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DENDROFLORA COMPOSITION AND DIVERSITY OF MALI PARK IN OBRENOVAC

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Abstract: *Dendroflora as a basic element of a green area plays a key role in the fulfilment of ecosystem services in all landscape architecture structures within a city. The objective of this paper is to show dendroflora diversity through the analysis of dendrofloristic elements of Mali Park in Obrenovac. In the studied area of 0.65 ha 28 taxonomic categories were identified including 10 Gymnosperms and 18 Angiosperms, with 218 trees recorded in total. The most dominant species in the park are Cedrus atlantica (Endl.) G.Manetti ex Carrière (Gymnosperms) and Betula pendula Roth (Angiosperms). According to origin, the taxa are divided into four categories with different share: allochthonous taxa (13), autochthonous taxa (12), cultivars (2), hybrid taxa (1). The research indicates the importance of increasing the share of resistant species in the dendrofund, with an emphasis on autochthonous species, in order to maintain ecological stability and improve quality of life.*

Keywords: urban green spaces, biodiversity, taxa selection, origin of taxa, sustainable management.

SASTAV I RAZNOVRSNOST DENDROFLORE MALOG PARKA U OBRENOVCU

Apstrakt: *Dendroflora kao osnovni element zelene površine ima ključnu ulogu u ispunjavanju ekosistemsih usluga svakog od objekata pejzažne arhitekture u gradu. Cilj ovog rada je prikazati raznovrsnost dendroflore kroz analizu dendroflorističkih elemenata Malog parku u Obrenovcu. Na istraživanom području, površine 0.65 ha identifikovano je 28 taksonomskih kategorija, 10 u okviru golosemenica i 18 u okviru skrivenosemenica, sa ukuno 218 zabeleženih stabala. Najbrojnije vrste u parku su Cedrus atlantica (Endl.) G.Manetti ex Carrière (Golosemenice) i Betula pendula Roth (Skrivenosemenice). Prema poreklu, taksoni su podeljeni u 4 kategorije sa različitim učešćem: alohtoni taksoni (13), autohtoni taksoni (12), kultivari (2), hibridni taksoni (1). Istraživanje ukazuje na važnost povećanja udela otpornih vrsta u dendrofondu, potencirajući autohtone vrste, a sve u cilju održavanja ekološke stabilnosti i povećanja kvaliteta života.*

Ključne reči: urbane zelene površine, biodiverzitet, izbor taksona, poreklo taksona, održivo upravljanje.

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1. INTRODUCTION

Urban green areas represent spaces of great importance for increasing biodiversity in cities. Therefore, cities play an important role in the preservation of biological diversity through management of green infrastructure (Aronson et al. 2017). A city park, as an element of green infrastructure, represents a public space (Vujković, 1995) and plays an important role in establishing contact between people and nature (Anastasijević, 2011). In addition to improving the physical and mental health of users, the importance of parks in a city reflected in their positive effect on microclimate of the space, mitigating the heat island effect, purifying air pollutants, reducing the impact of noise and wind, as well as preserving flora and fauna.

Mali Park is located in the eastern part of Obrenovac, within the Topolice settlement. This park is especially significant because it is located in the immediate vicinity of residential areas and is therefore intensively used on a daily basis. In addition to its pronounced social importance, the park also has ecological role as a habitat for various woody taxa that offer many benefits for the environment.

The objective of this research is the analysis of dendrofloristic elements in Mali Park in Obrenovac (including the character, origin, vitality and ornamentality of taxa), as well as to assess the ability of the recorded taxa to adapt to changing environmental conditions in an urban environment. Also, the importance of dendroflora in preservation of flora and fauna biodiversity in urban conditions is presented in this paper.

2. MATERIALS AND METHODS

The research area is Mali Park in Obrenovac. The City Municipality of Obrenovac (44°39'N; 20°12'E) is located in the central part of the lower Kolubara basin and territorially represents one of the 17 municipalities of the City of Belgrade. Kralja Aleksandra I Street to the north, Vojvode Putnika Street to the east, and Uzun Mirkova Street to the south and west define the park borders (Figure 1). The area of the researched green infrastructure object is 0.65 ha.

