



## Genus *Leucojum* L. (Amaryllidaceae) – distribution and threatened status in Serbia

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**ABSTRACT** This article presents the distribution of two *Leucojum* species (*L. aestivum* and *L. vernum*) in Serbia, on the basis of field research, herbarium and literature data. The distribution, ecological preferences as well as threatened status of the *Leucojum* species in Serbia is estimated according to 2001 IUCN Red list categories and criteria and should provide useful information for conservation management of these species in SE Europe.

**KEY WORDS:** *Leucojum*, distribution, ecology, threatened status, Serbia

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### INTRODUCTION

According to WEBB (1980) there are eight species of genus *Leucojum* L. in Europe, while according to MEUSEL *et al.* (1965), the genus *Leucojum* is distributed both in Europe and in most of the Mediterranean region. In the Balkans 3 species occur, well known European species *L. vernum* and *L. aestivum* and recently described *L. ionicum* Kit Tan, Mullaj, Sfikas & Strid, endemic of the W. Greece and S. Albania (KIT TAN *et al.* 2004).

The more recent phylogenetic studies, based on plastid and ribosome DNA, have shown that the genus *Leucojum* includes only two species: *Leucojum aestivum* L. with two subspecies (*L. aestivum* subsp. *aestivum* and *L. aestivum* subsp. *pulchellum* (Salisb.) Briq.) and *Leucojum vernum* L. (LLEDO *et al.* 2004). All the other species cited for European flora by WEBB (1980) were placed back into the genus *Acis* Salisb. In light of these results the genus *Leucojum* is distributed in Europe and the northern part of Mediterranean, while the genus *Acis* Salisb. occurs in W Mediterranean and N Africa (LLEDO *et al.* 2004).

Two species of the genus *Leucojum* (*L. vernum* and *L. aestivum*) are distributed in Serbia (STJEPANOVIĆ–VESELIČIĆ 1975). Populations of both species are under various human impacts being threatened in many localities. Therefore they are included in the Preliminary Red List of Flora of Serbia.

This paper presents the distribution and determines the threat status of species from genus *Leucojum* (*L. aestivum* and *L. vernum*) in Serbia, according to the new field studies, literature and herbarium sources.

### MATERIAL AND METHODS

The present study of the genus *Leucojum* in Serbia is based on field observations and plant material collected in most of the regions of Serbia. All relevant literature was also checked for additional information on the distribution patterns of two *Leucojum* species. Revision of herbaria collections was performed at Herbarium of the Institute of Botany and Botanical Garden “Jevremovac”, University of Belgrade (BEOU), the Herbarium of the Natural

History Museum in Belgrade (BEO), the Herbarium of Department of Biology and Ecology, Faculty of Natural Sciences and Mathematics, University of Novi Sad (BUNS) (HOLMGREN *et al.* 1990; <http://sciweb.nybg.org/science2/IndexHerbariorum.asp>), as well as the Herbarium collection of Teaching College in Sombor (HPVŠ).

Distribution of threatened plant species in Serbia is mapped on 10 x 10 sq. km at UTM grid system (LAMPINEN 2001). The estimation of threatened status of the listed species for the territory of Serbia is made according to criteria and categories of IUCN (2001).

