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INTRODUCTIONS IN THE COMPOSITION OF THE ADVENTIV FRACTION OF THE FLORA OF VOLYN POLISSYA

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One of the leading factors of adventithation of regional flora is the introduction of plants, which is considered as the process of resettlement or transfer of populations of plant species outside their natural range, as an ecological and biological study and the introduction into culture in a certain territory of plants that have not grown here before. All human activity related to the practical use and restoration of vegetation is based on the introduction of plants, which play an extremely important role in the development of the productive forces of society.

Introducers are one of the potential sources of replenishment of the spontaneous flora with new adventive species. From the point of view of the potential possibility of introduced plant species to naturalithation in new territories, the analysis of methods for assessing the success of introduction deserves attention.

The results of exploring the run wild of introduction are resulted in consisting of the adventive flora of Volyn Polissya. To that belonging 139 species of 116 genuses from 49 families. In the middle of appreciably prevail kenophitie are set, at the vital form grass policarpics. 41 of species show the tendency to naturalization in the natural and the half-natural ecotops.

It should also be noted that currently a number of species that were originally bred as cultivated species are now in the territory of Ukraine, including within the borders of the Volyn Polissia, in a state of expansion or showing similar trends and possessing high invasive activity. Among them: Impatiens parviflora, Acer negundo, Ambrosia artemisifolia, Echinocystis lobata, Amorpha fruticosa, Helianthus tuberosus, Heracleum sosnowskyi, Reynoutria japonica, Padus serotina and some others. Single isolated localities with high projection coverage of such alien species as Impatiens grandulifera, Grindelia squarrosa, Helianthus subcanescens, Populus laurifolia. Adventive flora on the territory of the Volyn Polissya is largely formed with the participation of wild introducers, among which eukenophytes are clearly predominant.

Key words: *Volyn Polissya, introduction species, adventive flora, archeophitie, kenophitie, naturalization.*

Ойцюсь Л. В., Попельницька О. В. Інтродуценти у складі адвентивної фракції флори Волинського Полісся

Основною рушійною силою адвентизації місцевої флори є інтродукція рослин. В основі цього процесу лежать переселення або переміщення популяцій видів рослин за межі їхнього природного ареалу (це ті рослини, які раніше тут не зростали) як з метою еколого-біологічного дослідження, так і для вирощування в культурі на певній території.

Аналізуючи адвентивну фракцію спонтанної флори Волинського Полісся та її видовий склад, ми виділили 188 видів рослин, які є здичавілими інтродуцентами, ці види належать до 142 родів і 58 родин, це становить близько 54 % від загального числа таких адвентивних видів рослин, що були виявлені на території регіону. Серед зареєстрованих видів адвентивних рослин близько п'ятдесяти практично постійно зростають поруч із культурними рослинами як бур'яни. Зазначені види рослин розподіляють на дві групи: перша – види, здичавіння яких відбулося безпосередньо на території Волинського Полісся (156 видів), це ті, які вирощуються або вирощувались у культурі, друга – представлена культурними видами, які потрапили на територію регіону з інших регіонів, будучи вже здичавілими (32 види). Співвідношення цих двох груп вказує на те, що більшість інтродукованих видів на території Волинського Полісся перейшли безпосередньо в категорію адвентивних видів.

Певна кількість видів рослин, які на території України, у тому числі на Волинському Поліссі, спочатку розводили як культурні, зараз перебувають у стані експансії або проявляють її ознаки, володіючи

високою інвазійною активністю, серед них: Impatiens parviflora, Acer negundo, Ambrosia artemisifolia, Echinocystis lobata, Amorpha fruticosa, Helianthus tuberosus, Heracleum sosnowskyi, Reynoutria japonica, Padus serotina та інші. На деяких територіях відмічені поодинокі ізольовані локалітети рослин, які проявляють високий рівень проєкційного покриття таких неаборигенних видів, як Impatiens grandulifera, Grindelia squarrosa, Helianthus subcanescens, Populus laurifolia.

Ключові слова: *Волинське Полісся, інтродуковані види, адвентивна флора, археофіти, кенофіти, натуралізація.*

Introduction. One of the leading factors in the advent of regional flora is plant introduction, which is considered to be the process of relocation or transfer of plant species populations outside their natural range, as well as the ecological and biological study and introduction of plants that have not grown here before.

All human activity related to the practical use and restoration of vegetation relies on the introduction of plants, which plays an extremely important role in the development of society's productive forces.

The role of introduced flora species is extremely important in agriculture and green building, where they form the basis of plants cultivated here, and to a lesser extent in the forestry of our country. The vast majority of varieties and forms of cultivated plants grown in agroecosystems in Ukraine are based on species originating from regions outside the country and are thus alien to its natural flora. The same applies to most of the species of ornamental plants grown in the open field. In fact, almost the entire modern cultural flora of Ukraine is based on introductions.

