biology and life sciences forum

MDPI

Proceeding Paper

Invasive Plant Species of Recreational Zones of Kharkiv (Ukraine) †

Hanna Kazarinova * and Karina Zviahintseva

Department of Botany and Plant Ecology, V. N. Karazin Kharkiv National University, 4 Svobody Sq., 61022 Kharkiv, Ukraine; karina.zvyagintseva@karazin.ua

* Correspondence: hanna.kazarinova@karazin.ua; Tel.: +38-096-917-5420

† Presented at the 1st International Electronic Conference on Biological Diversity, Ecology and Evolution, 15–31 March 2021. Available online: https://bdee2021.sciforum.net/.

Abstract: The formation of synanthropic flora of any territory occurs in two ways: the penetration of anthropophytes (anthropophytization, adventization) and the transition of native plant species from natural phytocenoses to anthropogenic ecotopes (apophytization). The article highlights the results of the study of synanthropic flora and vegetation of recreational zones of Kharkiv (abandoned parks, recreational areas, and green areas) for 2018–2020. The classification of synanthropic vegetation was performed on the basis of processing geobotanical releves in programs Turboveg 2.91 and Juice 7.0.127. Ecological amplitudes of syntaxons were determined by ecological scales of Ya.P. Didukh. The study of invasive plant species was carried out according to the classification of D. Richardson et al. As part of the synanthropic vegetation of recreational zones of Kharkiv, we have found 15 invasive plant species. Most of them, according to the degree of invasive potential, belong to the group with high invasive capacity (11 species). Among them there are dominate species of the family *Asteraceae* (eight). The results of biomorphic analysis show that there are dominate therophytes (8 species), ecological analysis shows the domination of mesophytes (14 species) and geographical analysis shows the domination of species of North American origin (13). The structural analysis of the alien fraction of flora shows the dominance of kenophytes (15 species), xenophytes (6 species), and ergasiophytes (5 species), and epecophytes (7 species). Woody phytocenoses of the class *Robinietea* are sensitive to soil acidity and carbonate content in soil, thermal, and cryo-climate. In their composition, we have found eight invasive species. In plant communities of herbaceous annual vegetation of classes *Bidentetea* and *Galio-Urticetea*, which are adapted to the variability of damping and nitrification of the edaphotope, nine invasive plant species are growing. Ruderal phytocenoses of classes *Artemisietea vulgaris* and *Stellarietea mediae* are formed with the participation of 10 invasive plant species. These communities are sensitive to the variability of damping, soil acidity, total salt regime, nitrogen content in soil, thermal climate, humidity, and the continentality of the climate.

Keywords: invasive plant species; synanthropic vegetation; recreational zones; Kharkiv; Ukraine

Citation: Kazarinova, H.; Zviahintseva, K. Invasive Plant Species of Recreational Zones of Kharkiv (Ukraine). *Biol. Life Sci. Forum* **2021**, 2, 16. https://doi.org/10.3390/BDEE2021-09472

Academic Editor: Matthieu Chauvat

Published: 16 March 2021

1. Introduction

The formation of synanthropic flora in any territory occurs in two ways: (1) the penetration of anthropophytes (anthropophytization, adventization) and (2) the transition of native plant species from natural phytocenoses to anthropogenic ecotopes (apophytization) [1]. Urban flora is a type of anthropogenically transformed flora and forms in the conditions of urban agglomerations. It has a specific structure, as well as its own characteristic florogenetic processes. The need to study urban flora is determined by the fact that in this type of anthropogenically transformed flora, different types of flora "coexist" (flora of man-made ecotopes, recreational areas, agrophytocenoses, cultivated flora, etc.) [2].

Gardens and parks form a special type of urban landscape. The peculiarities of urban flora largely depend on city location and landscaping. The landscape design of gardens

and parks has its own patterns: the alternation of closed and open areas, flat places and elevations, dry slopes and ponds, and compliance with the natural basis of the created complexes [2].

