ANNALS OF THE
UNIVERSITY OF CRAIOVA

Series: ✓ *Biology*
✓ *Horticulture*
✓ *Food products processing technology*
✓ *Environmental engineering*

Vol. XXIX (LXV)- 2024

TREE DIVERSITY AND RESILIENCE IN BUCHAREST URBAN PARKS

Camen-Comănescu Petronela[1], Urziceanu Mihaela [2,4,*], Raicu Maria[1,3], Tomescu Claudia[5], Anastasiu Paulina[1,2]

[*] Botanic Garden "D. Brandza", University of Bucharest
[2] University of Bucharest, Faculty of Biology
[3] University of Agronomic Sciences and Veterinary Medicine Bucharest
[4] Reasearch Institute of the University of Bucharest (ICUB)
[5] University of Bucharest, Faculty of Geography

* *Correspondence author. E-mail*: petronela.comanescu@bio.unibuc.ro
mariana-mihaela.urziceanu@bio.unibuc.ro

Keywords: *urban biodiversity, woody plants, stress factors*

ABSTRACT

Urban parks are essential for maintaining biodiversity in cities. This study assesses the tree diversity and ecological resilience, and stress tolerance of species in five major parks in Bucharest: Herăstrău, Kiseleff, Tineretului, Cişmigiu, and Carol. A total of 125 species from 32 families were recorded, with the highest diversity in Cişmigiu and Carol and the lowest in Kiseleff. NMDS analysis revealed similar species compositions in all parks except Kiseleff, which was distinct. No significant correlations were found between species richness and park size or age, suggesting other factors, such as management, play a larger role. Species with higher tolerance to drought and air pollution are significantly more present in Bucharest's parks, while pest tolerance shows no significant difference in their presence. The predominance of non-native species, particularly invasive ones in Cişmigiu and Tineretului, underscores the need for better management. ANOVA results confirmed significant differences in the distribution of non-native species categories, emphasizing the importance of targeted strategies to control invasive species and promote native biodiversity.

INTRODUCTION

Trees are a vital component of urban floristic diversity, contributing significantly to environments such as streets, university campuses, parks, residential yards, and other open spaces (Liu et al. 2021, Liu & Slik 2022, Anderson & Cordell 1988, Nielsen et al. 2014). Urban trees provide essential ecosystem services, including the reduction of air pollution by releasing oxygen, sequestering CO2, absorbing gaseous pollutants, and intercepting particulate matter (Chen & Jim 2008, Nowak et al. 2006, Scott et al. 1998). Beyond air quality improvement, tree canopies help mitigate the urban heat island effect by reflecting and intercepting solar radiation, which moderates the temperatures around buildings and pavements (Akbari et al. 2001, Millward & Sabir 2011). Additionally, trees play a crucial role in reducing noise, stabilizing soils, minimizing erosion, and conserving biodiversity by providing habitats for wildlife (Endress 1990, Liu & Slik 2022, Salisbury et al. 2015).

However, urban trees are increasingly threatened by pests and diseases, whose impacts have intensified due to climate change. Recent pest invasions have led to significant losses in urban tree populations, underlining the importance of maintaining a diverse tree population to mitigate these threats (Lacan & McBride 2008, Nowak 2001). Higher taxonomic diversity, particularly at the genus and family levels, is often recommended, as pests and diseases tend to target specific taxa.

Urban parks, where trees form a key structural component, are particularly critical for fostering ecosystem resilience and supporting climate change adaptation (Blood et al. 2016). To preserve biodiversity, these parks should prioritize native species, while exotic species should only be planted if their invasive potential is minimal (Berthon et al. 2021, Liu & Slik 2022). Invasive species have already been responsible for replacing native trees and diminishing biodiversity in many urban areas (Narango et al. 2018, Shackleton 2016, Burghardt et al. 2010, Čeplová et al. 2017), with studies estimating that 62% of invasive species were introduced for horticulture and 13% for forestry purposes (Richardson & Rejmanek 2011).

In the face of climate change, urban areas are increasingly exposed to stressors like drought and heat waves, which significantly impact the health and stability of urban vegetation, including trees. In Bucharest, the intensification of droughts, combined with other stressors like air pollution and soil compaction, has made it crucial to evaluate the tolerance of tree species to environmental factors (Liu et al. 2021; Percival 2023). Traits such as drought tolerance, pest resistance, and pollution absorption are particularly important for assessing the resilience of urban trees and guiding future species selection (Gillner et al. 2014; Zhang & Brack 2021). Trees that exhibit strong adaptability to these stressors are more likely to survive and thrive in urban environments under future climatic conditions (Liu et al. 2021).

Given these challenges, the aim of this study is to assess the diversity and ecological resilience of trees in selected parks in Bucharest. By inventorying the species and evaluating traits relevant to climate resilience—such as drought pollution absorption, and pest resistance—this study seeks to provide authorities with data-driven recommendations for enhancing the resilience of urban forests. Such information is essential for ensuring that Bucharest’s green spaces continue to provide critical ecosystem services while adapting to future climate conditions.

MATERIAL AND METHODS

Study Area. The inventory was conducted in five parks in Bucharest, all of which are over 50 years old: **Cișmigiu** (established in 1799, 16 ha), **Kiseleff** (established in 1844, 3 ha), **Carol** (established in 1905, 41 ha), **Herăstrău** (established in 1936, 187 ha), and **Tineretului** (established in 1964, 150 ha) (Figure 1). The total surveyed area covered 397 hectares, which represents 1.65% of Bucharest's total area. These parks are not only significant green spaces but also serve as cultural landmarks with historical importance: Cișmigiu Park, located in the city center, is known for its romantic layout and history, being the oldest public park in Bucharest; Kiseleff Park is one of the smallest, located along the famous Șoseaua Kiseleff, a historical boulevard; Carol Park, south of the city center, is notable for its monumental architecture and the Tomb of the Unknown Soldier; Herăstrău Park, the largest, surrounds Lake Herăstrău and features a Village Museum showcasing Romania's rural architecture; Tineretului Park, designed for recreational purposes, includes a variety of sports facilities and has a rich birdlife due to its proximity to Lake Tineretului (Figure 1).

