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Dendroflora of the urban part of Srebrenik municipality

Dendroflora urbanog područja općine Srebrenik

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ABSTRACT

The results of the research on the urban dendroflora of the Srebrenik minicipality are presented in this paper. The research was conducted in the period March-August 2020-2021. In the field of research, 100 taxa were identified, which were classified into 37 families and 64 genera. The family Rosaceae stands out with the largest number of taxa, followed by Pinaceae, Aceraceae, and Cupressaceae. The analysis of the presence of deciduous and evergreen elements shows that deciduous trees predominate in the dendroflora of Srebrenik in relation to evergreen taxa. In the dendroflora of Srebrenik, allochthonous taxa (50 taxa) are more represented than autochthonous taxa (48 taxa). According to the number of taxa, angiosperms dominate (84 taxa) compared to gymnosperms (16 taxa). Allochthonous dendroflora shows the largest representation of taxa of Eurasian origin, followed by taxa from Asia, North America, Europe, while all others are represented by less than 10 taxa. The results of research on the dendroflora of Srebrenik show a lack of park areas and urban greenery, so it is necessary to pay special attention to the arrangement of existing and the formation of new green areas.

Key words: *urban dendroflora, inventory, Srebrenik*

INTRODUCTION – Uvod

Green areas in urban areas are becoming important in developing countries as they improve certain aspects of air quality (Thaiutsa et al., 2008; Pickett et al., 2008; Davies et al., 2011). The flora of urban areas usually consists of indigenous plants that are introduced from the surrounding natural and semi-natural habitats, and allochthonous plants that were introduced intentionally for the purpose of cultivation or came there by chance (Repić et al., 2013). Due to their unique role in ecosystems, urban forests and trees have been extensively studied in Malaysia (Sreetheran et al., 2006), Taiwan (Huang et al., 2009), and Germany (Strohbach and Haase, 2012). Goel & Singh (2006) collected important data on the diversity of dendroflora of the city of Delhi and identified suitable trees for expanding green areas. There are a significant number of papers dealing with the research of dendroflora of Bosnia and Herzegovina in the area of Banja Luka (Stupar, 2009), Sarajevo (Omano-

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Figure 1: Satellite image of the investigated area

Slika 1: Satelitski snimak istraživanog područja

vić et al., 2012), Jajce (Hadžić et al., 2016), Tuzla (Dervišević et al., 2018), Bihać (Delić et al., 2018) and Brčko (Huseinović et al., 2020). Research on similar problems has been conducted in neighboring Croatia in the area of Šibenik (Milović, 2000), Split (Rušćić, 2002), Zadar (Milović, 2008), Omiš (Tafra, 2012) and Šibenik-Knin County (Pandža, 2016). According to the available literature data dealing with this issue, no similar research has been conducted in the municipality of Srebrenik.

The municipality of Srebrenik is located in the northeastern part of Bosnia and Herzegovina and belongs to Tuzla County. It is located at 44°42′26.7″ north latitude and 18°29′31.2″ east longitude. The area of the municipality is 249 km², and the average altitude is 199 meters. The municipality of Srebrenik is exposed to the climatic influence of the Pannonian Plain from the north and northwest, while the Dinaric Mountains from the south hinder the penetration of air masses from the Mediterranean. Depending on the natural-geographical factors in this area, a moderately warm and humid climate with a warm summer was formed (Hatunić, 2009; Zukić, 2016).

This paper aims to analyze and inventory the dendroflora of green areas in the urban part of the municipality of Srebrenik to assess the state of urban greenery. This study did not include green areas of private greenery, is private gardens, or only those parts that border public areas, such as hedges or individual trees.

MATERIAL AND METHODS - Materijal i metode

The paper inventories the dendroflora of the urban area of Srebrenik municipality (Figure 1). Dendroflora research was conducted in the period March-August 2020.-2021. years. The collected plant material was determined in the laboratory of the Faculty of Natural Sciences and Mathematics in Tuzla.