The aim of the work is to study invasive plant species in the flora and vegetation of recreational zones of Kharkiv (abandoned parks, recreational areas, green areas) for 2018–2020.

2. Materials and Methods

We studied the synanthropic flora and vegetation of abandoned parks, recreational areas and green areas for the period of 2018–2020 (Figure 1). The study of invasive plant species was carried out according to the classification of D. Richardson et al., and taxonomic and biomorphic analyzes by Tolmachev [3] and Raunkiaer [4]. The classification of synanthropic vegetation was performed by the ecological-floristic method. Selection of syntaxons was based on the processing of geobotanical releves in the programs Turboveg 2.91 [5] and Juice 7.0.127 [6]. Syntaxonomy follows to the "Prodrome of the Vegetation of Ukraine" [7]. Ecological amplitudes of syntaxons were determined by ecological scales of Ya.P. Didukh [8].

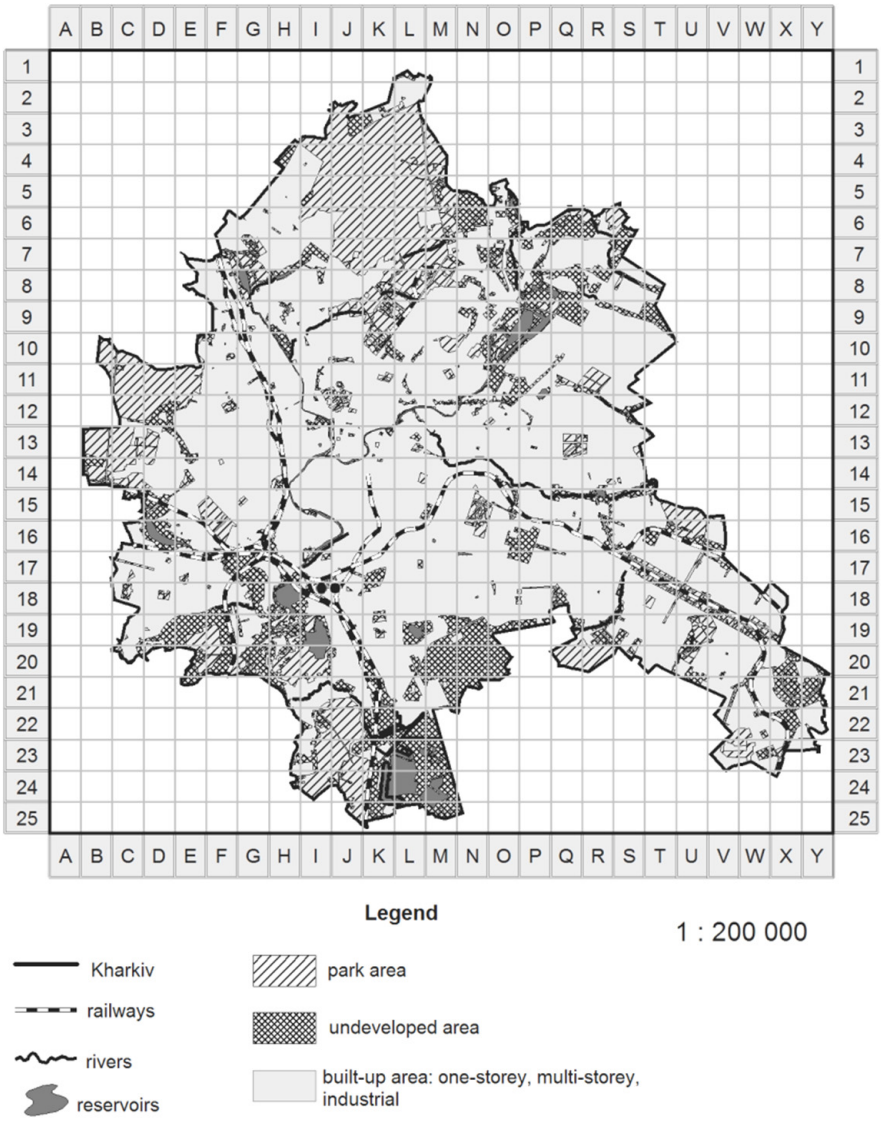

Figure 1. Map of the recreational zones of Kharkiv.

