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RESEARCH ARTICLE

Phytocoenotic conditions of ornamental woody and shrub introducents in semi-natural communities of Chernihiv's green infrastructure

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Abstract

The research aims to perform a comparative phytocoenotic analysis of the growth conditions of ornamental woody and shrub introducents within four semi-natural communities of Chernihiv's green infrastructure (the Yalivshchyna, Sviate, Podusivka Forest, and Boldyn Hills tracts). The study evaluates the impact of environmental drivers, canopy closure, and understory structure on the naturalization success of alien plants, against the backdrop of the city's total introduced dendroflora, comprising 123 species, 2 subspecies, and 79 varieties across 33 families. Based on comprehensive architectural and adaptive criteria, the spontaneous exotic complex of 49 species recorded within the analyzed semi-natural communities was differentiated into three distinct functional-ornamental categories: shade-casting structural trees, visual and seasonal accent shrubs, and textural background, barrier, and screen plants. The work relies on field surveys conducted between 2023 and 2025, involving 58 geobotanical relevés on sampling plots of 225–625 m².

For the first time, a comprehensive analysis of Chernihiv's forest tracts was conducted at the syntaxonomic level, identifying the pathways of their anthropogenic and climatic transformation. A direct correlation was established between decreased canopy closure (down to 20–40 %, e.g., in the Yalivshchyna tract) and the intensity of naturalization of light-demanding invasive species (*Prunus serotina*, *Acer negundo*, and *Amelanchier spicata*). The role of nitrogen-fixing transformer species, primarily *Robinia pseudoacacia*, was proven to drive the replacement of native alliances (*Dicrano-Pinion*) with nitrophilous communities of the class *Robinieta* (alliance *Chelidonio-Robinion*). It was substantiated that current climate warming trends, characterized by climate aridization and milder winters, act as key drivers for both drought-tolerant and previously winter-susceptible introducents to bypass historical ecological barriers, accelerating their understory expansion and altering natural successional pathways. On the slopes of the Boldyn Hills tract, the structural encroachment of *Caragana arborescens* and *Parthenocissus quinquefolia* threatens rare, relict *Festuco-Brometea* communities, which have been reduced to an isolated patch of approximately 10 m².

The results demonstrate a profound syntaxonomic convergence between native forest (*Vaccinio-Piceetea* and *Quercetea pubescentis*) and shrub (*Rhamno-Prunetea*) classes and anthropogenically induced vegetation (*Robinieta* and *Galio-Urticetea*). Ornamental introducents form stable hybrid cultural phytocoenoses that gradually diminish the natural authenticity of forest massifs, culminating in the development of the 'urban forest' syndrome. While relict forest cores with complex vertical structures exhibit higher ecological resilience, sparse forest-park zones and highly fragmented steppe micro-refugia require urgent differentiated management strategies and targeted population regulation of invasive transformer species.

Keywords: introduced species, transformer plants, hybrid phytocoenoses, syntaxonomy, Braun-Blanquet approach, urban forests

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Introduction

In the modern era of rapid urbanization and global climate change, the role of green infrastructure (GI) in maintaining ecological stability and providing ecosystem services has become paramount (Jaskulski & Jaskulska, 2012; Rewald et al., 2020). However, urban and semi-natural ecosystems within GI are increasingly threatened by the spontaneous naturalization and subsequent invasion of non-native woody species (Burda & Koniakin, 2019). Introduced ornamental trees and shrubs, initially planted for aesthetic or utilitarian purposes, often escape cultivation, leading to profound changes in forest phytodiversity and ecosystem functioning (Vološčuk, 2012; Galkin & Doiko, 2015). In Ukraine, the process of naturalization and invasion of woody exotics has reached a critical scale, particularly under conditions of global warming (Nuzhyna et al., 2023).

Among the most aggressive invaders, *Robinia pseudoacacia* L. and *Acer negundo* L. stand out due to their high adaptive capacity and ability to act as ecosystem transformers (Dotsenko et al., 2021; Krasnoshtan & Krasnoshtan, 2025). Recent studies have highlighted how invasive tree species deconstruct natural regeneration patterns, altering species density and diversity in the understory (Dyderski & Jagodziński, 2020). Furthermore, the success of these exotics is often linked to their specific ecological strategies, which allow them to thrive in anthropogenically disturbed environments, such as fallows or transformed cultural phytocoenoses, where native species struggle (Kimeichuk & Kaidyk, 2022; Kotsun et al., 2023).

A crucial factor in the stabilization of invasive populations is the specific phytocoenotic environment. Research indicates that tree crown density significantly influences the dominant plant species of the herb-shrub stratum (Kovalenko et al., 2023). While the vitality and distribution of introduced woody plants have been monitored

in various urban agglomerations (Kornienko et al., 2025; Vyshenska & Lyshenska, 2025), a comprehensive comparative analysis of the phytocoenotic conditions facilitating the integration of ornamental exotics into semi-natural communities remains insufficiently explored. Specifically, the interplay between canopy closure and the syntaxonomic structure of urban forests in the Chernihiv Polissya region requires deeper investigation.

Chernihiv, located on the ancient terraces of the Desna River, represents a unique model for studying these processes due to its diverse GI, which includes relict pine stands and transformed landscapes (Lukash et al., 2024). Despite monitoring efforts in other regions, there is a lack of comparative data on how different types of semi-natural ecosystems respond to the pressure of ornamental introducers (Mikeladze et al., 2025).

The aim of this study is to perform a comparative phytocoenotic analysis of the growth conditions of ornamental woody introducers in four distinct semi-natural ecosystems of Chernihiv's GI. We focus on evaluating how canopy closure and herb layer coverage correlate with the syntaxonomic structure and invasive potential of introduced species to determine the stability of these transformed communities.

Material and methods

The study was conducted within the GI of Chernihiv (Chernihiv Polissya, Ukraine) during the growing seasons of 2023–2025. To evaluate the phytocoenotic conditions and the state of ornamental woody introducents, four distinct semi-natural locations were selected: the Yalivshchyna, Sviate, Podusivka Forest, and Boldyn Hills tracts. These sites represent a gradient of anthropogenic transformation, ranging from relict pine forests to memorial parks and former botanical garden areas.

The selection and evaluation of the monitored introduced dendroflora were

based on the inventory data by [Morskyi \(2026\)](#) with updates, filtering out the species established within the investigated semi-natural communities. To justify their analysis as representatives of ornamental plants, we adopted modern landscape forestry and horticultural criteria focusing on both structural and eco-physiological values in urban GI. In accordance with these approaches, the analyzed introducents were classified based on their primary botanical and ornamental status as long-lived perennials with persistent aboveground structures ([Bradley & Fair, 2022](#)), their structural role within spatial and architecture-driven urban vegetation layers ([Ossola et al., 2019](#)), and their functional performance under varying canopy shading intensities in urban green spaces ([Francini et al., 2023](#)). This framework allowed us to differentiate the target flora into distinct groups based on their habitus, seasonal visual dynamics, and adaptation within the phytocoenosis.

Data collection was based on comprehensive field surveys using standard geobotanical methods ([Yakubenko et al., 2018](#)). A total of 58 phytocoenotic relevés were performed during the peak of the vegetation period. The sampling plots ranged from 225 to 625 m², depending on the structural complexity and homogeneity of the vegetation. For each plot, the following parameters were recorded: vertical stratification (layers), species composition of each layer, and the vital status of introduced woody plants.

Special attention was paid to the quantitative characteristics of the phytocoenoses. Canopy closure (crown density) of the first and second arboreal layers was estimated as a percentage, reflecting the light regime under the forest canopy. The total projective cover of the herb-shrub layer (third layer) and the individual coverage of dominant species were also determined. The naturalization success and invasive strategies of ornamental exotics (competitive-stable, invasive-expansive, or local-ornamental) were assessed based on their presence in different strata and the availability of viable regeneration.

To specify the parameters of naturalization and invasive potential, we implemented a comprehensive scoring framework adapted from [Lukash et al. \(2024\)](#). This approach quantifies plant activity and environmental

resilience across multiple indicators, including the degree of annual shoot maturation, habitus preservation, shoot-forming capacity, generative development, vegetative and seed reproduction, and phenotypic plasticity. Additionally, resistance traits (drought, wind, pest, and soil compaction resistance), growth intensity, and edificatory capacity were evaluated. Each indicator was scored on a one-to-five-point scale, where five represents splendid/high performance, and one denotes poor/low performance [Lukash et al. \(2024\)](#).

The syntaxonomic affiliation of the analyzed communities was determined according to the Braun-Blanquet approach. Classification at the level of classes, orders, alliances, and associations, as well as the verification of their diagnostic, characteristic, and differential species, was performed using specialized syntaxonomic guides ([Matuszkiewicz, 2019](#)) and the national database reference standards ([Ukrainian Geobotanical Site, 2026a, 2026b, 2026c](#)). The nomenclature of all vascular plant taxa follows the World Flora Online database ([WFO, 2026](#)).

