, Kobiljska forest, near to

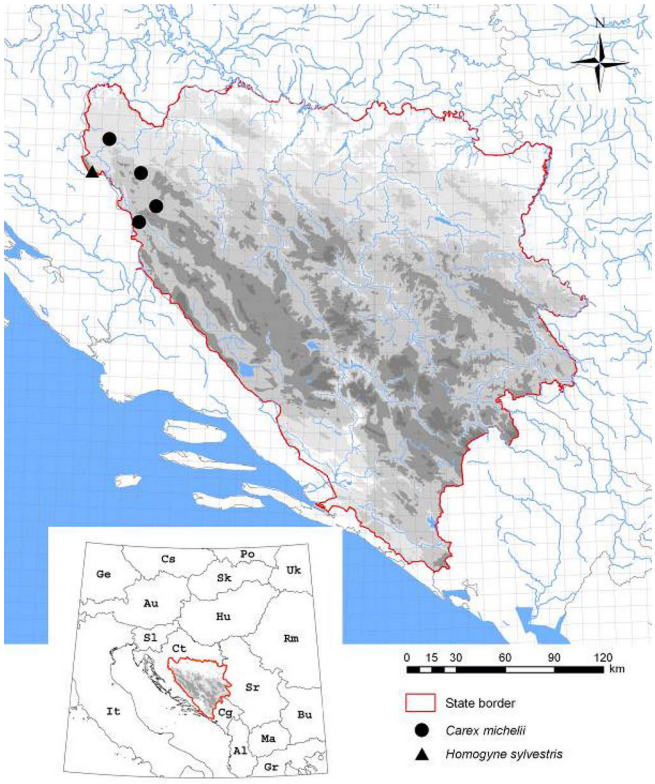

Fig. 1. Distribution of *Carex michelii* and *Homogyne sylvestris* in Bosnia and Herzegovina.

Fig. 2. *Gagea spathacea* in Cerovljani (Photo: Đ. Milanović).

Bukoviško lake, Hraščica forests near Renkovci, Mlajtinci near Ivanjski, Moravske toplice, Tiloš near Borejci, south of Lemerje, beside Dobel brook in Topolovci, Sušava, Rakičan forest, Lukačevci in Noršinci and Gržeča, Virje and Čučja mlaka in Brežičko-krška valley (Acceto 1990), Gasterajska šuma (270 to 300 m a.s.l.), vnožje gozdnega območja med zaselkoma Amerika in Šantl (zahodno od potoka Velika pri Lenartu v Slovenskuh goricah) (Jogan 2007), Lipovci - gozdiček ob gramoznici "Vučja graba", Gančani - Hraščički gozd (severni del) and Trnje - gozd ob potoku Črncu (Bakan 2011).

Common oak forests in Posavina region in Bosnia have not been the subject of detailed floristic and vegetation studies in the past or they were investigated only superficially. The main reason for the oversight of this species would be the early termination of the vegetation cycle (already in April). The nearest known locality of Lipovljani in Croatia lies ca. 40 km northwestward. (Figure 3)

Habitat: *Gagea spathacea* has very specific ecological requirements. It doesn't inhabit strongly anthropogenically-influenced sites (Peterson *et al.* 2004), so it grows only in well-preserved, mainly private, northern Bosnian common oak boskets (*Carpino betuli-Quercetum roboris*) together with: *Quercus robur, Carpinus betulus* (tree layer); *Ruscus aculeatus, Acer tataricum, Acer campestre, Cornus sanguinea, Ligustrum vulgare, Euonymus europaea, Crataegus monogyna* (shrub layer); *Anemone nemorosa, Carex brizoides, Stellaria holostea, Asarum europaeum, Crocus neapolitanus, Lamiastrum galeobdolon, Gagea lutea, Pulmonaria officinalis, Veronica hederifolia* etc (herb layer). It is very possible that this species has a wider distribution in this type of habitat.

Estimated Red List category: Critically Endangered **CR** (A3c; B1ab (i, iii, iv); B2ab (i, iii, iv)). Common oak was ruthlessly exploited as in the past so also nowadays, so such boskets occupy small surface areas and are distributed very locally in Posavina region. The continuing decline in quality of this forest habitat could result in extinction of this species on the territory of BiH.