In the list of dendroflora, taxa are presented in alphabetical order. Determination of taxa was performed based on numerous literature sources: Tutin (1964-1980); Pignattti (1982); *Šilić* (1990a, 1990b); Domac (1994), Šilić (2005) and Stupar (2005, 2009). Popular names are given according to Domac (1994), Vidaković and Franjić (2004), and Idžojtić (2005a 2005b). The nomenclature of taxa in the flora list was harmonized according to Nikolić (2012). Cultivar names are listed according to an international standard (Hoffman, 2005). The following information is given for each taxon: scientific and popular name, an indication of whether the species is deciduous or evergreen, and geographical origin for non-native taxa. The distribution of taxa into deciduous (D), evergreen (E), and as well as data on geographical origin was taken from Pignatti (1982), Walters (1989); Erhardt et al. (2002). The classification of dendroflora into these categories was performed according to the established situation in the study area.

RESULTS AND DISCUSSION – Rezultati i diskusija

List of flora - Popis flore

The list of dendroflora of the urban part of Srebrenik municipality is shown in Table 1.

Table 1: List of dendroflora of the urban part of Srebrenik municipality

Tabela 1: Popis dendroflore urbanog dijela općine Srebrenik

GYMNOSPERMAE				
Number	**Botanical name**	**Popular name**	**Geografic origins**	**D/E Deciduosus/ Evergreen species**
CUPRESSACEAE				
1.	*Chamaecyparis lawsoniana* (A. Murray bis) Parl	Port Orford Cedar	North America	E
2.	*Chamaecyparis pisifera* (Siebold & Zucc.) Endl.	Cultivity of Sawara false cypress	-	E
3.	*Juniperus communis* L.	Common blueberry	Europe, Asia, Africa	E
4.	*Juniperus horizontalis* Moench	Crawling blueberry	North America	E
5.	*Juniperus virginiana* L.	Virgin's blueberry	North America	E
6.	*Platycladus orientalis* (L.) Franco	Eastern thuja	Asia	E
7.	*Thuja occidentalis* L.	American thuja	North America	E
PINACEAE				
8.	*Abies concolor* (Gordon) Lindl. ex Hildebr.	American white pine	America	E
9.	*Larix decidua* Mill.	European larch	Europe	D
10.	*Picea abies* (L.) H.Karst.	Common sprice	Europe	E
11.	*Picea pungens* Engelm.	Prickly spruce	North America	E
12.	*Pinus mugo* Turra	Dwarf mountain pine	Europe	E
13.	*Pinus nigra* J.F.Arnold	Black pine	Europe	E
14.	*Pinus silverstris* L.	White pine	Europe, Asia	E
15.	*Pinus strobus* L.	Eastern white pine	North America	E
TAXACEAE				
16.	*Taxus baccata* L.	Common jew	Europe, Asia, North Africa	E
ANGIOSPERMAE				
ACERACEAE				
1.	*Acer campestre* L.	Field maple	Europe, Asia, North America	D
2.	*Acer negundo L.*	Boxelder maple	North America	D
3.	*Acer platanoides* L.	Norway maple	Europe, Asia	D

GYMNOSPERMAE				
Number	**Botanical name**	**Popular name**	**Geografic origins**	**D/E Deciduosus/ Evergreen species**
4.	*Acer platanoides* L. "Crismon King"	-	Cult.	D
5.	*Acer pseudoplatanus* L.	Sycamore	Europe, Asia	D
6.	*Acer saccharinum* L.	Silver maple	America	D
7.	*Acer tataricum* L.	Tatarian maple	Europe, Asia	D
ADOXACEAE				
8.	*Viburnum bodnantense* Aberc. 'Dawn'	Arrowwood "Dawn"	-	D
ANACARDIACEAE				
9.	*Rhus typhina* L.	Staghorn sumac	North America	D
ARALIACEAE				
10.	*Hedera helix* L.	Common ivy	Europe, Africa, Asia	E
BERBERIDACEAE				
11.	*Berberis thunbergii* DC.	Japanese barberry	Asia	
12.	*Berberis vulgaris* L.	Common barberry	Europe, Asia	D
13.	*Mahonia aquifolium* (Pursh) Nutt	Oregon grape	North America	D
BETULACEAE				
14.	*Betula pendula* Roth.	European white birch	Europe, Asia	D
BIGNONIACEAE				
15.	*Catalpa bignonioides* Walter	Catalpa tree	North America	D
BUXACEAE				
16.	*Buxus sempervirens* L.	Boxwood	Western and Southern Europe, Northern Africa	E
CORYLLACEAE				
17.	*Carpinus betulus* L.	Common hornbeam	Europe, Asia	D
18.	*Corylus avellana* L.	Common hazel	Europe, Asia	D
19.	*Corylus maxima* Mill. