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Ecological Inventory and Condition of Green Spaces in the Historical Center of Ivano-Frankivsk: Analysis Using the Example of Mickiewicz Square and the Ruska Triytsia Square

Vasyl Boichuk[1], Nadiia Riznychuk[1*]

[1]*Department of Biology and Ecology, Vasyl Stefanyk Carpathian National University, Ivano-Frankivsk 76018, Ukraine*

*Corresponding author: Nadiia Riznychuk: nadiia.riznychuk@cnu.edu.ua

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Abstract

Amid contemporary challenges related to climate change, urbanization, and biodiversity loss, high-quality monitoring of urban green spaces is becoming increasingly essential. This article presents the results of an ecological inventory and assessment of tree and shrub plantings in the central part of Ivano-Frankivsk—specifically, Mickiewicz Square and the Ruska Triytsia Square. The study encompasses an analysis of species composition, age structure, morphometric parameters, phytosanitary condition, and observed damage (including fungal infections, hollows, mechanical injuries, trunk inclinations, etc.). In total, over 200 planting objects were recorded, with *Tilia cordata* Mill., *Aesculus hippocastanum* L., *Syringa vulgaris* L., and other ornamental species prevailing. A comparative evaluation of the ecosystem value of the surveyed areas was carried out, and potential threats to their sustainable existence were identified. A comprehensive set of recommendations is proposed to enhance the resilience of urban green spaces under anthropogenic pressure, including sanitary and formative pruning, treatment, installation of protective barriers, replacement of hazardous trees, and other interventions. The results may serve as a basis for greening strategies, urban environment management, preservation of the city's historical landscape, and enhancement of its climate resilience.

Keywords: urban greening, urban environment, green infrastructure, sustainable development, biodiversity, climate change.

1. INTRODUCTION

Urbanized areas of modern cities serve not only social and economic functions but also form unique local ecosystems that significantly influence the microclimate, air quality, noise levels, and psychological well-being of residents. Green spaces play a crucial role in maintaining the ecological balance of the urban environment, particularly in central districts where anthropogenic pressure is most intense (Khalaim et al., 2021; Dronova et al., 2023). Ivano-Frankivsk, as one of Ukraine's historic

cities, preserves numerous examples of cultural heritage, complemented by green squares, parks, and plantings that shape the landscape structure of the urban space.

The relevance of conducting an ecological inventory of green spaces in the central part of Ivano-Frankivsk lies in the need to update data on the condition of urban greenery and to define measures for its restoration and rational use. This study focuses on Mickiewicz Square and the Ruska Triytsia Square - areas of high historical and cultural value that are intensively used for public recreation (Ma et al., 2021; Dronova et al., 2023).

The purpose of this study is to carry out a comprehensive inventory of tree and shrub plantings, assess their physiological condition, identify damages and risk factors, and develop recommendations to optimize maintenance and enhance the ecological resilience of the urban environment.

2. RESEARCH OBJECTIVE, METHODOLOGY AND DATA

The study was conducted within the central part of Ivano-Frankivsk, specifically in Mickiewicz Square and the Ruska Triytsia Square. These areas represent key components of the city's historical landscape and possess high recreational and cultural value. The primary objective was to carry out a complete ecological inventory of existing green plantings to assess their condition and plan further maintenance measures.

Fieldwork included visual examination of each tree and shrub with parameters recorded in standardized inventory sheets (Nielsen et al., 2014). The recorded data included species identity, planting type, plant height, trunk diameter and circumference, estimated age, morphological damage (presence of hollows, rot, fungi, bark injuries, trunk lean, wires, nails, etc.), crown condition (estimated percentage of dry branches), and presence of decorative or technical elements (lamps, garlands, fences, etc.). Data collection followed standardized forms developed by the authors.

The inventory was conducted using a custom-designed data collection form and subsequently aggregated in tabular format. In total, over 200 plant units of various ages and species were surveyed. The dominant tree species included *Tilia cordata* Mill., *Aesculus hippocastanum* L., *Fraxinus* spp., and *Syringa vulgaris* L., among others.

Data analysis was based on comparative dendroecological evaluation methods, descriptive statistical approaches, and classification of tree condition according to damage level and required maintenance actions (Bidolakh, 2023).

3. RESULTS AND DISCUSSION

The ecological inventory revealed a considerable diversity of green plantings within Mickiewicz Square and the Ruska Triytsia Square. In total, more than 200 specimens of trees and shrubs were recorded, representing over 30 species. Among the tree species, the most prevalent were *Tilia cordata* Mill., *Aesculus hippocastanum* L., *Acer platanoides* L., and *Fraxinus pennsylvanica* Marshall. As for shrub species, the dominant ones included *Syringa vulgaris* L., *Forsythia* Vahl, and *Spiraea* spp. (Fig. 1).

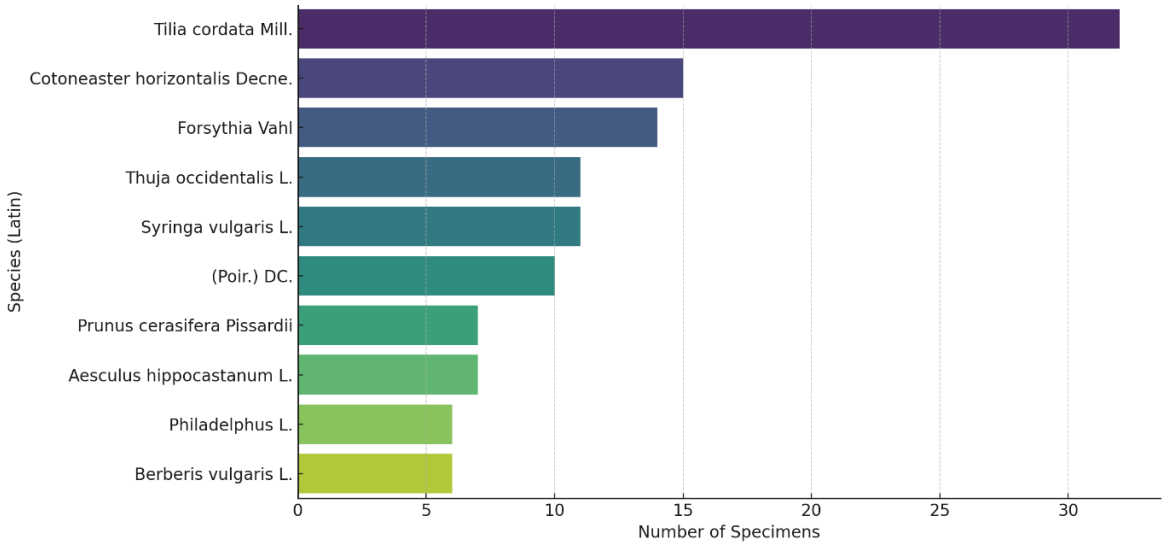

Fig. 1. The most common species of Mickiewicz Square and the Ruska Triytsia Square.

The height of plants varies within a broad range—from 0.25 m in hedges to 34 m in individual mature trees. The majority of plantings (over 60%) fall within the 2–10 m range, indicating a predominance of ornamental shrubs and young trees. At the same time, the presence of tall trees (over 20 m in height) reflects the presence of aged vegetation with high ecological and cultural value (Fig. 2).

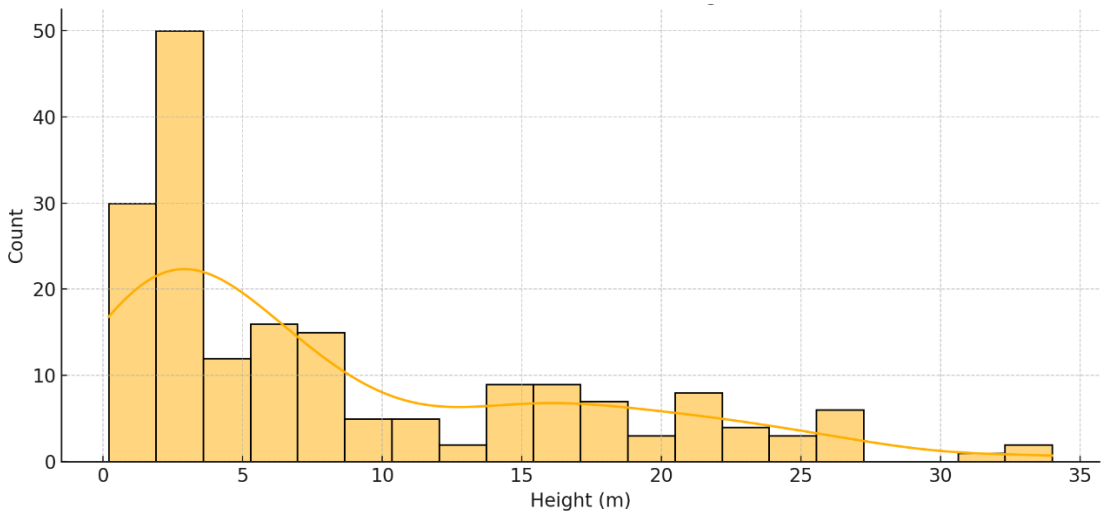

Fig. 2. Plant height structure in Mickiewicz Square and Ruska Triytsia Square.

The distribution of tree trunk diameters also shows considerable variability: from 0.03 m to 0.94 m. Most trees have a trunk diameter within the 0.2–0.5 m range, which corresponds to the middle-age category; however, there are also large specimens that require continuous monitoring and maintenance (Fig. 3).

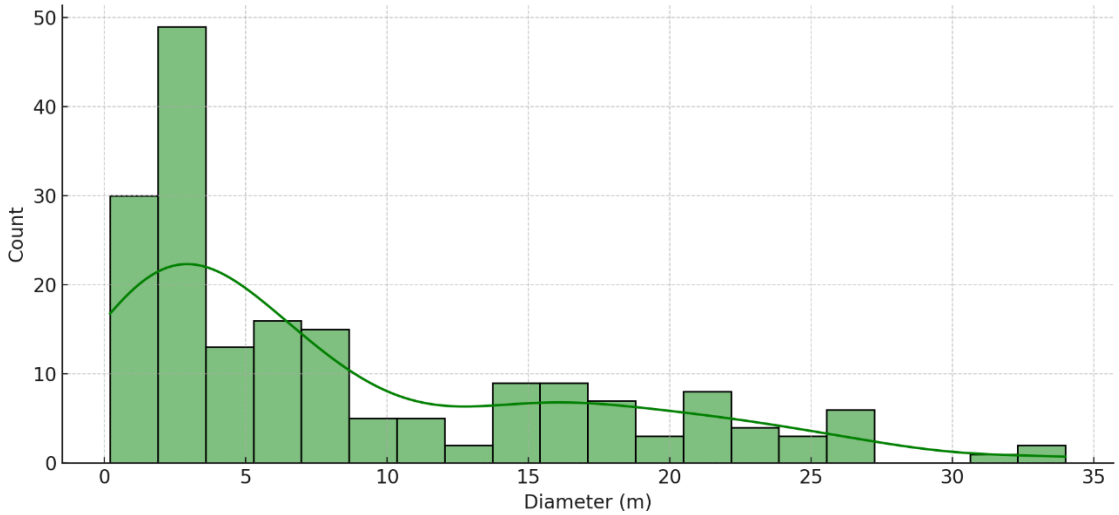

Fig. 3. Plant diameter structure in Mickiewicz Square and Ruska Triytsia Square.

During the survey, numerous cases of mechanical damage, the presence of fungi, hollows, trunk inclinations, and crown development disorders (dieback, broken branches, asymmetry) were recorded. According to preliminary assessment, more than 25% of the trees show signs of moderate or poor phytosanitary condition. The main causes of damage include intense anthropogenic pressure, insufficient maintenance, mechanical injuries from decorations, garlands, and wires, as well as soil compaction.