3. ***Leucojum vernum*** L. (fam. **Amaryllidaceae**)

BiH: Cerovljani village near the town of Gradiška, ass. *Carpino betuli-Quercetum roboris* Rauš 1973, 04. 04. 2006., 45° 02' 58" N, 17° 12' 30" E, *coll. Đ. Milanović & V. Stupar,* Priv. Herb. of Đ. Milanović 20/13 - 08;

BiH: Aleksići village near Banja Luka, 4 micro-localities in ass. *Carpino betuli-Quercetum roboris* Rauš 1973, 23. 04. 2012., 44° 50' 48" N, 17° 22' 42" E, *coll. Đ. Milanović & D. Nikić,* Priv. Herb. of Đ. Milanović 20/13 - 10; Herb. Fac. Silv. (Figure 5).

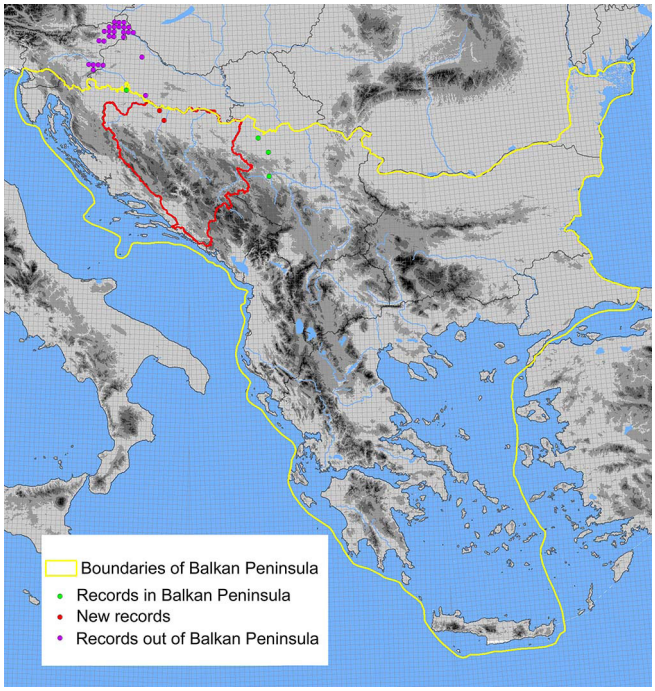

Fig. 3. Distribution of *Gagea spathacea* in the Balkan Peninsula and former republics of Yugoslavia.

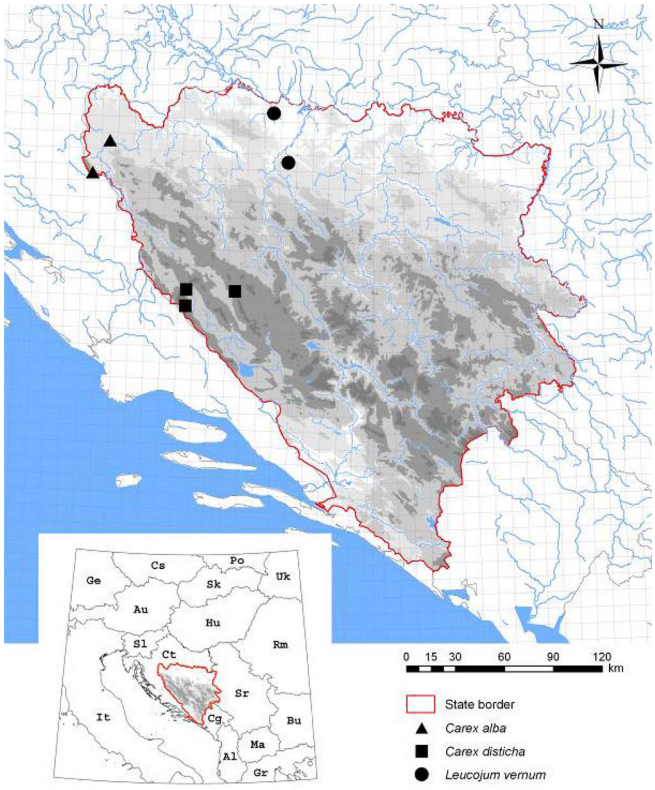

Fig. 4. Distribution of *Carex alba, Carex disticha* and *Leucojum vernum* in Bosnia and Herzegovina.

