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## NEW DATA ON RARE VASCULAR PLANTS IN THE FLORA OF „LOWER PRUT LAKES” RAMSAR SITE (REPUBLIC OF MOLDOVA)

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The article presents data on the results of the monitoring of rare and endangered vascular plants in the „Lower Prut Lakes” Ramsar site, in the southwestern part of the Republic of Moldova. New information on the presence of five rare species – *Acorus calamus* L., *Allium sphaeropodum* Klokov, *Dichodon viscidum* (M. Bieb.) Holub, *Leucojum aestivum* L. and *Ornithogalum boucheanum* (Kunth) Asch. in the studied territory, as well as bioecological, chorological, habitat, zoological peculiarities, and some population characters are elucidated.

**Keywords:** Republic of Moldova, rare vascular plant species, Ramsar site „Lower Prut Lakes”.

### DATE NOI PRIVIND PLANTELE VASCULARE RARE DIN FLORA SITULUI RAMSAR „LACURILE PRUTULUI DE JOS” (REPUBLICA MOLDOVA)

În articol sunt prezentate date despre rezultatele monitorizării plantelor vasculare rare și pe cale de dispariție în situl Ramsar „Lacurile Prutului de Jos”, în partea de sud-vest a Republicii Moldova. Sunt elucidate informații noi privind prezența a cinci specii rare – *Acorus calamus* L., *Allium sphaeropodum* Klokov, *Dichodon viscidum* (M. Bieb.) Holub, *Leucojum aestivum* L. și *Ornithogalum boucheanum* (Kunth) Asch. în teritoriul studiat, cât și particularități bioecologice, corologice, de habitat, zoologice, precum și unele caractere populaționale ale acestora.

**Cuvinte-cheie:** Republica Moldova, plante vasculare rare, situl Ramsar „Lacurile Prutului de Jos”.

### Introduction

The strategy for the conservation of rare species of vascular plants, protected by law and included in the Red Book of the Republic of Moldova, provides for the protection of their specific populations. In this regard, in order to identify new populations, as well as to assess the current state of these populations, the targeted work should be carried out. The subsequent study of the population dynamics will allow to predict the prospects for the specific populations development, to substantiate measures for their preservation and, if necessary, for their expansion and restoration of the number of individuals. These studies are the main component of the monitoring of protected species of plants, which can be considered as one of the practical measures for the implementation of the strategy of conservation of protected vascular plant species.

### Material and methods

The herbarium samples of high vascular plants were collected from the territory of “Lower Prut Lakes” Ramsar site, critically processed under laboratory conditions using specific regional floras and herbarium specimens [1-12] and determined as rare species for the studied area. The name correctness was verified in the Herbarium of the National Botanical Garden (Institute) of the Republic of Moldova. The nomenclature of the species and their general distribution area is given in accordance with the modern literature [1-17]. Distribution in the Republic of Moldova is given on the basis of label data on herbarium specimens stored in the Herbarium of the National Botanical Garden of the Republic of Moldova. The rarity of species in the Republic of Moldova is assessed according to the IUCN categories and criteria [18, 19]. Rare species are identified on the basis of their local distribution in the Republic of Moldova. The following symbols are used to denote the species occurrence: ○ – locality, where the species has grown in the past (before 1970) and ● – locality, where the species grows in the present (from

1970 to 2022). For each taxa the following data is provided: Latin, Romanian and Russian names, the plant family, biological and ecological characteristics, distribution, habitats, the rarity category with criteria, protection status in the republic (protected by law [20], inclusion in the 3<sup>rd</sup> edition of the Red Book of the Republic of Moldova [21]), as well as in the Red Book of vascular plants of Ukraine [22].

