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ORIGINAL ARTICLE

Modern distribution and phytocenotic features of *Allium* L. in the forest steppe of Dnipro region

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This paper is focused on the distribution of *Allium* L. in forest steppe, as this taxon characterized by small amount of chorological and phytocenotic information for Dnipro region. Our own database included more than 20 years of observations over the distribution, state of populations, and phytocenology of various species of *Allium* L. A total of 12 species of this genus have been identified in the specified territory. Among them four species have more-less widespread distribution at least in some parts of the region and show signs of synanthropophilia (*Allium vineale*, *A. waldsteinii*, *A. oleraceum*, and *A. scorodoprasum*); two occasionally encountered species of natural habitats (*Allium ursinum, A. angulosum*); some species with a relatively high representation of populations in groups of meadow-steppe vegetation on crystalline bedrock exposures and at-risk populations in other natural habitats (*Allium senescens* subsp. *montanum*, *A. podolicum*, and *A. sphaerocephalon*); several rare species for this region (*Allium flavescens, A. paczoskianum,* and *A. guttatum*). We also described their conservation status and suggested recommendations for regional protection with regards to their ecological and phytocenotic features.

Keywords: *Allium* L.; Dnipro region forest steppe; Phytocenotic features; Chorology; Rare species.

Introduction

Periodic generalizations of chorological and phytocenotic data within individual taxa of the flora of natural regions are one of the elements in the monitoring system of the current state of flora. They allow us to assess changes in the distribution of individual species that have occurred in the region and make it possible to predict the trends of such changes in the future. The Dnipro forest steppe natural region (included in the composition of Kyiv and Seredniоprydniprovya and Pivdennodniprovya terraced lowland physical and geographical regions) (Ecological..., 2006) provides a quite adequate territory for such generalizations and analysis. Regional floras of these physical and geographical areas have many common features, and it is appropriate to make a general assessment for them. There is very limited information on the distribution of *Allium* L. species within the Dnipro region. Hence, the purpose of our research was to update and generalize the chorological information on *Allium* L. for the area of the Dnipro forest steppe and to highlight the phytocenotic information on its habitat.

Materials and Methods

We summarized all the literature data on specific habitats of the species, as well as materials from herbarium collections, primarily from the National Academy of Sciences of Ukraine M.H. Kholodny Institute of botany (*KW*) and others. However, the main data we used were the output of own observations during last 20 years concerning the distribution, state of populations and the nature of phytocenology of various species of *Allium* L. Species taxonomy nomenclature was presented according to the information resource for Euro-Mediterranean plant diversity (http://www.emplantbase.org/home.html/). The higher syntaxonomic units were presented according to L. Mucina et al., (2016). "Prodrome of the vegetation of Ukraine" (Dubyna, 2019).

Results and Discussion

We identified 12 species of *Allium* L. The chorological data and phytocenotic features of each species of this genus are presented below.

***Allium angulosum* L.**

The species usually encountered in wet and swampy meadows, flooded in spring. For the researched region, it is constantly occurred on the floodplain in the lower reaches of the Dnipro River and its tributaries. Under conditions of meadow biotopes of the backwaters with abruptly alternating water supply, the species has a fairly wide phytocenotic range. Being an assectator species with a constancy of up to 20%, it is easily encountered in areas irregularly flooded during high flood in spring and drying up in summer in *Agrostion vinealis* union groupings Sipaylova, Mirkin, Shelyag et V. Solomakha 1985. In conditions of wetter ecotopes and encountered in separate *Arrhenatherion elatioris* groupings Luquet 1926 (*Festucion pratensis* groupings Sipaylova et al., 1985 (syntax. syn.)), as an assectator species and occasionally a co-dominant, it shows a constancy up to 50%. A pronounced phytocenotic optimum is found in *Pastinaco sativae-Arrhenatheretum elatioris* Passarge 1964 (*Alopecuretum pratensis* Regel 1925 (syntax. syn.)) and *Poo palustris-Alopecuretum pratensis* associations Shelyag-Sosonko et al., in Shelyag-Sosonko et al., 1987, having a consistency of more than 50%, and is mainly a co-dominant with a coverage of up to 30% (Kuzemko, 2009). Occasionally, in years of high and long-term flooding (in particular, 2013), groupings of the species were encountered in the territory of the Kaniv Reserve floodplain where it dominates and its herbage ration reached 50%. Thus, this species is a typical plant in floodplain meadows of the researched region.