Description: Bulb 15-30 cm in diameter. Leaves 10-25 cm x 5-25 cm, lorate, appearing during anthesis. Scape 12-35 cm, usually exceeding the leaves, stout, with a small central cavity and two narrow wings. Flowers usually solitary, rarely 2; spathe 25-40 mm, 1-valved, convolute below, about equaling the pedicel. Perianth segments 15-25 mm, white with a green or yellow spot just below the thickened apex (Webb 1980). It is similar to *Galanthus nivalis,* but it is clearly different at anthesis. On the other hand, it often grows together with snowdrop and there is a big possibility of overlooking it or confusion when both are in the vegetative stages.

Distribution: The main area of distribution is central Europe, extending locally to Belgium, the Pyrenees, north Italy and West Balkans. It is not present in the Mediterranean region. In Croatia it is quite often in riparian mixed forests in Slavonia, but is very rare in Serbia, registered from several localities: Malinik and Podgorac (Pančić 1874), Gornja Resava, Lazareva klisura, Židilje and Berbatovo (Jovanović *et al.* 2009). The distribution in Bosnia is shown in Figure 4.

Habitat: The species mainly inhabits hygrophilous forest on damp or shady places. On new localities it appears in the association *Carpino betuli-Quercetum roboris*, where it occupies the lowermost shaded positions, which are out of the reach of flood, but sometimes with *Alnus glutinosa* in the tree layer. The dominant tree species are *Quercus robur, Carpinus betulus* and, in some places, *Alnus glutinosa;* in the scrub and herb layers species present are: *Rubus hirtus, Carex brizoides, Anemone nemorosa, Crocus neapolitanus* etc.

Estimated Red List category: Endangered **EN** (B1ab (i, iii, iv); B2ab (i, iii, iv)). The species inhabits habitats similar to those of *Gagea spathacea*, but it has a wider ecological amplitude and grows normally in stronger degraded Common oak and Alder forests in the Pannonian region of BiH. The populations in Aleksići are at very high risk of extinction, because there is a high impact of man. In Cerovljani village the populations are stable.

4. ***Carex disticha*** Huds. (fam. **Cyperaceae**) (**Syn.:** *Carex intermedia* Gooden., non Retz.; *Carex teretiuscula* Gooden. subsp. *modesta* (J.Gay) Nyman).

BiH: Livanjsko polje, Zagrab-Ždralovac, without precise coordinates and collection date, *coll. H. Ritter-Studnička*, Herbarium SARA.

BiH: Livanjsko polje, near to Gornji Kazanci village, 2 micro-localities on the edge of *Caricetum ripariae* Máthé et Kovács 1959, 30. 05. 2009., 08. 06. 2012., 44° 01' 28" N, 16° 36' 45" E; 44° 01' 12" N, 16° 37' 12" E *coll. Đ. Milanović & V. Stupar,* Priv. Herb. of Đ. Milanović 22/01-22 (Figure 6).

BiH: Glamočko polje, near to Petrovo vrelo village, 4 micro-localities among Ševari and Lugovi, *Magnocaricion*

Koch 1926, 09. 06. 2011., 44° 05' 17" N, 16° 53' 04" E, *coll. Đ. Milanović, V. Stupar & J. Brujić,* Priv. Herb. of Đ. Milanović 22/01-130.

Description: Stems (15-) 30-100 (-120) cm; basal sheaths dark brown. Leaves 2-4 mm wide, shorter than or almost equaling stems. Spikes 15-30, the lower and upper usually female, the middle usually male; inflorescence 3-7 (-10) x 1-2 cm, the lowest spikes sometimes slightly remote. Utricles 4-5 mm, brown or reddish-brown, conspicuously veined. Stigmas 2. *Carex disticha* belongs to the section *Ammoglochin* Dumort. and is similar to *C. arenaria* L., *C. reichenbachii* Bonnet and *C. repens* Bellardi, with middle spikes with both male and female flowers. It differs from them in structure of the inflorescence: middle spikes entirely male, terminal or upper spikes entirely female (Chater 1980).

Distribution: This species is widely distributed in Europe but absent from the extreme north and most of the Mediterranean region (Chater 1980). It is very rare in Croatia: NP Plitvička jezera (Krga 1992), assigned as DD category in the Red List of vascular flora of Croatia (Nikolić & Topić 2004). Although some studies were conducted in this area (Ritter-Studnička 1954, 1972, 1973, 1974; Ritter-Studnička & Grgić 1971) this species has never been recorded. The distribution in BiH is shown in Figure 4.