Results

The formation of the modern vegetation cover within Chernihiv's GI is a result of the long-term interaction between natural fluvial processes and intensive anthropogenic transformation dating back to the 17th century ([Bondar, 2014](#)). The studied forest tracts are predominantly localized on the ancient river terraces (sandy and loamy-sandy) of the Desna and Bilous rivers, characterized by sod-weakly podzolic soils. These edaphic conditions historically supported pine and mixed oak-pine forests, which still form the ecological core of the city's GI.

A key historical factor in the enrichment of the local dendroflora was the establishment of a botanical garden in the Yalivshchyna tract. This period initiated the mass introduction of exotic woody species from Western Europe, North America, and the Far East. Furthermore, the creation of memorial complexes (e.g., in the Podusivka Forest and Sviatopetr tracts) led to the intentional planting of ornamental trees and shrubs, which subsequently became the primary sources for spontaneous naturalization. That is, over time, the intensive

and historically prolonged presence of exotics has driven a deep phytocoenotic transformation, gradually dissolving the boundaries between natural forest refugia and deliberately designed urban greenery layouts.

Currently, the studied GI objects function under significant urban pressure, including recreational use and technogenic soil transformation. However, they serve as crucial hydrogeological zones; for instance, the Yalivshchyna tract provides approximately 30% of the city's water supply through artesian wells (Kravchenko et al., 2016). The convergence of forest elements with escaped ornamental exotics has created unique semi-natural phytocoenoses, where the natural succession is significantly influenced by invasive ecosystem transformers.

According to recent comprehensive assessments (Morskyi, 2026) and our revised data, the ornamental introduced dendroflora of Chernihiv's GI is represented by 123 species, 2 subspecies, and 79 varieties from 33 families. Based on the structural, visual-seasonal, and adaptation criteria derived from modern horticultural and landscape forestry frameworks (Ossola et al., 2019; Bradley & Fair, 2022; Francini et al., 2023), the analyzed complex of introduced woody and shrub plants, consisting of 49 species recorded within the semi-natural communities of Chernihiv, was differentiated into three distinct functional-ornamental categories:

1. Shade-casting structural trees, which establish the primary spatial framework, canopy, and sub-canopy layers due to their prominent habitus and long-lived aboveground structures (e.g., *Robinia pseudoacacia*, *Quercus rubra* L., *Acer negundo*, *A. saccharinum* L., *Larix decidua* (L.) Mill., *Pinus strobus* L., *P. banksiana* Lamb., *P. nigra* J.F. Arnold, *Fraxinus pennsylvanica* Marshall, *Aesculus hippocastanum* L., *Gleditsia triacanthos* L., *Ulmus pumila* L., *Populus deltoides* W. Bartram ex Marshall, *Juglans mandshurica* Maxim., *J. regia* L., *Phellodendron amurense* Rupr., *Catalpa bignonioides* Walter, *Cladrastis kentukea* (Dum. Cours.) Rudd, *Armeniaca vulgaris* L., and *Corylus colurna* L.).
2. Visual and seasonal accent shrubs (specimen plants), characterized by outstanding aesthetic attributes during

blooming or autumn transitions, operating effectively as standalone or group features within forest edges and ecotones (e.g., *Syringa vulgaris* L., *Philadelphus coronarius* L., *Cornus alba* L., *Forsythia intermedia* Zabel, *Chaenomeles japonica* (Thunb.) Lindl. ex Spach, *Rhus typhina* L., *Cotinus coggygria* Scop., *Amelanchier spicata* (Lam.) K. Koch, *Prunus serotina* Ehrh., *P. virginiana* L., *P. cerasifera* Ehrh., *P. maackii* Rupr., and *P. tomentosa* Thunb.).

3. Textural background, barrier, and screen plants, representing stress-tolerant species and adaptive lianas that form dense understory matrices, vegetative barriers, or vertical stratification within the phytocoenosis (e.g., *Thuja occidentalis* L., *Amorpha fruticosa* L., *Ligustrum vulgare* L., *Caragana arborescens* Lam., *Physocarpus opulifolius* (L.) Maxim., *Sorbaria sorbifolia* (L.) A. Braun, *Spiraea × vanhouttei* (Briot) Zabel, *S. japonica* L.f., *Juniperus sabina* L., *Berberis aquifolium* Pursh, *Lycium barbarum* L., *Parthenocissus quinquefolia* (L.) Planch., *Lonicera caprifolium* L., *L. tatarica* L., *Vitis amurensis* Rupr., and *Hedera helix* L.).

The Sviatye tract represents a unique relict massif of ancient forest ecosystems on the Desna River terrace. The phytocoenoses are characterized by a complex multi-layered structure with high site quality indices (I–II classes) of the main forest-forming species.

The first arboreal layer (height 30–36 m, canopy closure 30–50%) is dominated by *Pinus sylvestris* L. (aged 70–250 years, trunk diameter up to 90 cm). A distinctive feature is the successful integration of ornamental introducers into the upper canopy: *Quercus rubra*, which at the age of 50–100 years reaches a height of 32 m and a trunk diameter of 80 cm, as well as *Pinus banksiana* (up to 30% participation) and *Robinia pseudoacacia* (up to 20%). Other species in this layer include *Quercus robur*, *Betula pendula*, *Alnus glutinosa* (L.) Gaertn., *Populus tremula* L., and *Pyrus communis* L.

The second layer (height up to 5 m, canopy closure 10%) is characterized by the

active naturalization of *Prunus serotina* (10% coverage), which forms group plantings. Other introduced species recorded here are *Amelanchier spicata* and *Acer negundo*. The native component is represented by *Malus sylvestris* (L.) Mill., *Frangula alnus* Mill., and the regrowth of *Acer platanoides* L. *Prunus tomentosa* occurs along the forest edges.

The third layer (herb-shrub stratum, height up to 1 m) has a high total projective cover of 80%. Dominance is held by grasses: *Elymus repens* (L.) Gould (up to 60%), *Calamagrostis epigejos* (L.) Roth (up to 20%), and *Poa pratensis* L. (10%). The presence of psammophytes, such as *Koeleria glauca* (Spreng.) DC. and *Pilosella officinarum* F.W.Schultz & Sch.Bip., alongside nitrophils like *Chelidonium majus* L. (10%) and the invasive *Solidago canadensis* L., reflects the convergence of relict and anthropogenically transformed elements. Viable regeneration of *Quercus rubra* (2%) was recorded, indicating its high adaptive potential within the tract.

The Yalivshchyna tract is a core part of the Yalivshchyna Regional Landscape Park, which serves as a vital component of Chernihiv's GI. The contemporary vegetation of the park has been shaped through a combination of natural processes and artificial interventions, notably the functioning of a botanical garden between 1946 and 1963 (Karpenko & Pototska, 2012).

The first arboreal layer (height up to 28 m, canopy closure 20–40%) is dominated by mature stands of *Pinus sylvestris* of the first site quality class. These stands often include an admixture of *Robinia pseudoacacia*, *Acer platanoides*, and *Tilia cordata* Mill. On specific plots, *Quercus rubra* shows dominance and presence across all strata, reaching up to 60% participation.

The second layer is characterized by a high degree of naturalization of ornamental exotics. The leading role is played by *Prunus serotina* (up to 40%), accompanied by *Amelanchier spicata* (up to 20%), *Acer negundo* (10–15%), and *Sambucus racemosa* L. (up to 10%). The native component in this stratum is represented by *Frangula alnus* (up to 5%).

The third layer (herbaceous-dwarf shrub stratum, with a total projective cover of 55–70%) exhibits a high degree of synanthropization, particularly under the canopy of *Pinus sylvestris* and *Betula pendula*. The dominant matrix of the herbage is formed

by the light-loving and ruderalized grasses *Agrostis capillaris* L. (15%) and *Elymus repens* (up to 15%), indicating noticeable pastured or recreational disturbance. Concurrently, this stratum preserves a resilient diagnostic core of native boreal forest flora typical of the class *Vaccinio-Piceetea* Br.-Bl. in Br.-Bl. et al. 1939 and the alliance *Dicrano-Pinion* (Libbert 1933) W. Matuszkiewicz 1962. This acidophilous component is represented by scattered individuals and micro-groups of *Solidago virgaurea* L., *Melampyrum pratense* L., *Luzula pilosa* (L.) Willd., *Pteridium aquilinum* (L.) Kuhn, *Maianthemum bifolium* (L.) F.W.Schmidt, *Hieracium umbellatum* L., and *Hypochaeris radicata* L. The transition towards sub-mesophytic sandy pine-oak communities is further emphasized by the presence of *Convallaria majalis* L. and *Polygonatum odoratum* (Mill.) Druce. Notably, the ground layer fragments are additionally reinforced by the local development of small, distinct cushions of typical forest bryophytes, namely *Pleurozium schreberi* (Brid.) Mitt. and *Dicranum polysetum* Sw.