## RESULTS AND DISCUSSION

### Distribution of *Leucojum aestivum* in Serbia (Fig. 1)

Literature data: Bačka: Sombor: Bogojevo – CR54, near canal (PRODÁN 1916); between Bački Monoštor and Bezdan – CR47, ass. *Deschampsietum caespitosae* (BABIĆ 1955); Bečej: surroundings – DR25 (OBRADOVIĆ 1962); Novi Sad: Futog – CR91 (ZORKÓCZY 1896); Kački Rit fen – DR11 (ZORKÓCZY 1896); Ratno Ostrvo – DR11 (ZORKÓCZY 1896; OBRADOVIĆ 1966); Koviljski Rit fen – DQ20 (ZORKÓCZY 1896); Hrastova Greda, Topolova Greda, Jamina and Varoška Ada – DQ20, ass. *Crataego-Populetum albae*, subass. *quercetosum*, aluvium; Veliki Pesak sand and Jamina – DQ20, ass. *Crataego-Populetum albae* subass. *typicum*, aluvium; Mala Alga – DQ20, ass. *Salicetum albae pannonicum* subass. *caricetosum elatae*, ass. *Rubus caesius-Phragmites communis*, aluvium (PARABUĆSKI 1972); Jamina – DQ20, ass. *Crataego-Populetum albae*, aluvium; Kurjačka greda – DQ20, ass. *Salicetum albae pannonicum*, aluvium; Mala voda – DQ20, aluvium; Tonja – DQ20, ass. *Crataegus nigra-Amorpha fruticosa*, aluvium (PARABUĆSKI 1973); Banat: Deliblatska Peščara sands (GAJIĆ 1983; OBRADOVIĆ & PANJKOVIĆ 1980); between Dubovac and Kovin – EQ05, EQ15, ass. *Caricetum tricostato vulpinae* (BABIĆ 1955); between Vračev Gaj and Dubovac – EQ16, EQ26, ass. *Deschampsietum caespitosae* (BABIĆ 1955); Srem: Beočin: Novi Ledinci and Novi Rakovac – DR00, between Petrovaradin and Sremski Karlovci – DR10, ass. *Caricetum tricostato vulpinae*, ass. *Deschampsietum caespitosae* (BABIĆ 1955); Sremski Karlovci – DR20 (ZORKÓCZY 1896); wet places (SCHULZER *et al.* 1866; OBRADOVIĆ 1966); Petrovaradin – DR11 (BABIĆ 1955; OBRADOVIĆ 1966); wet meadows (ČOLOVIĆ 1956; ATANACKOVIĆ 1954); near Tekije – DR11, flooded meadows (VUKOVIĆ 1972); Obedska Bara pond – DQ25 (BROZ 1958; GAJIĆ & KARADŽIĆ 1991); near ruined church “Majka Angelina”, ass. *Populetum albae*, ass. *Saliceto-Populetum albae*; ass. *Ulmeto-Fraxineto-Quercetum roboris*, ass. *Quercetum roboris*, ass. *Fraxinetum oxycarpae* (MIŠIĆ & ČOLIĆ 1974); between Obedska Bara pond and Kupinovo – DQ25, alliance *Populion albae* (SLAVNIĆ 1953); Sremska Mitrovica: Laćarak – CQ88; Martinci – CQ78, wet