In this regard, it should be noted that the creation of ornamental parks and botanical gardens played a major role in the introduction of plant species new to the region. Such parks were established directly in Volyn Polissya and adjacent territories in the late XVIII and early XX centuries. For example, in 1827, a park was founded in the village of Volodymyrets (now a complex natural monument of local importance called Volodymyrets Park), at the end of the eighteenth century – in the village of Hrani, Dubrovytsia district (now a complex natural monument of local importance "Tryputnyansky Park"). In the early twentieth century, parks appeared in the village of Oleksandriia, Rivne district (now a park-monument of landscape art of local importance "Oleksandriia Park") and in the village of Zirne, Bereznovskyi district (this park was laid out by the prominent Irish landscape architect D. Mickler, nowadays it is Zirnenskyi Park, a monument of landscape art of local importance). In addition, parks were created on the territory of the then Volyn region in the village of Hoshcha (now Hoshcha Park, a park and landscape art monument of local importance), the village of Tuchyn (now Tuchyn Park, a park and landscape art monument of local importance), the village of Velyki Mezhyrychi (now Velykomezhyrychi Park, a park and landscape art monument of local importance), and the village of Horodok (now Horodok Park, a park and landscape art monument of local importance). The creation of the Botanical Garden in Kremenets with the participation of D. Mikler was quite important. A small private botanical garden was founded in the village of Samostryly, Korets district, by Vladslav Boreiko [1, 2].

At the same time, introductions are one of the potential sources of replenishing the spontaneous flora with new adventive species. From the perspective of the potential for introduced plant species to naturalize in new areas, it is worthwhile to analyze methods for assessing the success of introduction. For example, according to the scale of E. V. Wolfe [3], the most successful introduction is when the introduced specimens reach the stage of seed reproduction, or according to the scale of M. A. Kohno and A. M. Kurdyuk when the reproduction of introductions occurs by self-sowing due to the formation of fully germinating seeds. Thus, the ultimate goal of the practice of introduction comes into conflict with the tasks of protecting the natural flora from phytoinvasions. After all, when individuals of any species achieve such successful results of introduction, it becomes fully capable of competing with native species. In this case, targeted introduction turns into spontaneous naturalization of non-native species outside the cultivated area. Therefore, the working version of the national strategy on non-native species recognizes the following main problems: ensuring reliable protection of cultivated plants and forest species by preventing the importation and dispersal of potentially dangerous organisms, control of introduction activities, all stages of importation and acclimatization of new non-native forest tree species, crops, genetically modified organisms, etc [6, 8, 9].

Materials and methods. In scientific works, when analyzing the adventitious fraction of the spontaneous flora, feral introductions are usually not separately identified. One of the most comprehensive summaries of the synanthropic flora of Ukraine notes that of the widely cultivated plants, only a few occasionally go wild and spread outside of culture. Most of these species belong to the families *Poaceae* and *Apiaceae* [5]. However, according to the peculiarities of naturalization, a group of ergasiophytes is distinguished, which includes wild cultivated plants localized near the cultivation sites [5]. However, it should be noted that this group does not fully reflect the situation with feral introductions, as they can act as ephemerophytes or be representatives of the stable component, in particular epecophytes or agriophytes,

depending on the degree of naturalization. Ergasiophytes should be considered as one of the groups of adventitious species distinguished by their source of origin, i.e. those that originate from introduced cultivated plants, regardless of the place and degree of naturalization.

The analysis of the history of the introduction and spread of many adventive species in Ukraine shows that the main role in this process, especially in the initial stages, was played by the introduction and subsequent feralization of introduced forms. When studying the distribution of non-native plant species in Volyn Polissya, a significant presence of feralized introductions in the adventive flora was noted, which prompted a more detailed analysis of the place and role of this group in phytoinvasions in the region [10].

It should be noted that indications of the growth of wild cultivated plants in Volyn Polissia can be found in the works of nineteenth-century botanists. For example, J. K. Pachosky in his "Flora of Polesie..." provides information on 16 species that show a tendency to naturalization (e.g., *Malva mauritiana*, *M. moschata*, *Alcea rosea*, *Medicago sativa*, *Cucurbita pero*, *Helianthus annuus* and some other species) [4]. I. F. Schmalhausen also points out the feralization of certain species in the region [7].

Disscusion. The analysis of the species composition of the adventitious fraction of the spontaneous flora of Volyn Polissya revealed 188 species of feral introductions belonging to 142 genera and 58 families, which is 54.0% of the total number of non-native species found in the region.

In addition, about 50 species of adventitious plants more or less constantly accompany cultivated plants as weeds. The identified species are divided into two groups: one is represented by species that are or were cultivated and whose invasion occurred directly on the territory of Volyn Polissya (156 species); the second is represented by cultivated species that are introduced to the region from outside the region, being already invaded (32 species). The ratio between these two groups indicates that the transition of the vast majority of introductions to the category of adventive species occurs directly on the territory of Volyn Polissya.

A small group of hemierhasiophytes was separately identified, which is represented by feral introductions that cannot reproduce and naturalize independently in the conditions of Volyn Polissya (e.g., *Cucumis sativus L*., *Zea mays L*.). However, species of this group were constantly observed during floristic studies. The existence of these species outside of cultivated areas is possible only if their diasporas are constantly introduced. They are concentrated mainly in garbage dumps, landfills, abandoned places or near human settlements.