***Allium scorodoprasum* L.**

A frequent species in the region. It has been observed in the Kholodnyi Yar area and on the edge of a pine forest on Zhovnyne Island in the water area of the Kremenchuh Reservoir. Herbarium collections of this type have also been made in the Mykhailova Hora area in the vicinity of Prokhirovka, Kaniv district, along a path (18.06.2010); in forest clearings in the Imshan area, in the vicinity of Yasnozirya, Cherkasy district (06.07.2008); in the forests of the Derenova Hora area, in the vicinity of Derenkivets, Korsun-Shevchenkivskyi district (11.06.2007); on meadow-steppe slopes with crystalline bedrock exposure in Bohuslav (13.07.05); on meadow-steppe slopes in the Kozatskyi Val area, in the vicinity of Khyzhyntsi, Lysiansk district (05.07.2012); on steep meadow-steppe slopes of forest terraces along the Supii river valley near Tashan, Pereiaslav-Khmelnytsky district (02.06.2012). Samples of this plant have been collected at bush fallows near Trakhtemyriv on 22.06.2012. They differ from typical specimens due to significantly larger size of all organs. The generalization of descriptions of meadow vegetation (Kuzemko, 2009) reveals the highest correlation of its distribution on the Kyiv plateau with the groupings of the *Arrhenatherion elatioris* union Luquet 1926 (*Festucion pratensis* Sipaylova et al., 1985 (syntax. syn.)), in particular in the *Holcetosum lanati* subasociation of *Festucetum pratensis* Soo 1938, where it was encountered fairly constantly and had up to 30% coverage. Obviously, the phytocenological nature of this meadow plant shows signs of synanthropophilia (Protopopova, 1991).

***Allium sphaerocephalon* L.**

A less common species in the region. It was encountered in the groupings of meadow-steppe vegetation in the Tulinetski Perelisky area in the vicinity of Tulyntsi, Mironivka district, in the Dzhulaika area in the vicinity of Prydniprovske, Chornobaiivka region (01.07.2008). It was also encountered in groupings of ammophylous herbs on the islands of Zhovnyne and Dobrobut in the waters of the Kremenchuh reservoir, as well as in the glades of pine forests in the Rusko-Polianskyi botanical reserve. It also grows within the same phytocenoses in the Zmiini Ostrovy area in the Kaniv Reserve. It shows the highest constancy (up to 70 %) in the phytocenoses of the Podillia stony steppes (*Astragalo-Stipetum* R. association Knapp. 1944) and on meadow-steppe slopes of Podillia with limestone bedrock exposure (up to 50% constancy) (Kuzemko, 2009). This species occurs much less frequently in ammophylous phytocenoses of the Dnipro forest steppe zone. M. V. Klokov (1979) believes that the species should belong to the meadow-steppe and pinewood floristic complexes.

***Allium podolicum* Blocki ex Racib. & Szafer**

A rare species of flora in the region. Herbarium collections were sampled on granite outcrops on the banks of the Ros River at Korsun (11.07.2006); on granite outcrops on the banks of the Hirskii Tikych River in Yurpol and Buki, Mankivsky district (02.08.2006). It shows high constancy (up to 60 %) in xerothermic phytocenoses with limestone bedrock exposure in Podillya (*Aurinio saxatilis-Allietum podolici* association Onishchenko 2001) and slightly lower (up to 30%) on meadow-steppe slopes with exposure of various crystalline rocks (*Campanulo rotundifoliae-Dianthetum deltoidis* association Balátová-Tuláčková 1980 (*Thymo pulegioides – Festucetum ovinae* association Oberd. et Görs in Görs 1968 (art. 31)) (Kuzemko, 2009). In these places, the population growth has a high number (hundreds of plants). It was also observed in pinewood forest glades in the Mikhailivskyi forest area (Bortnyak et al., 1990). It is mentioned (Fitzailo, 2003) as growing in the pine forests of the Kyiv upland region as an assectator of the *Cladonio-Pinetum* association Jurassek 1927. Phytocenoses including this plant in similar ecotopes on separate Islands of the Sulska Bay (islands between Demyanivka and Lyashchivka), where it is represented by small populations (individual plants), have been described. With 10-30% coverage: *Festuca beckeri* (Hack.) Trautv., *Agropyron pectinatum* (M. Bieb.) P. Bauv., *Thymus tschernjajevii* Klok. & Desjat-Shost.. With 1-5% coverage: *Linaria genistifolia* (L.) Mill., *Polygonum arenarium* Waldst. et Kit. Individual plants were represented by: *Astragalus varius* S. G.Gmel., *Otites borysthenicus* Klokov, *Hypericum perforatum* L., *Centaurea borysthenica* Gruner, *Peucedanum oroselinum* Moench, *Euphorbia seguieriana* Neck., *Koeleria glauca* (Spreng.) DC., *Helichrysum arenarium* (L.) Moench, *Gypsophila paniculata* L., *Allium sphaerocephalon, Asparagus officinalis* L., *Potentilla arenaria* Borkh.

