

UDC 712.3

DOI: 10.56318/as/1.2023.23

Halyna Lukashchuk

PhD in Agriculture

Lviv Polytechnic National University

79013, 12 Stepan Bandera Str., Lviv, Ukraine

<https://orcid.org/0000-0003-4043-8771>

Iaryna Onufriv*

PhD in Architecture

Lviv Polytechnic National University

79013, 12 Stepan Bandera Str., Lviv, Ukraine

<https://orcid.org/0000-0003-0261-4738>

Stepan Tupis

PhD in Architecture

Lviv Polytechnic National University

79013, 12 Stepan Bandera Str., Lviv, Ukraine

<https://orcid.org/0000-0003-3772-5243>

Green space and planning structure optimisation ways in parks and monuments of landscape architecture

Abstract. Renovation of urban space is not possible without new approaches to the formation of green spaces of the landscape gardening heritage. In restoring parks-monuments of landscape art, simultaneous consideration of ecological and biological foundations, preservation of the historical structure of plantations and landscape planning framework, as well as meeting the modern needs of users of these spaces is an important issue. The research aims to formulate practical recommendations on the main ways to optimise the planning structure and green spaces, as well as means of protecting biodiversity in parks and monuments of landscape art. The study used general scientific methods (analysis and synthesis, field research) and special methods (dendrological, cartographic, historical, and architectural analysis, and computer methods for processing graphic data). During the pre-project stage of the study, the prerequisites for the formation of Zhovtnevyi Park in the structure of the Chernivtsi landscape were identified. A list and description of typical plant species typical for the area were provided. In addition, the pre-project study analysed conflicts in the park, which were divided into the following main groups: transport and pedestrian, functional, natural, anthropogenic, and visual. The interconnection of different types of conflicts and their impact on the conservation of biodiversity of green spaces in the park was revealed. As a result, new elements of the planning structure have been formed that improve the landscape-spatial organisation of the park's territory and contribute to the optimisation of green spaces. The project developed and analysed in this study has selected an assortment of plants that enrich the biodiversity of park plantings and can be used in the design of other urban parks. The example of the project for the maintenance and reconstruction of Zhovtnevyi Park in Chernivtsi demonstrates practical planning approaches and recommendations aimed at maximising the preservation of the natural landscape and enhancing its functional and artistic features

Keywords: biodiversity; city park; planting assortment; plant microhabitat; invasive species

Suggested Citation:

Lukashchuk, H., Onufriv, Ya., & Tupis, S. (2023). Green space and planning structure optimisation ways in parks and monuments of landscape architecture. *Architectural Studies*, 9(1), 23-35. doi: 10.56318/as/1.2023.23.

Journal homepage: <https://arch-studies.com.ua/en#>

Architectural Studies, 9(1), 23-35

Received: 01.05.2023 Revised: 17.06.2023 Accepted: 25.06.2023

*Corresponding author



Copyright © The Author(s). This is an open access article distributed under the terms of the Creative Commons Attribution License 4.0 (<https://creativecommons.org/licenses/by/4.0/>)



INTRODUCTION

Parks are living and perfect works of art that carry the function of preserving heritage (Kyseliov & Kyseliova, 2020). Parks-monuments of landscape gardening art are a category of protected objects defined by the Law of Ukraine on the Nature Reserve Fund. The most outstanding and valuable examples of park construction are declared as parks-monuments of landscape gardening for their protection and use for aesthetic, educational, scientific, environmental and health purposes. The territory of parks-monuments of landscape gardening art may be zoned following the requirements established for botanical gardens (Law of Ukraine No. 2456-12, 1992). They are objects of historical, cultural, and architectural heritage. Urban parks are usually artificially created oases of nature surrounded by an urbanised and aggressive environment. When establishing parks, dendrologists and landscape architects formed a species diversity and a certain palette of species, which has been significantly transformed over time and operation. Therefore, one of the main problems of most urban parks in the world today is the reduction of biodiversity of plant and animal life. In particular, a significant number of invasive species are often found in parks. Insufficient plant care leads to the presence of a significant number of dangerous and dead trees. These negative impacts lead to changes in the structure of plantations.

The preservation of urban parks is a major task for modern scientists. Territorially, urban parks, monuments of landscape art, are located in the middle of the urban system, which is constantly growing and changing. In this regard, the space is losing its original ratio of architectural and natural dominants; opportunities for achieving aesthetic expressiveness of the environment by means of landscape architecture are not being realised; the role of natural elements of the landscape as integral components of architectural ensembles is underestimated. The problem of preserving natural resources was formulated at the UN Conference on Environment and Development held in 1992 in Rio de Janeiro, which adopted the International Convention on Biodiversity, supported by 190 countries (Convention of the..., 1992). Greening urban and peri-urban areas is given special attention in the recently adopted Pan-European Biodiversity Strategy for 2021-2030 (European Commission, 2020), which states that green urban spaces, from parks and gardens to green roofs and urban farms, provide a wide range of benefits for people: they provide food and filter water, and supply air for breathing. The document also highlights the importance of nature for human mental and physical well-being and society's ability to cope with global change, health threats and disasters through nature. However, it also notes that green spaces are often losing out in the competition for land as the proportion of the population living in urban areas continues to grow. This strategy aims to reverse these trends and halt the loss of green ecosystems in cities.

Many foreign studies are concerned with the study of public opinion regarding the comfort of staying in parks

and meeting the needs of different categories of visitors to urban parks. These studies often use sociological methods of surveying park visitors. In particular, it is worth mentioning an article published by Taiwanese scientists on the needs of park visitors in Taiwan (Wu & Song, 2017). The researchers identify three basic needs of park visitors, namely: safety (high priority), accessibility (moderately high priority), and constant park maintenance (medium priority), and summarise the needs of all visitors. There are also numerous studies that focus on the needs of people in specific age groups, such as the elderly. H.K. Yung Esther *et al.* (2017), based on a sociological survey, argue that for older people, the most important criterion for the quality of urban parks is the ability to form social connections and improve social participation and inclusion of spaces.

Ukrainian scientists studying the problem of urban greening design emphasise the importance of considering the existing urban environment and its historical context, as well as involving city residents in the design process (Petryshyn *et al.*, 2022). Due to the modern development of urban areas, a special urban environment has been formed – the ecological condition of which requires constant monitoring (environmental monitoring). Plants react very sensitively to changed conditions, so they can serve as indicators of the state of the environment (Lukashchuk, 2018). In particular, scientists from the Central region of Ukraine, who studied the current state of plantations in the parks-monuments of Vinnytsia region, proved that the parks they examined have an unsatisfactory sanitary condition of plantations, and their ecological condition is critical (Yelisavenko *et al.*, 2018). This once again emphasises the need for special attention to the problems of optimising greenery in urban parks.

Thus, this study aims to develop specific planning tools for optimising green spaces and protecting biodiversity in parks of landscape art. These means of protection include the selection and supplementation of the existing range of plantings during the reconstruction of urban parks, including parks of landscape art monuments. The problem of optimising and forming sustainable green spaces in protected areas requires scientifically sound approaches that should be based on an understanding of the biological processes that occur in the area.

MATERIALS AND METHODS

The research is based on the reconstruction project of the Zhovtnevyi Park, a monument of landscape art in Chernivtsi, which was developed by the author's team of the Research Laboratory 117 (Tupis *et al.*, 2022) in 2021 at the request of the park administration.

The study used both general scientific methods and special methods. General scientific methods include an analytical review of publications and literature, international conventions, Ukrainian regulations, and legislation, as well as scientific publications and dissertations. Field research was conducted on the territory of Zhovtnevyi Park, accompanied by photographic documentation of the



territory and identification of characteristic viewpoints on the ground. In the course of the field research, observations were made of the behaviour of park visitors and the places of their stay and the negative impact on plants and landscaping in the park were recorded. The special research methods used in the pre-project studies and during the project development included the following: dendrological, cartographic, historical, and architectural, and computer-based graphic data processing.

The dendrological surveys of the territory of Zhovtnevyi Park in Chernivtsi were carried out on 15.09.2021 and 06-07.10.2021 by the route method, which is one of the main methods of geobotanical research. The names of plants used in the article are given according to the plant list version 1.1 (2013). In addition, during the dendrological surveys, taxonomic descriptions, and vegetation maps (Ukrainian State Design..., 1989) provided by the administration of Zhovtnevyi Park were used. The cartographic method was used to create graphic materials for the project based on the vegetation maps and comparison with modern data obtained during the route survey. These materials were used as a basis for writing the article. In the course of the study of age-old trees, the methodology of distribution of age-old woody plants by age and assessment of their aesthetic condition on a six-point scale was used (Shlapak *et al.*, 2011).

In addition, the pre-design study included a historical and architectural analysis of the cartographic material, in particular, the evolution of the development of the territory of Zhovtnevyi Park and its surroundings, the location

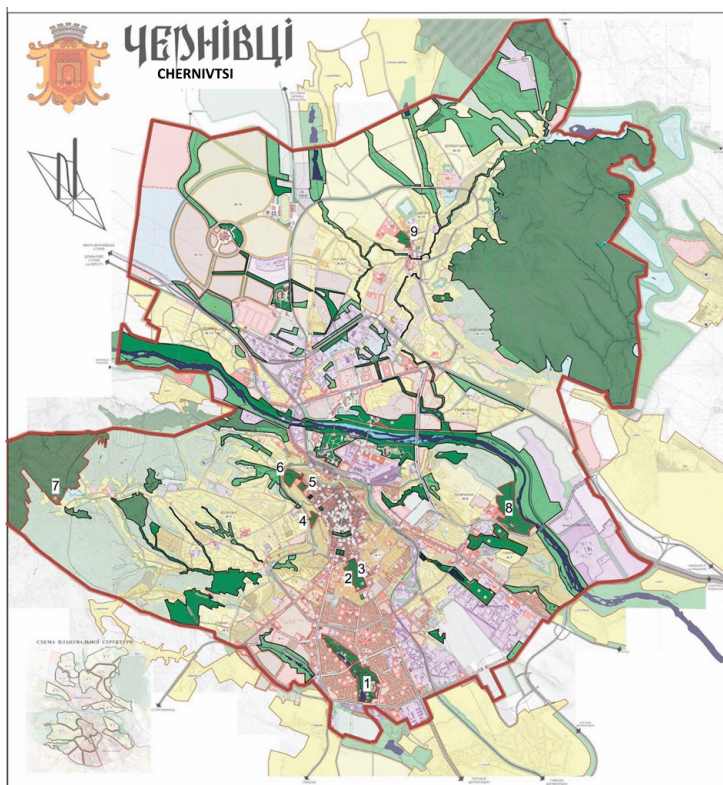
of the park in the structure of Chernivtsi, its landscape planning, spatial organisation, style and patterns of formation.

At the design stage, computer software was used to analyse the existing spatial structure of the park, which involved calculating the area under green spaces, lawns, meadows, and water bodies. This was used to determine the ratio of open and closed spaces in the park.

RESULTS

Prerequisites for the formation of vegetation in Zhovtnevyi Park

There are 331 protected areas in the Chernivtsi region with a total area of 103598.3 ha, which is 12.8% of the region's area (Chorney *et al.*, 2017). Today, there are nine parks-monuments of landscape art of local significance within the city of Chernivtsi with a total area of 108.55 ha. These are the Taras Shevchenko Chernivtsi Park of Culture and Recreation (16.9 ha), the J. Schiller Park (10.0 ha), the Yuriy Fedkovych Park (10.0 ha), the park square on Soborna Square (0.75 ha), the park square on Korduba Street (0.5 ha), and the park on the city's main street. Korduba (0.5 ha), Sadgirskyi Park on Tolyatti Street (2.0 ha), Sadgirskyi Park on Pidkova Street (7.3 ha), park square on Stetsenko Street (0.5 ha), Zhovtnevyi Park (63.5 ha). The basis of the city's parks-monuments of landscape gardening art is formed by the manor parks of the Austro-Hungarian historical period (XIX century) (Reshetiuk, 2017). Zhovtnevyi Park occupies an important place among the objects of the nature reserve fund of local importance in Chernivtsi (Fig. 1).



LEGEND:

- city limits
- forests
- public forested space
- newly-planted
- main nature reserve fund objects

1. Zhovtnevyi Park, a park-monument of landscape art of local importance
2. Botanical garden of national importance "Chernivtsi"
3. Park-monument of landscape gardening art of local importance "Taras Shevchenko Chernivtsi Park of Culture and Recreation"
4. Park-monument of landscape art of local importance "F. Shiller Park"
5. Dendrological park of national importance "Chernivtsi"
6. Park-monument of landscape gardening art of local importance "Y. Fedkovych Park"
7. Landscape reserve of national importance "Tsetsino"
8. Landscape reserve of national importance "Hot Urban"
9. Sadhirskyi Park, a landscape art monumental of local importance

Figure 1. Map of the location of Zhovtnevyi Park in the natural framework of Chernivtsi

Source: created by the authors based on the general layout of Chernivtsi





The Chernivtsi city centre is located to the south of the Prut River on a hill. The northern edge of this hill drops steeply into the river valley, and in the south, it looks like a gently sloping plain, where Zhovtnevyi Park is located. In the second half of the XX century, the territory where the current Zhovtnevyi Park, a monument of landscape art, is located, was used for grazing, hayfields, and orchards. Work on the creation of the park area began on 18 April-May 1968. During the first year, the area of about three ha was landscaped. To preserve the greenery and improve the further development of the territory as a recreation area for the city's residents, the decision of the Chernivtsi Regional Executive Committee of 30.05.1969 No. 198 created Zhovtnevyi Park (Chernivtsi City Council, 2019), which covers an area of 72 ha and is located in a picturesque stream valley in a residential area with a population of up to 63 thousand people. Thus, the construction of Zhovtnevyi Park was supposed to create excellent conditions for recreation and significantly increase the total number of green spaces in the city.