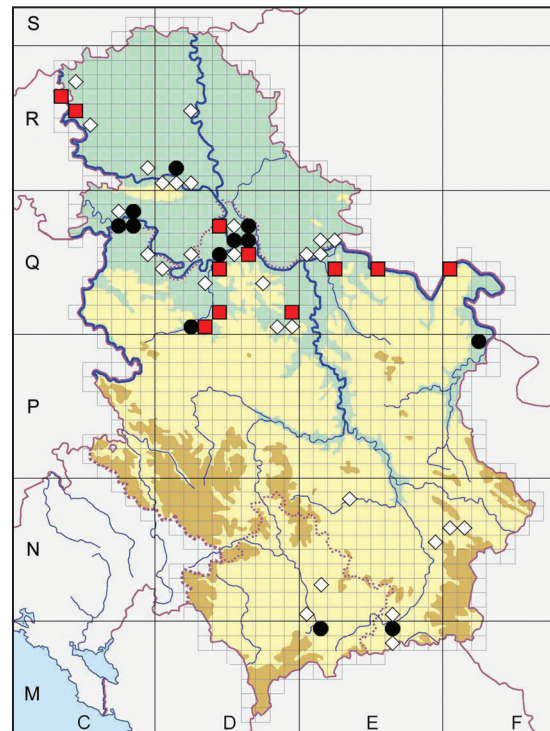
meadows near the Sava river (GODRA 1872); Zemun – DQ56, wet places (SCHULZER *et al.* 1866) Šumadija: Belgrade: (PANČIĆ 1874); Ada Ciganlija – DQ55, ass. *Querceto-Fraxinetum excelsioris* (RAJEVSKI 1950); Ada Huja – DQ55, ass. *Populeto-Salicetum* (GAJIĆ 1954); Veliko Blato – DQ56, DQ57, DQ66, DQ67 (JANKOVIĆ 1953); Makiš – DQ45, ass. *Populetum nigro-albae* (ILIĆ-VUKIĆEVIĆ 1956); Pomoravlje: Jasenica valley: Bašin “Pečenik” – DQ80 and Mramorac “Lug” – DQ90, ass. *Querceto-Fraxinetum serbicum mixtum*) (JOVANOVIĆ B & DUNJIĆ 1951); Mramorac – DQ90, ass. *Poeto-Alopecuretum pratensis* subass. *typicum* and subass. *poetosum pratensis*, facies *trifoliosum*; Mramorac “Sastavci” – DQ90, ass. *Poeto-Alopecuretum pratensis* subass. *typicum*; Natalinci – DQ80, ass. *Poeto-Alopecuretum pratensis* subass. *typicum* (JOVANOVIĆ R. 1957); Mramorac “Birovič” – DQ90, ass. *Caricetum vulpinae-ripariae* subass. *caricetosum vulpinae* within the alliance *Magnocaricion*; Mramorac – DQ90, ass. *Caricetum vulpinae-ripariae* subass. *caricetosum ripariae* within the alliance *Magnocaricion*; Đurinci – DQ73, ass. *Phalaridetum arundinaceae*, ass. *Scirpetum maritimi* within the alliance *Phragmition communis*, ass. *Caricetum vulpinae-ripariae* subass. *caricetosum ripariae*, ass. *Helleochareto-Caricetum nutantis* within the alliance *Magnocaricion* (JOVANOVIĆ R. 1958); Đurinci – DQ73, wet meadows near the stream (GAJIĆ 1964); NW Serbia: Šabac – CQ95 (PANČIĆ 1874); Nočaj (Cerik) and Turske Livade – CQ87; Zasavica (Zasavica II) – CQ88; Banovo Polje and Jovača – CQ77 (ŽUNIĆ 2002); Posavina: Kujavica-Vučevica – DQ04, ass. *Alnetum glutinosae* (ILIĆ-VUKIĆEVIĆ 1956); Obrenovac: Brović – DQ33, ass. *Trifolieto-Alopecuretum pratensis* subass. *trifolietosum hybridi typicum* within the alliance *Arrhenatherion elatioris*; Lončanik – DQ33, ass. *Trifolieto-Alopecuretum pratensis* subass. *trifolietosum hybridi typicum* within the alliance *Arrhenatherion elatioris* (CINCOVIĆ 1959); NE Serbia: Negotin – FP29 (PANČIĆ 1874); Krivaja and Mali Rit – FP29 (MARINOVIĆ 1953); C Serbia: Toplica valley: Bresničić village – EN38 (RANĐELOVIĆ 1989); SE Serbia: Lužnica – FN06, FN16, wet meadows; Vlasotince – EN95 (RANĐELOVIĆ & STAMENKOVIĆ 1986); S Serbia: Mt. Rujan Planina – EM68, EM69 (RANĐELOVIĆ & STAMENKOVIĆ 1984); Bujanovac – EN60, wet meadows (RANĐELOVIĆ & STAMENKOVIĆ 1986); Kosovo: Priština – EN12; Lipovica (Štimlje) – EM19; Lipljan – EN00 (HUNDOZI 1983-1986); Uroševac: surroundings – EM19, wet meadows (JURIŠIĆ 1923).

Herbarium and field data: Bačka: Apatin: Apatinski Rit fen – CR36 (*Perić R. pers. comm.*); between Bačka Palanka and Sombor: Sviloje – CR45 (*Pal B. field obs.*); Koviljski rit: Kozjak and Rogoznjača – DQ20 (leg. *Parabućski S.*, 09-Apr-1961, BEOU); Banat: Pančevo: surroundings – DQ66 (leg. *Grebenščikov O.*, 20-May-1947, BEO); between Pančevo and Ovča – DQ66, DQ67, wet meadows (leg. *Grebenščikov O.*, 20-May-1947, BEO); dam near old road to Pančevo –

DQ66, flooded area of Tamiš and Dunav rivers (Stevanović V., 1990 pers. comm.); Kotež (Joškićev Dunavac) – DQ56, near dam (Stevanović V., 1990 pers. comm.); Srem: Zemun: left riverside of the Sava river – DQ56 (leg. Stojadinović D., 12-May-1939, det. Lindtner V. BEO); 10 km before Crvenka – DQ47 (Stevanović V., 1990 pers. comm.); Petrovaradin: near Tekije – DR11, flooded meadows (leg. Vuković B., 14-Apr-1971, BUNS); Petrovaradinske Livade – DR11 (leg. Bećarević J. 1337, 06-Apr-1953, HPVŠ in BUNS); Šumadija: Belgrade: near playing-field Kijevo (leg. Grebenščikov O., 02-May-1933, BEO); Beli Potok (Zavojnička river) – DQ65, wet meadows (leg. Diklić N., 26-Apr-1954, BEO); Kumodraž – DQ65, near road at the edge of oak forest (leg. Krstić T & Nikolić V., 01-May-1959, BEO); Makiš – DQ45, meadow near canal (leg. Krstić T., 21-May-1953, BEO); Makiš (Bele Vode) – DQ45, wet meadows (leg. Rajevski L., 10-Apr-1937, BEO); Lazarevac: Kolubara valley – DQ41, mesophilous oak forest (leg. Sigunov A., 04-Apr-1973, det. Diklić N., BEO); Županjac – DQ30, wet meadows (leg. Niketić M & Tomović G., 11-Apr-2009, BEO, BEOU) Obrenovac: junction of Kolubara river – DQ44, (leg. Stevanović V, Jovanović S, Lakušić D & Vukojičić S. 4909, 13-Mar-1997, BEOU); Pomoravlje: Smederevska Palanka: Kusadak – DQ91, wet meadows (leg. Tomić A. 77, 27-Apr-1992, BEOU); NW Serbia: Šabac: Nočaj (Cerik) – CQ87 (leg. Erdeši J., 28-May-2001, BUNS); Zasavica (Zasavica II) – CQ88 (leg. Žunić B., 15-Jul-2001, BUNS); Turske Livade – CQ87 (leg. Žunić B., 15-Jul-2001, BUNS); Banovo Polje and Jovača – CQ77 (leg. Žunić B., 19-Aug-2001, BUNS); NE Serbia: Đerdapska Klisura gorge: Brnjica – EQ54, pond, (leg. Nikolić V & Diklić N., 20-Apr-1968, det. Nikolić V., BEO); Pecka Bara – FQ04, pond, (leg. Nikolić V & Diklić N., 20-Apr-1968, det. Nikolić V., BEO); Negotin: surroundings – FP29 (leg. Jovanović A. 28889, May-1908, BEO); ponds (leg. Pančić J. 12231, Jun-1853, BEOU); Majdanpek: Debeli Lug – EQ24, mixed beech forest near stream (leg. Černjavski P., 25-Apr-1947, det. Niketić M., BEOU); S Serbia: Bujanovac: between Levosoje and Nesalce (near the river Moravica) – EM69 (leg. Niketić M & Tomović G., 03-May-2009, BEO, BEOU); Kosovo: Uroševac – EM19 (leg. Jurišić Ž. 28888, May-1914, BEO).

The species *Leucojum aestivum* was recorded in 52 UTM squares. Most records are situated in the area of Podunavlje and Posavina (flooded area along the rivers Danube and Sava), r. Kolubara and tributary r. Jasenica of Velika Morava river. The northernmost locality is in vicinity of Bezdan and Monoštor in Bačka province, the easternmost point is situated in vicinity of Negotin (NE Serbia) while southernmost limit of distribution is in S Kosovo (Uroševac) and S Serbia (Bujanovac, Mt. Rujan) (Fig. 1).

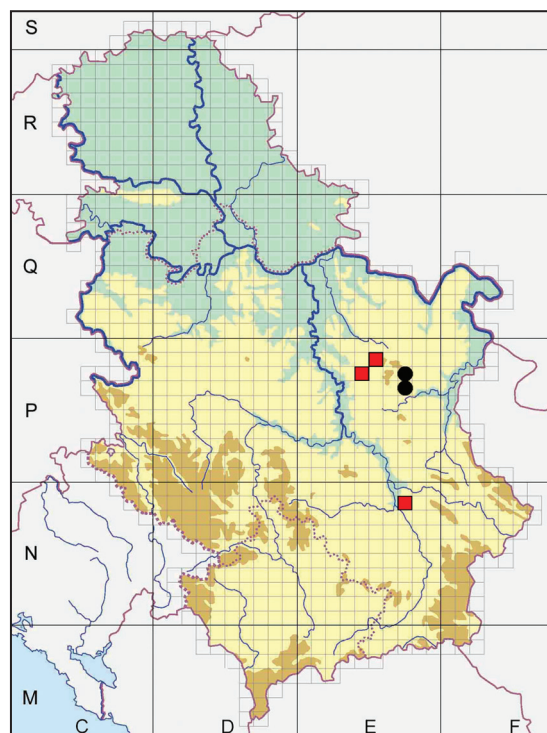
The habitats of *L. aestivum* are wet or periodically flooded lowland forests and meadows, mostly marsh-