### Results and Discussions

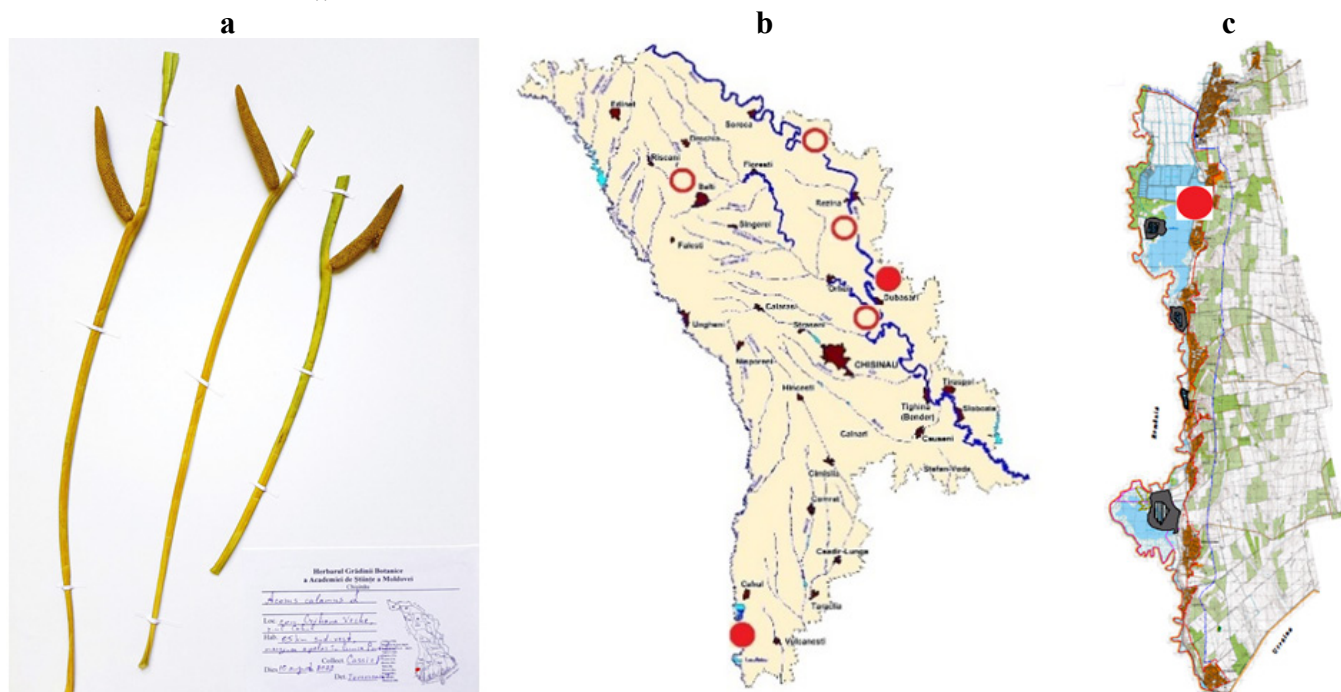
During 2019-2022, when conducting a floristic survey of the territory of the „Lower Prut Lakes” Ramsar site, in order to identify the general floristic composition and study the state of rare species of vascular plants, a number of new locations of plant populations were identified – *Acorus calamus* L., *Allium sphaeropodum* Klokov, *Dichodon viscidum* (M.Bieb.) Holub, *Leucojum aestivum* L., *Ornithogalum boucheanum* (Kunth) Asch.

*Acorus calamus* L. – Obligeană comună – Аир болотный, а. обыкновенный, Аирный корень (Araceae Family) (Fig. 1a). It is a perennial rhizomatous geophyte. It blooms in May-June, bears fruit in August-September. It multiplies by seeds and vegetatively through parts of rhizomes. Hygrophilic plant of wet habitats.

At present, this species is known, in the Republic of Moldova, from the vicinity of the commune Doibani, Dubasari district, Transnistrian region on the territory of the Scientific reserve „Iagorlâc” and from the commune Crihana Veche, Cahul district on the territory of the „Lower Prut Lakes” Ramsar site. In the past, the presence of the species was recorded near the towns of Camenca (Transnistrian region) and Balti, the village Saharna, Rezina district and the village Ohrincea, Criuleni district (Fig. 1b, 1c).

The native range distribution of this species is Asia and central part of North America; extinct in the District of Columbia, Illinois, Indiana, New Jersey, North Dakota, Rhode Island, Virginia; introduced into Scandinavia, Crimea, Caucasus, South Asia (Pakistan), South America and other regions [3, 9, 13].

**Fig. 1. *Acorus calamus* L.: a – herbarium sample, b – distribution in the Republic of Moldova, c – distribution in the „Lower Prut Lakes” Ramsar site.**



The species on the territory of the republic is adventitious, almost completely naturalized in the river meadows, lake shores, sometimes in standing waters. In the „Lower Prut Lakes” Ramsar site was observed on the shore of the fishponds constructed in the northern part of Lake Manta (Fig. 2). It grows in dispersed groups, forming patches of 10-50 m<sup>2</sup> in association with other hygrophilous species, such as: *Alopecurus aequalis* Sobol., *Bolboschoenus maritimus* (L.) Palla, *Butomus umbellatus* L., *Carex melanostachya* M. Bieb. ex Willd., *Carex otrubae* Podp., *Ceratophyllum demersum* L., *Hydrocharis morsus-ranae* L., *Lemna*