The area of the park is 63.5 ha, of which 6.5 ha are occupied by decorative lakes. On the territory of Zhovtnevyi Park, a stream flows along the bottom of the park from the northwestern to the southeastern part of the park, which is a tributary of the Korovia River. The stream is shallow up to 0.5 m, 0.5-1.5 m wide. Lakes are formed in three places on it. The lakes are filled with rain and melt water and underground flow. The first lake was formed by crossing the beam with an earthen dam. The second lake is a digging lake formed by artificially deepening a part of the gully and thereby creating conditions for retaining surface and groundwater. The third lake is the largest in the park, covering an area of 2 ha, formed by blocking the gully with an earthen dam; its maximum depth is 2.5 m, it is heavily silted, swampy, and overgrown in the upper reaches, and no intensive erosion is observed. The hydrological conditions of the park are characterised by the close occurrence of groundwater. In the floodplain of the stream and the gully, groundwater is at a depth of up to 0.5 m. The relief of the park's territory is represented by a gully and foreseeable slopes of different steepness. The width of the gully along the bottom is from 20 to 60 m. The territory of the park, which occupies the gully and the anticipated slopes, is a 2 km long section in the direction from northwest to southeast, 140 m wide in the north-eastern part of the section and 450 m wide in the south-eastern part. At a distance of about 1.2 km from the top of the main gully, a short but visible lateral gully joins it. Due to this arrangement, the lower part of the park, which is located between these beams and rises to 25 metres above the level of the beam junction, looks like a hill from the top. This hill, the middle of which is a plateau with a slight slope, offers beautiful views of the entire valley

with the silhouette of Mount Tsetsino and the distance towards the village of Velykyi Kuchuriv (Tokaryuk, 2019).

The studied territory of the park contains communities of forest, meadow, marsh vegetation types, aquatic and coastal water phytocoenoses, and significant areas of synanthropic communities (Korzhan, 2011). In Zhovtnevyi Park, 46 species of adventitious plants were identified, which formed rather dense and numerous populations within the groups of 9 associations, 8 unions, 8 orders, and 7 vegetation classes. The main biotopes of adventitious plants in the park are synanthropic, forest (anthropogenic broadleaf forests), and ruralised coastal and herbaceous habitats (Tokaryuk, 2019).

When Zhovtnevyi Park was created, fragments of forest vegetation were left behind, alleys were formed to suit the terrain, and alley and tapeworm plantings were laid out with introductions. The alley of pyramidal poplar, which was part of a field road in the past, has been preserved and remains an important element. To recreate elements of the forest landscape and to reforest degraded areas, massifs were formed, mostly pure deciduous with a predominance of *Robinia pseudoacacia* L., *Acer platanoides* L., *Aesculus hippocastanum* L., *Quercus rubra* L. or with a small participation of related species. Today, these plantations look like massifs in which, in the absence of targeted care, a natural biological process of change of woody plant species took place, overgrowing with low-value tree and shrub species by self-seeding. Groups of *Picea abies* (L. Karst.) were partially destroyed and remained as individual tapeworms. Some groups have been preserved in the protected part of the park. Groups of *Fagus sylvatica* L., *Acer pseudoplatanus* L., *Acer campestre* L. remained an important element of the park landscape. As for all park territories in Zhovtnevyi Park, urbanisation is causing synanthropisation of the vegetation cover. This leads to the depletion of the species composition of native species.

According to the computer analysis of the graphic materials of the territory of Zhovtnevyi Park, the existing spatial structure of the park was characterised, which is distributed as follows: the area under greenery is 54.4382 ha (86% of the total area of the park), of which the approximate area under lawns and meadows is 14 ha (25.72% of the area under greenery). The area under water bodies is 6.1087 ha (9.65% of the total area of the park). The preserved garden areas are usually a semi-open landscape type with low completeness. This type of landscape also includes the area of ruderal meadow with some clumps of trees.

The park is conventionally divided into two parts: the first is the northern part, covering 41.8829 ha, and the second is the southern part, covering 21.4105 ha. In Zhovtnevyi Park, 80 plant microgroups were identified, often with one predominant tree species, but with different participation in the composition of the plantation (Fig. 2).

