Received 30.04.2025 Revised 29.07.2025 Accepted 23.09.2025

Vol. 21, No. 5
2025

Scientific Reports of the National University of Life and Environmental Sciences of Ukraine

Journal homepage: https://scireports.com.ua/en

UDC 630*262:582.736.3:574.42(477.44)

Doi: 10.31548/dopovidi/5.2025.43

Structural characteristics of pine stands and analysis of the invasive spread of black locust (*Robinia pseudoacacia* L.) near the settlement of Dashiv, Vinnytsia region

Vasyl Krasnoshtan*
PhD
Pavlo Tychyna Uman State Pedagogical University
20300, 2 Sadova Str., Uman, Ukraine
https://orcid.org/0000-0001-8572-5008

Ihor Krasnoshtan
PhD in Biological Sciences, Associate Professor
Pavlo Tychyna Uman State Pedagogical University
20300, 2 Sadova Str., Uman, Ukraine
https://orcid.org/0000-0003-1317-546X

Abstract. One of the key problems of modern ecology and forestry is the spread of black locust, which leads to the transformation of forest ecosystems and loss of biodiversity. The aim of the study was to determine the structural features of secondary pine stands and analyse the invasive spread of *Robinia pseudoacacia* L. The study was conducted in 2025 in a pine forest in Vinnytsia region using the Braun-Blanquet method with an assessment of the stratification and frequency of occurrence of species; additionally, for black locust, an analysis of the age structure of the population was performed based on trunk diameter and plant height. The survey was carried out at the forest edge and in the inner areas of the forest. It was found that the species composition of the forest stand is spatially differentiated. The central part of the community was formed mainly by Scots pine (*Pinus sylvestris* L.) and silver birch (*Betula pendula* Roth.), while black locust dominated the eastern forest edge, forming tree, undergrowth and shrub layers. The presence of all age groups of black locust was detected, from seedlings to old generative individuals, indicating its stable regeneration and high invasive potential. The species was

Suggested Citation:
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. doi: 10.31548/dopovidi/5.2025.43.

**Corresponding author*

absent in the inner areas of the forest, which is due to the dense canopy of autochthonous trees and competition with the native flora. The results obtained indicate the local, ecotonal nature of the black locust invasion, concentrated in the edge parts of the forest stand adjacent to agricultural landscapes. The presence of numerous young generations is a sign of invasive pressure, which may lead to a gradual expansion of the population. The results obtained can be used in forestry practice to monitor invasive species and develop measures to preserve biodiversity

Keywords: forest stand; species composition; age structure; invasive species; black locust

Introduction

Introduced tree species pose a serious threat to the stability of forest ecosystems, as they are capable of actively spreading, changing the natural structure of communities and disrupting the balance between species. Such processes are often accompanied by a decrease in the diversity of autochthonous flora, suppression of young generations of native trees, and transformation of environmental conditions. Particular attention should be paid to black locust (*Robinia pseudoacacia* L.), a species that is distinguished by its rapid growth, ecological plasticity, and ability to form stable populations even in environments with disturbed natural relationships. It easily establishes itself on forest edges, in secondary plantations and in areas where economic activity has been carried out for a long time, gradually displacing local species and changing the nature of forest ecosystems.

The problem of biological invasions in forest plantations is becoming increasingly acute in a number of regions around the world. Secondary forest communities that form on the site of former agricultural landscapes or outside the natural range of dominant species are often particularly vulnerable to the introduction of invasive species, in particular invasive tree species (Jones & Yamamoto, 2024). One of the most aggressive introduced species is black locust (*Robinia pseudoacacia* L.), which has a high capacity for spread due to the formation of dense communities and interaction with other tree species. In particular, E.T. Nilsen & C.D. Huebner (2023) showed that *R. pseudoacacia* forms compact clusters of trees and undergrowth, where the closest neighbours are most often individuals of the same species, as well as other introduced and invasive species. The authors also noted that areas dominated by *R. pseudoacacia* are characterised by high tree density and specific differences in species composition, confirming its ability to influence the structure and dynamics of local forest communities.

In anthropogenically transformed landscapes, where natural succession relationships are disrupted, invasive species are capable of altering the structure and dynamics of phytocenoses and influencing the functioning of ecosystems. In particular, a review by M. Langmaier & K. Lapin (2020) showed that introduced tree and herbaceous species, including *Robinia pseudoacacia*, *Prunus serotina* and others, suppress the natural regeneration of autochthonous trees through competition for light and resources, as well as alter the chemical properties of the soil, enriching it with nitrogen and changing microbial communities. Similar conclusions are described in the work of M.J. Woods (2023), where author noted that invasive plants can not only displace local species in areas affected by degradation processes, but also significantly modify the chemical composition of the soil (acidification, carbon input), which affects the nutrient cycle and reduces the chances of restoring the autochthonous dendroflora.