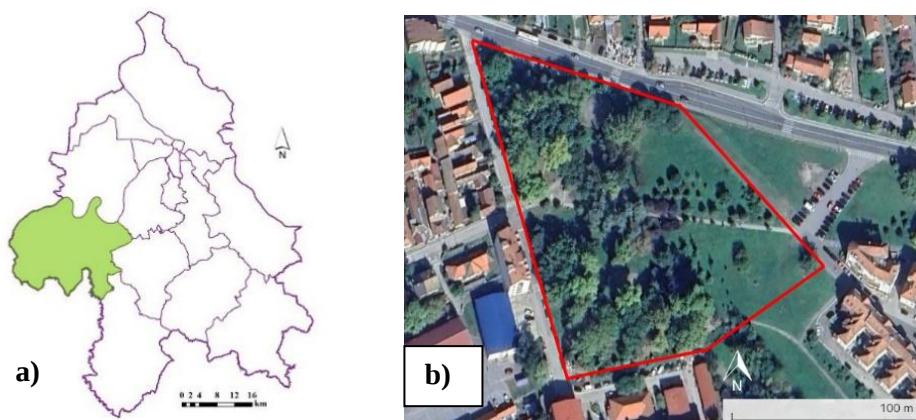


Figure 1. *a) The position of the City Municipality of Obrenovac, b) Study site*

The research is based on identification of dendrofund of the park, as well as the collection of basic parameters of all tree individuals, according to which vitality and ornamental ratings are determined. The sample included 218 trees. The first procedure of the research was determination of tree taxa in Mali Park. When establishing the bioecological basis (Anastasijević, 2011) and collecting field data, vitality and ornamental ratings were assigned based on the researcher's visual assessment, ranging from 1 to 5, according to the established ordinal scale (Stojanović et al. 2011; Mitrović et al. 2025). The presence and types of damages, determined based on the recorded symptoms and classified as mechanical, physiological, entomological, and phytopathological, affected the overall estimate of vitality and ornamental rating.

Mark for vitality was assigned for each tree according to the following valuation scale:

- 1 – heavily diseased, damaged or dry tree;
- 2 – significantly diseased, damaged or rotting tree, which still survives;
- 3 – vital tree that needs regular care measures to survive;
- 4 – vital tree that requires occasional care to maintain that vitality;
- 5 – completely healthy tree.

Guided by standard characteristics specific to each individual taxon (Ocokoljić and Petrov, 2022), ornamental marks of each tree were evaluated as follows:

- 1 – a tree without decorative properties;
- 2 – a tree with poor decorative properties;
- 3 – a tree of standard habitus with certain defects;
- 4 – a tree with very good decorative properties, regular habitus with minor defects;
- 5 – a tree with excellent decorative properties, extremely well developed without visible defects in appearance.

3. RESULTS

In total, 28 tree taxa with 218 individuals were identified and classified in Mali Park (Table 1). 10 taxa, i.e. 41 trees belong to Gymnosperms, while 177 trees were recorded within Angiosperms, classified into 18 taxonomic categories. The presented distribution of dendroflora of Mali Park shows Angiosperms as dominant (81.19%) over Gymnosperms (18.81%).

On the researched area *Cedrus atlantica* (Endl.) G.Manetti ex Carrière with 18 trees, i.e. 43.90% share in Gymnosperms represents the most abundant taxon. For the remaining 9 taxa from this subdivision 7 or less individuals were recorded in the field. The most abundant deciduous taxa in the park are *Betula pendula* Roth (28 trees), *Platanus × hispanica* Mill. ex Münch. (22 trees), *Fraxinus angustifolia* Vahl. (21 trees), *Prunus cerasifera* 'Atropurpurea' (20 trees) and *Aesculus hippocastanum* L. (18 trees). For the remaining taxa from Angiosperms, 13 individuals or less were identified.