In deep ravines and shaded slopes characterized by the *Querco-Pinetum* var. *coryletosum* J. Matuszkiewicz 1988 association, the phytocoenoses exhibit a high conservation value and a well-defined structural complexity. This syntaxon is characterized by a dense understory dominated by *Corylus avellana* L., alongside *Rubus idaeus* L., which creates a shaded, humid microclimate. The stable co-dominance of old-growth *Pinus sylvestris* and *Quercus robur* in the overstory, accompanied by *Acer platanoides*, confirms the rich mixed forest nature of these habitats. The ground layer is distinctly formed by a characteristic core of diagnostic and differential herbs, including *Pteridium aquilinum*, *Calamagrostis arundinacea* (L.) Roth, *Moehringia trinervia* (L.) Clairv., *Polygonatum multiflorum* (L.) All., and *Viola reichenbachiana* Jordan ex Bor. Within these structurally optimal microhabitats, rare regional sciophilous ferns, such as *Dryopteris dilatata* (Hoffm.) A.Gray, *Polystichum aculeatum* (L.) Roth, and *Gymnocarpium dryopteris* (L.) Newman, occur locally. Furthermore, these micro-climatically stable environments support small populations of strictly protected orchids listed in the Red Book of Ukraine, namely *Epipactis helleborine* (L.) Crantz and *Platanthera bifolia* (L.) Rich.

Based on the floristic data provided by Karpenko et al. (2023), we identified and analyzed 72 species of introduced trees and shrubs belonging to 26 families within the GI of the Yalivshchyna Regional Landscape Park. The complete taxonomic composition and formal nomenclature with species authorities are systematically compiled in Table 1.

In terms of taxonomic diversity, Rosaceae is the dominant family with 21 species (28.8% of the total introduced dendroflora), followed by Fabaceae with six species (8.2%), while families such as Oleaceae, Sapindaceae, and Pinaceae are represented by four species each (Table 1).

Crucially, the semi-natural phytocoenoses of Yalivshchyna feature successfully naturalized populations of *Robinia pseudoacacia*, *Quercus rubra*, *Amelanchier spicata*, *Prunus serotina*, *P. virginiana*, *P. cerasifera*, *Caragana arborescens*, *Amorpha fruticosa*, *Lonicera caprifolium*, and *Parthenocissus quinquefolia*. Concurrently, since the existence of the former botanical garden, species such as *Thuja occidentalis*, *Larix decidua*, *Pinus strobus*, *P. nigra*, *Catalpa bignonioides*, *Cladrastis kentukea*, *Prunus maackii*, and *Corylus colurna*, as well as *Acer saccharinum*, *Fraxinus pennsylvanica*, *Aesculus hippocastanum*, *Chaenomeles japonica*, *Physocarpus opulifolius*, *Sorbaria sorbifolia*, *Ptelea trifoliata*, *Rhus typhina*, *Forsythia intermedia*, *Spiraea × vanhouttei*, *S. japonica*, *Ligustrum vulgare*, *Berberis aquifolium*, *Lycium barbarum*, *Juglans mandshurica*, *J. regia*, *Phellodendron amurense*, *Vitis amurensis*, and *Hedera helix* have successfully grown as components of these forest phytocoenoses, while strictly maintaining their localized distribution.

However, the presence of *Acer negundo* and *Robinia pseudoacacia* in these semi-natural communities represents a major ecological challenge. These alien species function as aggressive transformers that rapidly expand into disturbed habitats, successfully outcompeting native woody flora and significantly modifying local phytocoenotic conditions (Fig. 1).

The Podusivka Forest tract is located on the left-bank terrace above the floodplain of the Bilous River. The phytocoenoses in the northern part of the tract are localized within a memorial complex zone, where the sod-weakly podzolic soils show signs of

technogenic transformation and recreational pressure.

The first arboreal layer (height up to 22 m, canopy closure up to 65%) is characterized by a clearly defined structure. The forest core is formed by native species: *Betula pendula* (30%) and *Acer platanoides* (10%). The group of ornamental introducers in the upper canopy is represented by the coniferous exotic *Pinus strobus* (5%), alongside *Populus deltoides* (3%) and *Robinia pseudoacacia* (2–10%). The presence of the liana *Humulus lupulus* L. is recorded in this stratum.

The second layer (height up to 5 m, canopy closure up to 45%) is distinguished by a high diversity of ornamental and invasive introducers. *Robinia pseudoacacia* (20%) plays a dominant role, actively shaping the community structure and showing successful natural regeneration. Other participants include the invasive *Acer negundo* (1–5%) and the fruit-bearing introducer *Juglans regia* (1%). Single specimens of *Prunus cerasifera*, *Amelanchier spicata*, and *Elaeagnus angustifolia* L. occur. The ornamental shrub component is represented by *Syringa vulgaris*, *Ligustrum vulgare*, and the coniferous shrub *Juniperus sabina*. The native flora is sparsely represented by *Acer platanoides* (1%) and *Salix × fragilis* L.

The third layer (herb-shrub stratum, height up to 1 m, total projective cover up to 50%) is dominated by the grass *Dactylis glomerata* L. (up to 50%). Significant coverage is formed by the nitrophilous *Chelidonium majus* (up to 30%), indicating soil nitrogen enrichment. Other herbaceous species include *Carex hirta* L. (7%), *Elymus repens* (5%), *Poa pratensis* (5%), *Berteroa incana* (L.) DC., *Taraxacum officinale* F.H.Wigg., *Achillea millefolium* L., *Erigeron canadensis* L., *Cicerbita muralis* (L.) Wallr., *Anthriscus sylvestris* (L.) Hoffm., and *Rumex acetosa* L.

The Boldyn Hills tract, including the Malii Ravine tract, represents one of the most ecologically complex segments of Chernihiv's GI. Its high scientific value is underpinned by the nature monument "Group of Centuries-Old Oaks", comprising approximately 40 specimens of *Quercus robur* aged 300–400 years. The site serves as a unique forest-steppe refugium within the Polissya region, evidenced by the presence of the steppe relict *Stipa capillata* L. (listed in the Red

Table 1. Taxonomic composition of introduced woody and shrub plants in the green infrastructure of Yalivshchyna Regional Landscape Park.

Family	Number of species	Introduced species
Rosaceae	20	<i>Amelanchier spicata</i> , <i>Aronia melanocarpa</i> (Michx.) Elliott, <i>Armeniaca vulgaris</i> , <i>Cotoneaster acutifolius</i> Turcz., <i>Cotoneaster horizontalis</i> Decne., <i>Cotoneaster lucidus</i> Schltdl., <i>Chaenomeles japonica</i> , <i>Malus domestica</i> Borkh., <i>Malus baccata</i> (L.) Borkh., <i>Physocarpus opulifolius</i> , <i>Prunus cerasifera</i> , <i>P. serotina</i> , <i>P. tomentosa</i> , <i>P. maackii</i> , <i>P. virginiana</i> , <i>Rosa rugosa</i> Thunb., <i>Sorbaria sorbifolia</i> , <i>Spiraea japonica</i> , <i>Spiraea media</i> Schmidt, <i>Spiraea salicifolia</i> L.
Fabaceae	6	<i>Amorpha fruticosa</i> , <i>Caragana arborescens</i> , <i>Cladrastis kentukea</i> , <i>Gleditsia triacanthos</i> , <i>Robinia pseudoacacia</i> , <i>Robinia viscosa</i> Vent.
Pinaceae	4	<i>Larix decidua</i> , <i>Picea pungens</i> Engelm., <i>Pinus nigra</i> , <i>Pinus strobus</i>
Oleaceae	4	<i>Forsythia intermedia</i> , <i>Fraxinus pennsylvanica</i> , <i>Syringa josikaea</i> J.Jacq. ex Rchb., <i>S. vulgaris</i>
Sapindaceae	4	<i>Acer negundo</i> , <i>A. pseudoplatanus</i> L., <i>A. saccharinum</i> , <i>Aesculus hippocastanum</i>
Cupressaceae	3	<i>Juniperus sabina</i> , <i>J. virginiana</i> L., <i>Thuja occidentalis</i>
Caprifoliaceae	3	<i>Lonicera caprifolium</i> , <i>L. tatarica</i> , <i>Symphoricarpos albus</i> (L.) S.F.Blake
Juglandaceae	3	<i>Juglans cinerea</i> L., <i>J. mandshurica</i> , <i>J. regia</i>
Anacardiaceae	2	<i>Cotinus coggygria</i> , <i>Rhus typhina</i>
Berberidaceae	2	<i>Berberis thunbergii</i> DC., <i>Berberis aquifolium</i>
Fagaceae	2	<i>Fagus sylvatica</i> L., <i>Quercus rubra</i>
Rutaceae	2	<i>Phellodendron amurense</i> , <i>Ptelea trifoliata</i> L.
Salicaceae	2	<i>Populus balsamifera</i> L., <i>P. nigra</i> var. <i>italica</i> Münchh.
Vitaceae	2	<i>Parthenocissus quinquefolia</i> , <i>Vitis amurensis</i>
Araliaceae	1	<i>Aralia elata</i> (Miq.) Seem., <i>Hedera helix</i>
Betulaceae	1	<i>Corylus colurna</i>
Bignoniaceae	1	<i>Catalpa bignonioides</i>
Cornaceae	1	<i>Cornus alba</i>
Elaeagnaceae	1	<i>Elaeagnus angustifolia</i> L.
Grossulariaceae	1	<i>Ribes aureum</i> Pursh
Hydrangeaceae	1	<i>Philadelphus coronarius</i>
Malvaceae	1	<i>Tilia americana</i> L.
Moraceae	1	<i>Morus alba</i> L.
Phyllanthaceae	1	<i>Flueggea suffruticosa</i> (Pall.) Baill.
Solanaceae	1	<i>Lycium barbarum</i>
Ulmaceae	1	<i>Ulmus pumila</i>

Book of Ukraine) and an isolated locality of *Prunus mahaleb* L., marking its northernmost distribution limit (Fig. 2).

The first arboreal layer (height 22–28 m, canopy closure 40–60%) is dominated by *Quercus robur* and *Acer platanoides*. However, *Robinia pseudoacacia* acts as a co-dominant in many sections, showing exceptional vitality

on south-facing eroded slopes. The upper canopy also includes *Pinus sylvestris*, *Fraxinus excelsior* L., and *Ulmus laevis* Pall., with occasional occurrences of *Populus tremula* and *Betula pendula*. Notably, the spatial and vertical architecture of this stratum is significantly altered on the slopes by the widespread expansion of the woody liana *Parthenocissus*



Figure 1. Transformed forest phytocoenosis in the Yalivshchyna tract: aggressive expansion of invasive alien species (*Robinia pseudoacacia* and *Acer negundo*) into the forest phytocoenosis.

quinquefolia, which actively climbs and blankets the tree trunks while simultaneously invading the ground cover.

On the slope of the Malii Ravine located on the opposite side of the railway line, the analyzed phytocoenosis is structurally defined by an artificial forest belt composed of coeval *Ulmus pumila* trees characterized by uniform age and height parameters. However, in stark contrast to the typical linear structure of the forest belt, on the actual erodible slope of the ravine, *Ulmus pumila* acts as a distinct co-dominant alongside *Robinia pseudoacacia*. The understory canopy created by this aggressive introduced pair heavily shades the ground, resulting in a floristically impoverished herbaceous layer. The ground cover within this section is overwhelmingly dominated by the nitrophilous, shade-tolerant annual weed species *Galium aparine* L. *Aesculus hippocastanum* frequently occurs in the understory and herb layers. On non-forested

slope sections located near the railway, *Lycium barbarum* actively expands its presence.

The second layer (shrub and understory stratum, height 3–7 m, canopy closure 35–45%) is distinguished by an extraordinary diversity of both native diagnostic components and naturalized ornamental or fruit-bearing exotics. Extensive thickets are formed by introduced taxa, including *Syringa vulgaris*, *Philadelphus coronarius*, *Caragana arborescens*, *Lonicera tatarica*, and *Symphoricarpos albus*. The naturalization of fruit-bearing species is highly pronounced, with *Armeniaca vulgaris*, *Cerasus avium* (L.) Moench, *Prunus divaricata* Ledeb., and *P. spinosa* L. actively regenerating. However, this stratum concurrently maintains a resilient framework of native calciphilous and thermophilous shrubs. Crucially, we recorded the stable presence of *Prunus mahaleb*, which develops alongside *P. spinosa*, *Euonymus europaeus* L., *E. verrucosus* Scop., *Cornus sanguinea* L., and *Crataegus fallacina* Klokov.

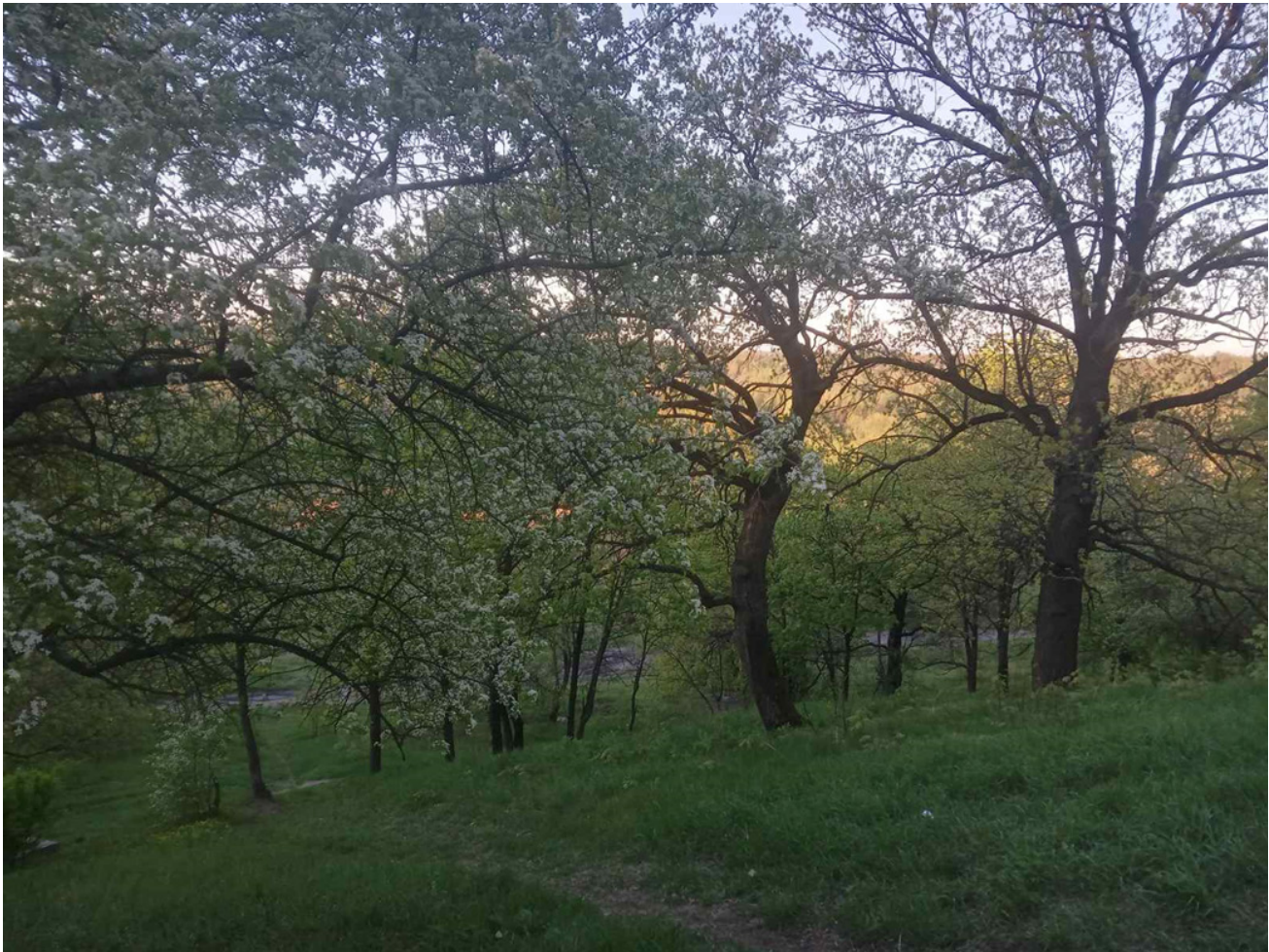


Figure 2. Thermophilic community on the southern slope of the Boldyn Hills tract: blooming shrubs of *Prunus mahaleb* occurring throughout the phytocoenosis against the background of aged *Quercus robur* trees.

The ground herb layer (projection cover 50–70%) demonstrates a sharp ecological shift towards xerophilous and heliophilous species, actively outcompeting typical sciophilous nemoral forest herbs. The native herbaceous core is represented by *Stachys recta* L., *Clinopodium vulgare* L., *Trifolium alpestre* L., and *Carex praecox* Schreb. On highly eroded, south- and southwest-exposed slopes, the intensive infiltration of true steppe and petrophytic elements is observed, highlighted by the occurrence of *Stipa capillata*, *Euphorbia cyparissias* L., *Allium oleraceum* L., alongside spring annuals such as *Veronica verna* L., *Myosotis ramosissima* Rochel, and *M. arvensis* (L.) Hill. The xerothermic character of the slopes is also maintained by *Campanula bononiensis* L., and *Vincetoxicum officinale* Moench.

Concurrently, severe recreational pressure has accelerated the ruderalization and synanthropization of the ground layer. This

trend is confirmed by the high abundance of nitrophilous and ruderal species. The dominant complex is formed by *Chelidonium majus*, *Glechoma hederacea* L., and *Ballota nigra* L., indicating long-term anthropogenic pressure and nitrogen-enriched soils. In shaded areas, *Urtica dioica* L., *Geum urbanum* L., and *Impatiens parviflora* DC. reach significant coverage. Synanthropic elements such as *Arctium lappa* L., *Leonurus cardiaca* L., and *Stellaria media* (L.) Vill. are frequent, reflecting the 'urban forest' status of the tract.

Discussion

The analysis of the syntaxonomic structure of the studied tracts reveals a complex convergence between natural forest ecosystems and anthropogenically induced communities. While it is challenging to identify specific associations due to high disturbance

levels, the diagnostic species composition at the level of alliances and classes, according to the European vegetation classification system (Mucina et al., 2016), clearly indicates the phytocoenotic preferences of woody introducers.

In the Sviate and Yalivshchyna tracts, the primary forest matrix retains distinct refucial features of the class *Vaccinio-Piceetea* (specifically the alliance *Dicrano-Pinion* (Libbert 1933) W. Matuszkiewicz 1962). While open sandy areas support typical psammophytes like *Koeleria glauca* and *Pilosella officinarum*, the autochthonous nature of these pine forests is convincingly confirmed by a resilient core of acidophilous boreal herbs, ferns, and bryophytes. The stable persistence of *Solidago virgaurea*, *Melampyrum pratense*, *Luzula pilosa*, *Pteridium aquilinum*, and supplemented by characteristic diagnostic ferns of the *Vaccinio-Piceetea* class, such as *Maianthemum bifolium*, *Athyrium filix-femina* (L.) Roth, *Dryopteris carthusiana* (Vill.) H.P.Fuchs, and *Gymnocarpium dryopteris*, underscores the high ecological authenticity of the stands. Together with local cushions of *Pleurozium schreberi* and *Dicranum polysetum*, this complex aligns with the national syntaxonomic standards for Ukrainian forest vegetation (Ukrainian Geobotanical Site, 2026c), indicating that these urban woodlands successfully function as core fragments of regional phytodiversity (Andriienko, 2006). Moreover, in more humid ravines, this matrix transitions into the *Quercus-Pinetum* var. *coryletosum* association, marked by sub-mesophytic indicators such as *Convallaria majalis* and *Polygonatum odoratum*.

Moreover, in more humid ravines and steep slopes, this boreal forest matrix naturally transitions into the *Quercus-Pinetum* var. *coryletosum* association. The floristic composition of these mixed pine-oak stands is strongly characterized by the persistent presence of essential differential species of the *Quercus-Pinetum* (W. Matuszkiewicz 1981) J. Matuszkiewicz 1988 association, most notably *Calamagrostis arundinacea*, *Pteridium aquilinum*, and *Pinus sylvestris*. Concurrently, the specific sub-mesophytic variant var. *coryletosum* is clearly distinguished by a well-developed understory of *Corylus avellana* and the typical herb-layer indicator *Melica nutans* L. The presence of this entire

diagnostic complex fully correlates with the regional descriptions of subcontinental pine-oak forests established for the Ukrainian Polissya (Andriienko, 2006). This syntaxonomic linkage is further emphasized by the stable development of accompanying sub-mesophytic indicators such as *Convallaria majalis* and *Polygonatum odoratum*, which thrives under the shaded microclimatic conditions provided by the dense hazel canopy.

However, these communities face profound structural shifts due to intense synanthropization. The intensive naturalization of the invasive alien trees *Prunus serotina* and *Quercus rubra* triggers a successional transition. Within this urban ecotone, these exotics act as aggressive 'shuttle' species, actively capturing vacant ecological niches between the declining light-demanding pine stands and emerging mesophytic broad-leaved elements.

The most profound transformation is observed in the Podusivka Forest and parts of the Yalivshchyna and Malii Ravine tracts, which gravitate toward the class *Robinietaea Jurko ex Hadač et Sofron 1980* (alliance *Chelidonio-Robinion* Hadač et Sofron 1980). The constant presence of *Robinia pseudoacacia* as a dominant in the second layer, coupled with high coverage of the diagnostic species *Chelidonium majus*, marks these sites as classic anthropogenic urban forests. Here, the nitrogen-fixing capacity of black locust facilitates a shift from the native *Dicrano-Pinion* toward nitrophilous communities, effectively 'locking' the succession in a ruderalized state typical of anthropogenically altered landscapes.

The structural and floristic analysis of the Boldyn Hills tract reveals a highly atypical, multi-component syntaxonomic architecture that deviates substantially from the classic mesophytic broad-leaved forests of the alliance *Carpinion betuli* Issler 1931 common to the region (Andriienko, 2006; Solomakha, 2008). The almost complete absence of sciophilous nemoral herbs, coupled with the dominance of heliophilous, xerothermic, and calciphilous species, points to a powerful genetic and ecological link with the subcontinental thermophilous oak forests of the class *Quercetea pubescentis* Doing-Kraft ex Scamoni et Passarge 1959. This specific phytocoenotic pattern strongly aligns with the

distribution and composition of xerothermic oak communities described across Central-Eastern Ukraine (Goncharenko & Kovalenko, 2019). According to national standards, this affinity is confirmed by the presence of core diagnostic taxa of the class, most notably *Acer tataricum* L., *Prunus mahaleb*, and *Vincetoxicum hirundinaria* Medik. (Ukrainian Geobotanical Site, 2026b).

Furthermore, the unique microclimatic and edaphic conditions of the south-facing river-terrace slopes support a resilient complex of diagnostic elements representing the specific forest-steppe alliance *Aceri tatarici-Quercion* Zólyomi 1957 (Didukh, 2019; Ukrainian Geobotanical Site, 2026a). The native structural framework of this alliance includes *Quercus robur*, *Acer campestre* L., *Euonymus verrucosus*, *Poa nemoralis* L., *Dactylis glomerata*, and *Geum urbanum*, alongside open-edge thermophytes like *Stachys recta*, *Clinopodium vulgare*, and *Salvia pratensis* L. Critically, the close taxonomic ally *Crataegus fallacina* successfully replaces the typical *Crataegus monogyna* Jacq. within this regional variant. This pre-existing thermophilous microenvironment has facilitated the successful secondary integration and naturalization of decorative xerophytic exotics. Specifically, *Cotinus coggygria* and *Ligustrum vulgare* have deeply adapted to the steep slopes, combining with the native framework to form stable, anthropogenically modified components of the *Aceri tatarici-Quercion* communities.

Within this framework, the presence of *Prunus mahaleb*, acting as a key diagnostic species of the *Quercetea pubescentis* class (Ukrainian Geobotanical Site, 2026b), serves as a decisive regional indicator that signals the relict, forest-steppe nature of these communities developed on well-drained, highly insolated river-terrace slopes. The ongoing phytocoenotic dynamics of the tract, heavily influenced by this thermophilous microenvironment, are governed by two parallel vectors: steppisation and synanthropization.

Steppisation is visibly manifested through the edge-effect and microclimatic conditions of the steep slopes, which facilitate the stable integration of steppe elements belonging to the class *Festuco-Brometea* Br.-Bl. et Tx. ex Soó 1947 (e.g., *Stipa capillata* and *Carex praecox*). Crucially, these relic

steppe communities have been reduced to a critically fragmented, small isolated patch covering an area of approximately 10 m². The spatial extent of this micro-refugium is continuously shrinking on an annual basis due to the aggressive expansion of the invasive alien trees (*Robinia pseudoacacia* and *Acer negundo*) and the dense encroachment of the introduced shrub *Caragana arborescens* (Fig. 3). This shrub component was historically introduced as a bioengineering tool designed for slope stabilization and erosion control (Gholami et al., 2017) within the fragile network of the Malii Ravine system of the Boldyn Hills. Consequently, synanthropization within Chernihiv's GI is directly driven by intense urbanization, where the long-term phytocoenotic consequences of historical ornamental and soil-protective plantings actively suppress the native herbaceous authenticity. The structural core of the *Rhamno-Prunetea* Rivas Goday et Borja 1961 shrub communities, originally outlined by *Prunus spinosa* and *Crataegus fallacina*, has been significantly modified by the expansion of aggressive introduced exotics (*Syringa vulgaris* and *Philadelphus coronarius*) and the proliferation of nitrophilous weeds like *Impatiens parviflora*. Furthermore, the structural degradation of these shrub ecotones is accelerated by the extensive spread of the woody liana *Parthenocissus quinquefolia*, which blankets both the ground cover and the woody understory.

The xerothermic slopes are being actively suppressed by the invasive expansion of *Robinia pseudoacacia* and *Acer negundo*, which catalyze a transition toward ruderalized forest communities of the class *Robinietea*. Locally, in shaded and disturbed ravines with high organic accumulation, nitrophilous elements of the fringe class *Galio-Urticetea* Passarge ex Kopecký 1969 are also prominent.

Ultimately, the modern phytocoenoses of Boldyn Hills function as highly transformed ecotones where the pristine diagnostic framework of the *Quercetea pubescentis* class is actively adjusting to continuous ruderalization, severe alien invasions, and heavy recreational loads.

Thus, decorative introducers in Chernihiv's GI act as catalysts for syntaxonomic convergence. They facilitate the replacement of specialized forest alliances (*Dicrano-*



Figure 3. Degradation of the relict steppe micro-refugium on the slopes of the Malii Ravine (Boldyn Hills): active encroachment and displacement of the native *Stipa capillata* community by the invasive tree *Robinia pseudoacacia* and the introduced soil-protective shrub *Caragana arborescens*.

Pinion and *Carpinion betuli*) with eurytopic anthropogenic classes (*Robinieta* and *Galio-Urticetea*), leading to the formation of hybrid 'cultural phytocoenoses' where the boundaries between natural and artificial vegetation are significantly blurred.

The integration of ornamental introducers into Chernihiv's GI follows patterns observed across European urban landscapes, where anthropogenic vegetation classes increasingly overlap with natural forest remnants. According to the hierarchical classification by [Mucina et al. \(2016\)](#), the expansion of the class *Robinieta* represents a significant shift in successional trajectories. Our findings in Podusivka Forest and "Yalivshchyna" confirm that *Robinia pseudoacacia* acts as a potent ecosystem transformer, facilitating a transition from the native *Dicrano-Pinion* (Libbert 1933) W. Matuszkiewicz 1962 toward nitrophilous ruderalized communities. This

aligns with observations by [Dotsenko et al. \(2021\)](#) and [Krasnoshtan & Krasnoshtan \(2025\)](#), who emphasize the role of black locust in altering soil chemistry and suppressing native regeneration.

A key factor determining the stability of these semi-natural ecosystems is canopy closure. Our data show a clear correlation between lower crown density (20–40 % in Yalivshchyna tract) and the higher naturalization success of sun-loving exotics like *Prunus serotina* and *Acer negundo*. This 'canopy-opening' effect, also noted by [Kovalenko et al. \(2023\)](#) and [Dyderski & Jagodziński \(2020\)](#), creates light gaps that favor invasive species over shade-tolerant native seedlings. In contrast, the relict stands in the Sviatohrovska grove demonstrate higher resistance due to their complex vertical structure, where *Quercus rubra* and *Pinus banksiana* have reached a state of competitive equilibrium with the native canopy.

The case of Boldyn Hills highlights a unique syntaxonomic convergence where the presence of the class Rhamno-Prunetea (ornamental shrubs) and relicts of Festuco-Brometea are under pressure from ruderalization. The dominance of *Chelidonium majus* (alliance Chelidonio-Robinion) in the herb layer of all studied sites serves as a diagnostic marker of ‘urban forest’ syndrome, a phenomenon documented in other Ukrainian cities like Kyiv (Vyshenska & Lyshenska, 2025) and Vinnytsia (Krasnoshtan & Krasnoshtan, 2025).

To integrate the documented successional trends, we developed a generalizing conceptual scheme of the syntaxonomic transformation driven by ornamental and protective woody introducents within Chernihiv’s GI (Fig. 4).

The primary objects of transformational impact are two key groups of natural phytocoenoses within the city’s GI: coniferous forests of the class Vaccinio-Piceetea (specifically, the alliances Dicrano-Pinion and the association Querco-Pinetum) as well as thermophilous forest, shrub, and dry grassland communities of the classes Quercetea pubescentis, Festuco-Brometea, and Rhamno-Prunetea.

Driven by the synergistic effect of environmental factors and the establishment of adventive species, these communities undergo differentiated successional processes. Under the combined pressure of ubiquitous transformers (*Acer negundo* and *Robinia pseudoacacia*) and habitat-specific transformers (*Quercus rubra* and *Prunus serotina*), the class Vaccinio-Piceetea shifts into derivative communities (*Pinus sylvestris*–*Robinia pseudoacacia*, *Pinus sylvestris*–*Prunus serotina*, and *Pinus sylvestris*–*Quercus rubra*). These newly formed communities ecologically merge the diagnostic species sets of the classes Vaccinio-Piceetea, Robinietea, and Galio-Urticetea.

Simultaneously, the thermophilous classes (*Quercetea pubescentis* etc.), driven by the expansion of *Caragana arborescens*, *Acer negundo*, and *Robinia pseudoacacia*, transform into the derivative communities *Quercus robur*–*Robinia pseudoacacia* and *Quercus robur*–*Acer negundo*.

In the long-term successional perspective, both transformational pathways exhibit a clear syntaxonomic convergence, leading to

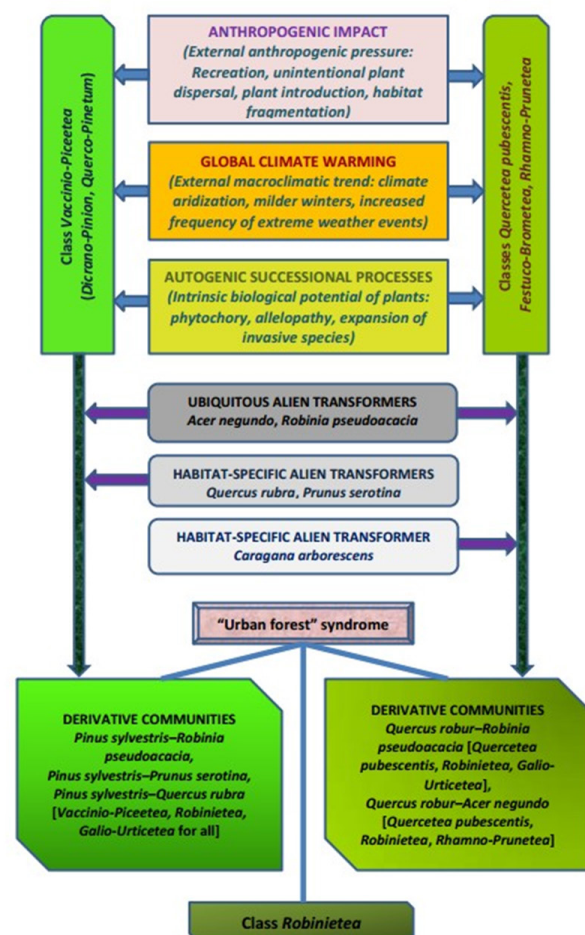


Figure 4. Conceptual framework of syntaxonomic transformation of urbanized phytocoenoses within the green infrastructure of Chernihiv under the influence of environmental factors and alien plant transformers.

a complete transition into the ruderal woody class Robinietea. The aggregation of these partially or completely degraded, forest-like urban ecosystems constitutes a unified ecological phenomenon described as the ‘urban forest’ syndrome, which marks the final stage of digression within the GI.

The ongoing trend of global climate warming significantly acts as a catalyst for the successful naturalization of ornamental woody species in the urban environment of Chernihiv. According to Nuzhyna et al. (2023), the shift toward a more temperate-continental climate with milder winters and prolonged vegetation periods creates favorable thermal conditions for many thermophilous exotics that were previously limited by severe frost events. Climate change not only increases the survival rate of established individuals but also enhances the reproductive success

of invasive transformers like *Robinia pseudoacacia* and *Acer negundo* (increasingly appearing in urban ruderal sites). As noted by Dotsenko et al. (2021) and Kornienko et al. (2025), changes in precipitation patterns and temperature regimes can destabilize native forest communities (Dicrano-Pinion), making them more susceptible to colonization by drought-tolerant exotics like *Elaeagnus angustifolia* and *Morus alba* L. In Chernihiv's GI, this 'climatic facilitation' accelerates the transition of decorative introducents from localized garden plantings to dominant components of anthropogenically-derived 'urban forests'.

The expansive growth of the introduced alien trees *Quercus rubra* and *Prunus serotina* within the analyzed tracts represents a significant phase of their secondary ecological expansion. Originally planted as forest-culture or ornamental components of urban GI, these species now exhibit aggressive invasive behavior, presenting a verified threat to natural protected ecosystems across Ukraine (Protopopova & Shevera, 2019). Fueled by highly effective zoochorous seed dispersal, rapid juvenile growth, and high resilience to local microclimatic shifts, they successfully colonize ecotones and semi-natural forest edges. This ongoing expansion allows them to actively outcompete native understory flora, suppress the natural regeneration of autochthonous trees, and significantly alter both the productivity and light regimes of the invaded forest communities (Dyderski & Jagodziński, 2021).

The successful naturalization of *Rhus typhina* and *Ptelea trifoliata* further reflects the shifting ecological strategies of ornamental plants toward invasive expansion (Lukash et al., 2024). Additionally, species such as *Juglans mandshurica* and *Phellodendron amurense* show stable regeneration under the canopy of semi-natural forests, benefiting from the reduced frequency of late spring frosts.

Thus, our study confirms that decorative introducents in Chernihiv's GI do not merely exist as individual exotics but form stable, anthropogenically-derived phytocoenoses. These 'hybrid' systems, while maintaining some biodiversity value (e.g., relict localities on Boldyn Hills), are progressively losing their natural authenticity, moving toward the stage

of cultural phytocoenoses as defined by Burda & Koniakin (2019).

Importantly, the aggressive behavior of Chernihiv's semi-natural introduced dendroflora aligns with the established botanical consensus regarding phytoremedial risks in Ukraine. According to the foundational framework by Protopopova & Shevera (2019), seven of the spontaneous exotic species recorded within our study areas – *Acer negundo*, *Robinia pseudoacacia*, *Quercus rubra*, *Gleditsia triacanthos*, *Fraxinus pennsylvanica*, *Ulmus pumila*, and *Prunus serotina* – belong to the high-risk group of highly active invasive plants. These taxa are classified as destructive – transformer species capable of altering vertical stratification, disrupting native community structures, and driving extensive synanthropization (Protopopova & Shevera, 2019). The environmental threat of these particular trees is so acute that they were recently included in the governmental draft initiatives and regional forestry registers aimed at banning their further use for afforestation and shelterbelt establishment.