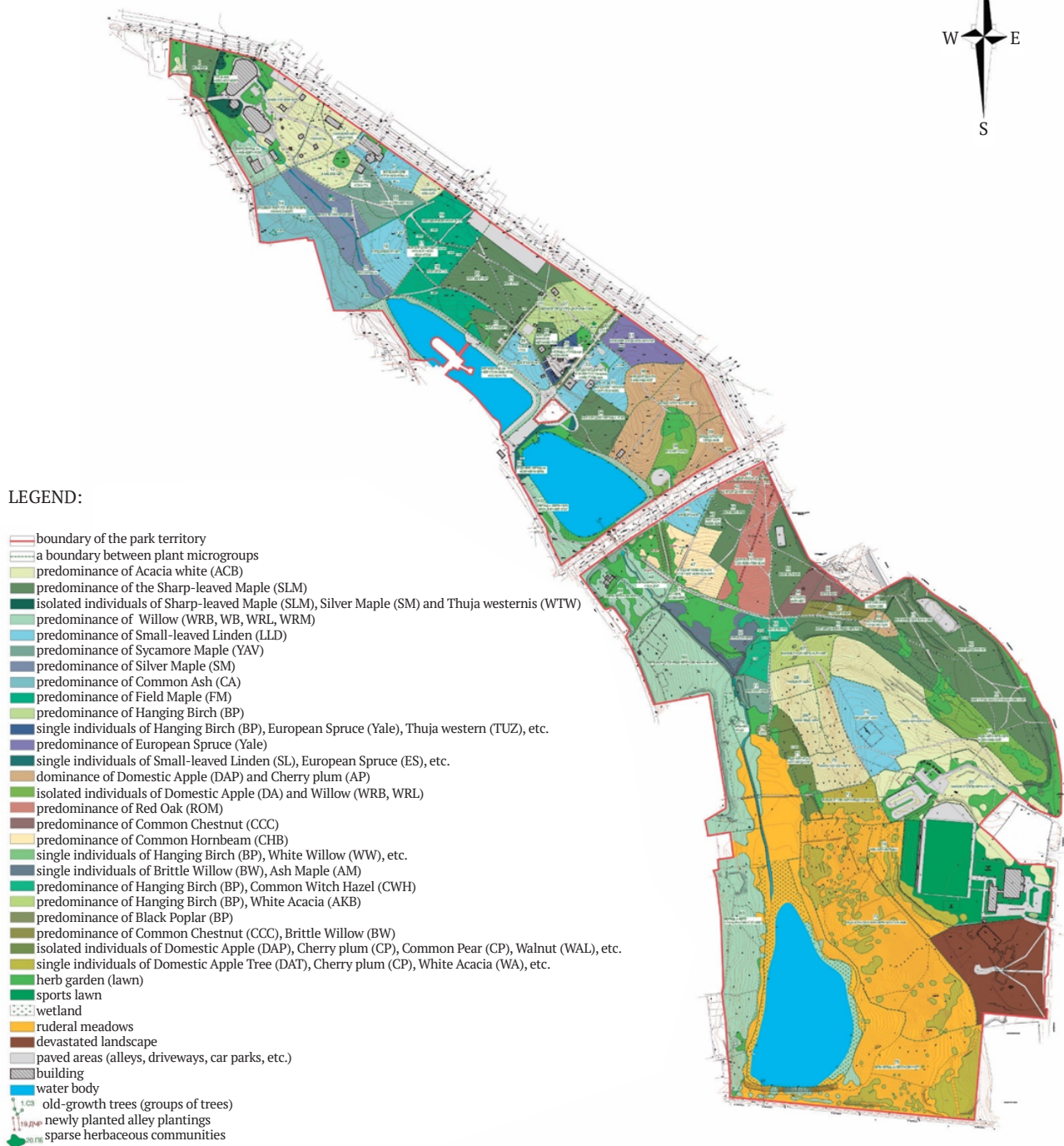


Figure 2. The basic planting plan for Zhovtnevyi Park

Source: Project for the maintenance and reconstruction of the Zhovtnevyi Park, a monument of landscape art in Chernivtsi (Tupis et al., 2022)

Having analysed the plant microhabitats, it should be noted that certain species are landscape-forming in the park. These are the species that are predominant in certain plant micro-groups. These include *Robinia pseudoacacia* – 12 microhabitats; *Acer platanoides* L. – 14 microhabitats; species of the genus *Salix* L. – nine microhabitats; *Tilia cordata* Mill – seven microhabitats; *Acer pseudoplatanus* – three microhabitats; *Acer sacharinum* L. – two microhabitats;

Acer campestre – three microhabitats; *Betula pendula* Roth. – two microhabitats; *Picea abies* – three microhabitats; *Malus domestica* Borkh., *Prunus cerasifera* Ehrh. – four micro-groups; *Quercus rubra* – three micro-groups; *Aesculus hippocastanum* and with the participation of *Salix fragilis* L. – three micro-groups. *Populus pyramidalis* Roz. – three microhabitats. The remaining nine micro-groups are represented by a set of different species without the dominance of a particular species.

The study separately identifies a list of plants that are concentrated near recreational complexes and attractions in Zhovtnevyi Park. These are mostly ornamental tree and shrub plants that are not separated into separate micro-groups geographically. They are included in the list of dendroflora. They can be called conventionally: micro-groups of ornamental plants. These are plantations of the later period of planting and new plantings, they include modern ornamental forms and hybrids of woody plants. During the surveys of park plantations, trees or groups of trees were identified that have lost their aesthetic value, attractiveness and are at different stages of drying out and digression. First of all, these are the trees of the first tier of communities dominated by *Robinia pseudoacacia*, which have reached their age limit. They are characterised by partial or complete drying out of the trunk, dominated by drying out of branches of the 1st and 2nd orders, and damage to *Viscum album* L.

In the microhabitats dominated by the common bitter chestnut, there are traces of damage by diseases, pests, and pathogenic fungi. There is a massive defeat of mistletoe in micro-groups dominated by silver maple. There is an accidental dead wood of *Populus canadensis* on the site. The communities dominated by species of the *Salix* genus in the plantation become susceptible to various diseases and pests as they reach the age of ageing. Groups formed from fruit trees require special attention and sanitary care. Most of them have reached the age of obsolescence and are in a state of emergency. Some of them need gradual rejuvenation. In almost all micro-groups of Zhovtnevyi Park, a significant number of trees have some damage as a result of natural disasters (windstorms, storms, snowstorms, frost cracks). Due to the improper formation of tree communities in the past, as well as untimely felling, the territory of micro-groups is becoming cluttered, and less resistant tree species are being suppressed by other, more resistant ones. As a result of these processes, ornamental shrubs and trees of the lower tier die off and *Sambucus nigra* L. and *Cornus sanguinea* L. spread. In all microhabitats, there is a lot of self-seeding of sharp-leaved maple, which has a low level of biological stability. Over the period of existence of Zhovtnevyi Park, in the absence of targeted care, a natural biological process of change of woody plant species has occurred, which has led to changes in the landscape characteristics of microhabitats. The young self-seeding and

overgrowth have grown, changing the contours of groups and clumps, individual vistas, and glades.

In general, the degradation of green spaces in the surveyed area of Zhovtnevyi Park is caused by a combination of biological, environmental, organisational, legal, financial, and economic factors.

Analysis of the existing dendroflora

Since no tree-by-tree inventory of tree and shrub species was carried out in the studied territory of the Zhovtnevyi Park of the Monument of Landscape Art in Chernivtsi, the species composition of the dendroflora is not complete. The species diversity of park plantations is an extremely important feature of them, as it determines the structure and strategy of plant communities' development in specific conditions. The route surveys of the park territory revealed the growth of 125 species, cultivars and hybrids of trees and shrubs belonging to 32 families. They belong to two divisions: *Pinophyta* – 21 species (16.8% of the total number of species), and *Magnoliophyta* – 104 taxa (83.2%). Representatives of *Magnoliophyta* prevail. The most numerous is the family *Rosaceae* Juss. (24 taxa), which is connected with the inclusion of old orchards in the park territory. Many representatives of this family belong to the micro group of ornamental species that do not act as landscape-forming species and are concentrated near entertainment areas and attractions. The next largest family by the number of species is *Salicaceae* Lindl. (13 taxa). Such presence of species of this family is due to the presence of fresh and humid hydrothermal conditions on the territory: close occurrence of groundwater, the location of a significant area along the bottom of the gully where the stream flows and the presence of three lakes. These are the remnants of a natural vegetation cover typical of the Prut riverbed and its floodplains and floodplain terraces. The family *Pinaceae* Lindl. includes ten species and cultivars, most of which are ornamental. The family *Cupressaceae* F. Neger. Eight taxa belong to the family *Hydrangeaceae* ENDL. This is a group of ornamental species of later establishment. Next are the families *Aceraceae* Lindl. and *Caprifoliaceae* Vent. (seven taxa each). Representatives of the *Aceraceae* family are landscape-forming. Other families are represented by one to five taxa (Fig. 3). Representatives of many of these families are predominant in the microhabitats.