To maintain ecological resilience and ornamental value of the area, it is recommended to:

- Carry out sanitary and formative pruning of trees with crown deformities.
- Eliminate mechanical damage and sources of hazard (wires, garlands, nails).
- Install protective barriers around young and valuable trees.
- Treat affected specimens and, if necessary, remove hazardous trees.
- Plant additional species, taking into account their bioecological compatibility and adaptation to urban conditions.

The inventory results provide a sound basis for decision-making in the field of urban greening, historical landscape conservation, and climate adaptation planning.

4. CONCLUSIONS

The results of the ecological inventory of green plantings in Mickiewicz Square and the Ruska Triytsia Square in Ivano-Frankivsk revealed a high level of biodiversity, including both autochthonous and introduced species of trees and shrubs. It was found that most plants are in satisfactory or good condition; however, a significant portion requires sanitary intervention, treatment, or replacement. The presence of mature trees enhances the ecosystem and cultural value of the landscape but simultaneously requires careful monitoring. The key ecological issues identified include mechanical damage, signs of infection (fungal diseases, hollows), crown deformities, and anthropogenic stressors such as lighting equipment, wires, and soil compaction. To improve the condition of the green spaces, it is recommended to implement a comprehensive care system that includes sanitary pruning, fertilization, mulching, the creation of protective zones around trees, and the gradual renewal of plantings. The collected data serve as an essential information base for planning environmental protection measures within the historical center of Ivano-Frankivsk, ensuring its sustainable development, and maintaining ecological balance in an urbanized environment.

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Data availability. The data presented in this study are available on request from the corresponding author.

Declarations

Conflict of interest. The authors have no competing interests to declare relevant to this article's content.

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Boichuk Vasyl, PhD student at the Department of Biology and Ecology, Vasyl Stefanyk Carpathian National University, Ivano-Frankivsk, Ukraine;

E-mail vasya.boychuk.7@gmail.com

ORCID ID: 0009-0001-5173-3218

Riznychuk Nadiia, PhD in Biology, Associate Professor, Department of Biology and Ecology, Vasyl Stefanyk Carpathian National University, Ivano-Frankivsk, Ukraine;

E-mail nadiia.riznychuk@cnu.edu.ua

ORCID ID: 0000-0002-4863-6775

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Анотація

У межах сучасних викликів, пов'язаних зі зміною клімату, урбанізацією та втратою біорізноманіття, важливого значення набуває якісний моніторинг стану зелених насаджень у містах. Стаття присвячена екологічній інвентаризації та оцінці стану деревно-чагарникових насаджень у центральній частині м. Івано-Франківськ – на площі Міцкевича та в сквері Руської Трійці. Дослідження охоплює аналіз видового складу, вікової структури, морфометричних параметрів, фітосанітарного стану та наявних пошкоджень (включаючи ураження грибами, дупла, механічні ушкодження, нахили тощо). Загалом зафіксовано більше 200 об'єктів озеленення, серед яких переважають липа дрібнолиста (*Tilia cordata*), гіркокаштан звичайний (*Aesculus hippocastanum*), бузок звичайний (*Syringa vulgaris*) та інші декоративні види. Проведено порівняльну характеристику екосистемної цінності досліджуваних територій та виявлено загрози їхньому сталому існуванню. Запропоновано комплекс рекомендацій щодо підвищення стійкості зелених насаджень в умовах антропогенного навантаження, включаючи санітарну та формувальну обрізку, лікування, встановлення огорож, заміну аварійних дерев та інші заходи. Отримані результати можуть бути використані для планування заходів з озеленення, управління міським середовищем, збереження історико-ландшафтного обличчя міста та підвищення його кліматичної стійкості.

Ключові слова: озеленення, міське середовище, зелена інфраструктура, сталий розвиток, біорізноманіття, зміни клімату.