In Ukraine, the impact of black locust on local flora was studied by A. Tokaryuk *et al.* (2021), who, using the example of the Prut-Dniester interfluve, demonstrated the ability of black locust to lead to the loss of regional phytodiversity of both herbaceous plants and trees. At the same time, I.I. Korshikov *et al.* (2021), studying steppe ravines in the Dnipropetrovsk region, noted that *Robinia pseudoacacia* forms the most numerous self-sown populations in the studied locations and exhibits the greatest invasive potential among other plant species, displacing native species and transforming natural communities.

The high invasiveness of black locust is largely explained by its biological characteristics, but some scientists note that certain environmental factors can either promote or slow down invasive processes. For example, M.A. Holmes *et al.* (2021) showed that land use history and abiotic factors determine the spread of introduced shrubs in secondary forests in the Appalachians, formed on the site of former agricultural and industrial areas. This highlights the importance of considering anthropogenic factors when studying invasive processes in forest ecosystems.

Despite the large number of publications devoted to the invasive properties of *Robinia pseudoacacia*, the issue of its spread in young forest ecosystems of anthropogenic origin, formed on the site of former agricultural land, has not yet been sufficiently studied. In this regard, there is a need for regional studies combining floristic analysis with the study of forest community structure.

The aim of the study was to investigate the structure of secondary pine stands formed on former agricultural land and to analyse the invasive spread of black locust (*Robinia pseudoacacia* L.) within them.

To achieve this goal, the following tasks were set:

- to determine the species composition and vertical structure of the pine stand;
- to assess the spatial distribution (horizontal zonation) of black locust within the study area;
- to analyse the quantitative indicators and age structure of the black locust population.

The scientific novelty of the work lies in conducting a detailed regional study of the invasion process of *Robinia pseudoacacia* in secondary forest stands on the site of former agricultural landscapes. For the first time in the studied region, a comprehensive analysis of the vertical and horizontal structure of the dominant pine stand was carried out in combination with a quantitative assessment of the black locust population, which allows for a deeper understanding of the factors that influence the success of its spread in such conditions.

Materials and Methods

The research was conducted in a Scots pine forest stand near the settlement of Dashiv, Haisyn District, Vinnytsia Region, in 2025, in compliance with the ethical standards set out in the Convention on Biological Diversity (1992). The forest stand was formed on a north- and west-facing hillside. It borders the Lysa Lypa river to the east and north. Agricultural land is located to the west and south of the forest (Fig. 1). The area of the plantation was about 16 hectares (Public Cadastral Map of Ukraine, n.d.).

To conduct a floristic analysis of the forest stand, three experimental plots measuring 20×20 m were established in the eastern, western and central parts of the forest, which made it possible to take into account the spatial heterogeneity of the vegetation cover. The vegetation was described using the Braun-Blanquet method (Westhoff & van der Maarel, 1978), which involved selecting homogeneous representative plots and assessing each species on a coverage/abundance scale. For each plot, the species composition, stratification structure and relative participation of species in the formation of the community were recorded. The degree of coverage was indicated on the Braun-Blanquet assessment scale: from “r” (isolated specimens) and “+” (<1% coverage) to gradations 1-5, reflecting the increase in the coverage of the species in the phytocenosis (from 1 – <5% to 5-75-100%). This approach made it possible to quantitatively characterise the spatial heterogeneity of vegetation and identify differences in the structure of the eastern, central and western parts of the plantation.