**Fig. 1** Distribution of the species *Leucojum aestivum* L. in Serbia. Indication of localities: red (gray) square – new chorological records; white rhomboid – literature records; black dot – both literature and herbarium records

like, water-soaked terrain near rivers, river islands and swamps, on alluvium, meadow soil and gley soil. This plant was found in the following plant communities: *Querceto-Fraxinetum excelsioris* (RAJEVSKI 1950); *Alnetum glutinosae*, *Populetum nigro-albae* (ILIĆ-VUKIĆEVIĆ 1956); *Querceto-Fraxinetum serbicum mixtum* (JOVANOVIĆ B & DUNJIĆ 1951); *Poeto-Alopecuretum pratensis* (JOVANOVIĆ R. 1957); *Phalaridetum arundinaceae*, *Scirpetum maritimi*, *Caricetum vulpinae-ripariae*, *Hellechareto-Caricetum nutantis* (JOVANOVIĆ 1958); *Salicetum-albae pannonicum*, *Crataego-Populetum albae* (PARABUĆSKI 1973); *Ulmeto-Fraxineto-Quercetum roboris*, *Quercetum roboris*, *Fraxinetum oxycarpae*, *Populetum albae*, *Saliceto-Populetum albae* (MIŠIĆ & ČOLIĆ 1974); *Populetum-albae* (SLAVNIĆ 1951); *Populeto-Salicetum* (= *Populetum nigro-albae*) (GAJIĆ 1954), *Trifolieto-Alopecuretum pratensis* (CINCOVIĆ 1959), *Deschampsietum caespitosae*, *Caricetum tricostato vulpinae* (BABIĆ 1955).

Also, this species was found in Posavina area in the plant communities *Genisto elatae-Quercetum roboris* subass. *caricetosum remotae* and *Genisto elatae-Quercetum roboris* subass. *caricetosum brizoides* (RAUŠ 1980), in the Slavonian forest (Croatia) in the association *Leucojo-Fraxinetum angustifoliae*, as well as in the oak forest (*Quercus robur* subsp. *scutariensis-Periploca graeca*) in the surroundings of Skadar Lake in Montenegro (HORVAT 1963).



**Fig. 2** Distribution of the species *Leucojum vernum* L. in Serbia. Indication of localities: red (gray) square – new chorological records; black dot – both literature and herbarium records

### Distribution of *Leucojum vernum* in Serbia (Fig. 2)

Literature data: NE Serbia: Crnorečka: Podgorac – EP76; Mt. Malinik – EP77 (PANČIĆ 1874).

Herbarium and field data: NE Serbia: Mt. Kučajske Planine: Gornja Resava (Vinatovača) – EP58 (leg. *Ostojić D.* 4858, 02-Apr-1997, BEOU); Zlot: Podgorac – EP76 (leg. *Pančić J.* 12233, Apr-1869, BEOU); Lazareva Klisura gorge: Valja de Mizlok – EP77 (*Mišić R.*, Mar-2009 *pers. comm.*); Župa: Židilje – EP47 (leg. *Pančić J.* 12232, Mar-1877, BEOU); SE Serbia: Mt. Seličevica: Berbatovo village – EN78 (*Niketić M.*, Apr-1979 *field obs.*).

*Leucojum vernum* was recorded in only 5 UTM squares. Most localities are situated in NE. Serbia (Mt. Kučajske Planine, Mt. Malinik, Podgorac), while one locality is in a more southern area, in the vicinity of Niš (Mt. Seličevica) (Fig. 2).

Habitats of *L. vernum* are generally the mesophilous deciduous forests often beech forests, scrubland and wet meadows on humus-rich soil, but there are no data in which community this plant was found in the territory of Serbia. In addition, *L. vernum* inhabits the association *Chrysanthemo-Aceretum* in Bosnia and Herzegovina and Croatia, as well as the association *Fraxino angustifoliae-Carpinetum* in Slavonia region in Croatia (BORHIDI 1963).