Habitat: It grows mainly in damp meadows, on the border of peat-bogs, in dikes and on wet road banks. On both sites it grows within or on the edge of periodically-flooded *Magnocaricion* communities forming the facies. In Livanjsko polje, *Carex disticha* grows on sandy and silty soil on the edge of *Caricetum ripariae* and in Glamočko polje it grows on peat soil in many micro-depressions in the flat part of the Polje, mainly within the transitions of fragmentarily-developed *Caricetum rostrato-vesicariae* communities to surrounding *Molinia*-meadows.

Estimated Red List category: Critically Endangered **CR** (B1; B2a; B2biii; D). After the construction of a network of drainage channels, the habitat conditions were heavily changed in the Bosnian karst fields, which led to rapid drying up of the soil, even during the early development of vegetation. *Carex disticha* still grows only in places where these changes have not been fully reflected, such as some micro or macro depressions in flat parts of the Poljes. However, such places are very rare and they are in the process of being overgrown, so the populations of this species are declining and are already reduced to a minimum.

5. ***Carex alba*** Scop. (fam. **Cyperaceae**)

BiH: Plješevica Mt, everywhere around Skočajska draga locality nearby Skočaj village in the forest *Carici albae-Fagetum* M. Moor 1952, dolomite, 530 m a.s.l., 12. 04. 2011., 44° 45' 14" N, 15° 50' 24" E, *coll. Milanović Đ. & Nikić D.,* Milanović Đ. Private Herbarium 22/01 - 97, Herb. Fac. Silv. (Figure 7).

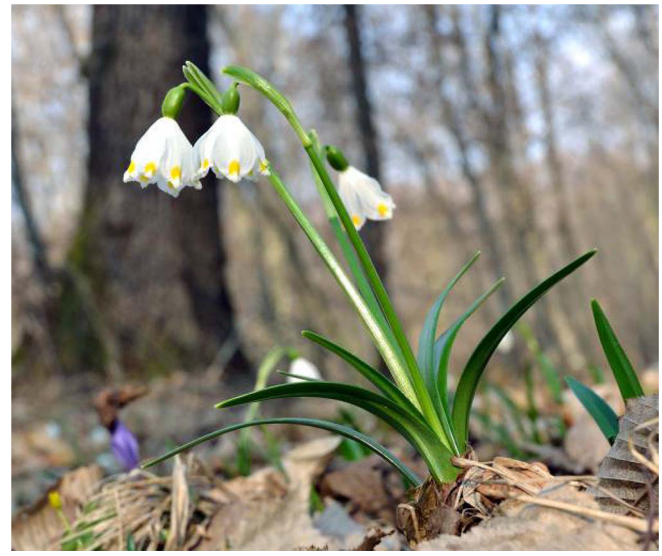

Fig. 5. *Leucojum vernum* at Aleksići village (Photo: Đ. Milanović).

BiH: Una valley, above the source of the Dobrenica stream near to Ostrožac, *Seslerio autumnalis-Ostryetum* Horvat et Horvatić 1950, dolomite, 250 m a.s.l., 22. 05. 2010., 44° 45' 14" N, 15° 50' 24" E, *coll. Milanović Đ. & Brujić J.,* Milanović Đ. Private Herbarium 22/01 – 73.

Description: Stems 10-25 (40) cm, smooth or weakly scabrid above, with yellowish-brown sheaths at the base. Leaves 0.5-1.5 (2) mm wide, pale green, shorter than stems. Male spike solitary, pedunculate; female spikes 1-3, on peduncles 1-5 cm, the upper usually overtopping the male spike. Lowest bract with a somewhat inflated sheath, 7-15 mm. Female glumes whitish; utricles brown or blackish-brown, smooth. 2n=54. *Carex alba* belongs to the section *Lamprochlaenae* (Drejer) L. H. Bailey and is similar to *Carex supina* and *Carex liparocarpos*, both with dark basal sheaths (Chater 1980).