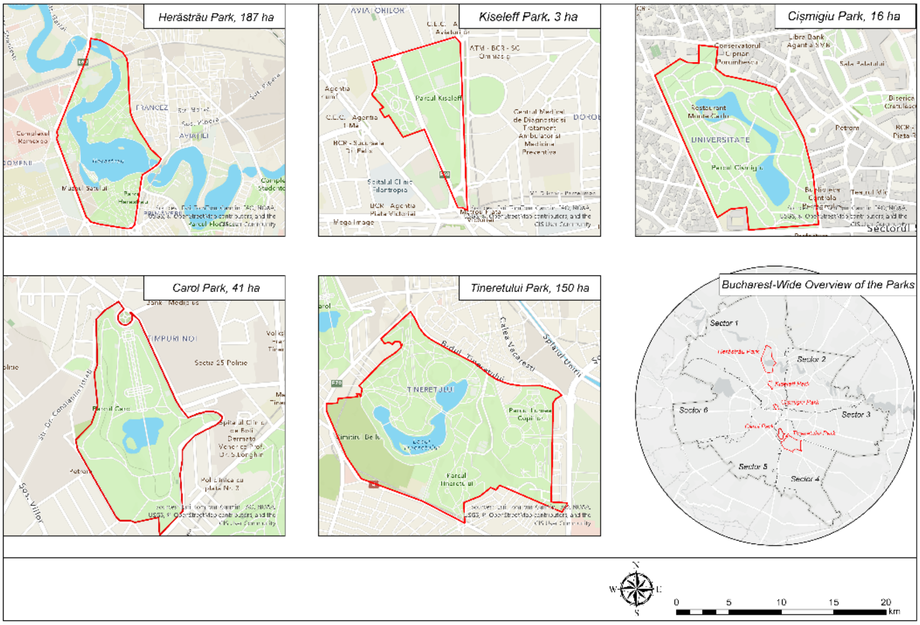

Figure 1. Map of Bucharest Urban Parks: Herăstrău, Kiseleff, Cişmigiu, Carol, and Tineretului with City-Wide Overview

Data Collection and Tree Inventory. Frequent visits were carried out over a six-month period (April 2024 – September 2024) to identify and record the trees cultivated in these parks. The inventory also included several hybrids and varieties of species that are commonly used in landscaping in Romania. We included all taxa classified as either "tree" or "shrub or tree" in the Plants of the World Online database (POWO, 2024). This database was also used for the nomenclature and nativity classification of the species. Tree identification was based on various botanical references, including: Beldie (1953), Zanoschi et al. (1996), Spohn & Spohn (2008), Russell & Cutler (2012), Sârbu et al. (2013).

For each taxon, the following characteristics were recorded: family, nativity, invasive status, and traits relevant to resilience in urban conditions, such as drought tolerance, pest vulnerability, air pollution tolerance, A full dataset is available upon request, but for the purposes of this study, only synthesized analyses and key species lists are presented.

Trait Analysis and Data Sources. We retrieved information on species traits from several key sources: Niinemets & Valladares (2006), Online databases such as: UFEI (https://selectree.calpoly.edu/), CITREE (https://citree.de/), University of Florida IFAS Extension (https://hort.ifas.ufl.edu/), Trees and Shrubs Online (https://treesandshrubsonline.org/). These sources provided critical data on tree tolerance to environmental stressors such as drought, heat, air pollution, and pest resistance, which are vital for understanding species' ecological resilience in urban environments.

Statistical Analysis. Taxonomic diversity was assessed based on the number of species, genera, and families present in each park. We used Non-metric Multidimensional Scaling (NMDS) based on the Jaccard distance to compare species composition between parks. The NMDS analysis was performed using R software (version 4.4.1; R Core Team, 2024) with the "vegan" package. The stress value for the NMDS plot was calculated to ensure an accurate fit, with values below 0.1 considered indicative of a good fit.

Spearman's rank correlation was used to examine the relationships between species richness and park characteristics such as park size and year of establishment. These correlations were calculated using R software, and significance was determined based on the rho values and p-values. Additionally, ANOVA was applied to compare native and non-native species diversity across the parks.

To analyze species' tolerance to various environmental stressors (drought, heat, pests, air pollution), species were grouped into three tolerance levels (Low, Moderate, High). A one-way ANOVA was conducted to examine differences in the average number of species across these tolerance levels. Excel was used for initial data processing, and R was used for statistical significance testing. Results were deemed statistically significant at a p-value < 0.05.

The spatial data was processed using ArcGIS Pro 3.3.1 (ESRI, 2024), enabling the mapping of the five parks across Bucharest.

RESULTS AND DISCUSSIONS

Species Richness and Taxonomic Diversity

A total of 125 species from 63 genera and 32 families were recorded across the five parks (Appendix 1), covering a surveyed area of 397 hectares (1.65% of Bucharest's total area). Cismigiu Park exhibited the highest taxonomic diversity, with 85 species, 53 genera, and 27 families, while Kiseleff Park showed the lowest diversity with 44 species, 30 genera, and 17 families. Intermediate diversity levels were observed in Carol (84 species), Tineretului (73 species), and Herăstrău (74 species) (Figure 2).

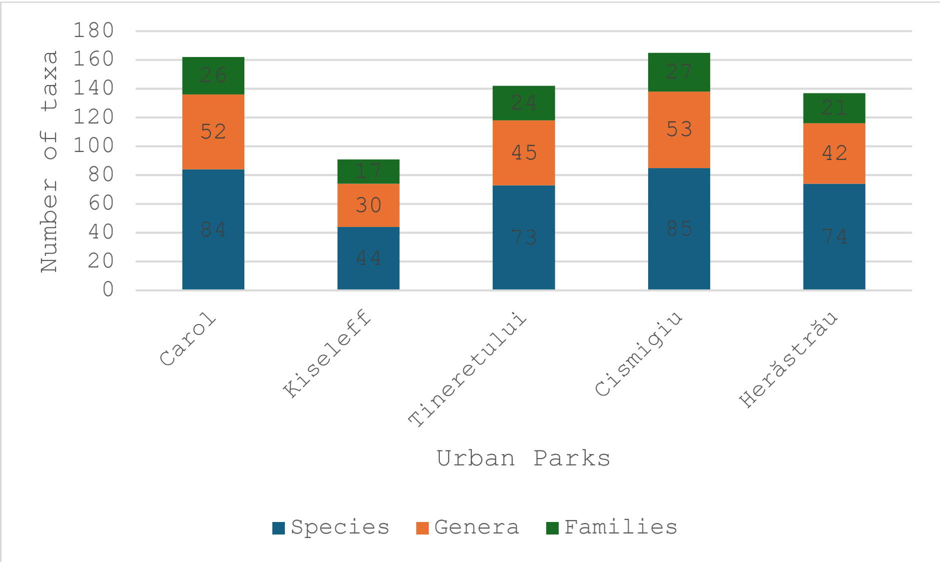

Figure 2. Taxonomic Diversity of Tree Species, Genera, and Families in Bucharest Urban Parks

These results reflect patterns commonly found in European cities, where species diversity is influenced by historical factors, park size, and urban planning (D’Amato et al., 2023; Konijnendijk et al., 2005).

Across the parks, Rosaceae and Pinaceae were the most represented families, each with 15 genera. The genus *Prunus* had the highest number of species (9), including both ornamental and fruit-bearing species (e.g., *Prunus serrulata*, *Prunus laurocerasus*, *Prunus cerasus*). Other dominant genera included *Acer* (7 species), *Fraxinus* (6 taxa), and *Populus* (5 taxa). These genera are frequently selected for urban environments due to their aesthetic appeal and resilience to urban stressors such as drought and pollution (Bassuk, 2003).

Taxon Frequency and Species Distribution

The frequency analysis (Figure 3) shows that 26 taxa (20.8%) were present in all five parks, with species such as *Acer campestre, Acer negundo, Acer platanoides, Aesculus hippocastanum, Fraxinus angustifolia, Populus nigra, Robinia pseudoacacia, Tilia platyphyllos, and Tilia tomentosa* being the most frequently encountered. These species are widely favored in urban environments for their ability to provide shade, mitigate air pollution, and resist urban stressors. Additionally, 23 species were found in four parks, including *Albizia julibrissin, Clerodendrum trichotomum* and *Prunus laurocerasus*, while 16 species were identified in three parks and 20 species in two parks, reflecting varying degrees of adaptability to local environmental conditions. A significant portion of species (38 taxa, 30.15%) were considered rare, being found in only one park. These include ornamental trees typically found in botanical gardens, such as *Aesculus carnea*, *Aesculus pavia*, *Torreya nucifera*, *Exochorda racemosa*, and *Clerodendrum trichotomum*, as well as popular "trendy" species that have recently gained traction in urban landscaping, like *Cedrus atlantica*, *Cedrus deodara*, *Ilex aquifolium*, *Ilex cornuta*, and *Liriodendron tulipifera* (Sjöman et al., 2012).

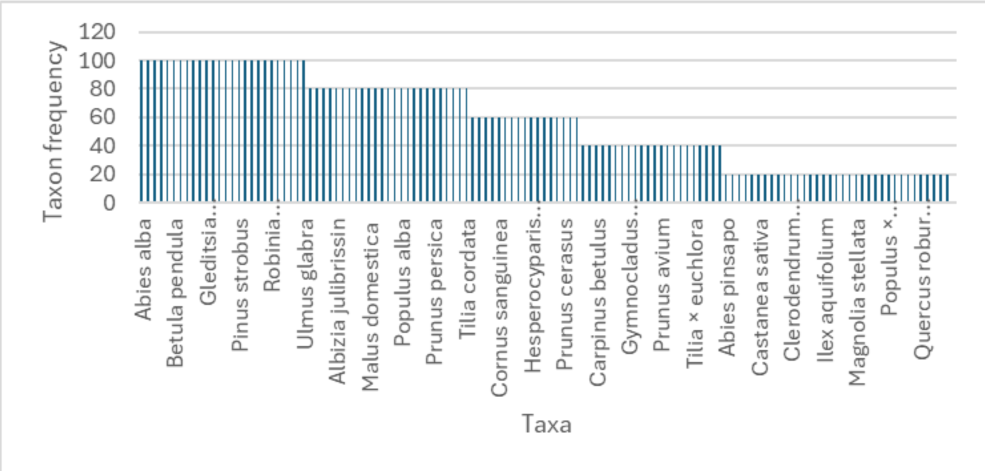

Figure 3. Taxon Frequency Distribution Across Bucharest Urban Parks

NMDS Analysis of Species Composition

The Non-metric Multidimensional Scaling (NMDS) analysis, based on Jaccard distances (Figure 4), revealed clustering of Carol, Cismigiu, Tineretului, and Herăstrău, indicating a similar species composition among these parks. Kiseleff, however, showed a more distinct species composition, positioned separately on the NMDS plot. This difference suggests that Kiseleff harbors species less commonly found in other parks, possibly due to unique environmental conditions or management practices. The low stress value (0.00009) indicates a high accuracy of the data representation.

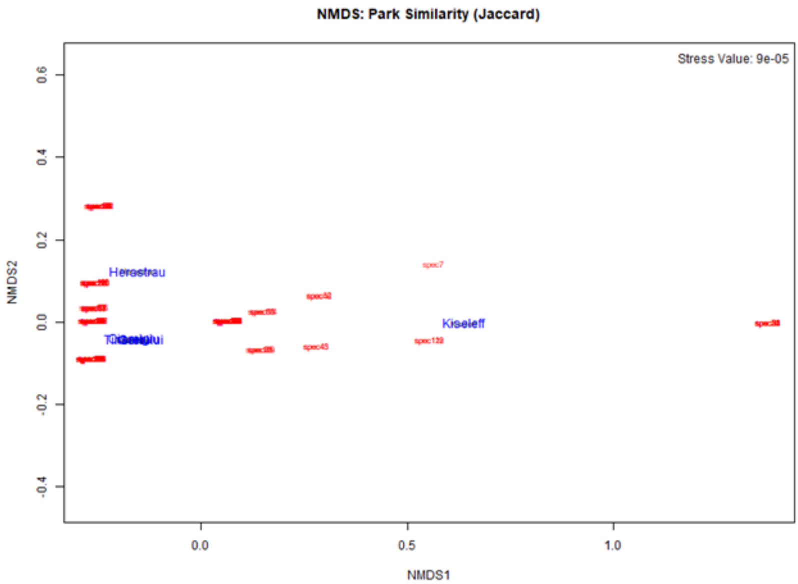

Figure 4. NMDS Plot of Species Composition Similarity Among Bucharest Urban Parks (Jaccard Index)

Correlation Between Species Richness, Park Size, and Age

The Spearman correlation analysis found no significant relationship between species richness and park size (rho = 0.1, p = 0.95) or the year of establishment (rho = -0.4, p = 0.5167) (Figures 5 and 6). This suggests that other factors, such as ecological management and environmental conditions, may play a larger role in influencing species diversity in Bucharest's urban parks. The absence of correlation between park age and species richness is consistent with findings from other urban studies, where management practices and environmental stressors have a stronger impact than park history (D'Amato et al., 2023).

Native and Non-Native Species Distribution

The analysis of native and non-native species (Figure 7) shows a clear predominance of non-native species in all parks. Carol and Cişmigiu had the highest numbers (54 species each), significantly outnumbering native species. Tineretului and Herăstrău also recorded high counts of non-native species (48 and 44, respectively), while Kiseleff had the fewest (26). This high presence of non-native species raises concerns about potential ecological imbalances, particularly due to the spread of invasive species. The one-way ANOVA confirmed a statistically significant difference between native and non-native species diversity across the parks ($F(1, 8) = 10.39$, $p = 0.012$), indicating the need for targeted management to maintain ecological balance in parks with a high proportion of non-native species.

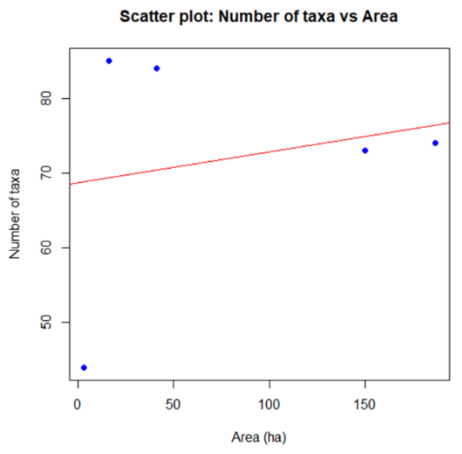

Figure 5. Taxa vs. Park Area

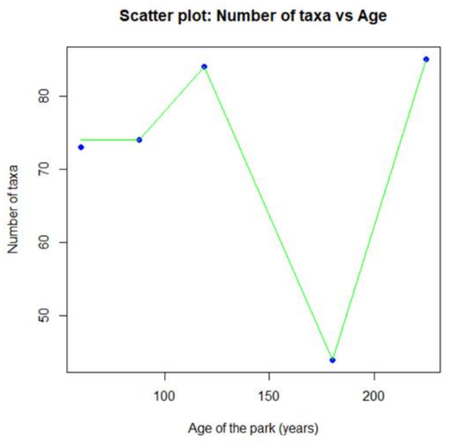

Figure 6. Taxa vs. Park Age

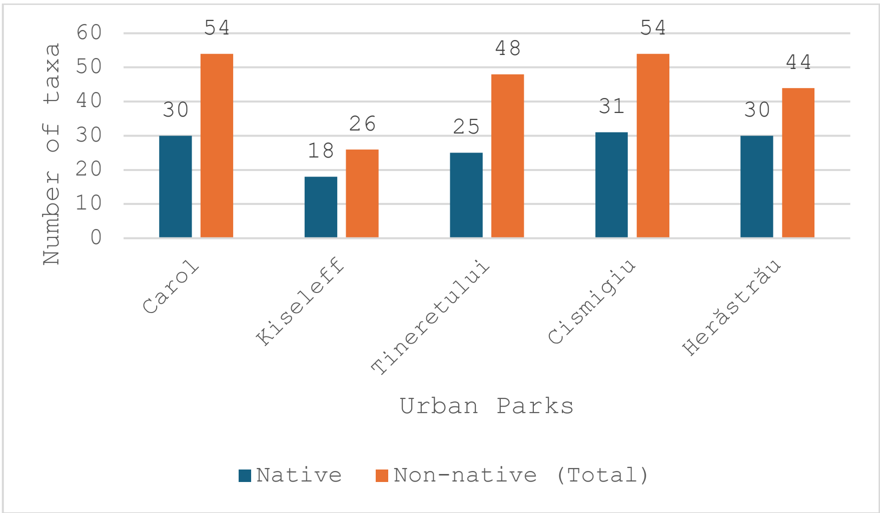

Figure 7. Comparison of native and non-native species across five urban parks in Bucharest.