3. Results and Discussion

In the composition of the synanthropic vegetation of recreational zones of Kharkiv, we found 15 invasive plant species. Most of them, according to the degree of invasive potential, belong to the group with high invasive capacity (11 species) [9]. Invasive plant species of the family *Asteraceae* (8) dominate in the taxonomic spectrum, which is characteristic of the synanthropic flora of Ukraine [10]. The families *Balsaminaceae*, *Vitaceae*, *Fabaceae*, *Aceraceae*, *Amaranthaceae*, *Portulacaceae*, and *Nyctaginaceae* are represented by one species. The biomorphic analysis shows the dominance of therophytes (eight species), which is typical for recreational zones of Kharkiv. Hemicryptophytes take the second place (four species) and phanerophytes the third (three species). Among the invasive plant species, there are dominate mesophytes (14), species of North American origin (13), kenophytes (15), xenophytes (6), ergasiophytes (5), and epecophytes (7). Using ecological scales, we calculated the tolerance zones of the identified plant communities in the hyperspace of 12 ecological factors. The class *Robinietea* Jurko ex Hadač et Sofron 1980 is represented by plant communities of unions *Balloto nigrae-Robinion pseudoacaciae* Hadač et Sofron 1980, *Chelidonio majoris-Robinion pseudoacaciae* Hadač et SofronexVítková in Chytrý 2013, *Chelidonio-Acerion negundi* L. Ishbirdina et A. Ishbirdin 1991 nom. inval. (art. 3o, 5), *Geo-Acerion platanoidis* L. Ishbirdina et A. Ishbirdin 1991nom. inval. (art. 3o, 5), which include invasive species *Acer negundo* L., *Robinia pseudoacacia* L., *Parthenocissus inserta* (A. Kern.) R. M. Fritsch, *Conyza canadensis* (L.) Cronquist, *Erigeron annuus* (L.) Desf. (*Phalacroloma annuum* (L.) Dumort), *Grindelia squarrosa* (Pursh) Dun., *Impatiens parviflora* DC., and *Solidago canadensis* L. The studied synanthropic woody phytocenoses are distributed in recreational zones of the city and along roads and streams. They have narrow tolerance zones to soil acidity and carbonate content in soil, as well as to thermal and cryo-climate (Figure 2).