Distribution: The center of the distribution area is the south part of central Europe, extending to the east Pyrenees on the west, northeast Russia on the east and central Balkans on the south. The species is rare in the Balkans, registered in Croatia (three groups of localities: NP Plitvička jezera, Gorski kotar and Krapina) (Nikolić 2007) and Serbia (Fruška gora and around Belgrade) (Jovanović-Dunjić 1976). The distribution in Bosnia is shown in Figure 4.

Habitat: The species inhabits dry woods, schrub and stony places. In Illyrian conditions it grows mainly in *Carici albae-Fagetum* M. Moor, described from Plitvička jezera, where it is a characteristic species (Topić & Vukelić 2009). On Bosnian slopes of Plješevica Mt it is fairly common in those forests, developed on steep

Fig. 6. The spike of *Carex disticha* in Livanjsko polje (Photo: A. Vrdoljak).

Fig. 7. Habitus of *Carex alba* (Photo: Đ. Milanović).

dolomite slopes with rendzine or calco-cambisol soil types.

Proposed Red list category: NT (near threatened) – the same reasons as for *Homogyne sylvestris*.

6. ***Carex michelii*** Host (fam. **Cyperaceae**)

BiH: Una valley, above the source of the Dobrenica stream near to Ostrožac, *Seslerio autumnalis-Ostryetum* Horvat et Horvatić 1950, dolomite, 250 m a.s.l., 22. 05. 2010., 44° 45' 14" N, 15° 50' 24" E, *coll. Milanović Đ. & Brujić J.,* Milanović Đ. Private Herbarium 22/01 – 74 (Figure 8).

BiH: Bosanski Petrovac, slopes of Samnjak hill near to Suvaja village, *Orno-Quercetum cerris* Stef. 1968, limestone, 700 m a.s.l., 27. 06. 2011., 44° 35' 39" N, 16° 18' 54" E, *coll. Stupar V & Milanović Đ..,* Milanović Đ. Private Herbarium 22/01 – 142;

BiH: Grmeč Mt, Cerovača above Krnjeuša village, *Orno-Quercetum cerris* Stef. 1968, limestone, 650 m a.s.l., 01. 06. 2011., 44° 43' 03" N, 16° 15' 05" E, *coll. Stupar V.,* Herb. Fac. Silv.

BiH: Osječenica Mt, Biljeg hill nearby Malo Očijevo

Fig. 8. Spikes of *Carex michelii* beside the source of Dobrenica stream (Photo: Đ. Milanović).

village, 680 m, *Orno-Quercetum cerris* Stef. 1968, limestone, 27. 06. 2012., 44° 30' 13" N, 16° 09' 59" E, *coll. Stupar V.,* Herb. Fac. Silv.

BiH: Osječenica Mt, Grap above Luke village, *Orno-Carpinetum orientalis* Fab., Fuk. et Stef. (1961) 1963,

limestone, 720 m a.s.l., 27. 06. 2012., 44° 28' 42" N, 16° 14' 60" E, *coll. Stupar V.,* Herb. Fac. Silv.

Description: A perennial plant with long, slender rhizomes. Stems 20-60 cm, obtusely trigonous, sometimes smooth. Leaves shorter than stems, 2-3 mm wide. Male spike 10-20 x 5-7 mm, oblong-clavate; female spikes 1-2, 10-20 mm. Female glumes pale brown, utricles often glabrous, with a beak 2-3 mm. 2n=62. It belongs to section *Rhomboidales* Kük. and it is similar to *Carex depauperata* and *Carex brevicollis*, both caespitose plants without rhizomes (Chater 1980). In the vegetative stage it is also similar to *Carex caryophyllea*, which has a wide ecological amplitude and often grows together with *Carex michelii*.

Distribution: The species is distributed in Europe and Asia, from central Italy to northwest Iran. The distribution of this species in Bosnia and Herzegovina is completely unknown. It was registered somewhere from Herzegovina by Ascherson & Kanitz (1877), but without the exact locality. This information was cited by Hayek (1931) and other authors in the past, also without any exact locality.

The first exact localities were recorded by Protić (1902) from Treskavica Mt, Prijevor below Maglić Mt and Željeznica valley. The author was a semi-skilled botanist, so he adduced many plants in this paper which certainly don't grow in Bosnia and Herzegovina. These records were not cited by Beck-Mannagetta (1903) in Flora of Bosnia, Herzegovina and Novopazarski Sandžak, although he has had Protić's herbarium material from these places. On the other hand, after comprehensive studies on Maglić Mt, *Carex michelii* was not registered at the locality of Prijevor and no habitats exist here which this species is known to inhabit. So, there was confusion, probably with the similar *Carex caryophyllea*, which occurs very often in all these places and was not adduced in the paper.