When categorizing the non-native species (Figure 8), Carol and Cişmigiu had the highest numbers of casual species (17 and 20, respectively). Tineretului and Herăstrău showed a greater number of invasive species (9 and 8, respectively), posing a risk of outcompeting native species. In contrast, Kiseleff had fewer invasive species (4), suggesting greater resilience to ecological disruptions. The ANOVA for the distribution of non-native species categories also revealed a significant difference ($F(3, 16) = 12.05$, $p = 0.00022$), showing that casual and acclimatized species are more prevalent in some parks. These findings emphasize the need to monitor non-native species to prevent the further spread of invasive taxa and ensure the sustainability of urban biodiversity.

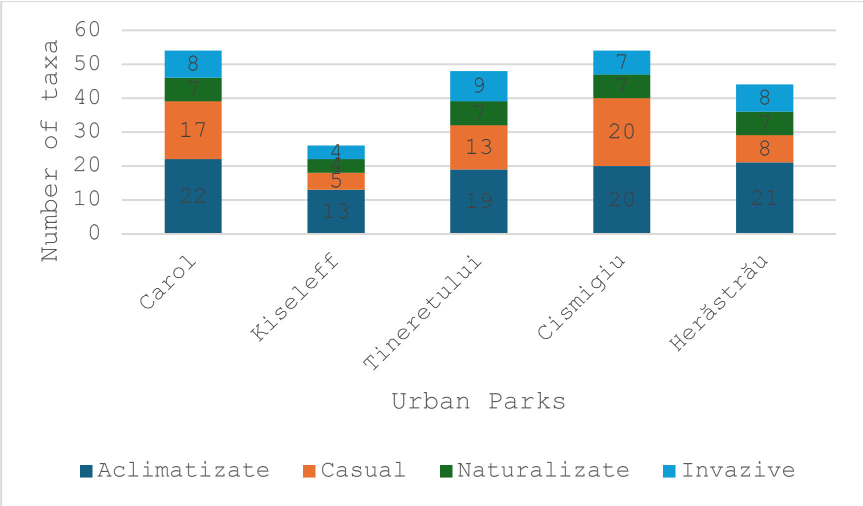

Figure 8. Distribution of Non-Native Species Categories Across Bucharest Urban Parks

Stress Tolerance of Species

The analysis of tree species across the five parks in Bucharest, categorized by their tolerance to environmental stress factors—Drought, Pest, and Air Pollution—grouped into three tolerance levels (Low, Moderate, and High), revealed important findings. As shown in Table 1, the one-way ANOVA results indicated significant differences between tolerance categories for Drought ($p = 6.4e\text{-}05$) and Air Pollution ($p = 0.0182$). This suggests that species with higher tolerance to these factors are more prevalent, emphasizing the role of drought resilience and air quality in shaping species diversity in urban parks. Among these are *Pinus nigra*, *Pinus sylvestris*, *Sambucus nigra*, *Styphnolobium japonicum*, species very resistant to drought, pest and air pollution and which are present with high frequency in the five parks.

These findings align with research from Mediterranean cities, where species such as *Pinus pinea* and *Quercus ilex* are preferred for their drought and heat resistance (Konijnendijk et al., 2005; Sieghardt et al., 2005).

In contrast, the Pest tolerance analysis yielded a p-value of 0.0796, which is not statistically significant, but approaching significance. This suggests that pest tolerance may moderately influence species distribution, though it is less decisive compared to drought and air pollution. The high proportion of species with strong drought and pest tolerance as *Fraxinus pennsylvanica, Pinus nigra, Populus alba, Robinia pseudoacacia,* underscores the necessity of selecting resilient species to withstand the growing challenges of climate change, such as heat waves, water scarcity, and the emergence of new pest threats (Sieghardt et al., 2005). This is particularly crucial as urban environments face increasing pressures, making the selection of resilient tree species vital for sustaining urban biodiversity.

Table 1.

ANOVA Results for the Number of Tree Species by Tolerance to Drought, Pest, and Air Pollution in Bucharest Parks

Factor	p-value	Interpretation
Drought	6.4e-05	Significant differences between tolerance levels ($p < 0.05$)
Pest	0.0796	No significant differences ($p > 0.05$), but approaching significance
Air Pollution	0.0182	Significant differences between tolerance levels ($p < 0.05$)

CONCLUSIONS

This study highlights the biodiversity and ecological resilience of tree species across five major parks in Bucharest. The results show that Cismigiu and Carol parks have the highest species diversity, while Kiseleff displays the lowest, indicating potential areas for ecological improvement. The prevalence of non-native species, especially invasive species in Tineretului and Herăstrău, raises concerns about biodiversity management, emphasizing the need for targeted interventions to control invasive species and promote native species.

The analysis revealed that species with higher tolerance to drought and air pollution are significantly more common in Bucharest’s parks, while pest tolerance shows no statistically significant influence, indicating that resilience to drought and air quality plays a more decisive role in shaping species distribution

Overall, the study underscores the importance of diverse and resilient urban tree populations to maintain ecological balance and enhance urban sustainability. Effective management strategies focusing on species diversity, the control of invasive species, and the promotion of stress-tolerant species are essential for the future sustainability of Bucharest’s urban parks.

REFERENCES

Akbari, H., Pomerantz, M., Taha, H. 2001. Cool surfaces and shade trees to reduce energy use and improve air quality in urban areas. Sol. Energy 70, 295–310.

Anderson, L.M., Cordell, H.K.1988. Residential property values improve by landscaping with trees. Southern J. Appl. Forestry, 9, 162–166.