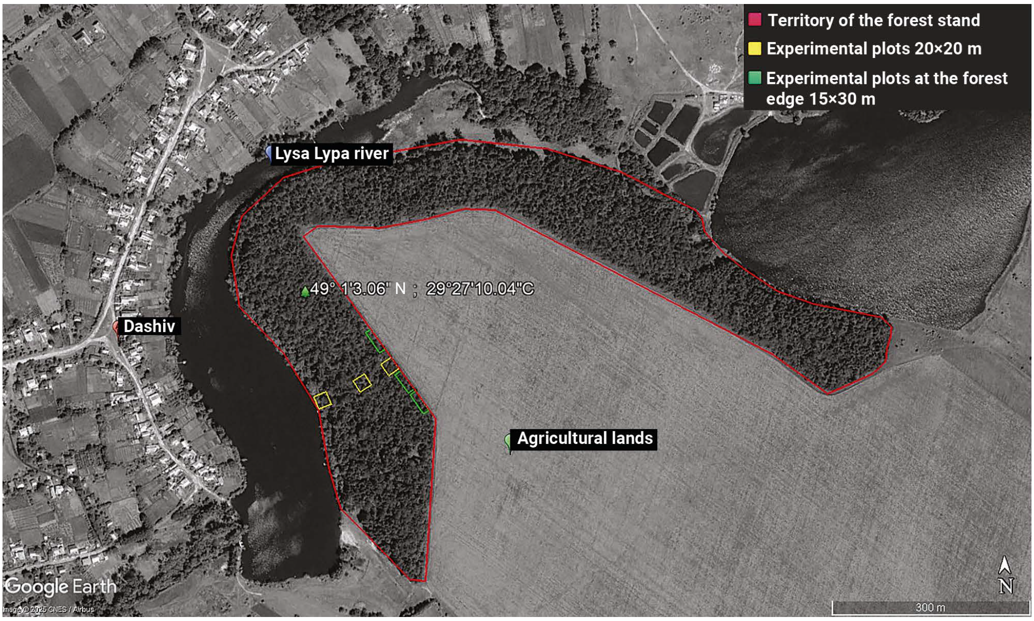

Figure 1. *Pine stands near the settlement of Dashiv, Vinnytsia region, Ukraine*
Source: developed by the authors based on Satellite imagery (n.d.)

For the visual classification of *Robinia pseudoacacia* plants by age group, their height and trunk diameter at a height of 1.3 m were determined. Seedlings and juvenile plants were assessed only by height, while generative plants were assessed by height and trunk diameter. Individuals were classified into groups: old generative (height 12-18 m, trunk diameter 15-40 cm), young generative (height 2-12 m, trunk diameter 2-15 cm), juvenile (height 0.3-2.0 m) and seedlings (height up to 0.3 m). The number of individuals in each group was recorded along the forest edge in three areas 30 m long and 15 m wide, which made it possible to determine the age structure of the population and its spatial boundaries.

Results and Discussion

Research into the structural characteristics of pine stands has revealed marked spatial heterogeneity in the composition and distribution of tree and shrub species. A multi-tiered phytocenotic system has formed within the studied area, where the participation of native and introduced species varies depending on the ecological conditions of individual sites. The most contrasting differences are observed between the edge zones of the stand and its central part, which is due to differences in light levels, moisture and competitive relationships. The research has established that the species composition of the forest stand is heterogeneous and varies depending on the location of the studied areas (Table 1). The eastern part of the forest is characterised by a pronounced dominance of black locust, which forms three layers: tree, undergrowth and shrub (Fig. 2).

The high number of individuals of different ages and the ability of the species to occupy several structural levels indicate stable population recovery and an active invasive process. As a result, local indigenous species are significantly suppressed, and the phytocenotic structure becomes monodominant. It is particularly noteworthy that black locust forms dense undergrowth and thick thickets, which limit the penetration of light to the lower tiers, further reducing the chances for natural restoration of the local flora. However, despite the pronounced dominance of black locust, isolated representatives of other species are still found in the eastern part of the forest, in particular *Pinus sylvestris* (coverage degree – 1), which occupies the tree layer. The presence of *P. sylvestris* in this area is probably explained by the development of this species before the invasion of black locust, which allowed the plants to occupy a dominant position in the upper forest layer and not experience competitive pressure from other species. At the same time, the absence of young Scots pine individuals indicates the inability of plants to reproduce under the invasive influence of black locust.

Table 1. *Phytocenotic structure of forest stand according to Braun-Blanquet*

Species / Layer	East	Centre	West
Robinia pseudoacacia (I, II, III)	5	1	–
Betula pendula (I, II)	+	3	3
Pinus sylvestris (I)	1	4	3
Prunus avium (II, III)	2	1	3
Crataegus sp. (III)	–	r	1
Alnus incana (II)	–	–	1
Quercus robur (II)	–	–	2
Carpinus betulus (II, III)	–	1	1
Fraxinus excelsior (II)	–	–	1
Rubus idaeus (IV)	–	–	r
Fragaria vesca (IV)	–	–	1
Bryophyta spp. (V)	+	2	2

Note: layers: I – tree, II – undergrowth, III – shrub, IV – herbaceous, V – moss and lichen. Score – degree of coverage according to the Braun-Blanquet scale. Symbols "–" – absence of species in the area; "r" – isolated individuals; "+" – <1% coverage