*minor* L. and *Lemna trisulca* L., *Myriophyllum spicatum* L., *Nymphoides peltata* (S. G. Gmel.) O.Kuntze, *Oenanthe aquatica* (L.) Poir., *Phragmites australis* (Cav.) Trin. ex Steud., *Potamogeton gramineus* L., *Potamogeton filiformis* Pers., *Ranunculus sceleratus* L., *Sagittaria sagittifolia* L., *Salvinia natans* (L.) All., *Spirodela polyrhiza* (L.) Schleid., *Trapa natans* L., *Typha angustifolia* L., *Vallisneria spiralis* L. Vegetative and generative specimens were recorded in the existing populations. The population status is stable.

**Fig. 2. The habitat of *Acorus calamus* L. in the „Lower Prut Lakes” Ramsar site.**

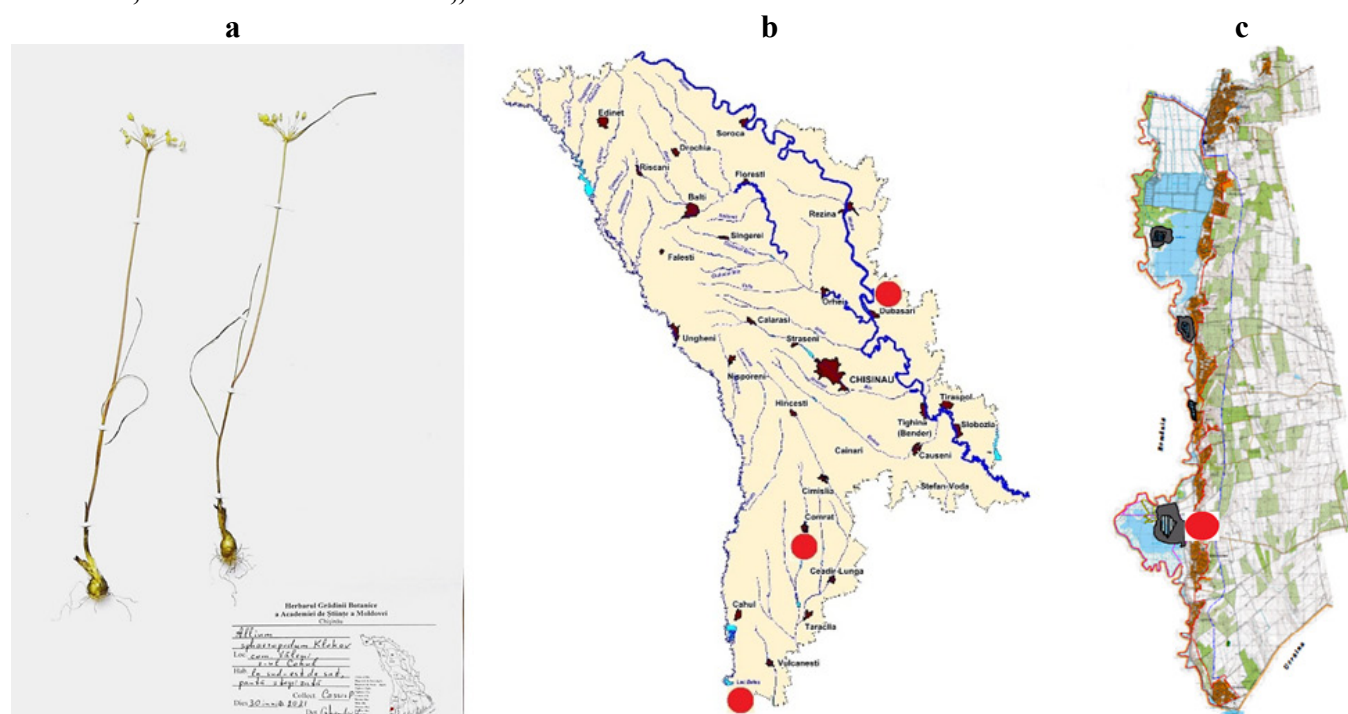


In the Republic of Moldova, the species is cultivated in the Collection of Medicinal Plants of the National Botanical Garden (Institute), Rare species. According to the IUCN criteria, it is assessed as an endangered species [Endangered (EN)] – A4ce; B2ab (i, iii, iv).