Table 1. Representation of tree taxa in the park

Subdivision	Taxon	Number of individuals	Mean vitality	Mean ornamentality
Gymnosperms	<i>Abies alba</i> Mill.	1	4	4
	<i>Abies concolor</i> (Gordon & Glend.) Lindl. ex Hildebr.	2	4	4
	<i>Abies pinsapo</i> Boiss.	2	2	2
	<i>Cedrus atlantica</i> (Endl.) G.Manetti ex Carrière	18	2.78	2.72
	<i>Picea abies</i> (L.) H.Karst	7	3.14	3.14
	<i>Picea pungens</i> Engelm.	5	3.80	3.80
	<i>Pinus halepensis</i> Mill.	1	3	4
	<i>Pinus strobus</i> L.	1	3	2
	<i>Pinus sylvestris</i> L.	1	4	4
	<i>Pseudotsuga menziesii</i> (Mirb.) Franco	3	3	3
Angiosperms	<i>Acer negundo</i> L.	13	3.31	3.23
	<i>Acer platanoides</i> L.	10	3.10	3.10
	<i>Acer pseudoplatanus</i> L.	2	3.50	3.50
	<i>Acer pseudoplatanus</i> 'Atropurpureum'	2	4	4
	<i>Aesculus hippocastanum</i> L.	18	2.89	2.89
	<i>Betula pendula</i> Roth	28	3.07	3.04
	<i>Catalpa bignonioides</i> Walter	8	3	3
	<i>Celtis australis</i> L.	3	3	3.67
	<i>Fraxinus angustifolia</i> Vahl.	21	3.14	3.14
	<i>Fraxinus ornus</i> L.	2	3.50	3.50
	<i>Juglans regia</i> L.	5	3	3
	<i>Morus alba</i> L.	1	4	4
	<i>Platanus</i> × <i>hispanica</i> Mill. ex Münch.	22	3.77	3.54
	<i>Populus alba</i> L.	1	4	5
	<i>Prunus cerasifera</i> 'Atropurpurea'	20	3.15	3.25
	<i>Robinia pseudoacacia</i> L.	9	3.67	3.56
	<i>Styphnolobium japonicum</i> (L.) Schott	3	4	3.67
	<i>Tilia platyphyllos</i> Scop.	9	4	3.89

According to their origin, the taxa recorded in Mali Park can be classified into the following four categories: autochthonous, allochthonous, hybrid taxa and cultivars. Allochthonous species are the most represented in the field compared to the other categories (Figure 2). A total of 13 allochthonous taxa (46.46%) were identified, namely: *Abies concolor* (Gordon & Glend.) Lindl. ex Hildebr., *Abies pinsapo* Boiss., *Cedrus atlantica* (Endl.) G.Manetti ex Carrière, *Picea pungens* Engelm., *Pinus halepensis* Mill., *Pinus strobus* L., *Pseudotsuga menziesii* (Mirb.) Franco, *Acer negundo* L., *Aesculus hippocastanum* L., *Catalpa bignonioides* Walter, *Morus alba* L., *Robinia pseudoacacia* L. and *Styphnolobium japonicum* (L.) Schott.

A total of 12 autochthonous taxa (42.84%) were determined in Mali Park: *Abies alba* Mill., *Picea abies* (L.) H.Karst, *Pinus sylvestris* L., *Acer platanoides* L., *Acer pseudoplatanus* L., *Betula pendula* Roth, *Celtis australis* L., *Fraxinus angustifolia* Vahl., *Fraxinus ornus* L., *Juglans regia* L., *Populus alba* L., and *Tilia platyphyllos* Scop.

Cultivars were used significantly less (7.14%) - *Acer pseudoplatanus* 'Atropurpureum', *Prunus cerasifera* 'Atropurpurea', while hybrids are the least represented in the park (3.57%) with only one taxon identified - *Platanus* × *hispanica* Mill. ex Münch.