Source: developed by the authors based on own research

Figure 2. *Robinia pseudoacacia in the eastern part of the forest*

Source: authors' photo

To a certain extent, representatives of *Prunus avium* (coverage degree – 2) are found in the eastern part of the forest, in particular on the forest edge, in the undergrowth and shrub layer. The ability of wild cherry to survive in conditions of black locust dominance is determined by its ecological characteristics, which, according to L.V. Kalashnikova & J.V. Doroshenko (2021), include mesoxerophily, shade tolerance and mesotrophy. In the central part of the forest, the species composition of the dendroflora has a number of significant differences compared to the eastern part. In this area, there are only a few plants of black locust (coverage degree – 1) and a clear dominance of two other species: *Pinus sylvestris* and *Betula pendula* (coverage degree – 4 and 3, respectively), which occupy the tree layer and undergrowth (Fig. 3).

Figure 3. *Pinus sylvestris and Betula pendula in the central part of the forest*
Source: authors' photo

The dominance of these two species is probably explained by their significant development in the period preceding the invasion of black locust, which made the conditions in the central part of the forest unfavourable for the development of light-demanding plants. However, some other species are still able to exist in these conditions due to their ecological characteristics, in particular shade tolerance. In the undergrowth and shrub layer of the central part of the forest, one can find *Prunus avium* and *Carpinus betulus* (coverage level 1 for both species), as well as isolated representatives of *Crataegus* sp., which, together with black locust, occupy small light gaps in the lower layers of the forest.

The western part of the forest plantation is characterised by a number of specific conditions that distinguish this area from the central and eastern parts. In particular, it is located on a depression in the relief, which is the river bank. As a result, there is a slightly lower level of illumination and proximity to the groundwater surface. These specific conditions have determined the characteristic quantitative and qualitative composition of the local flora. In the western part of the forest, as in the central part, *Betula pendula* and *Pinus Sylvestris* remain dominant (coverage level 3 for both species), forming the tree layer of the forest. However, in the undergrowth and shrub layer, *Prunus avium* (coverage degree – 3) occupies a dominant position, which is explained not only by the relative shade tolerance of this species, but also by the sufficient moisture supply for its intensive development in conditions of proximity to a water body (Fig. 4).

Figure 4. *Prunus avium in the western part of the forest (marked in red)*
Source: authors' photo

The western part of the forest also hosts a number of autochthonous tree species that are not found in the eastern or central parts. For example, *Alnus incana, Carpinus betulus, Fraxinus excelsior* and *Crataegus* sp. (coverage level – 1 for all species) can be found here, occupying mainly the undergrowth and shrub layers. *Quercus robur* is somewhat more prevalent here (coverage level – 2). In addition to trees, the western part of the forest also has more active herbaceous vegetation compared to other studied areas. There are isolated representatives of *Rubus idaeus* and *Fragaria vesca*, which, given the growing conditions, are suppressed due to lack of light. This difference in the development of herbaceous vegetation may be due to the fact that, although there is shading in the western part of the forest, it is not as pronounced as in the eastern part. In addition, the better moisture supply in the western part of the forest compared to the eastern and central parts contributes to the development of herbaceous cover. Another significant difference that characterises the western part of the studied forest stand is the complete absence of black locust plants in all layers.

Thus, a floristic study of different areas of the forest stand indicates the existing horizontal differentiation of the species composition of the dendroflora against the background of the general dominance of Scots pine. The reasons for this differentiation include different lighting conditions, moisture levels and soil characteristics. These conclusions are consistent with the results of studies by other authors. For example, J.F. Maciel-Nájera *et al.* (2021) in their study of oak-pine forests in Mexico found that the composition of understory plants depends significantly on soil conditions. According to their data, indicators such as the content of calcium, phosphorus, potassium and organic matter in the soil had a stronger influence on the presence of certain species than even the availability of sufficient light. The results of the current study also confirm the key role of edaphic factors in shaping the species composition of forest phytocenosis, which indicates the universality of this ecological principle.