This species is protected by the state as a rare species (category IV) [20], territorially protected within the Scientific reserve „Iagorlic” and Biosphere Reserve „Lower Prut”. To preserve the species on the territory of the republic, it is necessary to continue the monitoring of existing populations and the detection of new growing sites, the multiplication of the species in *ex-situ* conditions and its extension in natural habitats.

***Allium sphaeropodum* Klokov** (= *Allium flavum* subsp. *tauricum* (Besser ex Rchb.) K. Richt.) – Ceapă sferopodă – Лук круглоногий (Alliaceae Family). Perennial plant, geophyte (Fig. 3a). Blooms in June; fruiting in August. It is propagated by seeds and vegetatively. Steppic xerophilous species. Medicinal plant.

**Fig. 3. *Allium sphaeropodum* Klokov: a – herbarium sample, b – distribution in the Republic of Moldova, c – distribution in the „Lower Prut Lakes” Ramsar site.**



In the Republic of Moldova, it is found near Slobozia Mare commune, Cahul district, between Chirsova and Ferapontievca communes, UTA Găgăuzia; com. Goian, Dubasari district, Transnistrian region (Fig. 3b, 3c). The native range of occurrence of this species is Middle (Romania) and Eastern (Republic of Moldova, Ukraine, Central and Southern parts of European Russia) Europe, Crimea, Mediterranean (Bulgaria, East Aegean Is., Greece) region, Caucasus, Western (Turkey) and Central (Iran, Kazakhstan) Asia.

Typical habitats for this species in the region are steppic calcareous slopes, loessoid steppic areas from the Bugeac steppe (Fig. 4). In primary steppes in the south of the country, it grows solitarily or in small groups of 2-10 mature plants per 1 m<sup>2</sup>. The total surface of population is circa 1 ha, and represented by individuals of different ages. On the studied territory isolated plants or groups of 3-7 plants can be met near the village Slobozia Mare in the grassland association with *Agropyron pectinatum* (M. Bieb.) Beauv., *Ajuga chia* Schreb., *Artemisia lerchiana* Weber ex Stechm., *Asperula tenella* Heuff. ex Degen, *Astragalus austriacus* Jacq., *Bothriochloa ischaemum* (L.) Keng, *Dianthus carbonatus* Klokov, *Eryngium campestre* L., *Festuca valesiaca* Gaudin, *Galatella villosa* (L.) Rchb.f., *Galium humifusum* M.Bieb., *Gypsophila pallasii* Ikonn., *Herniaria besserii* Fisch. et Horenem., *Koeleria cristata* (L.) Pers., *Linaria genistifolia* (L.) Mill., *Linum austriacum* L., *Melica transsilvanica* Schur, *Nigella arvensis* L., *Plantago urvillei* Opiz, *Potentilla arenaria* Borkh., *Potentilla argentea* L., *Potentilla astracanicum* Jacq., *Salvia nemorosa* L., *Sideritis montana* L., *Stipa capillata* L., *Stipa lessingiana* Trin. et Rupr., *Stipa ucrainica* P.A.Smirn., *Teucrium chamaedrys* L., *Teucrium capitatum* L., *Thymus marschallianus* Willd., *Veronica teucrium* L., *Xeranthemum annuum* L.