***Allium guttatum* Stev.**

A very rare species. We have registered it only in two places in Seredne Prydniprovya. It was registered on meadow-steppe slopes in the southern vicinity of Lubentsi, Kamyansky district. The herbarium collections and descriptions of phytocenoses (Shevchyk V. L. and Senchylo O.O., description of 10 m^2 area) have been made for this species growing on sheer meadow-steppe slopes of forest terraces along the valley of the Supii River near Tashan, Pereiaslav-Khmelnytskyi district (02.06.2012). This population is represented by single plants of generative age. *Elytrigia intermedia* (Host) Nevski (up to 15% coverage) dominated in the herbage. With a coverave of up to 2 % we registered *Bromopsis inermis* (Leys.) Holub, *Salvia nemorosa* L., *Chamaecytisus austriacus* (L.) Link, and *Cleistogenes bulgarica* (Bornm.) Keng. We also determined individual plants of *Medicago procumbens* Besser, *Falcaria*

vulgaris Bernh., *Gypsophila paniculata, Eryngium campestre* L., *Verbascum lychnitis* L.,*V. phoeniceum* L., *Convolvulus arvensis* L., *Achilea setaceae* Waldst. et Kit., *Thymus marshallianus* Willd., *Hypericum perforatum, H. elegans* Stephan ex Willd., *Jurinea cyanoides* (L.) Rchb., *Astragalus dasyanthus* Pall., *Artemisia marshalliana* Spreng., *Potentilla arenaria* Borkh., *Asperula cynanchica* L., *Botriochloa ischaemum* (L.) Keng., *Euphorbia virgate* Waldst. et Kit., *E. Kaleniczenkoi* Czern., *Festuca valesiaca* Schleich. ex Gaudin, *Thalictrum minus* L., *Allium scorodoprasum* L., *Asparagus polyphyllus* Steven, *Centaurea scabiosa* L., *Koeleria cristati* Pers., *Lotus torulosus* (Chiov.) Fiori, *Veronica prostrate* L., and *Dianthus membranaceus* Borbas. It is likely that this is the only known habitat of this Eastern Mediterranean species in the left bank of Ukraine. M. V. Klokov (1979) refers this species to the floristic complex of species of southern (Black Sea) sandy steppes, considering it a Black Sea regional endemic.

***Allium oleraceum* L.**
A common type of fresh and dry, medium-rich and rich edaphotopes. It grows both in open areas and in pinewood forests, sparse forests of mixed and deciduous forests as well as in artificial forest plantations, including *Robinia pseudoacacia* L. plantations. More than several dozen herbarium collections have been sampled from the Serednie Prydniprovya region. Phytocenologically, the species is characteristic of the *Hyperico perforate – Scleranthion perennis* union Moravec 1967 (Kuzemko, 2009). It is also found with low constancy (up to 15%) in groupings of dry meadows with variable moisture supply (Galietalia veri, Mirkin et Naumova 1986). M. V. Klokov (1979), noted the frequent distribution of the species in pinewood forests, referred it to the general forest subnemoral complex. Generally, in addition to natural phytocenoses, it is quite widespread in human transformed habitats and considered a synanthropic species (Protopopova, 1991).

***Allium senescens* L. subsp. *montanum* (Fr.) Holub** is occasionally encountered on bedrock exposures or in meadow steppes, and is a rare ammophylous species for the region. It is relatively common and has been repeatedly encountered on granite bedrock exposures in the valley of the Ros river in Korsun-Shevchenkivskyi and in similar ecotopes along the valley of the Hirskii Tikych river in the vicinity of Yurpil and Buky, Mankiv district. In Podillya, it is a characteristic species for the *Alysso alyssoidis – Sedion* union groupings Oberd. et Müller in Müller 1961, formed on limestone exposures (Kuzemko, 2009). It has also been encountered in glades and woodlands in pinewood forests, in particular, in the Mikhailivskyi forest area (Bortnyak et al.,1990). M. V. Klokov (1979) refers it to the ammophylous-petrophilic pinewood flora complex, assuming the idea that its populations localized in pinewood forest terraces may represent a separate race of the species.