Thus, the eastern part of the forest, in particular the forest edge, receives a large amount of light, which is a critical condition for the development of black locust, especially young individuals. According to research by T. Ábri *et al.* (2024), young black locust seedlings demonstrate high photosynthetic efficiency, which increases proportionally to the increase in light intensity within a wide range. This confirms that black locust is a light-loving species that needs a lot of light for successful development, which is observed in the current study. In addition, this site is located on a hill, which is characterised by less moisture availability compared to lowlands. Since, according to research by D. Bartha *et al.* (2008), black locust is more resistant to moisture deficiency than autochthonous species, this gives it a significant advantage in the competition for natural resources. However, moving westward, in the central part of the forest, conditions change dramatically: *Pinus sylvestris* and *Betula pendula* in this area create significant shading, which makes local conditions unfavourable for the development of young black locust plants. This trend was also noted by H. Kato-Noguchi & M. Kato (2024) when describing the invasive characteristics of black locust and its impact on the species diversity of forest plantations. They note that black locust cannot tolerate shade, and its seedlings and young trees develop successfully only where there is sufficient light or a thin canopy.

The western part of the forest is characterised not only by its spatial orientation, but also by its proximity to water and its location at the foot of a hill, which creates favourable conditions for the development of more moisture-loving and light-undemanding plants: *Prunus avium*, *Alnus incana*, *Quercus robur, Carpinus betulus* and *Fraxinus excelsior*. In this part of the forest, black locust probably not only does not receive enough light for development, but also has no ecological advantages over the autochthonous flora, which makes its spread in this location extremely difficult. This is partly consistent with the conclusions of A. Cierjacks *et al.* (2013), who emphasised that black locust can actively displace native species only under conditions of sufficient light and resource availability, while in wetter and shadier areas its invasive potential is reduced. In the case of the current study, the relief and increased soil moisture create advantages for native species and further limit the spread of black locust. Analysing the age structure of black locust in the eastern part of the forest (Table 2), it should be noted that the trees here are represented by both old generative individuals (trunk diameter 35-40 cm, well-developed canopy, presence of seed offspring), and young generative trees, as well as numerous juvenile plants and seedlings.

Table 2. *Age structure of black locust in the eastern part of the forest*

Age group	Characteristic (by morphometric traits)	Approximate quantity	Notes
Seedlings	1-year-old saplings, height <0.3 m	+++	Form a continuous strip under the canopy of older trees
Juvenile	1-3 year-old growth, height 0.3-2 m	+++	Form a dense understorey
Young generative	3 3-10 year-old trees, height 2-12 m, diameter 2-15 cm	++	Actively growing, but are outcompeted by pine in height
Old generative	Height 12-18 m, diameter 35-40 cm	++	Form the tree layer of the forest edge

Note: +++ – very numerous, ++ – well represented, + – isolated
Source: developed by the authors based on own research

This age structure indicates stable reproduction and high invasive potential of the species in the edge part of the forest stand. The accumulation of individuals of different generations forms a multi-tiered structure of the community, in which black locust occupies both the tree and shrub-undergrowth levels. A sharp decline in the number of black locust trees with deeper penetration into the forest indicates limited penetration of the species into the established forest stand. The main barriers are likely to be the dense canopy of native trees, which significantly reduces the light available to the lower tiers, as well as competitive interaction with native species in conditions that are more favourable to them. Thus, black locust exhibits the properties of an ecotone invasive species, concentrating in the zone of contact between the forest and agricultural landscapes. The age structure of the population at the forest edge has all the characteristics of an expansive one, as confirmed by the coexistence of several generations. This distribution reflects favourable conditions for reproduction: openness to the field, sufficient insolation, and the presence of mother trees that produce both seeds and vegetative shoots. In turn, the absence of black locust in the inner areas of the forest indicates that the invasion is localised and closely depends on the anthropogenically transformed environment.

The results obtained are consistent with the study by R. Motta *et al.* (2009), who, using the example of floodplain forests in Italy, showed that *Robinia pseudoacacia*, after active colonisation, forms the upper and middle tiers, but gradually loses its ability to regenerate in the inner parts of the forest stands due to a lack of light and increased competition with native flora. At the same time, in contrast to the data presented, where the authors record signs of gradual degradation of black locust plantations, in the conditions of the studied forest edge, this species shows signs of active expansion, indicating the early stages of the invasion process. Similar trends are noted by M. Vítková *et al.* (2019), who summarised data on the spread of black locust in Europe in their work. The authors showed that the species most intensively colonises disturbed areas, forest edges, clearings and other open spaces, while its spread is significantly limited in mature forest ecosystems. The results of the current study fully confirm this pattern: the highest density of young individuals was observed precisely in areas of contact with the agricultural landscape, while in the depths of the forest, the formation of new generations of black locust was minimal. Additional confirmation of this is provided by R. Crosti *et al.* (2016), who, studying forest plantations in Central Italy, showed that the penetration of black locust is most intense on abandoned agricultural land located near parent trees. At the same time, semi-natural forest areas in their study proved to be much more resistant to invasion, showing minimal spread of the species.