These localities mentioned from west Bosnia are the first confirmed records for this species in the country (Figure 1). It is also very rare in Montenegro: Virpazar (Pulević 2005) and Dinoško polje (Hadžiablahović 2004). In Croatia it is registered from 20 localities, but has the status DD (Data Deficient) (Nikolić & Topić 2004) and is not so rare in Serbia (Vojvodina and around Belgrade) (Jovanović-Dunjić 1976).

Habitat: *Carex michelii* inhabits dry grasslands, scrub and termophilous oak forests. In Bosnia it prefers termophilous *Quercus cerris* and/or *Quercus pubescens* forests, with sparse closure, exposed to frequent grazing or often burned in spring. In such conditions this species is mostly sterile and difficult for identification during the whole year. This could be the main reason why *Carex michelii* was not confirmed for BiH in the past.

Proposed Red list category: DD (Data Deficient)

CONCLUSION

During the latest floristic investigations in Bosnia and Herzegovina, six new species of flora for the state were detected:

1. *Homogyne sylvestris* Cass from Plješevica Mt;
2. *Gagea spathacea* (Hayne) Salisb. at three localities from Banja Luka to Gradiška;
3. *Leucojum vernum* L. at two localities nearby Banja Luka and Gradiška;
4. *Carex disticha* Huds. in Livanjsko and Glamočko Polje;
5. *Carex alba* Scop. at two localities nearby Bihać in west Bosnia and
6. *Carex michelii* Host. at several places in termophilous forests of west Bosnia.

All of the above species in Bosnia are on the southern or southeastern border of their distribution area. *Homogyne sylvestris* and *Carex alba* belong to a group of species that occur quite often in Illyrian forests of Croatia and Slovenia, have diagnostic significance and have the fringe in their distribution on Plješevica Mt. As this mountain was not subject to earlier basic research, these species were not confirmed before for the territory of Bosnia and Herzegovina. Habitats of these species are well developed and are not endangered, so those species have been estimated as near threatened (NT).

The species *Gagea spathacea* and *Leucojum vernum* are geophytes that inhabit wet forests of *Carpino betuli-Quercetum roboris*, flower in early spring and finish their vegetation cycle already at the end of April. This phenomenon is typical for many geophytes and the main reason why these two plants were not previously recorded. Common oak forests have been reduced in the last 100 years to less than 25% of their earlier distribution, which was followed by a reduction of the distribution areas of both these species. Due to differences in ecological amplitude of these species, *Gagea spathacea* is estimated as Critically Endangered (CR), and *Leucojum aestivum* as Endangered (EN) species in Bosnia and Herzegovina.

Carex disticha is confirmed in Glamočko and Livanjsko polje in depressions in flat parts of the Poljes. In those places, the changes in soil water regime, after construction of a channel network, have not come to completion and such places retain moisture throughout the year. However, they are very rare and in the process of becoming overgrown, so the populations of this species are declining and already reduced to a minimum, so the threat category is estimated as Critically Endangered (CR).

Carex michelii was recorded from Herzegovina in the 19th century, but without any exact locality. It is confirmed

in termophilous Turkey oak and Downy oak forests in west Bosnia, but only in burned or frequent grazed forests. In such conditions it is almost always sterile and difficult for identification. The proposed threat category is Data Deficient (DD).

Acknowledgment — The authors thank to Sabaheta Abadžić for checking the Herbarium of the State Museum in Sarajevo and to Prof. Vladimir Stevanović for providing literature and usefull suggestions.

REFERENCES

Acceto M. 1973. Prispevek k poznavanju raširjenosti vrste *Gagea spathacea* v Sloveniji. *Biološki vestnik* **21(2)**: 111-114.

Acceto M. 1982. *Gagea spathacea* (Hayne) Salisb. tudi na Hrvaškem. *Biološki vestnik*, **30(2)**: 155-156.

Acceto M. 1986. *Gagea spathacea* in Slovenia. *Biološki vestnik* **34(1)**: 125-126.