***Allium waldsteinii* G. Don fil**.
A species of flora occasionally encountered in meadow-steppe lands and psammotopes in the region. We have gathered herbarium collections of it in the territory of Shelestiv island (Kaniv reserve) (15.06.2010) and in the Imshan area near Yasnozirya, Cherkasy region. Its greatest constancy (up to 10%) is shown in the groups of the *Festucion beckeri* union Vicherek 1972 (Kuzemko, 2009). It is also encountered much less frequently in the *Agrostion vinealis* union groupings Sipaylova, Mirkin, Shelyag et V. Solomakha 1985 (Kuzemko, 2009). At the same time, it shows signs of synanthropophilia and belongs to the category of apophytes (Protopopova, 1991). N. V. Klokov (1979) refers it to the meadow-steppe pinewood floristic complex, indicating its growth in the groupings of weed vegetation.

***Allium ursinum* L.**
A species with sporadic distribution in native broad-leaved forests of the region. Currently, its large local populations are present in the Kholodnyi Yar area, in a hornbeam forest of the Kaniv reserve, in the Chutiansky and Chorny forest areas, in the broad-leaved forests of the Smilyansky district (near Starosillia). In the forests of Podillya, it is encountered more often (up to 55% constancy and up to 50% coverage) and confined to *Isopyro thalictroidis-Carpinetum corydaletosum cavae* subassociation groupings Onyshenko 1998. In the region of the Dnipro forest steppe, it has become a rare species and is confined mainly to the *Galeobdolono lutei-Carpinetum sambucetosum nigrae* subassociation groupings Shevchyk et al., 1996, with a consistency of up to 8% and up to 50% coverage. (Onyshenko, 2009). This species is very rare on the left bank of the Dnipro (Bayrak, 1997). The species is listed in the Red Book and has the unappreciated conservation status (2009).

***Allium paczoskianum* Tuzs.**
The species was considered according to old herbarium collections gathered on the outskirts of Uman (Flora of the USSR, 1950). The latest data on its phytocenology is provided from the south of the left-bank forest steppe (Poltava region) (Didukh, Korotchenko, 1996). According to this source, it was encountered in the groupings of the *Veronico dillenii-Secalietum sylvestri* association Shevchyk et V. Solomakha 1996.

***Allium vineale* L.**
A fairly rare species of flora in the region (Chopyk et al., 1998). Was encountered in the region, according to old herbarium collections gathered on the outskirts of Smila (Flora of the USSR, 1950). According to other researchers (Bayrak, 1997), it is more common on the left bank of the Dnipro. At the same time, it shows signs of synanthropophilia and belongs to random apophytes (Protopopova, 1991).

***Allium flavescens* Bess.**
A very rare species growing on dry meadow-steppe slopes and bedrock exposures on the right bank of the Dnipro (Chopyk et al., 1998). Was encountered in the region, according to old herbarium collections gathered in the vicinity of Pishchana, Katerynopil district (Flora of the USSR, 1950). Modern data on its distribution on the left bank is referenced in the literature (Bairak, 1997).

Conclusion
Thus, 12 species of the genus *Allium* are widely known in Dnipro forest steppe. Among them four species that widely distributed in some parts of the region and demonstrate signs of synanthropophilia (*Allium vineale, A. waldsteinii, A. oleraceum,* and *A. scorodoprasum*); two occasionally encountered species of natural biotopes (*Allium ursinum, A. angulosum);* species with a relatively high abundance in meadow-steppe vegetation on crystalline bedrock exposures and potentially threatened populations in other natural habitats (*Allium senescens subsp. montanum, A. podolicum, A. sphaerocephalon*); rare or even extinct species (*Allium*

flavescens, A. paczoskianum, and *A. guttatum*). We suggested to include six species in the regional list of protected plant species (*Allium senescens* L. subsp*. montanum*, *A. podolicum, A. sphaerocephalon*, *A. flavescens, A. paczoskianum,* and *A. guttatum*).

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