The results obtained regarding the structural features of pine stands in combination with the invasive spread of *Robinia pseudoacacia* near the settlement of Dashiv are consistent with data from other studies on the transformational impact of this species on ecosystems. The work of P. Lakyda *et al.* (2025) shows that *R. pseudoacacia* plantations in urban parks in Dnipro change soil properties, particularly under conditions of technogenic pollution with heavy metals. This confirms the high ecological plasticity of black locust and its ability to modify the growing environment, which explains its competitiveness in natural and artificial forest communities. Thus, the available results indicate that the penetration of black locust into pine plantations not only changes their structural organisation but also potentially affects soil characteristics, creating risks for the stability of these ecosystems. At the same time, there is evidence that forest stands near water bodies are extremely vulnerable to black locust invasion. For example, a study by M. Varricchione *et al.* (2024) indicates that black locust creates significant invasive pressure on coastal ecosystems, which, like forest edges, are vulnerable to its spread, although in the current study, it was the forest areas adjacent to water bodies that proved to be the most resistant to invasion. In this regard, Ukrainian researchers S. Los *et al.* (2022) argue that in the conditions of Central Ukraine, particularly in the Kirovohrad region, established forest plantations are relatively resistant to black locust invasions. However, as the authors note, in areas adjacent to plantations, medium and high invasion activity was observed in more than 70% of cases, which indicates significant invasive pressure of the species in areas that have been subjected to anthropogenic influence. Therefore, when monitoring the spread of black locust, it is important to pay attention not only to forest plantations themselves, but also to adjacent areas that are regularly affected by human activity.

The study showed that the structural organisation of pine plantations is spatially heterogeneous and depends significantly on the ecological conditions of individual areas. It has been established that the invasive species *Robinia pseudoacacia* is concentrated mainly on forest edges, where it forms multi-tiered communities and demonstrates active reproduction. At the same time, its spread in the inner parts of the forest is significantly limited due to the dense canopy of native trees and higher moisture levels. The identified age structure of the black locust population indicates stable self-regeneration, which poses a potential threat to the local flora in the event of further anthropogenic disturbances. The results confirm the need for long-term monitoring of forest edges and marginal areas, as they are the most vulnerable to invasion.

Conclusions

The research has shown that the floristic composition and structural organisation of the studied forest stand are spatially heterogeneous and demonstrate pronounced horizontal differentiation. The tree stand is dominated by the native species *Pinus sylvestris* and *Betula pendula*, but locally, particularly on the eastern edge of the forest, the invasive species *Robinia pseudoacacia* dominates (coverage level – 5). Robinia forms a full-fledged multi-tiered structure (tree, undergrowth and shrub tiers), demonstrating active reproduction due to the presence of individuals of all age groups. This indicates the high invasive potential of the species under conditions of sufficient light and moisture deficiency, which are characteristic of the edge areas of the stand. At the same time, in the inner parts of the forest, where native species dominate and there is significant shading and higher soil moisture, black locust is much less common (coverage level – 1), which confirms its ecotone nature of distribution and limited competitiveness in stable forest communities. The western part of the forest, located near a reservoir, is characterised by a greater representation of moisture-loving autochthonous species (*Prunus avium, Alnus incana, Quercus robur, Carpinus betulus, Fraxinus excelsior*), which further reduces the possibility of black locust establishment, and as a result, it is completely absent in this area.

Thus, *Robinia pseudoacacia* exhibits the characteristics of a typical invasive species at the boundary between forest ecosystems and agricultural landscapes, where it forms stable, self-renewing populations. At the same time, its penetration into the established tree stand is limited by ecological barriers (lack of light, higher competition, increased moisture). The identified age structure and localised nature of Robinia's spread indicate the initial phase of the invasive process, which, however, in the event of anthropogenic disturbance of the tree stand, may transform into a more intensive spread with the displacement of native flora. In the long term, it is advisable to conduct long-term monitoring of forest edges and marginal areas, analyse the rate of black locust population recovery after possible disturbances to the tree stand, and study the interaction of this species with native flora in different ecological conditions. Special attention should be paid to assessing the invasive pressure of black locust on young generations of autochthonous tree and shrub species, which will allow for more accurate predictions of the further development of the forest ecosystems under study.

Acknowledgements

None.

Funding

None.

Conflict of Interest

None.

References

[1] Ábri, T., Gaganetz, D., & Csajbók, J. (2024). Light response curve analysis of juvenile black locust clones: A case study from eastern Hungary. *Journal of Forest Science*, 70(4), 202-207. doi: 10.17221/120/2023-jfs.