**Fig. 4. The habitat of *Allium sphaeropodum* Klokov in the „Lower Prut Lakes” Ramsar site.**

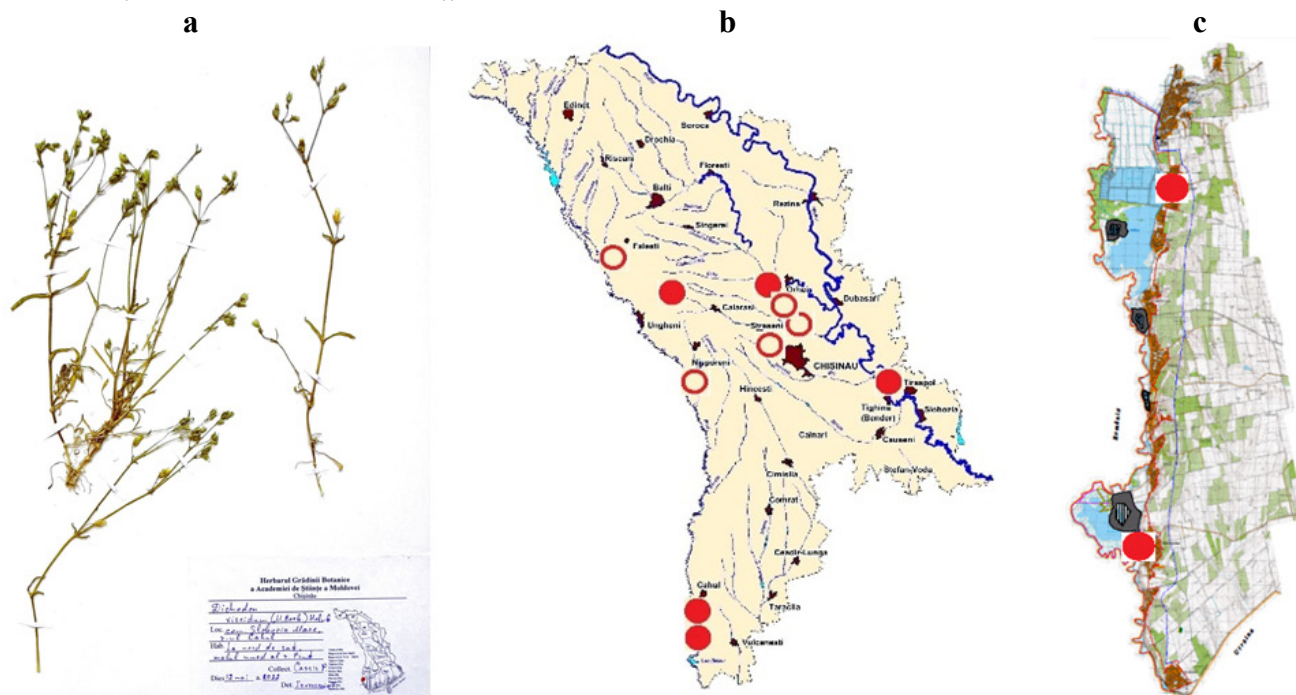


Rare species. According to the IUCN criteria taxa, it was assessed as an endangered species [Endangered (EN)] – A4cde; B2ab (i, ii, iii, iv), territorially protected within the Scientific Reserves „Iagorlic” and Biosphere Reserve „Lower Prut”. In the neighbouring Ukraine, it is included in the Red book as „Vulnerable”. For the successful protection of the species in the republic, it is advisable to include it in the list of species protected by law and in the 4<sup>th</sup> edition of the RBRM, to detect and take under protection new places, conserve *ex-situ* species.

***Dichodon viscidum*** (M. Bieb.) Holub (= *Stellaria viscida* M. Bieb., *Cerastium anomalum* Waldst. et Kit., *Cerastium dubium* (Bast.) Guepin, *Dichodon dubium* (Bast.) Ikonn.) – Cănăraș lipicios – Диходон клейкий (Caryophyllaceae Family). Annual plant, therophyte (Fig. 5a), blooms in April-June, bears fruit in May-August. It is propagated by seeds. Mesophyte, meadow plant.

In the Republic of Moldova, it is rarely found in the northern, central and southern districts: Puținței commune, Falești district; Brăviceni, Morozeni communes, Orhei district; Rădenii Vechi comm., Ungheni distr.; Barboeni village, Nisporeni distr.; Roșcani vill., Strășeni district; Ghidighici comm., Chisinau municipality; Tiraspol municipality; comm. Slobozia Mare, Crihana Veche, Cahul district (Fig. 5b, 5c). The natural occurrence range of this species is from Europe to Afghanistan, it grows in Central and Eastern (south) Europe, Crimea, the Mediterranean region, the Caucasus, Western Asia (Turkey, Afghanistan, Iran, Iraq, Lebanon-Syria, Palestine); introduced into north-western Africa (Algeria, Morocco) and into states of North America (Arkansas, Idaho, Illinois, Indiana, Kansas, Kentucky, Mississippi, Ohio, Oregon, Tennessee, Virginia, Washington).

**Fig. 5. *Dichodon viscidum* (M. Bieb.) Holub: a – herbarium sample, b – distribution in the Republic of Moldova, c – distribution in the „Lower Prut Lakes” Ramsar site.**



The habitat of the species is temporarily flooded or wet places – river meadows, cultivated lands, often on slightly saline soils. In the studies was found on the bank of the water basins of Crihana Veche commune and in the vicinity of Slobozia Mare, in wet places where the water has dried up (Fig. 6). It grows in small groups with the total area of population circa 0,5 ha, in association with: *Alopecurus aequalis* Sobol., *Bolboschoenus maritimus* (L.) Palla, *Butomus umbellatus* L., *Catabrosa aquatica* (L.) P. Beauv., *Eleocharis palustris* (L.) Roem. et Schult., *Oenanthe aquatica* (L.) Poir., *Persicaria hydropiper* (L.) Delarbre, *Phragmites australis* (Cav.) Trin. ex Steud., *Ranunculus sceleratus* L., *Rorippa amphibia* (L.) Besser, *Rorippa austriaca* (Crantz) Besser, *Rorippa x anceps* (Wahlenb.) Rchb., *Sagittaria sagittifolia* L., *Scirpus tabernaemontani* C.C.Gmel., *Torulinium caucasicum* Palla.