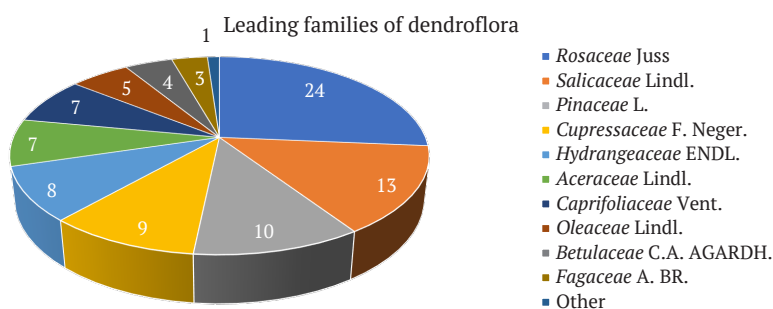


Figure 3. Diagram of the existing dendroflora in Zhovtnevyi Park

Source: developed by the authors



The park's phytocoenosis includes introduced species of woody plants and species listed in the Red Data Book of Ukraine: *Staphylea pinnata* L.. The newly introduced species include *Taxus baccata* 'Fastigiata'. The introduced species include: *Juglans mandshurica* Maxim, *Phellodendron amurense* Rupr, *Acer sacharinum* L. and *A. negundo* L., *Salix matsudana* Koidz., *Pinus pallasiana* Lamb., *Tsuga canadensis* Carr., *Picea pungens* Engelm., *Platycladus orientalis* (L.) Franco), *Thuja occidentalis* L., *Juniperus chinensis* L., *Catalpa bignonioides* Walt., *Platanus acerifolia* Willd., *Ailanthus altissima* (Mill.) Swingle, *Gleditsia triacanthos* L., *Robinia pseudoacacia*, *Quercus rubra* L., *Aesculus hippocastanum*, *Morus nigra* L., *Populus pyramidalis* in alley planting etc. Many ornamental shrubs are exotic in plant communities. These are *Calycanthus floridus* L., *Cotoneaster horizontalis* Decne, *Symphoricarpos albus* (L.) Blake. In total, there are 54 introduced species of woody plants. These species are characterised by high resilience under the current growing conditions.

Trees (79 taxa) predominate among the life forms that form the basis of this park. The shrub layer is of varying degrees of development and often forms thickets. The shrubs are represented by the following forest species: *Euonymus europaea* L., *Cornus sanguinea*, *Sambucus nigra*, rarely *Corylus avellana* L. and a large group of ornamental species and cultivars of later establishment: *Hydrangea sargentiana* Rehd., *Spiraea japonica* 'Albiflora', *Cotoneaster horizontalis* etc.

During the surveys, single old trees were found. These are the above-mentioned exotics (Manchurian walnut, Amur velvet) with trunk girths ranging from 0.34 to 1.10 m. Native age-old individuals are: *Pinus sylvestris* L., *Quercus robur*, *Pyrus communis* L., *Tilia cordata* Mill. in inline planting.

The centuries-old trees that have survived to this day in Zhovtnevyi Park in Chernivtsi give a certain idea of the original plantations, although they do not fully reflect their taxonomic structure. They give the plantations more expressiveness and power. Long-lived trees have scientific, aesthetic, and economic value and require measures for their protection and conservation.

As a result of dendrological analysis, the spread of highly active invasive species is observed in both parts of the park: *Acer negundo*, *Robinia pseudoacacia*, *Quercus rubra*, and occasionally *Amorpha fruticosa* L., *Ailanthus altissima*. The spread of invasive woody species should be continuously monitored. Sloping meadows, remnants of old gardens, wet meadows are overgrown with *Solidago canadensis* L., *Pastinaca sativa* L., *Helianthus tuberosus* L., *Rudbeckia laciniata* L. and other invasive species. Populations of these plants are tall. They suppress populations of native species. This contributes to the reduction in the number of populations of native species, and its rapid spread even into the water-coastal areas of the park's cultural and phytocoenosis can be observed. There is no haymaking in these meadow and water-coastal complexes, so they are also overgrown with low-value and invasive tree and shrub vegetation.

The existing layout of Zhovtnevyi Park is designed in such a way that there is an uneven distribution of visitors across the park. Certain areas of the park are overcrowded

with visitors, while other large areas of the park are virtually unused. Such a planning structure leads to the problem of irrational development of the park's territory with excessive anthropogenic impact on the park's natural complexes in crowded areas. A necessary step towards solving this problem would be to disperse visitors with the help of planning tools.

The main visual axes in the park are the park alleys and the valley space of the cascade of lakes. The northern half of the park has significantly less open space compared to the southern half of the park. Therefore, the visual connections in this area are best seen along the main wide alleys (Fig. 4; Fig. 5), around the lake (Fig. 6), and on the open lawn between the entrance from Heroiv Maidanu Street and the park administration building (Fig. 7). These visual disclosures have the character of separate viewpoints.



Figure 4. View along the central poplar alley of the park
Source: authors' photo



Figure 5. View along the alley of the park
Source: authors' photo





Figure 6. View from the lake shore

Source: authors' photo



Figure 7. View from the hill to the lawn from the side of the residential area on Heroiv Maidanu Street

Source: authors' photo

Among the main problems and conflicts in the park are the following groups: transport and pedestrian, functional, natural, anthropogenic, and visual. In addition, there are also financial problems (lack of adequate funding; insufficient number of employees to maintain the territory; outdated and insufficient material and technical base, lack of equipment), legal problems (illegal activities of unauthorised persons on the territory of the nature reserve fund), as well as those related to the safety of staying in the park

(lack of fencing of the park; lack of park security and video surveillance system). These conflicts have a negative impact on the conservation of biodiversity of green spaces and the comfort of visitors in the park.

Ways to optimise the park's green spaces

It is advisable to divide the strategy for the development of the greenery system in Zhovtnevyi Park into two periods: five years and ten years (Fig. 8).



Figure 8. Project of greening measures for Zhovtnevyi Park

Source: Project for the maintenance and reconstruction of the Zhovtnevyi Park, a monument of landscape art in Chernivtsi (Tupis et al., 2022)



Based on the research conducted within the project, a five-year action plan was drawn up:

- To protect and preserve green spaces, a full inventory of the territory of Zhovtnevyi Park should be carried out. A partial inventory of the greenery in the central part of the park was carried out in 2017-2018. At that time, 10.7742 ha were inventoried, while the rest of the territory was not.

- Sanitary measures aimed at preserving valuable species of woody plants and valuable and rare herbaceous plant communities should be carried out.

- Identify valuable and rare woody plants on the territory of Zhovtnevyi Park.

- Carry out sanitary felling to remove trees affected by phytopathogenic pests and entomological pests that cannot be treated (communities with common chestnut), as well as dead wood. These plantations are a source of disease spread and can significantly affect the condition of healthy trees.

- Phase out the plantations, leaving the healthier and more viable ones. Introduce species of common hornbeam, forest beech, common oak or sycamore maple into this community. In elevated areas – rock oak. In wetlands, introduced species of the genus willow, poplar, etc.

- It is advisable to restore old pyramidal poplar alleys by supplementing them with adults using double planting (planting parallel rows of large-sized seedlings with a pile of the earth closer to the alley with the gradual removal of old, damaged individuals). The distance from old individuals to young plantings depends on the condition of the crown of the old tree and can range from 2 to 5 m. By the time the old tree dies, the young individual should already serve as a full-fledged replacement.

- Urgent felling of dangerous and dry trees of the first tier, which are unstable and pose a threat to park visitors.

- Reconstructive felling, planting of new trees and flower arrangements to create new entrances to the park.