Bassuk, N. 2003. Recommended urban trees:Site assessment and tree selection for stress tolerance. Cornell University, Urban Horticulture Institute.

Beldie, A.1953. Plantele lemnoase din RPR. Bucureşti, Editura Agro-Silvică.

Berthon, K., Thomas, F., & Bekessy, S. 2021. The role of ‘nativeness’ in urban greening to support animal biodiversity. Landscape and Urban Planning, 205,103959.

Blood, A., Starr, G., Escobedo, F., Chappelka, A., & Staudhammer, C. 2016. How do urban forests compare? Tree diversity in urban and periurban forests of the southeastern US. Forests, 7(6), 120.

Burghardt, K.T., Tallamy, D.W., Philips, C., & Shropshire, K.J. 2010. Non-native plants reduce abundance, richness, and host specialization in lepidopteran communities. Ecosphere, 1, 1–22.

Čeplová, N., Lososová, Z., & Kalusová, V. 2017. Urban ornamental trees: a source of current invaders; a case study from a European City. Urban Ecosystems, 20, 1135-1140.

Chen, W.Y., Jim, C.Y. 2008. Assessment and valuation of the ecosystem services provided by urban forests. In: Carreiro, M.M., Song, Y.-C., Wu, J. (Eds.), Ecology, Planning, and Management of Urban Forests: International Perspectives, Springer, New York, pp. 53–83.

D'Amato, L., Bartoli, F., Savo, V., Paiella, P. A., Messina, F., & Caneva, G. 2023. Distribution Pattern of Urban Street Trees in Rome (Italy): A Multifactorial Evaluation of Selection Criteria. Sustainability, 15(19), 14065.

Endress, A.G. 1990. The importance of diversity in selecting trees for urban areas. Journal of Arboriculture, 16(6), 143-147.

Esri. 2024. ArcGIS Pro (Version 3.3.1). Esri Inc. https://www.esri.com

Gillner, S., Bräuning, A., & Roloff, A. 2014. Dendrochronological analysis of urban trees: climatic response and impact of drought on frequently used tree species. Trees, 28, 1079-1093.

Konijnendijk, C., Nilsson, K., Randrup, T., & Schipperijn, J. (Eds.). 2005. Urban forests and trees: a reference book. Berlin, Heidelberg: Springer Berlin Heidelberg.

Lacan, I., & McBride, J. R. 2008. Pest Vulnerability Matrix (PVM): A graphic model for assessing the interaction between tree species diversity and urban forest susceptibility to insects and diseases. Urban Forestry and Urban Greening, 7, 291–300.

Liu, J., & Slik, F. 2022. Are street trees friendly to biodiversity?. Landscape and Urban Planning, 218, 104304.

Liu, J., Zhao, Y., Si, X., Feng, G., Slik, F., & Zhang, J. 2021. University campuses as valuable resources for urban biodiversity research and conservation. *Urban Forestry & Urban Greening, 64*, 127255.

Millward, A. A., & Sabir, S. 2011. Benefits of a forested urban park: What is the value of Allan Gardens to the city of Toronto, Canada?. Landscape and urban planning, 100(3), 177-188.

Narango, Desirèe L., Tallamy, Douglas W., & Marra, Peter P. 2018. Nonnative plants reduce population growth of an insectivorous bird. *Proceedings of the National Academy of Sciences, 115*(45), 11549–11554.

Nielsen, A. B., Van Den Bosch, M., Maruthaveeran, S., & Van den Bosch, C. K. 2014. Species richness in urban parks and its drivers: A review of empirical evidence. Urban ecosystems, 17, 305-327.

Niinemets, Ü., & Valladares, F. 2006. Tolerance to shade, drought, and waterlogging of temperate northern hemisphere trees and shrubs. Ecological monographs, 76(4), 521-547.

Nowak, D.J. 2001. Potential effect of Anoplophora glabripennis (Coleoptera: Cerambycidae) on urban trees in the United States. Journal of Economic Entomology, 94,116–122.

Nowak, D. J., Crane, D. E., & Stevens, J. C. 2006. Air pollution removal by urban trees and shrubs in the United States. Urban forestry & urban greening, 4(3-4), 115-123.

Percival, G.C. 2023. Heat tolerance of urban tree species-a review. Urban Forestry & Urban Greening, 128021.

POWO. 2024. Plants of the World Online. Facilitated by the Royal Botanic Gardens, Kew. Retrieved 28 June-30 September 2024, from http://www.plantsoft heworldonline.org/.

Richardson, D.M., Rejmanek, M. 2011. Trees and shrubs as invasive alien species - A global review. Divers. Distrib., 17, 788–809.

Russell, T., Cutler, C. 2012. World Encyclopedia of Trees. Leicester: Anness Publishing.

R Core Team. 2024. R: A language and environment for statistical computing (Version 4.4.1). R Foundation for Statistical Computing. https://www.R-project.org/

Salisbury, A., Armitage, J., Bostock, H., et al. 2015. Enhancing gardens as habitats for flower-visiting aerial insects (pollinators): Should we plant native or exotic species? Journal of Applied Ecology, 52, 1156–1164.

Sârbu, I., Ştefan, N. & Oprea, A. 2013. Plante Vasculare din România. Bucureşti. Editura Victor B Victor.

Scott, K.I., McPherson, E.G., Simpson, J.R. 1998. Air pollutant upte by Sacramento's urban forest. J. Arboriculture 24, 224–2.

Shackleton, C. 2016. Do indigenous street trees promote more biodiversity than alien ones? Evidence using mistletoes and birds in South Africa. Forests, 7(12), 134.