### IUCN threat status of *Leucojum* species in Serbia and their conservation status

There are some published data

which confirmed disappearance of certain number of *Leucojum aestivum* populations from the natural habitats. For example, it was frequent in the vicinity of Bečej during the XIX century. However, at the end of the century species completely disappeared from this area (OBRADOVIĆ 1962). Also, *L. aestivum* inhabited marsh vegetation in the vicinity of Negotin (localities Mali Rit and Krivaja) before drainage of marsh and replacement into cropland. Numerous subpopulations of *L. aestivum* are under serious threat along Danube after building of Đerdap dam, i.e. increasing of river level and forming permanent flooded areas unfavorable for the species existence.

Main threat cause of *L. vernum* is inappropriate forest management, particularly in old beech forests and uncontrolled collecting for pharmaceutical purposes.

### Current threatened status of *Leucojum* species in Serbia according to 2001 IUCN Red List Categories and Criteria version 3.1

*Leucojum aestivum*: **Vulnerable** (VU E).

*Leucojum vernum*: **Endangered** (EN B1ab (i, iii, iv); B2ab(i, iii, iv)).

Certain localities inhabited by species of the genus *Leucojum* are situated in protected natural areas of Serbia. Obedska Bara, Koviljsko-Petrovaradinski Rit, Zasavica and Gornje Podunavlje are special nature reserves” where populations of *L. aestivum* are still abundant. However, majority of locality of *L. aestivum* in Serbia, particularly along Danube, Kolubara and Jasenica rivers as well as few ones in Kosovo and S Serbia are unprotected. In these localities their subpopulations size rapidly decreased in last 50 years. Two most important site for conservation of *L. vernum* are situated in Vinatovača and Lazareva klisura gorge having status of “general nature reserve” and “nature monument of I category”, respectively. In rest few localities populations of *L. vernum* are smaller, unprotected and exposed by severe threats. Both species are included into “List of protected plants in Serbia”.

### CONCLUSIONS

The genus *Leucojum* in Serbia is represented by two species *L. aestivum* and *L. vernum*. Both species are under severe threats. Distribution based on literature and herbarium sources as well as recent field studies is presented and threat status of both species is established.

The species *Leucojum aestivum* was recorded in 52 UTM squares. Most records were situated in the area of Podunavlje and Posavina (areas along the rivers Danube and Sava), while a smaller peak was recorded in the valley of river Jasenica. The habitats of *L. aestivum* are wet or periodically flooded lowland forests and meadows, mostly marsh-like, water-soaked terrain near rivers, river islands and swamps, on alluvium, meadow soil and gley soil.

The species *Leucojum vernum* was recorded in only 5 UTM squares. Most localities are situated in Northeastern Serbia (Kučajske Planine, Malinik, Podgorac), while one locality is distant southward in vicinity of Niš (Mt. Seličevica). Habitats of species *L. vernum* are generally the mesophilous deciduous, often beech forests, scrubland and wet meadows on humus-rich soil in mountains.

The main threat factors for species of genus *Leucojum* L. in Serbia are: 1. Draining the swamps, marshes and ponds in order to claim soil for cultivation; 2. Inappropriate forest management; 3. Uncontrolled collecting for pharmaceutical and horticultural purposes.

Applying the new IUCN Red List Categories and Criteria (2001), the threatened status of *L. aestivum* in Serbia is: Vulnerable VU E, while for *L. vernum* is Endangered EN B1ab(i, iii, iv); B2ab(i, iii, iv).

Majority of habitats of *Leucojum* species are situated inside of protected natural areas in Serbia. It is necessary to protect habitats with dense and vital populations of both species as well as start programme of *ex-situ* conservation.

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## REZIME

## Rod *Leucojum* L. (Amaryllidaceae) – rasprostranjenje i status ugroženosti u Srbiji

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U ovom radu predstavljeno je rasprostranjenje dve vrste iz roda *Leucojum* (*L. aestivum* i *L. vernum*) na teritoriji Srbije, na osnovu terenskih istraživanja i pregleda herbarijumskih zbirki, kao i na osnovu pregleda literaturnih podataka. Pored toga, date su ekološke karakteristike obe vrste, kao i njihovi statusi ugroženosti na osnovu najnovijih 2001 IUCN kriterijuma, što bi predstavljalo dobru osnovu za zaštitu ovih biljaka kako na području Srbije, tako i u čitavoj jugoistočnoj Evropi.

**KLJUČNE REČI:** *Leucojum*, rasprostranjenje, ekologija, status ugroženosti, Srbija