- Landscaping of the main park alley. A specific dendrological plan and working drawings can be proposed at further stages of designing parts of the park.

- Landscaping of the designed alleys and serpentine areas with viewing platforms.

- Preservation and rejuvenation of old orchard sites as a “placemark”.

The ten-year action plan provides for:

- Sanitary felling of trees of the second and third tiers that are dead or in the process of dying and reduce the aesthetic appeal of tree micro-groups near the entrance areas and in the area of emergency attractions.

- Felling of trees that hinder the development of more powerful and decorative trees, the continuation of the design of the projected alleys.

- Felling of trees in the area from the side of Parkovy passage, which covers views and individual interesting specimens, viewpoints, and compositional units. Reconstructive felling should be aimed at improving lighting and aeration conditions, increasing artistic expressiveness, emphasising the existing relief and picturesque water areas, creating perspectives, and improving the structure of plantations.

- Conservation and care of valuable groups within plant microhabitats.

- Reconstruction of heavily densified areas and the formation of edges of ornamental shrub species biologically compatible with the predominant species in the microhabitat along secondary projected alleys; while maintaining the contours of old plant communities. The age of the planting material should be selected depending on the age of the tree plantations. For old plantings, 4-5-year-old specimens with a clod of the earth are recommended, and for young ones – 2-3-year-old specimens. Young specimens should be planted with trees that have reached the age of natural death.

- In the peripheral areas of the park, the later plantings should be preserved and maintained.

- Regularly carry out sanitary maintenance of the park’s natural areas with the least possible intervention. Conduct a phased restoration of grass cover in areas overgrown with invasive vegetation. At the same time, use an integrated system of controlling invasive species, including the integrated use of mechanical, agrotechnical and biological methods of control and biological control.

- To systematically enrich the dendrological flora with species that are not invasive in the area and are suitable for the given ecotopes, introduce conifers to ensure the aesthetics of the winter landscape.

- Restore natural herb and flower gardens, while ensuring a continuous decorative effect (introduction of spring ephemerals into shade tree groups).

- Arrangement of an alpine slide in the second part of the park.

- It is recommended to introduce representatives of the family *Poaceae* Barnhart, *Cyperaceae* Juss. and *Juncaceae* Juss. following the existing ecotopes (along the stream in the second half of the park). Introduce aquatic plants into the lake’s coastal and water areas without disturbing the ecotope.

- Continuation of the restoration of old alleys (poplar alley), restoration of the Chernobyl alley from mountain ash, completion of landscaping of the designed alleys and observation decks with the formation of compositions.

In general, the project applied principled approaches to the formation of the planning structure of the park, which have a positive impact on the condition of green spaces and resolve the main conflicts in the park, namely the preservation of the integrity of the park’s territory; preservation of valuable ecological habitats through functional zoning; improvement of the existing vegetation of the park with the addition of species composition of plantations; even distribution of visitors through the park through the design of new alleys and paths, as well as changes in the functional zoning of the park’s territory; ensuring accessibility to the park with the design and construction of new entrances to the park and an underground connection between the two parts of the park separated by the motorway; improving the system of pedestrian paths and alleys by reconstructing existing and designing new pedestrian and bicycle connections, etc.

To preserve the authenticity of the site, the project included the restoration of individual trees and bushes, the





preservation and addition of historic orchards and a historic poplar alley. An important aspect of the project was to enhance the aesthetic expressiveness of the landscape as perceived by visitors. This was achieved by placing additional observation decks and designing new serpentine paths between them on the steep terrain in the southern part of the park, as well as increasing the overall decorativeness of the park's plantings (decorating entrances, main alleys and planning nodes with decorative plant compositions). The project considered the needs of the park users, in particular, places for picnics with the possibility of making bonfires in the warm season were provided, and areas for various purposes were designed: children's, sports, dog walking and utility areas.

DISCUSSION

The presented study results are formulated in the form of design measures and fundamental approaches related to the optimisation of the planting structure, landscape-spatial and planning structure of the Zhovtnevyi Park-Monument of Landscape Art in Chernivtsi (Ukraine). The developed planning approaches are based on pre-project studies, including the author's observations of the behaviour of park visitors. At the same time, it is also common among modern studies to use a sociological survey of visitors to urban parks to determine their needs in terms of age. In particular, the needs of older visitors are more specifically covered in the publication by Ma *et al.* (2021), which identifies the main factors to be considered in park planning, namely: sufficient insolation and aeration of spaces, comfortable temperature conditions, the presence of drinking fountains or tanks, the possibility of unimpeded movement along alleys and paths, a sufficient number of seating places for rest, and diverse vegetation. The design of pedestrian alleys and paths in urban parks in China from the perspective of older people is discussed in Y. Zhai & P. Baran (2017). The researchers found that the most desirable characteristics of pedestrian alleys for the elderly are the use of soft surfaces, good lighting, benches and flowers along the paths, significant length, and width (3-3.9 m) of the paths, paths along water bodies, shade, side visibility and visual connection with water, and lack of visual connection with areas of visitor concentration. The results of these studies once again confirm the correctness of the planning approaches used in the Zhovtnevyi Park reconstruction project, as much attention was paid to forming visual connections between visitors and water bodies and the paths along them, as well as the use of soft surfaces on the paths, etc. The needs of adolescent children were also considered in the project, in particular, additional playgrounds were designed, including an inclusive playground, as well as sports grounds and places for active recreation, such as a bicycle track with jumps. For children and adolescents, the arrangement of these facilities is the most important in the park, as evidenced by a study conducted among schoolchildren in Melbourne, Australia (Rivera *et al.*, 2022). According to the article, the six most frequently mentioned characteristics of

parks by schoolchildren surveyed that prevent them from visiting a park are play equipment (e.g. small/kids' playgrounds without play equipment without swings); social factors (e.g. crowded parks, presence of unwanted people); natural environment (e.g. small space without lawn, large open space with grass); maintenance (e.g. dirty facilities, litter); sports/recreational facilities (e.g. skate park); Other studies have also highlighted the importance of multifunctionality of park spaces (Roberts *et al.*, 2022), and the diversity of park plantings for different categories of visitors (He *et al.*, 2022).

The developed planning approaches to the design of the Zhovtnevyi Park, a monument of landscape gardening art, emphasised the quality of the plant material used, the diversification and enhancement of its decorative effect, and the cultivation of local plant species. These principles are in line with the results of research conducted on the selection of planting assortment. Among them is a joint publication by Portuguese and American scientists, in which they highlight the perception of plants in urban parks and the implications for the design and management of new urban ecosystems (Teixeira *et al.*, 2022). This study examines the issue of plant cultivation and spontaneous planting, as well as the planting of native and non-native species in urban greenery from the perspective of landscape architects. The problem of the quality and quantity of green spaces in parks, as well as how park landscaping can encourage park visits and promote the health of urban residents, is highlighted in a publication by Chinese scientists (Yang *et al.*, 2021). Their results showed that the quality of greenery is more strongly correlated with the total number of park visitors than the quantity. Both the quantity and quality of green spaces were more important for older visitors (aged 65 and older) than for children or adults.