The study of urban flora of the cities of the eastern part of Small Polissia revealed that ergasiophytes are represented by only 65 species and account for more than 28% of its species composition with a quantitative predominance of annual herbaceous polycarpics. On the territory of Volyn Polissya, the species composition of ergasiophytes was more diverse.

The taxonomic analysis of the species of the study group recorded by us shows that the most numerous are the following families: *Asteraceae* (26 species or 13.8% of the total number of feral introductions), *Rosaceae* (25 species or 13.3%), *Fabaceae* (12 species or 6.4%), *Brassicaceae* (9 species or 4.8%), *Solanaceae* (7 species or 3.7%), *Poaceae* (6 species or 3.2%). Together, these families account for about 45% of the total species composition of the analyzed group. In comparison with the spectrum of the most numerous ergasiophyte families given for the adventive fraction of synanthropic flora by V. V. Protopopova for the plain forest areas, only the family *Asteraceae* is the same; at the same time, *Fabaceae* and, especially, *Rosaceae* occupy higher positions in the studied region, and *Brassicaceae* and *Poaceae* are somewhat lower. Among the genera, the most numerous were *Helianthus* (5 species), *Spiraea, Cerasus* (4 species each), *Pinus, Physalis*, *Amelanchier*, *Mentha, Rudbeckia, Populus* (3 species each). The vast majority of ergasiophyte genera are represented by a single species.

By the time of introduction, the feralized introductions are distributed as follows: 21 species (11.2%) are archaeophytes, 68 species (36.2%) are cenophytes, and 99 species (52.6%) are eukenophytes. The noticeable predominance of eukenophytes, which account for more than half of the total number of species in the analyzed group and about 67% of all eukenophytes of the adventitious fraction, indicates the intensification of adventitious processes in Volyn Polissya due to the feralization of cultivated plants. The most likely reasons for this phenomenon are a significant expansion of the species range of cultivated plants in the region in recent decades, especially flower and ornamental plants, an increase in the area of transformed ecotopes, and climate change towards aridization.

The spectrum of life forms identified according to I. G. Serebryakov's classification is dominated by herbaceous polycarpics (48 species) and annuals (63 species), which together account for more than 59%. Trees, shrubs, and bushes combine 71 species (37.7%). Among the biological types of plants identified according to the classification of K. Raunkier, therophytes (63 species) and phanerophytes (66 species) prevail, with hemicryptophytes and geophytes being somewhat less numerous.

Among the registered species, more than 50% are ephemerophytes (96 species), which form the basis of the unstable component of the adventive fraction of the region's flora. However, it should be noted that this group of non-native species is quite heterogene-

ous. Feralization, spreading around cultivated areas and naturalization of these species has only recently begun and their future behavior is still uncertain.

By the degree of naturalization among ergasiophytes, epecophytes significantly prevail (140 species or 74.5%). This is another confirmation of V. V. Protopopova's data that the largest number of ergasiophytes in the adventive fraction in Ukraine is localized in the florocomplexes of completely transformed ecotopes.

Agriophytes are represented by 17 species, and agrioepecophytes by 31 species. Although the latter two groups together account for approximately 25%, they pose a significant threat to the native flora, as their species are naturalized in natural and semi-natural ecotopes. The phenomena of such naturalization were observed for such species as *Impatiens parviflora*, *I. grandulifera*, *Amorpha fruticosa*, *Reynoutria japonica*, *Quercus rubra*, *Pinus banksiana*, *Sorbaria sorbifolia*, *Padus mahaleb*, *Cerasus vulgaris*, *Parthenocissus quinquefolia*, *Salix fragilis*, *Echinocystis lobata*, *Cannabis ruderalis*, *Vinca minor* in tree and tree-shrub communities, *Heracleum sosnowskyi*, *Althaea officinalis*, *Lupinus polyphyllus*, *Solidago canadensis*, *Rudbeckia laciniata* – in meadow and forest edge communities, *Oenothera biennis*, *Asclepias syriaca* – in grassy sand communities, *Zizania latifolia* – in coastal and water communities. Some of the above species show quite noticeable phytocoenotic activity, acting as dominants or co-dominants in some areas.

It should also be noted that a number of species that were originally bred as cultivars are currently in a state of expansion in Ukraine, including within Volyn Polissya, or are showing similar trends and have high invasive activity. Among them: *Impatiens parviflora*, *Acer negundo*, *Ambrosia artemisifolia*, *Echinocystis lobata*, *Amorpha fruticosa*, *Helianthus tuberosus*, *Heracleum sosnowskyi*, *Reynoutria japonica*, *Padus serotina* and some others. There are also isolated localities with high projection coverage of such non-native species as *Impatiens grandulifera*, *Grindelia squarrosa*, *Helianthus subcanescens*, *Populus laurifolia*.

Results. Thus, it can be concluded that the adventive flora in Volyn Polissya is largely formed with the participation of feral introductions, among which eukenophytes are significantly dominant. A significant part of the introduced species is already naturalized or shows clear tendencies to naturalize in natural and semi-natural communities, posing a potential danger to the native flora.

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