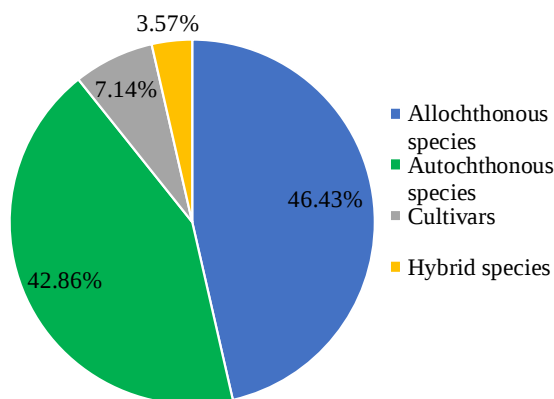


Figure 2. Overview of representation of taxa according to origin (%)

The taxa that received the highest average mark of vitality and ornamentality among Gymnosperms are *Abies alba* Mill., *Abies concolor* (Gordon & Glend.) Lindl. ex Hildebr. and *Pinus sylvestris* L. (mark 4). The species with the lowest vitality and ornamentality in the field is *Abies pinsapo* Boiss. (mark 2). These species were represented by 1-2 individuals in the park, so it is important to consider the most numerous species in the field - *Cedrus atlantica* (Endl.) G.Manetti ex Carrière whose average vitality mark amounts to 2.78, while average ornamentality mark is somewhat lower (2.72).

Among Angiosperms the highest average vitality and ornamentality marks were recorded for the taxa *Acer pseudoplatanus* 'Atropurpureum', *Morus alba* L., *Populus alba* L., *Styphnolobium japonicum* (L.) Schott. and *Tilia platyphyllos* Scop. (mark 4). *Aesculus hippocastanum* L. is a species from Angiosperms with the lowest average vitality and ornamentality mark, which is identical for both parameters and amounts to 2.89. For the species with the greatest number of individuals in the field, *Betula pendula* Roth, vitality and ornamentality marks are approximately equal (3.07; 3.04).

4. DISCUSSION

The results of the research show that the share of Angiosperms is significantly higher in the park compared to Gymnosperms. This ratio supports earlier research where it was also shown that the taxa from Angiosperms are dominant, and the reason is better adaptability to climate change and wider application in horticultural practice (Aronson et al., 2017; Sjöman & Nielsen, 2010). The presence of evergreen taxa, which are diverse, but represented by a small number of individuals, indicates the planned introduction of such species to achieve year-round aesthetic functionality of the park, which represents one of the important characteristics of landscape design.

The analysis of the origin of the taxa used in the park, whereby the ratio of autochthonous and allochthonous species is almost equal, is typical of many urban parks in Serbia (Djurdjević et al. 2025). Allochthonous species are frequently used due to their resistance to various urban stressors (Kovarík, 2011) such as air

pollution, high temperatures, droughts, groundwater withdrawal, etc. On the other hand, significant use of native species helps in preservation of natural identity of the location and contributes to ecosystem stability through providing habitat for autochthonous species of fauna. The presence of cultivars and hybrid species is important due to their specific characteristics (great resistance to the conditions of urban environment in species *Platanus* × *hispanica* Mill. ex Münch.), but also due to aesthetic significance provided by certain taxa (colour of *Prunus cerasifera* 'Atropurpurea'). Similar results are recorded in various cities around the world, which indicates the trend of biotic homogenization of urban spaces (McKinney, 2006).

5. CONCLUSION

In this research, 28 taxonomic units with 218 individuals are identified in Mali Park, Obrenovac. The composition, diversity, vitality and ornamentality of dendroflora were analyzed based on bioecological basis of dominant, but also all recorded taxa. The most abundant taxa in the field are *Betula pendula* Roth, *Platanus* × *hispanica* Mill. ex Münch., *Fraxinus angustifolia* Vahl., *Prunus cerasifera* 'Atropurpurea', and *Cedrus atlantica* (Endl.) G.Manetti ex Carrière. The recorded number of taxa on the researched area indicates that Mali Park has a significant role in preservation of flora and fauna biodiversity.

The analysis of the origin of taxa showed almost equal representation of native and allochthonous species, maintaining a balance between biodiversity conservation and the use of taxa that are more resistant to specific urban environmental conditions. The research of dendrofloristic elements supports the monitoring and management of the dendroflora in urban green spaces.