In the context of the prospects for the development of parks-monuments of landscape art, the following areas of promising use of parks are recommended: recreational and tourist, excursion, eco-educational, scientific and cognitive, and virtual exploitation. It is noted that an important component of the future of parks should be their promotion and development of a network of recreational and tourist infrastructure facilities on their territory (Pidhovna, 2020).

The created plan for Zhovtnevyi Park in Chernivtsi, Ukraine, takes into account the needs of visitors of all ages, emphasising the quality and variety of green spaces, comfortable conditions for recreation, and the provision of additional active recreation facilities. Recommendations on the prospects for park development are taken into account, including the expansion of recreational and tourist infrastructure and the promotion of the park as an important component of the urban environment.

CONCLUSIONS

Measures for the reconstruction of parks-monuments of landscape gardening art should be aimed at improving the aesthetic properties of parks, their conservation and rational use, promotion and adaptation to modern urban planning and social conditions. The optimisation of landscaping



in parks-monuments of landscape architecture should be carried out using a set of methods: restoration of the most valuable elements of plant micro-groups; conservation of trees and shrubs subject to protection; adaptation of the entire park complex to modern conditions. At the same time, the formation of new plantings – arrays, groups of trees and shrubs – should be carried out on the condition of preserving valuable woody plants. The condition and species composition of the green spaces of parks and monuments of landscape art should be constantly monitored, and their biodiversity should be preserved, used and managed sustainably for the sake of human benefits (intangible values and services), rather than “protected” from people in certain places.

The main planning measures designed to increase the quality of visitors’ stay in the territory of parks-monuments of landscape art, while not harming the vegetation, are even distribution of pedestrian alleys and paths across the park; creation of a multifunctional environment to meet the needs of different age groups of visitors; creation of a protected area within the most environmentally valuable parts of the park; adherence to the principle of “memory of place” in the planning concept with the preservation of authentic planting groups and functional use of individual parts of the park; creation of barrier-free pedestrian connections and accessibility for people with limited mobility to the park; development of bicycle infrastructure; arrangement of entrances to the park; use of plant compositions with high decorative value and the effect of continuous flowering along the trajectory of visitors; creation of visual accessibility and spatial diversity of the park; provision of utilitarian functions.

The proposed practical planning approaches and recommendations are aimed at maximising the preservation

of the natural landscape and enhancing its functional and artistic features. The greater the biodiversity of a park area, the better its biological balance and the better all its inhabitants will feel plants, animals and, ultimately, people. Numerous studies confirm that such approaches also meet the expectations and needs of park visitors. However, in the context of current global threats, such as viral pandemics, and the high level of mental health problems among people, including those affected by military operations, a more in-depth analysis of the impact of landscape architecture on people’s physical and mental health could be an important area of research in this area in the future. It would be important to identify specific plant species, their characteristics, and other means that should be used in the reconstruction of parks and monuments of landscape architecture in the context of this issue. Conducting relevant research would make it possible to improve the quality of further park reconstructions, as well as to increase people’s sense of safety during their stay in parks.

ACKNOWLEDGEMENTS

The results of the research presented in the article were obtained by the author’s team of the Research and Development Laboratory-117 of the Department of Urban Planning of Lviv Polytechnic National University during the development of the project for the maintenance and reconstruction of the Zhovtnevyi Park, a monument of landscape art, in 2021. The author’s team would like to thank the administration and employees of Zhovtnevyi Park for their assistance in the development of this project.

CONFLICT OF INTEREST

None.

REFERENCES

- [1] Chernivtsi City Council. (2019). *City parks. Park of culture and recreation “Zhovtnevyi”*. Retrieved from <https://city.cv.ua/mt/mystetstvo-i-dozvillia/miski-parky-31>.
- [2] Chorney, I., Korzyk, V., Skilskyi, I., Bilokon, M., & Avram, M. (2017). *Protected pearls of Bukovyna: Atlas-handbook* (256 pp.). Chernivtsi: Druk Art.
- [3] Convention of the Verkhovna Rada of Ukraine No. 995-030 “On Biological Diversity”. (June, 1992). Retrieved from https://zakon.rada.gov.ua/laws/show/995_030#Text.
- [4] European Commission. (2020). *Biodiversity strategy for 2030. Bringing nature back into our lives*. Retrieved from <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52020DC0380>.
- [5] He, M., Wang, Y., Wang, W.J., & Xie, Z. (2022). Therapeutic plant landscape design of urban forest parks based on the Five Senses Theory: A case study of Stanley Park in Canada. *International Journal of Geoheritage and Parks*, 10(1), 97-112. doi: 10.1016/j.ijgeop.2022.02.004.
- [6] Korzhan, K. (2011). Systematic structure of the urban flora of Chernivtsi. *Ukrainian Botanical Journal*, 68(3), 388-393. Retrieved from <http://www.irbis-nbuv.gov.ua/>.
- [7] Kyseliiov, V.M., & Kyseliiova, H.V. (2020). Historical parks of Ukraine. From history to modern times. *Bulletin of Odessa State Academy of Civil Engineering and Architecture*, 81, 18-25. Retrieved from <http://mx.ogasa.org.ua/handle/123456789/9092>.
- [8] Law of Ukraine No. 2456-12 “On Nature Reserve Fund of Ukraine”. (1992, June). Retrieved from <https://zakon.rada.gov.ua/laws/show/2456-12#Text>.
- [9] Lukashchuk, H. (2018). Degradation of the forest parks in conditions of the development of Lviv agglomeration. *Architectural Studies*, 4(2), 221-227. Retrieved from <https://science.lpnu.ua/sites/default/files/journal-paper/2019/apr/16448/15.pdf>.