[2] Bartha, D., Csiszár, Á., & Zsigmond, V. (2008). Black locust (*Robinia pseudoacacia* L.). In Z. Botta-Dukát & L. Balogh (Eds.), *The most important invasive plants in Hungary* (pp. 63-76). Vácrátót: HAS Institute of Ecology and Botany.

[3] Cierjacks, A., Kowarik, I., Joshi, J., Hempel, S., Ristow, M., Von Der Lippe, M., & Weber, E. (2013). Biological flora of the British Isles: *Robinia pseudoacacia*. *Journal of Ecology*, 101(6), 1623-1640. doi: 10.1111/1365-2745.12162.

[4] Convention on Biological Diversity. (1992, June). Retrieved from https://zakon.rada.gov.ua/laws/show/995_030#Text.

[5] Crosti, R., Agrillo, E., Ciccarese, L., Guarino, R., Paris, P., & Testi, A. (2016). Assessing escapes from short rotation plantations of the invasive tree species *Robinia pseudoacacia* L. in Mediterranean ecosystems: A study in central Italy. *iForest - Biogeosciences and Forestry*, 9(5), 822-828. doi: 10.3832/ifor1526-009.

[6] Holmes, M.A., Whitacre, J.V., Bennion, L.D., Poteet, J., & Kuebbing, S.E. (2021). Land-use history and abiotic gradients drive abundance of non-native shrubs in Appalachian second-growth forests with histories of mining, agriculture, and logging. *Forest Ecology and Management,* 494, article number 119296. doi: 10.1016/j.foreco.2021.119296.

[7] Jones, C.C., & Yamamoto, M.H. (2024). Long-term patterns and mechanisms of plant invasions in forests: The role of forest age and land-use history. *Biological Invasions,* 26(9), 3125-3145. doi: 10.1007/s10530-024-03365-8.

[8] Kalashnikova, L.V., & Doroshenko, J.V. (2021). Ecological characteristic of dendrosozophytes of the dendrological park "Oleksandria" of NAS of Ukraine. *Journal of Native and Alien Plant Studies*, 1, 119-124. doi: 10.37555/2707-3114.1.2021.247561.

[9] Kato-Noguchi, H., & Kato, M. (2024). Invasive characteristics of *Robinia pseudoacacia* and its impacts on species diversity. *Diversity*, 16(12), article number 773. doi: 10.3390/d16120773.

[10] Korshikov, I.I., Petrushkevych, Y.M., & Shevchuk, N.Y. (2021). Expansion of tree and shrub plant species into undisturbed steppe phytocenoses. *Journal of Native and Alien Plant Studies*, 1, 160-165. doi: 10.37555/2707-3114.1.2021.247571.

[11] Lakyda, P., Matushevych, L., Sakharuk, H., Lovynska, V., Holoborodko, K., & Sytnyk, S. (2025). The influence of *Robinia pseudoacacia* plantations on soil in the park areas of Dnipro city contaminated with heavy metals. *Ukrainian Journal of Forest and Wood Science*, 16(2), 115-135. doi: 10.31548/forest/2.2025.115.

[12] Langmaier, M., & Lapin, K. (2020). A systematic review of the impact of invasive alien plants on forest regeneration in European temperate forests. *Frontiers in Plant Science*, 11, article number 524969. doi: 10.3389/fpls.2020.524969.

[13] Los, S., Tereshchenko, L., & Petrenko, M. (2022). Approbation of the method for assessing the invasive activity and selection value of *Robinia pseudoacacia* L. in Kirovohrad region conditions. *Proceedings of the Forestry Academy of Sciences of Ukraine*, 24, 24-35. doi: 10.15421/412202.

[14] Maciel-Nájera, J.F., González-Elizondo, M.S., Hernández-Díaz, J.C., López-Sánchez, C.A., Bailón-Soto, C.E., Carrillo-Parra, A., & Wehenkel, C. (2021). Influence of environmental factors on forest understorey species in Northern Mexico. *Forests*, 12(9), article number 1198. doi: 10.3390/f12091198.

[15] Motta, R., Nola, P., & Berretti, R. (2009). The rise and fall of the black locust (*Robinia pseudoacacia* L.) in the "Siro Negri" Forest Reserve (Lombardy, Italy): Lessons learned and future uncertainties. *Annals of Forest Science*, 66(4), article number 410. doi: 10.1051/forest/2009012.