**Fig. 6. The habitat of *Dichodon viscidum* (M. Bieb.) Holub in the „Lower Prut Lakes” Ramsar site.**



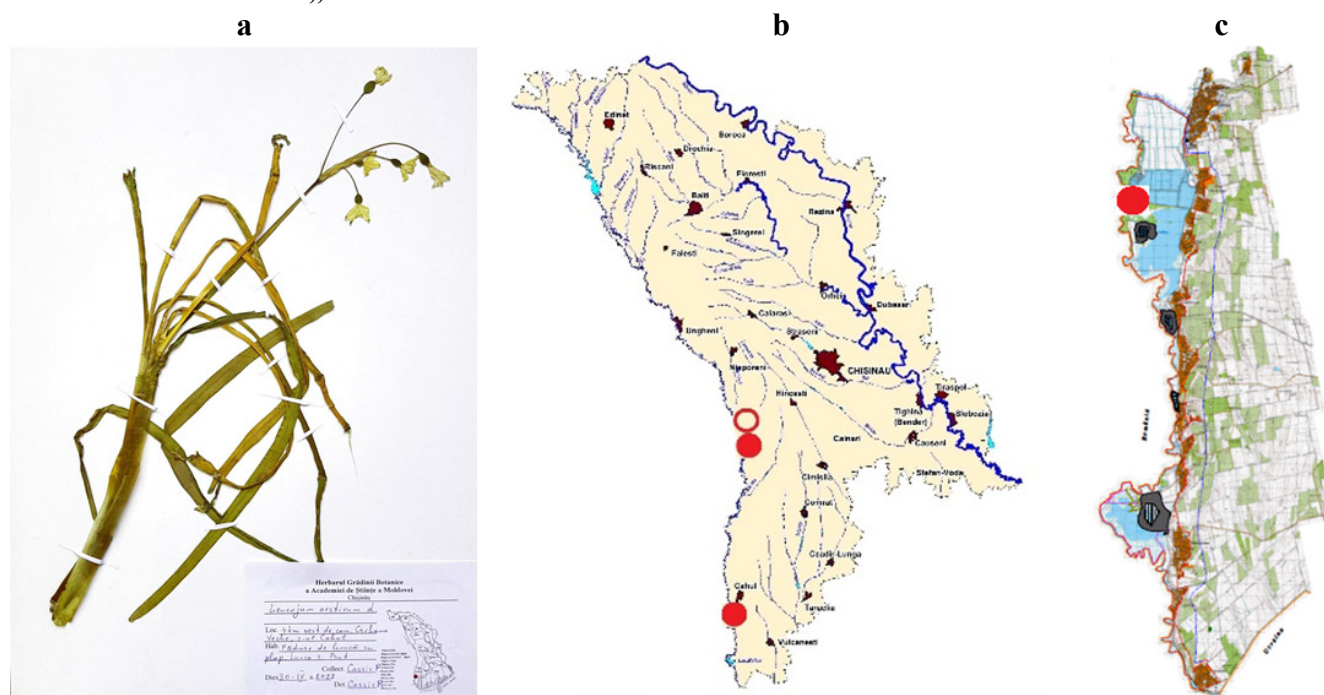
Rare species. According to the criteria of IUCN, it is estimated as endangered [Endangered (EN)] – A4ce; B2ab (i, iii, iv). In the Republic of Moldova, no protective measures regarding this species has been taken. It is territorially protected in the „Orhei” National Park, the Scientific reserves „Plaiul Fagului” and „Lower Prut”. For the successful protection of the species in the republic, it is advisable to include it in the list of species protected by law and in the 4<sup>th</sup> edition of the RBRM, detect and take under protection new places, conserve *ex-situ* species.

*Leucojum aestivum* L. – Omătuțe estival (Ghiocel bogat) – Белоцветник летний (Amaryllidaceae

Family). Perennial plant, spring bulbous geophyte (Fig. 7a). Blooms in April-May, fruits in June-July. It is propagated by seeds and bulbs. Forest hygromesophilic species. Decorative, medicinal plant.