- [10] Ma, X., Tian, Y., Du, M., Hong, B., & Lin, B. (2021). How to design comfortable open spaces for the elderly? Implications of their thermal perceptions in an urban park. *Science of The Total Environment*, 768, 144985. doi: [10.1016/j.scitotenv.2021.144985](https://doi.org/10.1016/j.scitotenv.2021.144985).
- [11] Petryshyn, H., Kryvoruchko, O., Lukashchuk, H., Danylko, N., & Klishch, O. (2022). Changing the qualities of urban space by means of landscape architecture. *Architectural Studies*, 8(1), 22-33. doi: [10.56318/as2022.01.022](https://doi.org/10.56318/as2022.01.022).
- [12] Pidhovna, S.M. (2020). *Parks-monuments of landscape art of Ternopil region: Retrospective analysis, structure of dendroflora, comprehensive evaluation*. (Doctoral thesis, National University of Environmental Sciences of Ukraine, Kyiv, Ukraine).
- [13] Reshетиuk, O. (2017). Prospects for using the parks of the nature reserve fund of Bukovyna to enrich its biodiversity. *Scientific Bulletin of NLTU of Ukraine*, 27(10), 42-50. doi: [10.15421/40271006](https://doi.org/10.15421/40271006).
- [14] Rivera, E., Timperio, A., Loh, V., Deforche, B., & Veitch, J. (2022). Adolescents' perceptions of park characteristics that discourage park visitation, *Urban Forestry & Urban Greening*, 74, 127669. doi: [10.1016/j.ufug.2022.127669](https://doi.org/10.1016/j.ufug.2022.127669).
- [15] Roberts, M., Glenk, K., & McVittie, A. (2022). Urban residents value multi-functional urban greenspaces, *Urban Forestry & Urban Greening*, 74, 127681. doi: [10.1016/j.ufug.2022.127681](https://doi.org/10.1016/j.ufug.2022.127681).
- [16] Shlapak, V.P., Muzyka, H.I., Vitenko, V.A., & Marno, L.I. (2011). Biometric indicators of age wood plants of the Sofiivka dendrology park and their age distribution by categories. *Scientific Bulletin of NLTU of Ukraine*, 21(5), 8-15. Retrieved from https://nv.nltu.edu.ua/Archive/2011/21_5/8_Szla.pdf.
- [17] Teixeira, C.P., Fernandes, C.O., Ryan, R., & Ahern, J. (2022). Attitudes and preferences towards plants in urban green spaces: Implications for the design and management of Novel Urban Ecosystems. *Journal of Environmental Management*, 314, 115103. doi: [10.1016/j.jenvman.2022.115103](https://doi.org/10.1016/j.jenvman.2022.115103).
- [18] The plant list: Version 1.1. (2013). Retrieved from <http://www.theplantlist.org/>.
- [19] Tokaryuk, A. (2019). Adventitious species in the vegetation of the park-landscape park of local importance "Zhovtnevyi Park" in Chernivtsi. *Biological Systems*, 11(2). doi: [10.31861/biosystems2019.02.228](https://doi.org/10.31861/biosystems2019.02.228).
- [20] Tupis, S., Sosnova, N., Onufriv, I., Lukashchuk, H., & Koznarska, H. (2022). *Certificate No. 113726 on the registration of the copyright for the work: "Project for the maintenance and reconstruction of the park-monument of landscape art "Zhovtnevyi" in the city of Chernivtsi"*. Lviv: Lviv Polytechnic National University.
- [21] Ukrainian State Design and Research Institute for Gas Supply, Heat Supply and Complex Development of Cities and Villages of Ukraine. (1989). *Correction of the project of the "Zhovtnevyi" city park in Chernivtsi. Dendrological studies*.
- [22] Wu, K.-C., & Song, L.-Y. (2017). A case for inclusive design: Analyzing the needs of those who frequent Taiwan's urban parks. *Applied Ergonomics*, 58, 254-264. doi: [10.1016/j.apergo.2016.06.015](https://doi.org/10.1016/j.apergo.2016.06.015).
- [23] Yang, Y., Lu, Y., Yang, H., Yang, L., & Gou, Z. (2021). Impact of the quality and quantity of eye-level greenery on park usage. *Urban Forestry & Urban Greening*, 60, 127061. doi: [10.1016/j.ufug.2021.127061](https://doi.org/10.1016/j.ufug.2021.127061).
- [24] Yelisavenko, Y.A., Mudrak, O.V., Vasylevskiy, O.H., & Smashniuk, L.V. (2018). Monuments parks of landscape art of Eastern Podillia – biodiversity conservation centers of regional ecological network. *Bulletin of the Uman National University of Horticulture*, 1, 78-82. doi: [10.31395/2310-0478-2018-1-78-82](https://doi.org/10.31395/2310-0478-2018-1-78-82).
- [25] Yung Esther, H., Ho Winky, K., & Chan Edwin, H. (2017). Elderly satisfaction with planning and design of public parks in high density old districts: An ordered logit model, *Landscape and Urban Planning*, 165, 39-53. doi: [10.1016/j.landurbplan.2017.05.006](https://doi.org/10.1016/j.landurbplan.2017.05.006).
- [26] Zhai, Y., & Baran, P.K. (2017). Urban park pathway design characteristics and senior walking behavior. *Urban Forestry & Urban Greening*, 21, 60-73. doi: [10.1016/j.ufug.2016.10.012](https://doi.org/10.1016/j.ufug.2016.10.012).

**Галина Богданівна Лукашук**

Кандидат сільськогосподарських наук
Національний університет «Львівська політехніка»
79013, вул. Степана Бандери, 12, м. Львів, Україна
<https://orcid.org/0000-0003-4043-8771>

Ярина Олегівна Онуфрив

Кандидат архітектурних наук
Національний університет «Львівська політехніка»
79013, вул. Степана Бандери, 12, м. Львів, Україна
<https://orcid.org/0000-0003-0261-4738>

Степан Павлович Тупісь

Кандидат архітектурних наук
Національний університет «Львівська політехніка»
79013, вул. Степана Бандери, 12, м. Львів, Україна
<https://orcid.org/0000-0003-3772-5243>

Шляхи оптимізації зелених насаджень та планувальної структури у парках-пам'ятках садово-паркового мистецтва

Анотація. Реновація міського простору не можлива без нових підходів у формуванні озелених просторів садово-паркової спадщини. При відновленні парків-пам'яток садово-паркового мистецтва важливою проблемою є одночасне врахування еколого-біологічних основ, збереження історичної структури насаджень та ландшафтно-планувальної основи, а також забезпечення сучасних потреб користувачів цих просторів. Метою статті є формування практичних рекомендацій щодо основних шляхів оптимізації планувальної структури та зелених насаджень, а також засобів захисту біорізноманіття у парках пам'ятках садово-паркового мистецтва. В ході дослідження були застосовані загальнонаукові (аналіз та синтез, польові дослідження) та спеціальні методи (дендрологічний, картографічний; історико-архітектурний аналіз; комп'ютерні методи з обробки графічних даних). В процесі передпроектного етапу дослідження виявлено передумови формування парку «Жовтневий» в структурі ландшафту м. Чернівці. Подано перелік та опис типових видів рослин, що характерні для даної місцевості. Окрім того, в процесі передпроектного дослідження проводився аналіз конфліктів на території парку, які були поділені на такі основні групи: транспортно-пішохідні, функціональні, природні, антропогенні, візуальні. Було виявлено взаємозв'язок різних видів конфліктів та їх вплив на збереження біорізноманіття зелених насаджень у парку. В результаті сформовано нові елементи планувальної структури, які покращують ландшафтно-просторову організацію території парку та сприяють оптимізації зелених насаджень. В розробленому та проаналізованому у статті проекті підібрано асортимент рослин, що збагачують біорізноманіття паркових насаджень та можуть бути використані при проектуванні інших міських парків. На прикладі проекту утримання та реконструкції парку «Жовтневий» в м. Чернівці продемонстровані практичні планувальні підходи та рекомендації, що спрямовані на максимальне збереження природного ландшафту та підсилення його функціональних і художніх особливостей

Ключові слова: біорізноманіття; міський парк; асортимент насаджень; рослинне мікрогруповання; інвазійні види