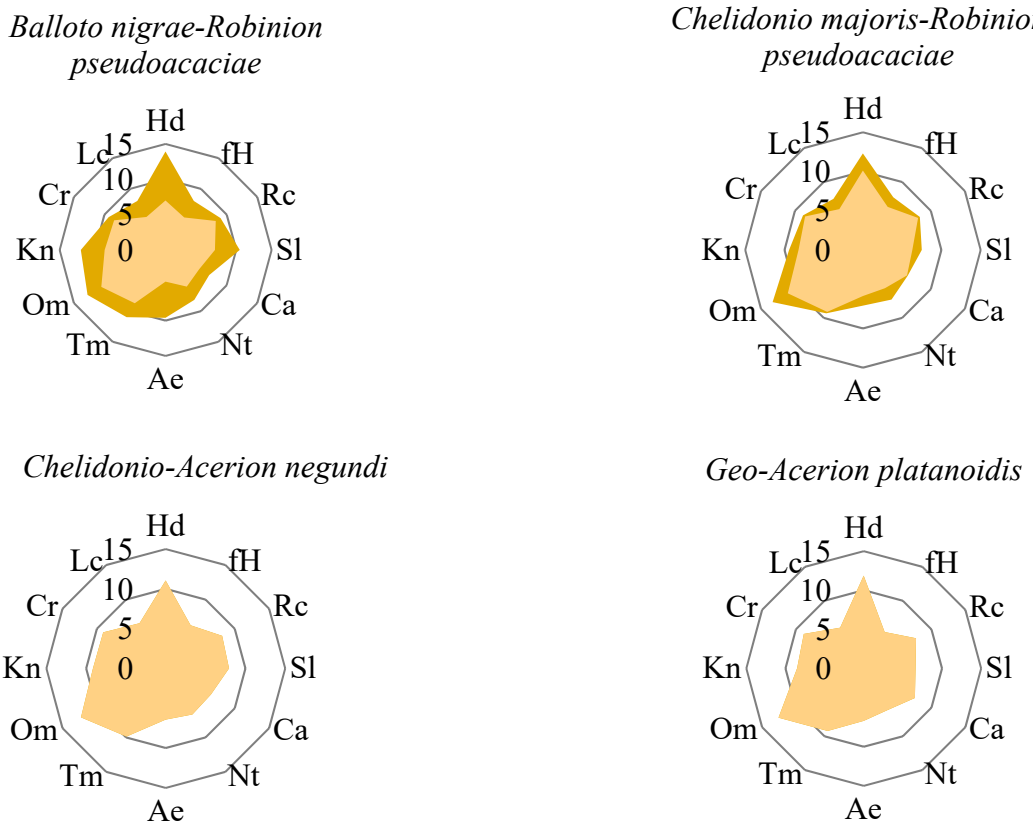

Figure 2. The tolerance zones of *Robinietea* phytocenoses in the hyperspace of ecological factors. Legend: Hd—soil water regime, fH—variability of damping, Rc—soil acidity, Sl—total salt regime, Ca—carbonate content in soil, Nt—nitrogen content in soil, Ae—soil aeration, Tm—thermal climate, Om—humidity, Kn—continentality of climate, Cr—cryoclimate, Lc—light.

In the composition of vegetation of unions *Bidention tripartitae* Nordhagen ex Klika et Hadač 1944 and *Chenopodion rubri* (Tx. in Poliet J. Tx. 1960) Hilbig et Jage 1972 of class *Bidentetea* Tx. et al. ex von Rochow 1951, we found *Bidens frondosa* L., *Ambrosia artemisiifolia* L., *Acer negundo*, *Impatiens parviflora*, *Erigeron annuus*, and *Parthenocissus inserta*. This pioneer vegetation near bodies of water have fairly wide tolerance zones and can withstand fluctuations in edaphotope damping and slight shading (Figure 3). Similar environmental parameters have ruderal communities of the remains of oak forests and wetlands along watercourses (rivers, streams) of class *Galio-Urticetea* Passarge ex Kopecký 1969. These cenoses include *Ambrosia artemisiifolia*, *Grindelia squarrosa*, *Erigeron annuus*, *Solidago canadensis*, and *Iva xanthiifolia* (Nutt.) Fresen. The vegetation of both classes is adapted to the variability of damping, nitrification of the edaphotope.