Although corresponding legislative restriction lists in Ukraine have faced regulatory and administrative adjustments, our empirical field data reveal a highly differentiated pattern of invasive activity among these seven transformers within Chernihiv's GI. A truly aggressive and widespread expansion into semi-natural communities is exhibited exclusively by *Acer negundo* and *Robinia pseudoacacia*. In contrast, species such as *Quercus rubra*, *Fraxinus pennsylvanica*, *Ulmus pumila*, and *Prunus serotina* demonstrate a moderated, localized invasion strategy; while they successfully naturalize and penetrate adjacent semi-natural phytocoenoses, their populations remain structurally contained and do not expand beyond the general boundaries of their historical introduction sites. The remaining taxon, *Gleditsia triacanthos*, exhibits strictly localized, non-expansive persistence. These regional micro-ecological nuances underscore that urban GI management must be tailored to the specific ecological behavior of each introduced transformer rather than relying on uniform administrative bans.

Conclusions

The syntaxonomic structure of Chernihiv's green infrastructure (GI) semi-natural ecosystems with ornamental introducents reflects a profound convergence between native vegetation frameworks – including forest (*Vaccinio-Piceetea* and *Quercetea pubescentis*) and shrub (*Rhamno-Prunetea*) classes – and anthropogenically induced communities of the classes *Robinietea* and *Galio-Urticetea*. This indicates the formation of hybrid cultural phytocoenoses, where the boundaries between natural and ruderal vegetation are significantly blurred.

The entire GI of Chernihiv maintains a highly diverse introduced dendroflora comprising 123 species, 2 subspecies, and 79 varieties within 33 families, primarily led by the Rosaceae, Fabaceae, and Cupressaceae families. The analyzed semi-natural tracts harbor a naturalized core of 49 specific introduced woody and shrub species, demonstrating that historical decorative and protective plantings act as a continuous source of structural transformation that suppresses native forest authenticity.

Canopy closure is a critical factor in ecosystem resistance to invasion. In tracts with lower crown density (20–40%, e.g., the Yalivshchyna tract), light-demanding exotics such as *Robinia pseudoacacia*, *Acer negundo*, *Prunus serotina*, and *Amelanchier spicata* demonstrate maximum expansive potential. Conversely, relict massifs with complex vertical structures (e.g., the Sviate tract) show higher resilience, where species like *Quercus rubra* achieve a competitive balance with native stands.

The nitrogen-fixing 'transformer' species, primarily *Robinia pseudoacacia*, catalyze a syntaxonomic shift in urban forests. This leads to the replacement of native alliances like *Dicrano-Pinion* with nitrophilous, ruderalized communities of the class *Robinietea* (alliance *Chelidonio-Robinion*), effectively stalling natural forest succession.

Current climate warming trends significantly catalyze the competitive and reproductive success of invasive transformer species within the forest understory. Concurrently, shifts in temperature regimes and precipitation destabilize native stands, making them highly susceptible to the rapid

expansion of drought-tolerant and light-demanding exotics. Among these, *Robinia pseudoacacia*, *Acer negundo*, and *Ulmus pumila* demonstrate aggressive expansive potential on dry, exposed habitats. Concurrently, the reduction of severe winter frost events favors the dense understory encroachment of *Prunus serotina*, *Quercus rubra*, and *Amelanchier spicata*, successfully bypassing historical ecological barriers and altering the natural successional pathways of urban woodlands.

On the steep slopes of the Boldyn Hills tract, the structural integrity of the rare, relict *Festuco-Brometea* communities is critically threatened, having been reduced to a fragmented and isolated patch of approximately 10 m². This micro-refugium is continuously shrinking under the combined pressure of the invasive expansion of *Acer negundo*, the vertical canopy alteration by the woody liana *Parthenocissus quinquefolia*, and the structural encroachment of *Caragana arborescens*, which was historically introduced for slope bioengineering and erosion control in the Malii Ravine system.

Management strategies for Chernihiv's GI must be differentiated: prioritize the immediate conservation of relict thermophilous, boreal, and endangered steppe cores in Boldyn Hills while implementing active control measures for invasive transformers in highly transformed urban forests like the Yalivshchyna, Sviate, and Podusivka Forest tracts.

References

- Andriienko, T.L. (Ed.). (2006). *Phytodiversity of Ukrainian Polissya and its conservation*. Phytosociocentre. (In Ukrainian)
- Bondar, O.M. (2014). *Chernihiv: city and fortress in the 14th–18th centuries*. Oleh Filiuk Publishing, Kyiv. (In Ukrainian)
- Bradley, L., & Fair, B. (2022). Woody ornamentals. In K.A. Moore & L.K. Bradley (Eds.), *North Carolina extension gardener handbook* (2nd ed.). NC State Extension. <https://content.ces.ncsu.edu/extension-gardener-handbook/11-woody-ornamentals>
- Burda, R.I., & Koniakin, S.N. (2019). The non-native woody species of the flora of Ukraine: introduction, naturalization and invasion. *Biosystems Diversity*, 27(3), 276–290. (In Ukrainian). <https://doi.org/10.15421/011937>

- Didukh, Y.P. (2019). Alliance *Aceri tatarici-Quercion* Zólyomi 1957. In D.V. Dubyna & T.P. Dziuba (Eds.), *Prodromus of the vegetation of Ukraine* (p. 379). Naukova Dumka, Kyiv. (In Ukrainian)
- Dotsenko, L.V., Chorna, V.I., Hrytsan, Y.I., Voroshylova, N.V., & Katsevych, V.V. (2021). Bioenvironmental characteristics of *Robinia pseudoacacia* steppe plantations in dependence to changes in some climatic factors. *Issues of Steppe Forestry and Forest Reclamation of Soils*, 50, 3–11. <https://doi.org/10.15421/442101>
- Dyderski, M.K., & Jagodziński, A.M. (2020). Impact of invasive tree species on natural regeneration species composition, diversity, and density. *Forests*, 11(4), Article 456. <https://doi.org/10.3390/f11040456>
- Dyderski, M.K., & Jagodziński, A.M. (2021). Impacts of invasive trees on alpha and beta diversity of temperate forest understories. *Biological Invasions*, 22(12), 235–252. <https://doi.org/10.1007/s10530-020-02367-6>
- Francini, A., Toscano, S., Ferrante, A., & Romano, D. (2023). Method for selecting ornamental species for different shading intensity in urban green spaces. *Frontiers in Plant Science*, 14, Article 1271341. <https://doi.org/10.3389/fpls.2023.1271341>
- Galkin, S., & Doiko, N. (2015). The problem of spontaneous naturalization of introduced plants in the Dendrological Park Olexandria of the NAS of Ukraine. *Plant Introduction*, 68, 89–98. (In Ukrainian). <https://doi.org/10.5281/zenodo.2527207>
- Gholami, L., Karimi, N., & Kavian, A. (2017). Soil bioengineering methods used in water management and stabilization slopes steep. *Journal of Ecohydrology*, 4(1), 149–162. (In Persian). <https://doi.org/10.22059/ije.2017.60897>
- Goncharenko, I., & Kovalenko, O. (2019). Oak forests of the class *Quercetea pubescentis* in Central-Eastern Ukraine. *Thaiszia – Journal of Botany*, 29(2), 191–215. <https://doi.org/10.33542/TJB2019-2-05>
- Jaskulski, D., & Jaskulska, I. (2012). Plant diversity in agroecosystems and agricultural landscapes. In G.A. Lameed (Ed.), *Biodiversity conservation and utilization in a diverse world* (pp. 3–22). InTech. <https://doi.org/10.5772/47729>
- Karpenko, Y., Pototska, S., & Sverdlov, V. (2023). Vascular plants of the spontaneous flora of the regional landscape park “Yalivschina” (Chernihiv city). *Biota. Human. Technology*, 3, 7–18. (In Ukrainian). <https://doi.org/10.58407/bht.3.22.1>
- Karpenko, Y.O., & Pototska, S.O. (2012). Chernihiv regional botanical garden: history of creation, development, decline and restoration. *Plant Introduction*, 56, 59–63. (In Ukrainian). <https://doi.org/10.5281/zenodo.2541115>
- Kimeichuk, I., & Kaidyk, O. (2022). Natural afforestation of the fallows in the Western Polissya. *Ukrainian Journal of Forest and Wood Science*, 13(4), 41–51. (In Ukrainian). [https://doi.org/10.31548/forest.13\(4\).2022.41-51](https://doi.org/10.31548/forest.13(4).2022.41-51)
- Kornienko, V., Pirko, I., Meskhi, B., Olshevskaya, A., Shevchenko, V., Odabashyan, M., Teplyakova, S., Vershinina, A., & Eroshenko, A. (2025). Evaluating the vitality of introduced woody plant species in the Donetsk–Makeyevka urban agglomeration. *Plants*, 14(20), Article 3160. <https://doi.org/10.3390/plants14203160>
- Kotsun, L., Kotsun, B., & Savchuk, L. (2023). North American woody plants in cultural phytocoenoses of Volyn region. *Notes in Current Biology*, 6(2), 11–15. <https://doi.org/10.29038/NCBio.23.2-3>
- Kovalenko, I., Kyrylchuk, K., Klymenko, H., Yaroshchuk, S., Yaroshchuk, R., Kovalenko, N., & Skyba, O. (2023). Influence of tree crown density on dominant plant species of the herb-shrub stratum in the zone of mixed forests. *Biosystems Diversity*, 31(3), 382–387. <https://doi.org/10.15421/012345>
- Krasnoshtan, V., & Krasnoshtan, I. (2025). Structural characteristics of pine stands and analysis of the invasive spread of black locust (*Robinia pseudoacacia* L.) near the settlement of Dashiv, Vinnytsia region. *Scientific Reports of the National University of Life and Environmental Sciences of Ukraine*, 21(5), 43–54. <https://doi.org/10.31548/dopovid/5.2025.43>
- Kravchenko, O.V., Yamko, O.Y., & Zaika, A.M. (2016). Report on scientific and technical development: calculation of drinking water supply standards for the population of Chernihiv (Contract No. 69-10-16) [Technical report]. Department of Urban Infrastructure. (In Ukrainian). https://water.cn.ua/files/services_structure/20180322-zvit.pdf
- Lukash, O., Miroshnyk, I., Morskyi, V., Stupak, Y., Aravin, M., Shakhnazarian, O., Sliuta, A., Sazonova, O., Strilets, S., & Szikura, A. (2024). Ecological strategies of ornamental invasive tree and shrub species in Chernihiv's green infrastructure. *Taiwan Journal of Forest Science*, 39(4), 311–322. [https://doi.org/10.7075/TJFS.202412_39\(4\).0006](https://doi.org/10.7075/TJFS.202412_39(4).0006)
- Matuszkiewicz, W. (2019). *Przewodnik do oznaczania zbiorowisk roślinnych Polski*. PWN, Warszawa.
- Mikeladze, I., Tsiskaridze, D., Manvelidze, Z., & Shainidze, G. (2025). Distribution and invasiveness of some invasive alien species (IAS) of plants in ecosystems of Colchis lowland (W Georgia / Sakartvelo). *Scientific Annals of the Danube Delta Institute*, 30, 91–106. <https://doi.org/10.3897/saddi.30.165717>