Sieghardt, M., Mursch-Radlgruber, E., Paoletti, E., Couenberg, E., Dimitrakopoulus, A., Rego, F., Hatzistatthis, A., Randrup, T. 2005. The abiotic urban environment: impact of urban growing conditions on urban vegetation. In: Konijnendijk, C.C., Nilsson, K., Randrup, T.B., Schipperijn, J. (Eds.), Urban Forests and Trees. Springer, Berlin, pp. 281–323.

Sjöman, H., Östberg, J., & Bühler, O. 2012. Diversity and distribution of the urban tree population in ten major Nordic cities. Urban Forestry & Urban Greening, 11(1), 31-39.

Spohn, M., Spohn, R. 2008. 350 arbres et arbustes. Paris: Delachaux et Niestle.

Zanoschi, V., Sârbu, D., & Toniuc, A. 1996. Flora lemnoasă spontană şi cultivată din România: încrengătura Angiospermatophyta. Vol 1-4. Glasul Bucovinei.

Zhang, B., & Brack, C. L. 2021. Urban forest responses to climate change: A case study in Canberra. Urban Forestry & Urban Greening, 57,126910.

Appendix 1. Inventory of Tree Species, Including Botanical Families, Nativity, Invasiveness, and: 1-Carol, 2-Kiseleff, 3-Tineretului, 4-Cișmigiu, 5- Herăstrău

Nr. crt.	Taxon	Family	Nativity	Invazivity
1.	Abies alba[1,2,3,4,5]	Pinaceae	native	
2.	Abies concolor[1,3,4,5]	Pinaceae	non-native	a
3.	Abies nordmanniana[3,4,5]	Pinaceae	non-native	a
4.	Abies pinsapo[5]	Pinaceae	non-native	a
5.	Acer campestre[1,2,3,4,5]	Sapindaceae	native	
6.	Acer negundo[1,2,3,4,5]	Sapindaceae	non-native	i
7.	Acer palmatum[2,5]	Sapindaceae	native	
8.	Acer platanoides[1,2,3,4,5]	Sapindaceae	native	
9.	Acer pseudoplatanus[1,3,4,5]	Sapindaceae	native	
10.	Acer saccharinum[1,3,4]	Sapindaceae	non-native	c
11.	Acer tataricum[2,3,4,5]	Sapindaceae	native	

Nr. crt.	Taxon	Family	Nativity	Invazivity
12.	Aesculus carnea[4]	Sapindaceae	non-native	a
13.	Aesculus hippocastanum[1,2,3,4,5]	Sapindaceae	non-native	c
14.	Aesculus pavia[4]	Sapindaceae	non-native	a
15.	Ailanthus altissima[1,3,4,5]	Simaroubaceae	non-native	i
16.	Albizia julibrissin[1,3,4,5]	Fabaceae	non-native	a
17.	Betula pendula[1,2,3,4,5]	Betulaceae	native	
18.	Broussonetia papyrifera[1]	Moraceae	non-native	c
19.	Buxus sempervirens[1,3,4]	Buxaceae	non-native	n
20.	Calocedrus decurrens[1,4]	Cupressaceae	non-native	a
21.	Caragana arborescens[5]	Fabaceae	non-native	c
22.	Carpinus betulus[1,4]	Betulaceae	native	
23.	Castanea sativa[3]	Fagaceae	non-native	a
24.	Catalpa bignonioides[1,2,3,4,5]	Bignoniaceae	non-native	n
25.	Catalpa ovata[3,4]	Bignoniaceae	non-native	c
26.	Cedrus atlantica[2]	Pinaceae	non-native	a
27.	Cedrus deodara[1]	Pinaceae	non-native	a
28.	Celtis australis[1,3,4,5]	Cannabaceae	non-native	c
29.	Celtis occidentalis[1,2,3,4]	Cannabaceae	non-native	c
30.	Cercis siliquastrum[1,3,4]	Fabaceae	non-native	c
31.	Chamaecyparis lawsoniana[1,3,4,5]	Cupressaceae	non-native	a
32.	Chamaecyparis pisifera[2]	Cupressaceae	non-native	a
33.	Cladrastis kentukea[4]	Fabaceae	non-native	c
34.	Clerodendrum trichotomum[4]	Verbenaceae	non-native	a
35.	Cornus mas[4]	Cornaceae	native	
36.	Cornus sanguinea[1,3,4]	Cornaceae	native	
37.	Corylus colurna[1,4]	Betulaceae	native	
38.	Crataegus monogyna[1,2,3,4,5]	Rosaceae	native	
39.	Diospyros virginiana[1,4]	Ebenaceae	non-native	c
40.	Exochorda racemosa[4]	Rosaceae	non-native	a
41.	Fagus sylvatica[4]	Fagaceae	native	
42.	Ficus carica[4]	Moraceae	non-native	c
43.	Fraxinus americana[1,2,4]	Oleaceae	non-native	c
44.	Fraxinus angustifolia subsp. angustifolia[1,2,3,4,5]	Oleaceae	native	
45.	Fraxinus angustifolia subsp. oxycarpa[2,3,4]	Oleaceae	native	
46.	Fraxinus excelsior[1,2,5]	Oleaceae	native	
47.	Fraxinus excelsior f. diversifolia[1,4,5]	Oleaceae	native	
48.	Fraxinus pennsylvanica[1,2,3,4,5]	Oleaceae	non-native	i
49.	Ginkgo biloba[1,4]	Ginkgoaceae	non-native	c
50.	Gleditsia triacanthos[1,2,3,4,5]	Fabaceae	non-native	n
51.	Gymnocladus dioicus[1,4]	Fabaceae	non-native	c
52.	Hesperocyparis arizonica[2,3,5]	Cupressaceae	non-native	a
53.	Ilex aquifolium[2]	Aquifoliaceae	non-native	a