Acceto M. 1988. New localities of the species characteristic of moist forests of oak and hornbeam (*Pseudostellaria europaea, Gagea spathacea, Omphalodes scorpioides*) in Slovenia. *Biološki vestnik* **36(2)**: 127-130.

Acceto M. 1990. Floristične zanimivosti iz subpanonskega sveta v Sloveniji. *Biološki vestnik* **38(3)**: 65-74.

Ascherson P & Kanitz A. 1877. *Catalogus Cormophytorum et Anthophytorum Serbiae, Bosniae, Hercegovinae, Montis Scodri, Albaniae*. Claudiopoli.

Bakan B. 2011. Pregled flore Zapadnega Dolinskega (Prekmurje, Slovenia). *Scopolia* **71**: 1-141.

Beck-Mannagetta G. 1903. Flora Bosne, Hercegovine i novopazarskog Sandžaka I – *Gymnospermae* i *Monocotyledones* (Nastavak). *Glasnik Zemaljskog muzeja u Bosni i Hercegovini* **15(1)**: 185-230.

Chater AO. 1980. *Genus Carex L*. In: Tutin TG, Heywood VH, Burges NA, Valentine DH, Walters SM & Webb DA (eds.). Flora Europaea **5**, pp. 290-323, Cambridge University Press, Cambridge.

Cronquist A. 1981. *An integrated system of classification of flowering plants*. Columbia University Press. New York.

Fritsch K. 1929. Siebenter Beitrag zur Flora von Steiermark. *Mitteilungen des naturwissenschaftlichen Vereins für Steiermark* **64-65**: 75.

Fukarek P & Stefanović V. 1958. Prašuma Perućica i njena vegetacija. *Radovi Poljoprivredno-šumarskog fakulteta* **3(2)**: 93-146.

Greuter W. 2006-2009. *Compositae (pro parte majore)*. In: Greuter W & Raab-Straube E (eds.). Compositae, Euro+Med Plantbase - the information resource for Euro-Mediterranean plant diversity.

Hadžiablahović S. 2004. The contribution to the flora of Montenegro. G*lasnik republičkog zavoda za zaštitu prirode Crne Gore* **27-28**: 07-17.

Hayek A. 1931. *Prodromus Florae Peninsulae Balcanicae 2 – Monocotyledonae*. Repertorium speciorum novarum regni vegetabilis, Dahlem bei Berlin.

Horvat I, Glavač V & Ellenberg H. 1974. *Vegetation Südosteuropas. Geobotanica selecta **4***. Gustav Fischer Verlag. Stuttgart.

IUCN 2001. IUCN *Red List Categories and Criteria, version **3.1***. Species Survival Commission, IUCN, Gland, Switzerland and Cambridge.

Jogan N. (ed.). 2007. Nova nahajališča 20. *Hladnikia* **20**: 41-43.

Jovanović-Dunjić R. 1976. *Genus Carex L*. In: Josifović M (ed.). Flora Srbije **8**, pp. 182-259. Srpska Akademija Nauka i Umetnosti, Beograd.

Jovanović S, Tomović G, Lakušić D, Niketić M, Pavlović M, & Boža P. 2009. Genus *Leucojum* L. (Amaryllidaceae) – distribution and threatened status in Serbia. *Bot. Serb.* **33(1)**: 45-50.

Krga M. 1992. Flora NP Plitvička jezera. *Plitvički glasnik* **5**: 27-66.

Marković M & Mikulić S. 1989. *Gagea spathacea* (Hayne) Salisb. u flori Hrvatske. Acta Bot. Croat. **48**: 169-172.

Mayer E. 1952. Seznam praprotnic in cvetnic slovenskega ozemlja. *Razprave SAZU* **5**: 1-427.

Nikolić T & Topić J. 2004. *Crveni popis ugroženih biljaka i životinja Hrvatske*. Državni Zavod za zaštitu prirode. Zagreb.

Nikolić T. (ed) 2007. *Flora Croatica Database* (URL http://hirc.botanic.hr/fcd). Prirodoslovno-matematički fakultet, Sveučilište u Zagrebu.

Pančić J. 1874. *Flora Kneževine Srbije*. Državna štamparija. Beograd.

Peterson A, John H, Koch E & Peterson J. 2004. A molecular phylogeny of the genus *Gagea* (Liliaceae) in Germany inferred from non-coding chloroplast and nuclear DNA sequences. Plant Syst. Evol. **245**: 145-162.

