ORIGINAL ARTICLE

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

V. L. Shevchyk¹, V. A. Badanina¹, A. V. Matsyura³, N. M. Hordii⁴, O. O. Bezsmertna¹², N. V. Rubanovska⁴, A. I. Babytskiy⁵

¹Taras Shevchenko National University of Kyiv
64/13 Volodymirskaya St., Kyiv, 01601, Ukraine
²Kiverty National Park "Tsumanska Pushcha"
20 Nezalezhnosti St., Volyns'Ka Oblast', Kiverty 45200, Ukraine
e-mail: olesya.bezsmertna@gmail.com
³Altai State University
61 Lenina pr., Barnaul, Russia, 656049
e-mail: amatsyura@gmail.com
⁴Kamyanets-Podilskiy Ivan Ohienko National University
61 Ohienko St., Kamyanets-Podilskiy, Khmelnytsk region, Ukraine, 32300
e-mail: natalkarubanovs@mail.ru
⁵National University of Life and Environmental Sciences of Ukraine
13 Heroiv Oborony St., 03041 Kyiv, Ukraine
e-mail: andriy.babytskiy@gmail.com

Received: 13.02.2020. Accepted 13.03.2020

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 Serednioprydniprovya 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 (*KI*) 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 assessor 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 assessor 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 (Allopecuretum pratensis Regel 1925 (syntax. syn.)) and Poo palustris-Allopecuretum 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 Zhovynule Island in the water area of the Kremenchuk Reservoir. Herbarium collections of this type have also been made in the Mykhaivola Hora area in the vicinity of Prokhirivka, Kaniv district, along a path (18.06.2010); in forest clearings in the Imshan area, in the vicinity of Yasnostyria, Cherkasy district (06.07.2008); in the forests of the Derenova Hora area, in the vicinity of Derenikievets, Korsun-Shevchenkovskyi district (11.06.2017); on meadow-steppe slopes with crystalline bedrock exposure in Bohuslav (13.07.05); on meadow-steppe slopes in the Kozatskiy Val area, in the vicinity of Khzyznytis, Lysiansk district (05.07.2012); on steep meadow-steppe slopes of forest terraces along the Supii river valley near Tashan, Pereiaslav-Khmelnitsky region (02.06.2012). Samples of this plant have been collected at bush clearings near Trakhtemiriv 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 Holcotosum lanati subassociation 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 symanthropophilia (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 Dzhulakha area in the vicinity of Prydniprovskoe, Chornobaiivka region (01.07.2008). It was also encountered in groupings of ammophyrous herbs on the islands of Zhovynule and Dobrobut in the waters of the Kremenchuk 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 backwaters with abruptly alternating water supply, the species has a fairly wide phytocenotic range. Being an assessor species with a coverage of up to 50%, 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 assessor 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 (Allopecuretum pratensis Regel 1925 (syntax. syn.)) and Poo palustris-Allopecuretum 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 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 Bukii, Mankivskyi 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 rotundifolii-Dianthetum deltois association Balatová-Tuláčková 1980 (Thymo pulegioides – Festucetum ovinae association Oberg. et Görs in Görs 1968 (art. 31)) (Kuzemko, 2009). In these cases, the population growth has a high number (hundreds of plants). It was also observed in pine forest glades in the Mikhailivskiy forest area (Bortnyak et al., 1990). It is mentioned (Fitzailo, 2003) as growing in the pine forests of the Kyiv upland region as an assessor of the Cladonio-Finetum association Jurassek 1927. Phytocenoses including this plant in similar ecotopes on separate Islands of the Suliska 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. Gmel., Orites borysthenicus Klokov, Hypericum perforatum L., Centaurea borysthenica Gruner, Peucedanum oroselinum Moench, Euphorbia seguieriana Neck., Koeleria glauca (Spr.) DC., Helichrysum arenarium (L.) Moench, Gypsophila paniculata L., Allium sphaerocephalon, Asparagus officinalis L., Potentilla arenaria L. We identified 12 species of Allium L. The chorological data and phytocenotic features of each species of this genus are presented below.

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, Kamiansky district. The herbarium collections and descriptions of phytocenoses (Shevchyk V. L. et al., 2009, Bortnyak et al., 1990). It is mentioned (Fitzailo, 2003) as growing in the pine forests of the Kyiv upland region as an assessor of the Cladonio-Finetum association Jurassek 1927. Phytocenoses including this plant in similar ecotopes on separate Islands of the Suliska 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. Gmel., Orites borysthenicus Klokov, Hypericum perforatum L., Centaurea borysthenica Gruner, Peucedanum oroselinum Moench, Euphorbia seguieriana Neck., Koeleria glauca (Spr.) DC., Helichrysum arenarium (L.) Moench, Gypsophila paniculata L., Allium sphaerocephalon, Asparagus officinalis L., Potentilla arenaria L. We identified 12 species of Allium L. The chorological data and phytocenotic features of each species of this genus are presented below.
Allium oleraceum L.

A common type of fresh and dry, medium-rich and rich edaphophytes. It grows both in open areas and in pine woodland 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 Prydniprova region. Phytoecologically, the species is characteristic of the Hyperico perforate – Sclerotanthion perennis union Moravec 1967 (Kuzemko, 2009). It is also found with low constancy (up to 15%) in groupings of dry woodlands with variable moisture supply (Galieta, 1986). M. V. Klovok (1979), noted the frequent distribution of the species in pinewood forests, referred it to the general forest subnemoral complex. Generally, in addition to natural phytocoenoses, 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 Hirske Ticky river in the vicinity of Yurpi and Buky, Mankiv district. In Podillya, it is a characteristic species for the Alysso alyssoidis – Sedion union groupings Oberg. et Muller in Muller 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. Klovok (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 ursinum L.