The results of this paper confirm that urban parks represent complex socio-ecological systems in which natural conditions and anthropogenic influence (such as the introduction of non-native species) are closely intertwined. The park is located in the immediate vicinity of a residential zone, which is why the potential for greater diversity is limited, but, at the same time, it represents a valuable structure of landscape architecture for improvement of people's quality of life through fulfillment of important ecosystem functions.

To improve the ecological value of the park it is recommended to increase the share of resistant species, with an emphasis on resistant autochthonous species and application of integral management strategies that will enable preservation of natural processes while meeting the social needs of users. Such an approach would contribute to the long-term preservation of biodiversity and the functionality of this green infrastructure object.

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Summary

This study deals with the determination of taxa and the analysis of dendrofloristic elements of trees in Mali Park in Obrenovac, as an important object of green infrastructure for preservation of biodiversity and improvement of environmental conditions. The objective of this paper is the analysis of the character, origin, vitality and ornamentality of the taxa, as well as the insight into ability of taxa recorded in the field to adapt to changed ecological conditions of urban environment. 28 taxa with 218 trees in total were identified and analysed in the researched area.

Angiosperms dominate the park with 177 trees (81.19%), whereby the most common species is *Betula pendula* Roth with 28 individuals. Gymnosperms are represented in the field with 41 trees (18.81%) and the most dominant species is *Cedrus atlantica* (Endl.) G.Manetti ex Carrière with 18 individuals. Based on the analysis of origin the taxa are divided

into 4 categories and allochthonous species are the most dominant (46.46%), then, there are slightly fewer autochthonous species (42.84%), followed by cultivars (7.14%), while hybrid species are the least represented in the park (3.57%). Taxa with the best vitality and ornamental marks are *Abies alba* Mill., *Abies concolor* (Gordon & Glend.) Lindl. ex Hildebr. and *Pinus sylvestris* L. (mark 4) while the species with the poorest marks for these two parameters is *Abies pinsapo* Boiss. (mark 2).

The obtained results indicate that the park has a great potential for the improvement of ecological, aesthetic and social functions through the enrichment of dendrofund by resistant, especially autochthonous taxa. Sustainable management of urban green infrastructure would enable ecosystem stability and increase diversity of flora and fauna as well as improve the quality of life in the city.

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Rezime

Ova studija se bavi determinacijom taksona i analizom dendroflorističkih elemenata drveća u Malom parku u Obrenovcu, kao važnim objektom zelene infrastrukture za očuvanje biodiverziteta i unapređenje uslova životne sredine. Cilj rada je analiza karaktera, porekla, vitalnosti i dekorativnosti taksona kao i uvid u mogućnost taksona zabeleženih na terenu da se prilagode izmenjenim ekološkim uslovima urbane sredine. Na istraživanom području je identifikovano i analizirano 28 taksona sa ukupno 218 stabala.

U parku dominiraju skrivenosemenice sa 177 stabala (81.19%), pri čemu je najčešća vrsta *Betula pendula* Roth sa 28 jedinki. Golosemenice su na terenu identifikovane sa 41 stablom (18.81%) i najdominantnija vrsta je *Cedrus atlantica* (Endl.) G.Manetti ex Carrière sa 18 jedinki. Na osnovu analize o poreklu, taksoni su podeljeni u 4 kategorije i najdominantnije su alohtone vrste (46.46%), potom, neznatno manje ima autohtonih vrsta (42.84%), za njima slede kultivari (7.14%), dok su hibridne vrste najmanje zastupljene u parku (3.57%). Taksoni sa najboljim ocenama vitalnosti i dekorativnosti su *Abies alba* Mill., *Abies concolor* (Gordon & Glend.) Lindl. ex Hildebr. i *Pinus sylvestris* L. (ocena 4) dok je vrsta sa najlošijim ocenama za ova dva parametra - *Abies pinsapo* Boiss. (ocena 2).

Dobijeni rezultati ukazuju da park ima veliki potencijal za unapređenje ekološke, estetske i socijalne funkcije kroz obogaćivanje dendrofonda otpornim, posebno autohtonim, taksonima. Održivim upravljanjem urbanom zelenom infrastrukturuom bila bi omogućena ekosistemska stabilnost i povećala bi se raznovrsnost flore i faune kao i kvalitet života u gradu.