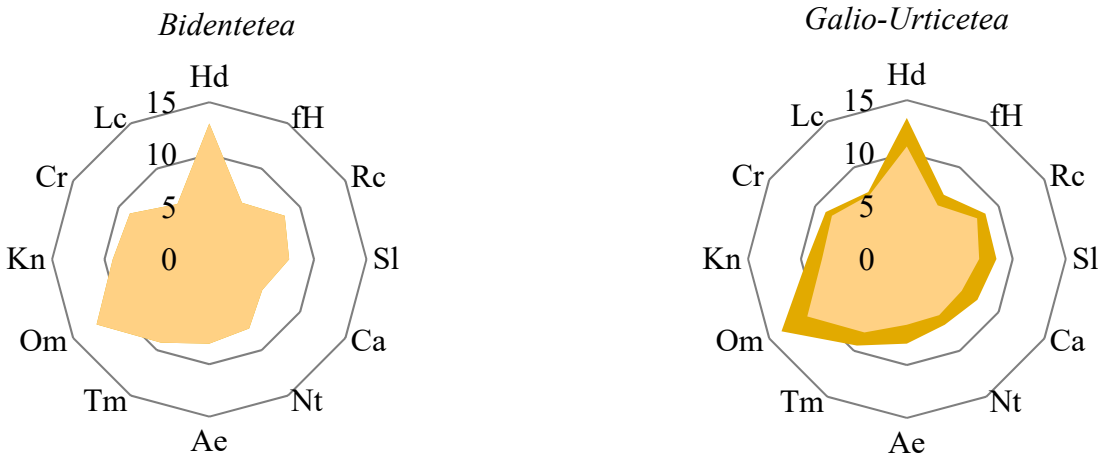

Figure 3. The tolerance zones of *Bidentetea* and *Galio-Urticetea* phytocenoses in the hyperspace of ecological factors. Legend is in Figure 2.

The vegetation of class *Artemisietea vulgaris* Lohmeyer et al. in Tx. ex von Rochow 1951 is represented by unions *Onopordion acanthi* Br.-Bl. et al. 1936, *Convolvulo arvensis-Agropyrion repentis* Görs 1967, and *Arction lappae* Tx. 1937, in which *Grindelia squarrosa*, *Solidago canadensis*, *Helianthus tuberosus* L., *Ambrosia artemisiifolia*, *Erigeron annuus*, *Oxybaphus nyctagineus* (Michx.) Sweet, and *Conyza canadensis* grow. Ruderal xerophytic communities of the class are distributed along roads and paths and in places of active recreation on nitrified soil, have narrow tolerance zones of variability of damping and soil acidity, and are sensitive to changes in thermal climate and humidity (Figure 4).

Ruderal vegetation of dry roadside areas and dumps in park zones of class *Stellarietea mediae* Tx. et al. in Tx. 1950 demonstrates sensitivity to soil acidity, total salt regime, nitrogen content in soil, and continentality of climate (Figure 5). In the unions *Panico-Setarion* Sissingh in Westhoff et al. 1946 and *Sisymbrion officinalis* Tx. et al. ex von Rochow 1951, we noted *Ambrosia artemisiifolia*, *Amaranthus retroflexus* L., *Conyza canadensis*, *Grindelia squarrosa*, *Erigeron annuus*, *Iva xanthiifolia*, and *Portulaca oleracea* L.