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 et V. Solomaka 1985 (Kuzemko, 2009). At the same time, it shows signs of synanthropophilia and belongs to the category of apophytes (Protopopova, 1991). N. V. Klovok (1979) refers it to the meadow-steppe pine woodland floristic complex, indicating its growth in the groupings of weed vegetation.

Allium waldsteinii G. Don fil.

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 Smilansky district (near Starosilia). 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 caeve subassociation groupings Onyshenko 1998. In the region of the Donipro forest steppe, it has become a rare species and is confined mainly to the Galeobdolonoluo 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).

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

vulgars Benth., Gypsophila paniculata, Eryngium campestre L., Verbascum thapsus L., V. phoenicium L., Convolvulus arvensis L., Achillea setacea Waldst. et Kt., Thymus marshallianus Willd., Hypericum perforatum, H. elegans Stephan ex Willd., Jurinea cyanoides (L.) Rchb., Astragalus dasylanthus Pall., Artemisia marshalliana Spreng., Potentilla arenaria Borkh., Asperula cynanchica L., Botrochloa ischaemum (L.) Keng., Euphorbia virgate Waldst. et Kt., E. Kaleniczenko Czern., Festuca valesiaca Schlech. ex Gaudin, Thalictrum minus L., Allium scorodoprasum L., Asparagus polyphyllus Steven, Centaurea scabiosa L., Koeleria cristata Pers., Lotus torulosus (Chiov.) Fiori, Veronica prostrata 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. Klovok (1979) refers this species to the floristic complex of species of southern (Black Sea) sandy steppes, considering it a Black Sea regional endemic.
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).

Acknowledgements
The authors express their sincere gratitude to D. Shiryeva (M.H. Kholodnyi Institute of Botany) for the materials provided.

References
Bairak, O.M. (1997). Notes of the flora of the Left Bank of the Dnipro region. Vascular plants. Poltava. Verstka.
Bortniak, M.M., Liubchenko, V.M., Voitiuk, Yu.O. (1990). Rare species of the Middle Dnipro region flora in the flora of the
Mykhailivskyi pine forest in Cherkasy region. Ukrainian Botanical Journal, 47 (4), 70-73.
Chopyk, V.I., Bortniak, M.M., Shevchyk, V.L. (1998) Notes of the flora of the Middle Dnipro region. Vascular plants. Kyiv.
Didukh, Ya.P. (Ed) (2009). The Red Book of Ukraine. Kyiv: Global Consulting.
Didukh, Ya.P., Korotchenko, I.A (1996). Steppe vegetation of the southern part of the Left Bank Forest Steppe of Ukraine. Classes
Festucetea vaginatae and Helianthemo-Thymetea. Ukrainian Phytocenotic Collection, A (2), 56-63.
Dubyna, D.V. (Ed.) (2019). Prodrome of the vegetation of Ukraine. Kyiv: Naukova dumka.
Fitsailo, T.V. (2003). Syntaxonomy of vegetation of the Kyiv plateau. Vaccinio-PiceeteaBr-BI class. 1939. Vegetation of coniferous
forests of Ukraine. Materials of working session. Kyiv: Phytosociocenter.
Ecological Encyclopedia. (2006). Kyiv: Center for Environmental Education and Information.
Klokov, M.V. (1979). Psammophilous floristic complexes in the territory of the USSR (attempt to analyze the psammophyton). News
taxonomy of higher and lower plants. 90-150.
Kuzemko, A. (2009). Dry grasslands on sandy soils in the forest and forest-steppe zones of the plains region of Ukraine: present
state of syntaxonomy. Gottingen: Tuexenia 29.
Kuzemko, A.A. (2009). Meadow vegetation. Molinio-Arrhenatheretea Class. In Yu.R. Sheliah-Sosonko (Ed.), Vegetation of Ukraine
(p. 367). Kyiv: Phytosociocenter.
Melnyk, V.I. (2000). Rare species of flora of the plain forests of Ukraine. Kyiv. Phytosociocenter.
Mucina, L., Bültmann, H., Dierßen, K., Theurillat, J.-P., Dengler, J. ... Tichý, L. (2016). Vegetation of Europe: hierarchical floristic
classification system of vascular plant, bryophyte, lichen and algal communities. Applied Vegetation Science, 19 (Supplement 1), 3-
264.
Onyshchenko, V.A. (2009) Forests of order Fagetalia sylvaticae in Ukraine. S.L. Mosyakin (Ed.). Kyiv. Alterpress.
Protopopova, V.V. (1991). Synanthropic flora of Ukraine and ways of its development. Kyiv. Naukova Dumka.

Citation:
Shevchyk, V.L., Badanina, V.A., Martsura, A.V., Hordii, N.M., Bezsmertna, O.O., Rubanovska, N.V., Babytskiy, A.I. (2020). Modern distribution and
phytocenotic features of Allium L. in the forest steppe of Dnipro region. Ukrainian Journal of Ecology, 10 (1), 273-276.
This work is licensed under a Creative Commons Attribution 4.0. License