In the Republic of Moldova, it is found only in the Prut river meadow in the vicinity of Cioara commune, Hîncești district, Sărata-Răzeși village, Leova district and Crihana Veche commune, Cahul district (Fig. 7b, 7c) [16]. The species is at the northern limit of natural range of occurrence. The native range of this species is from Europe to northern Iran – it is spread in Atlantic, Central and South-East Europe, Crimea, the Mediterranean region, Caucasus, Asia Minor (Turkey), Iran; introduced into Spain, Denmark, North America (south-western and south-eastern states), South Australia, New Zealand.

**Fig. 7. *Leucojum aestivum* L.: a – herbarium sample, b – distribution in the Republic of Moldova, c – distribution in the „Lower Prut Lakes” Ramsar site.**



Grows primarily in floodplain forests with white poplar, occasionally with an admixture of white willow, depressions with high level of moisture. It grows in groups forming clumps of 5-10 m<sup>2</sup>, of 5-25 specimens per square meter. On the territory of the Ramsar site, it is found in the white poplar forest in the Prut floodplain (Fig. 8), in association with: *Aegopodium podagraria* L., *Alopecurus arundinaceus* Poir., *Alsine media* L., *Astragalus glycyphyllos* L., *Chelidonium majus* L., *Galium aparine* L., *Galium intermedium* Schult., *Galium mollugo* L. *Geum urbanum* L., *Mycelis muralis* (L.) Dumort., *Myosoton aquaticum* (L.) Moench, *Phalaroides arundinacea* (L.) Rauschert, *Phleum pratense* L., *Ranunculus acris* L., *Ranunculus repens* L., *Rubus caesius* L., *Rubus canescens* DC., *Stellaria graminea* L., *Vitis sylvestris* C.C.Gmel.