Protić Đ. 1902. Treći prilog k poznavanju flore Bosne i Hercegovine. *Glasnik Zemaljskog muzeja u Bosni i Hercegovini* **14(1)**: 17-68.

Pulević V. 2005. *Građa za vaskularnu floru Crne Gore*. Republički zavod za zaštitu prirode Crne Gore. Podgorica.

Richardson IBK. 1980. *Genus Gagea Salisb*. In: Tutin TG, Heywood VH, Burges NA, Valentine DH, Walters SM & Webb DA (eds.). Flora Europaea **5**, pp. 26-28. Cambridge University Press, Cambridge.

Ritter-Studnička H. 1954. Flora i vegetacija livada kraških polja Bosne i Hercegovine. *Godišnjak Biološkog instituta u Sarajevu* **7**: 25-109.

Ritter-Studnička H & Grgić P. 1971. Die Reste Stileichenwälder in Livanjsko Polje (Bosnien). *Bot. Jahrb.* **91**(2-3): 303-347.

Ritter-Studnička H. 1972. Neue Pflanzengesellschaften aus den Karstfeldern Bosniens und der Hercegovina. *Bot. Jahrb.* **92(1)**: 108-154.

Ritter-Studnička H. 1973. Reliktgesellschaften des *Caricion davallianae* aus den Karstfeldern Bosniens. *Berichte des Geobotanischen Institutes der Eidg* **51**: 179-182.

Ritter-Studnička H. 1974. Die Karstpoljen Bosniens und der Hercegovina als Reliktstandorte und die Eigentümlichkeit ihrer Vegetation. *Bot. Jahrb.* **94(2)**: 139-189.

Rohlena J. 1942. Conspectus Florae Montenegrinae. *Preslia* **20**-**21**.

Tomović G & Niketić M. 2005. *Gagea spathacea* (Hayne) Salisb. (Liliaceae) – A new species for the flora of Serbia. *Arch. Biol. Sci.* **57(4)**: 291-294.

Tomović G, Niketić M, Zlatković B, Vukojičić S & Stevanović V. 2007. *Gagea spathacea*. In: Vladimirov V, Dane F, Nikolić T, Stevanović V & Tan K (ed.). New floristic records in the Balkans **2**, *Phytol. Balcan.* **12(2)**: 298-299.

Topić J & Vukelić J. 2009. *Priručnik za određivanje kopnenih staništa u Hrvatskoj prema Direktivi o staništima EU*. Državni zavod za zaštitu prirode. Zagreb.

Trinajstić I. 1990. Ad floram Jugoslaviae notulae taxonomico-nomenclatoricae et chorologicae. *Razprave IV Razreda SAZU* **31**: 359-373.

Turrill WB. 1929. *The plant life of the Balkan Peninsula – phytogeographical study*. Oxford.

Tutin TG. 1976. *Genus Homogyne Cass*. In: Tutin TG, Heywood VH, Burges NA, Valentine DH, Walters SM & Webb DA (eds.). Flora Europaea 4, pp. 188-189, Cambridge University Press, Cambridge.

Webb DA. 1980. *Genus Leucojum L*. In: Tutin TG, Heywood VH, Burges NA, Valentine DH, Walters SM & Webb DA (eds.). Flora Europaea **5**, pp. 76-77, Cambridge University Press, Cambridge.

REZIME

Novi nalazi vaskularne flore Bosne i Hercegovine

Đorđije Milanović, Vladimir Stupar, Jugoslav Brujić

U radu je predstavljeno 6 novih vrsta za floru Bosne i Hercegovine: *Homogyne sylvestris* Cass, *Gagea spathacea* (Hayne) Salisb., *Leucojum vernum* L., *Carex disticha* Huds., *Carex alba* Scop. and *Carex michelii* Host. Za svaku vrstu su prikazani lokaliteti, karakteristike staništa, distribucija u Bosni i Hercegovini i procenjen status i kategorije ugroženosti prema kriterijumima IUCN. Ovi podaci doprinose poznavanju distribucije ovih vrsta u Bosni i Hercegovini i na Balkanskom poluostrvu.

Ključne reči: novi floristički nalazi, rasprostranjenje, ugroženost, Bosna i Hercegovina.