[16] Nilsen, E.T., & Huebner, C.D. (2023). Spatial patterns of native *Robinia pseudoacacia* and invasive *Ailanthus altissima* and their influence on regeneration, abundance, and diversity of neighboring trees at local and regional scales. *Landscape Ecology*, 38(11), 2899-2916. doi: 10.1007/s10980-023-01760-5.

[17] Public Cadastral Map of Ukraine. (n.d.). Retrieved from https://kadastrova-karta.com/dilyanka/0521255400:02:000:0355.

[18] Satellite imagery. (n.d.). *Earth observation imagery*. Retrieved from https://www.airbus.com/en/products-services/space/earth-observation/satellite-imagery

[19] Tokaryuk, A., Chorney, I., Budzhak, V., & Volutsa, O. (2021). Influence of *Robinia pseudoacacia* L. (Fabaceae) plantations on phytodiversity of the Prut-Dnister interfluve. *Biosystems*, 13(2), 210-217. doi: 10.31861/biosystems2021.02.210.

[20] Varricchione, M., Carranza, M.L., D'Angeli, C., De Francesco, M.C., Innangi, M., Santoianni, L.A., & Stanisci, A. (2024). Exploring the distribution pattern of native and alien forests and their woody species diversity in a small Mediterranean city. *Plant Biosystems – an International Journal Dealing With All Aspects of Plant Biology*, 158(6), 1335-1346. doi: 10.1080/11263504.2024.2415613.

[21] Vítková, M., Sádlo, J., Roleček, J., Petřík, P., Sitzia, T., Müllerová, J., & Pyšek, P. (2019). *Robinia pseudoacacia*-dominated vegetation types of Southern Europe: Species composition, history, distribution and management. *Science of the Total Environment*, 707, article number 134857. doi: 10.1016/j.scitotenv.2019.134857.

[22] Westhoff, V., & Van Der Maarel, E. (1978). The Braun-Blanquet approach. In *Classification of plant communities* (pp. 287-399). Dordrecht: Springer. doi: 10.1007/978-94-009-9183-5_9

[23] Woods, M.J. (2023). *Restoring degraded and invaded landscapes: A soil-based approach*. (PhD dissertation, University of Dayton, Dayton, USA).

Структурна характеристика соснових насаджень та аналіз інвазійного поширення робінії (*Robinia pseudoacacia* L.) поблизу селища Дашів, Вінницької області

Василь Красноштан
Доктор філософії
Уманський державний педагогічний університет імені Павла Тичини
20300, вул. Садова, 2, м. Умань, Україна
https://orcid.org/0000-0001-8572-5008
Ігор Красноштан
Кандидат біологічних наук, доцент
Уманський державний педагогічний університет імені Павла Тичини
20300, вул. Садова, 2, м. Умань, Україна
https://orcid.org/0000-0003-1317-546X

Анотація. Однією з ключових проблем сучасної екології та лісівництва є поширення робінії звичайної, що призводить до трансформації лісових екосистем і втрати біорізноманіття. Метою роботи було визначити структурні особливості вторинного соснового насадження та проаналізувати інвазійне поширення *Robinia pseudoacacia* L. Дослідження було проведено у 2025 році у сосновому насадженні Вінницької області за методикою Braun-Blanquet з оцінкою ярусної організації та частоти трапляння видів; додатково для робінії звичайної виконано аналіз вікової структури популяції за діаметром стовбура та висотою рослин. Облік здійснювали на узліссі та у внутрішніх ділянках лісу. Встановлено, що видовий склад лісового насадження є просторово диференційованим. Центральна частина угруповання формувалась переважно сосною звичайною (*Pinus sylvestris* L.) та березою повислою (*Betula pendula* Roth.), тоді як на східному узліссі домінувала робінія, утворюючи деревний, підлісковий і чагарниковий яруси. Виявлено наявність усіх вікових груп робінії – від проростків до старих генеративних особин, що вказує на її стабільне відновлення та високий інвазійний потенціал. У внутрішніх ділянках лісу вид відсутній, що зумовлено щільним пологом автохтонних дерев і конкуренцією з аборигенною флорою. Отримані результати свідчать про локальний, екотонний характер інвазії робінії, зосередженої у крайових частинах деревостану, суміжних із агроландшафтами. Наявність численних молодих генерацій є ознакою інвазійного тиску, що може зумовити поступове розширення популяції. Отримані результати можуть бути використані у практиці лісового господарства для моніторингу інвазійних видів та розробки заходів зі збереження біорізноманіття

Ключові слова: лісові насадження; видовий склад; вікова структура; інвазійні види; робінія звичайна