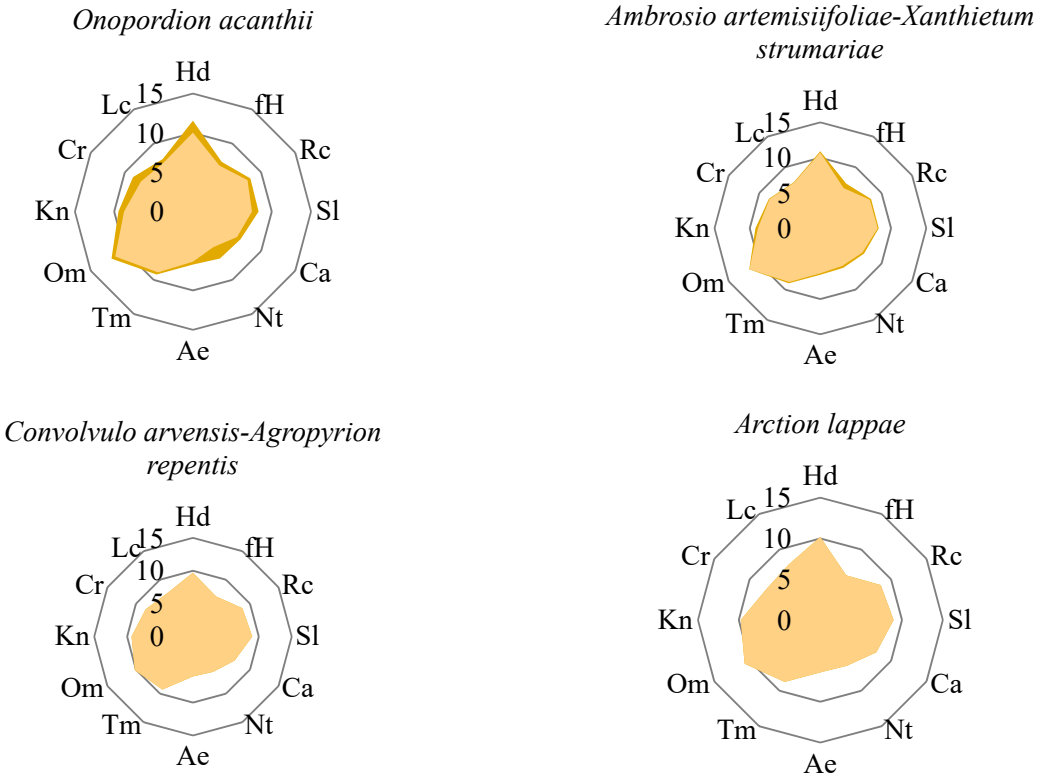

Figure 4. The tolerance zones of *Artemisietea vulgaris* phytocenoses in the hyperspace of ecological factors. Legend is in Figure 2.

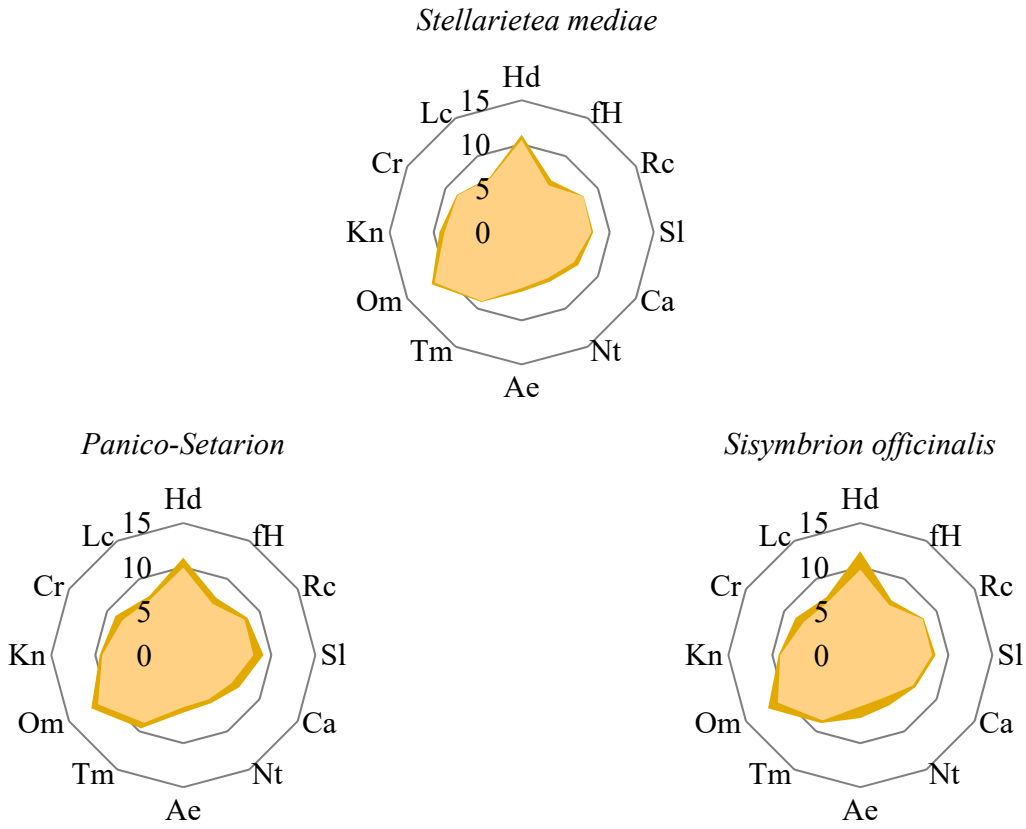

Figure 5. The tolerance zones of *Stellarietea mediae* phytocenoses in the hyperspace of ecological factors. Legend is in Figure 2.