Nr. crt.	Taxon	Family	Nativity	Invazivity
54.	Ilex cornuta[2]	Aquifoliaceae	non-native	a
55.	Juglans regia[1,2,3,4,5]	Juglandaceae	non-native	n
56.	Juniperus chinensis[1,5]	Cupressaceae	non-native	a
57.	Juniperus virginiana[1,3,5]	Cupressaceae	non-native	i
58.	Koelreuteria paniculata[1,2,3,4,5]	Sapindaceae	non-native	n
59.	Laburnum anagyroides[1,5]	Fabaceae	native	
60.	Larix decidua[5]	Pinaceae	native	
61.	Liquidambar styraciflua[3]	Hamamelidaceae	non-native	a
62.	Liriodendron tulipifera[5]	Magnoliaceae	non-native	a
63.	Maclura pomifera[1,4,5]	Moraceae	non-native	c
64.	Magnolia stellata[5]	Magnoliaceae	non-native	a
65.	Magnolia × soulangiana[1,2,3,4]	Magnoliaceae	non-native	a
66.	Malus domestica [1,2,3,5]	Rosaceae	non-native	a
67.	Malus × floribunda[1,3,4,5]	Rosaceae	non-native	a
68.	Morus alba[1,3,4,5]	Moraceae	non-native	i
69.	Morus nigra[1,3,4]	Moraceae	non-native	n
70.	Paulownia tomentosa[3,4]	Bignoniaceae	non-native	c
71.	Photinia × fraseri[2]	Rosaceae	non-native	a
72.	Picea abies[1,3,4,5]	Pinaceae	native	
73.	Picea laxa[1]	Pinaceae	non-native	a
74.	Picea pungens[1,2,3,4,5]	Pinaceae	non-native	a
75.	Pinus nigra[1,2,3,4,5]	Pinaceae	native	
76.	Pinus strobus[1,2,3,4,5]	Pinaceae	non-native	a
77.	Pinus sylvestris[1,3,4,5]	Pinaceae	native	
78.	Platanus occidentalis[3]	Platanaceae	non-native	c
79.	Platanus orientalis[1]	Platanaceae	non-native	c
80.	Platanus × hispanica[1,2,3,4,5]	Platanaceae	non-native	a
81.	Platycladus orientalis[1,2,3,4,5]	Cupressaceae	non-native	c
82.	Populus × canadensis[3]	Salicaceae	non-native	i
83.	Populus alba[1,3,4,5]	Salicaceae	native	
84.	Populus nigra[1,3,4,5]	Salicaceae	native	
85.	Populus nigra 'Italica'[3,4,5]	Salicaceae	native	
86.	Populus simonii [1,5]	Salicaceae	non-native	a
87.	Prunus amygdalus[4]	Rosaceae	non-native	a
88.	Prunus armeniaca[5]	Rosaceae	non-native	c
89.	Prunus avium[1,5]	Rosaceae	native	
90.	Prunus cerasifera[1,3,4,5]	Rosaceae	non-native	i
91.	Prunus cerasifera 'Pissardii'[1,3,4,5]	Rosaceae	non-native	a
92.	Prunus cerasus[1,3,4]	Rosaceae	non-native	a
93.	Prunus laurocerasus[1,3,4,5]	Rosaceae	non-native	a
94.	Prunus persica[1,3,4,5]	Rosaceae	non-native	c
95.	Prunus serrulata[4,5]	Rosaceae	non-native	a
96.	Pseudotsuga menziesii[1,3]	Pinaceae	non-native	a

Nr. crt.	Taxon	Family	Nativity	Invazivity
97.	Ptelea trifoliata[1]	Rutaceae	non-native	a
98.	Quercus cerris[5]	Fagaceae	native	
99.	Quercus robur subsp. robur[1,2,3,4,5]	Fagaceae	native	
100.	Quercus robur subsp. pedunculiflora[1]	Fagaceae	native	
101.	Quercus rubra[1,2,3,4,5]	Fagaceae	non-native	i
102.	Rhus typhina[5]	Anacardiaceae	non-native	n
103.	Robinia pseudoacacia[1,2,3,4,5]	Fabaceae	non-native	i
104.	Robinia viscosa[1]	Fabaceae	non-native	c
105.	Salix alba[1,3,4]	Salicaceae	native	
106.	Salix babylonica[3,4,5]	Salicaceae	non-native	c
107.	Sambucus nigra[1,3,4,5]	Adoxaceae	native	
108.	Scandosorbus intermedia[3,5]	Rosaceae	non-native	a
109.	Styphnolobium japonicum[1,2,3,4]	Fabaceae	non-native	c
110.	Syringa vulgaris[1,2,3,4,5]	Oleaceae	native	
111.	Tamarix tetrandra[3,4]	Tamaricaceae	non-native	c
112.	Taxodium distichum[1,3,4,5]	Cupressaceae	non-native	n
113.	Taxus baccata[1,2,3,4,5]	Taxaceae	native	
114.	Thuja occidentalis[1,2,3,5]	Cupressaceae	non-native	a
115.	Tilia cordata[1,3,4,5]	Malvaceae	native	
116.	Tilia platyphyllos[1,2,3,4,5]	Malvaceae	native	
117.	Tilia tomentosa[1,2,3,4,5]	Malvaceae	native	
118.	Tilia × euchlora[1,2]	Malvaceae	non-native	a
119.	Torreya nucifera[4]	Taxaceae	non-native	a
120.	Tsuga canadensis[1,5]	Pinaceae	non-native	a
121.	Ulmus glabra[1,2,3,4,5]	Ulmaceae	native	
122.	Ulmus laevis[1,2]	Ulmaceae	native	
123.	Ulmus minor[4,5]	Ulmaceae	native	
124.	Ulmus pumila[5]	Ulmaceae	non-native	n
125.	Viburnum rhytidophyllum[1,4]	Caprifoliaceae	non-native	c