**Fig. 8. The habitat of *Leucojum aestivum* L. in the „Lower Prut Lakes” Ramsar site.**

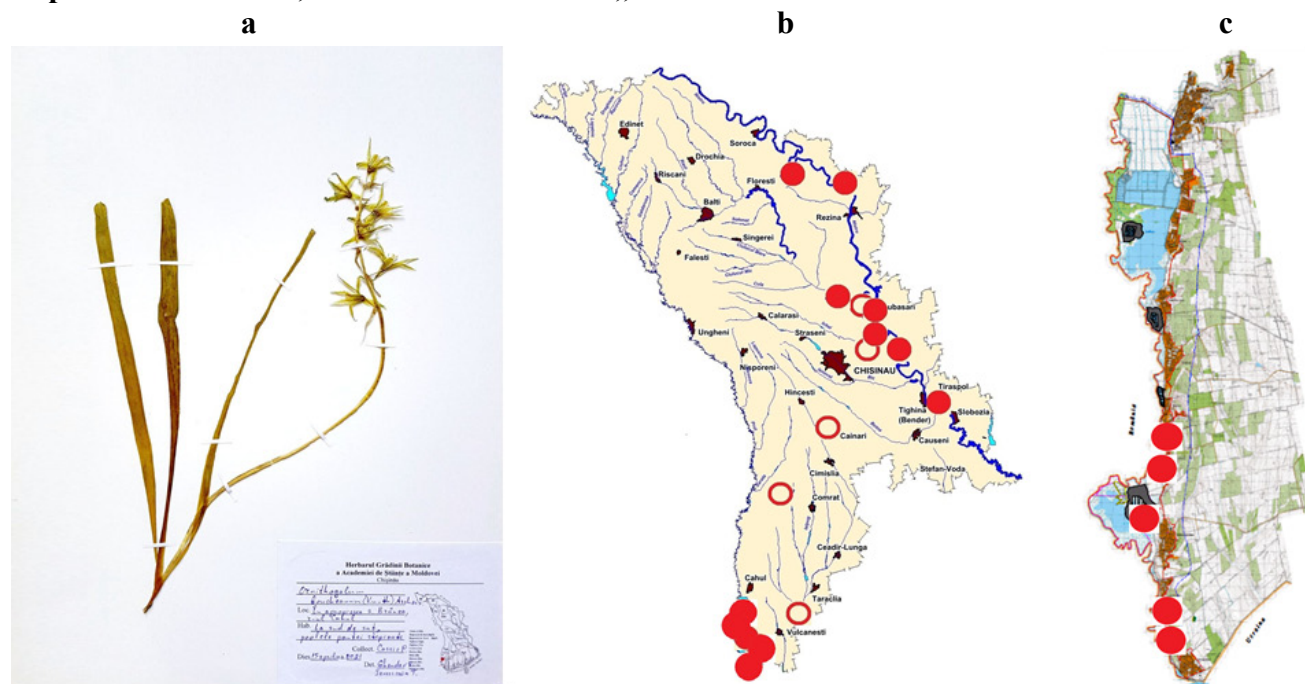


Rare Critically Endangered (CR) – B2ab (i, iii) species. Territorially protected within the limits of forest nature reserve „Dancu” and Biosphere Reserve „Lower Prut”. Protected by law as a species that is under threat of extinction (category II), included in the Red Book of the Republic of Moldova (3<sup>rd</sup> ed.) as critically endangered species (category CR), and cultivated *ex-situ* in the medicinal and decorative plant collections of the National Botanical Garden (Institute). Protected in Ukraine as vulnerable species [22]. To preserve the species on the territory of the republic, there is need to continue monitoring of existing populations and detection of new growing sites; multiplication of the species in *ex-situ* conditions and its extension in natural habitats.

***Ornithogalum boucheanum* (Kunth) Asch. (= *Myogalum boucheanum* Kunth)** – Lușcă, Lușcă Bouché – Птицемлечник Буше (Hyacinthaceae Family). Perennial bulbiferous, ephemeroïd, geophytic plant (Fig. 9a). Blooms in April-May, fruits in May-June. It is propagated by seeds. Mesophilic decorative species.

In the Republic of Moldova, it grows in the vicinity of communes of Țirnauca and Beloci (Transnistrian region), comm. Vertiujeni, Florești district, comm. Trebujeni, Brănești, Pohorniceni, Orhei district, comm. Zolonceni, Criuleni district, st. Zloți, Cimișlia district; comm. Șerpeni, Anenii Noi district, comm. Capaclia, Cantemir district, comm. Ciumai, Taraclia district; comm. Vadul lui Vodă, Chisinau municipality, comm. Brînza, Văleni, Slobozia Mare, Cîșlița-Prut, Giurgiulesti, Cahul district (Fig. 9b, 9c). The native range of distribution is Central Europe to North Caucasus. Aegean Islands, Greece, Italy, Macedonia, Montenegro, Serbia, Slovenia, Turkey), North Caucasus, introduced into Germany, Poland and Switzerland. Grows in glades with steppe vegetation of sub-arid forests, in the thickets, rarely, in river meadows. Forms small groups, the density is up to 10-20 plants per 1 m<sup>2</sup>. The populations are stable that include individuals of different ages [14]. On the territory of the Ramsar site, it is found at the foot of the steppe slope with southern exposure (Fig. 10).

**Fig. 9. *Ornithogalum boucheanum* (Kunth) Asch.: a – herbarium sample, b – distribution in the Republic of Moldova, c – distribution in the „Lower Prut Lakes” Ramsar site.**



Rare, endangered species. According to IUCN criteria, it is assessed as endangered [Endangered (EN)] – A2ac+4ace; B2ab (ii, iii, iv); D2. In the Republic of Moldova the species is protected by law (category VIII) and included in the Red Book (3<sup>th</sup> ed.). Territorially protected within the landscape reserves „Trebujeni” and „Cărbuna”, as well as in the forest nature reserve „Zolonceni”, „Lower Prut” Biosphere Reserve.

To preserve the species on the territory of the Republic of Moldova, we consider it necessary to monitor the state of existing populations and find new locations of growth, multiply the species in *ex-situ* conditions and repatriate it into natural habitats.

## Conclusions

For the first time, a number of new locations of rare species of vascular plants – *Acorus calamus* L. (in the vicinity of commune Crihana Veche, Cahul district), *Allium sphaeropodum* Klokov (comm. Slobozia Mare, Cahul distr.), *Dichodon viscidum* (M.Bieb.) Holub (comm. Slobozia Mare and Crihana Veche, Cahul distr.), *Leucojum aestivum* L. (Steven) Betcke (comm. Crihana Veche, Cahul distr.) and *Ornithogalum boucheanum* (Kunth) Asch. (comm. Brînza, Cahul distr.) were identified. For the effective protection, we recommend the following two species – *Allium sphaeropodum* Klokov and *Dichodon viscidum* (M.Bieb.) Holub. to be included in the list of vascular plants protected by law and in the 4<sup>th</sup> edition of the RBRM.

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