- Morskyi, V. (2026). Analysis of the acclimatized ornamental introduced woody plants flora of Chernihiv's green infrastructure. *Biota. Human. Technology*, 1, 12–27. <https://doi.org/10.58407/bht.1.26.1>
- Mucina, L., Bültmann, H., Dierßen, K., Theurillat, J.P., Raus, T., Čarni, A., Šumberová, K., Willner, W., Dengler, J., García, R.G., Chytrý, M., Hájek, M., Di Pietro, R., Iakushenko, D., Pallas, J., Daniëls, F.J.A., Bergmeier, E., Guerra, A.S., Ermakov, N., ... & Tichý, L. (2016). Vegetation of Europe: hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. *Applied Vegetation Science*, 19(S1), 3–264. <https://doi.org/10.1111%2Favsc.12257>
- Nuzhyna, N.V., Ivanova, I.Y., & Gaidarzhy, M.M. (2023). Introduced plant species in the urban environment of the temperate-continental climate zone under conditions of global warming. *Regulatory Mechanisms in Biosystems*, 14(4), 539–545. <https://doi.org/10.15421/022378>
- Ossola, A., Locke, D., Lin, B., & Minor, E. (2019). Greening in style: urban form, architecture and the structure of front and backyard vegetation. *Landscape and Urban Planning*, 185, 141–157. <https://doi.org/10.1016/j.landurbplan.2019.02.014>
- Protopopova, V.V., & Shevera, M.V. (2019). Invasive species in the flora of Ukraine. I. The group of highly active species. *Geo&Bio*, 17, 116–135. (In Ukrainian). <https://doi.org/10.15407/gb.2019.17.116>
- Rewald, B., Ammer, C., Hartmann, H., Malyshev, A.V., & Meier, I.C. (2020). Editorial: woody plants and forest ecosystems in a complex world-ecological interactions and physiological functioning above and below ground. *Frontiers in Plant Science*, 11, Article 173. <https://doi.org/10.3389/fpls.2020.00173>
- Solomakha, V.A. (2008). *Syntaxonomy of vegetation of Ukraine*. Phytosociocentre, Kyiv. (In Ukrainian)
- Ukrainian Geobotanical Site. (2026a). *Syntaxonomy of the vegetation of Ukraine: forest vegetation (alliance Aceri tatarici-Quercion Zólyomi 1957)*. Institute of Botany of the NAS of Ukraine, Kyiv. (In Ukrainian). <https://geobot.org.ua/syntaxonomy/729/>
- Ukrainian Geobotanical Site. (2026b). *Syntaxonomy of the vegetation of Ukraine: forest vegetation (class Quercetea pubescentis Doing-Kraft ex Scamoni et Passarge 1959)*. Institute of Botany of the NAS of Ukraine, Kyiv. (In Ukrainian) <https://geobot.org.ua/syntaxonomy/714/>
- Ukrainian Geobotanical Site. (2026c). *Syntaxonomy of the vegetation of Ukraine: forest vegetation (class Vaccinio-Piceetea Br.-Bl. in Br.-Bl. et al. 1939)*. Institute of Botany of the NAS of Ukraine, Kyiv. (In Ukrainian). <https://geobot.org.ua/syntaxonomy/634/>
- Vološčuk, I. (2012). Changes in forest phytodiversity caused by alien woody plants in Štiavnické vrchy Mts. *Thaiszia – Journal of Botany*, 22(2), 105–119.
- Vyshenska, I. G., & Lyshenska, D. (2025). Monitoring of invasive woody plant species in urban ecosystems of Kyiv. *NaUKMA Research Papers Biology and Ecology*, 8, 62–69. <https://doi.org/10.18523/2617-4529.2025.8.62-69>
- WFO. (2026). World Flora Online. <http://www.worldfloraonline.org>
- Yakubenko, B.Y., Popovych, S.Y., Ustymenko, P.M., Dubyna, D.V., & Churilov, A.M. (2018). *Geobotany: methodological aspects of research*. Lira-K, Kyiv. (In Ukrainian)

Фітоценотичні умови декоративних деревних та чагарникових інтродуцентів у напівприродних угрупованнях зеленої інфраструктури Чернігова

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Дослідження спрямоване на проведення порівняльного фітоценотичного аналізу умов зростання інтродукованих декоративних деревних і чагарникових рослин у чотирьох напівприродних угрупованнях зеленої інфраструктури Чернігова (урочища Ялівщина, Святе, Подусівський лісовий масив та Болдині гори). У роботі оцінено вплив екологічних факторів, зімкнутості крон та структури підліску на успішність натуралізації адвентивних рослин на тлі загальної інтродукованої дендрофлори міста, яка налічує 123 види, 2 підвиди та 79 різновидів із 33 родин. На основі комплексних архітектурних та адаптивних критеріїв спонтанний комплекс екзотів із 49 видів, зафіксований у досліджуваних напівприродних угрупованнях, було диференційовано на три

виразні функціонально-декоративні категорії: затінюючі структурні дерева, візуальні та сезонні акцентні чагарники, а також текстурні фонові, бар'єрні та екранні рослини. Робота базується на польових дослідженнях, проведених у період з 2023 по 2025 рік, що включали 58 геоботанічних описів на пробних площах розміром 225–625 м².

Уперше проведено комплексний аналіз лісових урочищ Чернігова на синтаксономічному рівні з визначенням шляхів їхньої антропогенної та кліматичної трансформації. Встановлено пряму кореляцію між зниженням зімкнутості крон (до 20–40 %, наприклад, в урочищі Ялівщина) та інтенсивністю натуралізації світлолюбних інвазійних видів (*Prunus serotina*, *Acer negundo* та *Amelanchier spicata*). Доведено роль азотфіксуючих видів-трансформів, насамперед *Robinia pseudoacacia*, у заміщенні корінних союзів (*Dicrano-Pinion*) нітрофільними угрупованнями класу *Robinieta* (союзу *Chelidonio-Robinion*). Обґрунтовано, що сучасні тенденції глобального потепління, які характеризуються аридизацією клімату та пом'якшенням зим, виступають ключовими драйверами для подолання історичних екологічних бар'єрів як посухостійкими, так і раніше чутливими до зим інтродуцентами, що прискорює їхню експансію у підлісок та змінює природні сукцесійні шляхи. На схилах урочища Болдині гори структурне впровадження *Caragana arborescens* та *Parthenocissus quinquefolia* загрожує рідкісним, реліктовим угрупованням класу *Festuco-Brometea*, які скоротилися до ізольованої ділянки площею близько 10 м².

Результати демонструють глибоку синтаксономічну конвергенцію між корінними лісовими (*Vaccinio-Piceetea* та *Quercetea pubescentis*) та чагарниковими (*Rhamno-Prunetea*) класами та антропогенно обумовленою рослинністю (*Robinieta* та *Galio-Urticetea*). Інтродуковані декоративні рослини формують стійкі гібридні культурні фітоценози, які поступово нівелюють природну автентичність лісових масивів, кульмінацією чого є розвиток синдрому "урбанізованого лісу". Тоді як реліктові лісові ядра зі складною вертикальною структурою виявляють вищу екологічну резистентність, розріджені лісопаркові зони та сильно фрагментовані степові мікрорефугіуми потребують невідкладних диференційованих стратегій менеджменту та цілеспрямованого регулювання чисельності інвазійних видів-трансформаторів.

Ключові слова: інтродуковані види, рослини-трансформери, гібридні фітоценози, синтаксономія, підхід Браун-Бланке, міські ліси