4. Conclusions

As a result of the study, we identified 15 invasive plant species in 5 classes of synanthropic vegetation of recreational zones of Kharkiv. Analysis of the taxonomic and biomorphic structure revealed a predominance plant species of *Asteraceae* family and herbaceous annuals. Woody phytocenoses the class *Robinietea* are the center of growth of eight invasive plant species. According to the results of ecological analysis, these plant communities are sensitive to soil acidity and carbonate content in soil, thermal, and cryo-climate. There are nine invasive plant species in the communities of herbaceous annual vegetation of classes *Bidentetea* and *Galio-Urticetea*, which are formed under conditions of variability of damping and nitrification of the edaphotope. Ruderal phytocenoses of classes *Artemisietea vulgaris* and *Stellarietea mediae* are formed with the participation of 10 invasive plant species. These communities are sensitive to the variability of damping, soil acidity, total salt regime, nitrogen content in soil, thermal climate, and humidity, as well as to the continentality of climate.

Author Contributions: Conceptualization, H.K. and K.Z.; methodology, H.K. and K.Z.; software, H.K.; validation, H.K. and K.Z.; investigation, H.K. and K.Z.; resources, K.Z.; writing—original draft preparation, H.K. and K.Z.; writing—review and editing, H.K.; visualization, H.K.; supervision, H.K. and K.Z. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Burda, R.I.; Protopopova, V.V.; Fedoronchuk, M.M.; Shevera, M.V. Synanthropization flora and vegetation—A threat to biodiversity. *Visn. Nac. Acad. Nauk Ukr.* **2013**, *2*, 77–80. (In Ukrainian)
2. Mil'kov, F.N. *Man-Made Landscapes. A Story about Anthropogenic Complexes*; Mysl': Moscow, Russia, 1978; pp. 54–56. (In Russian)
3. Tolmachev, A.I. *Introduction to the Geography Plants*; Leningrad University Publishing House: Leningrad, Russia, 1974; 244p. (In Russian)
4. Raunkiaer, C. *The Life Form of Plants and Statistical Plant Geography*; Claredon: Oxford, UK, 1934; 632p.
5. Hennekens, S. Turboveg for Windows 1998–2012. Version 2. 2012. 78p. Available online: https://ibot.sav.sk/cdf/tvwin.pdf (accessed on 21 October 2021).
6. Tichý, L.; Holt, J. *JUICE: Program for Management Analysis and Classification of Ecological Data: Program Manual*; Vegetation Science Group: Brno, Czech Republic, 2006; 98p.
7. Dubyna, D.V.; Dziuba, T.P.; Iemelianova, S.M.; Bagrikova, N.O.; Borysova, O.V.; Borsukevych, L.M.; Vynokurov, D.S.; Hapon, S.V.; Gapon, Y.V.; Davydov, D.A.; et al. *Prodrome of the Vegetation of Ukraine*; Nauk. Dumka: Kyiv, Ukraine, 2019; 784p. (In Ukrainian)
8. Didukh, Y.P. *The Ecological Scales for the Species of Ukrainian Flora and Their Use in Synphytoindication*; Phytosociocentre: Kyiv, Ukraine, 2011; 176p.
9. Zviahintseva, K.O.; Kazarinova, H.O.; Gamulya, Y.G. Invasive plant species of Kharkiv region: Characteristics and conditions of existence, Synanthropization of the vegetation cover of Ukraine. In Proceedings of the III All-Ukrainian Scientific Conference, Kiev, Ukraine, 26–27 September 2019; Book of Scientific Articles; Nash Format: Kyiv, Ukraine, 2019; pp. 69–73. (In Ukrainian)
10. Protopopova, V.V. *Synanthropic Flora of Ukraine and Ways of Its Development*; Nauk. Dumka: Kyiv, Ukraine, 1991; p. 204. (In Ukrainian)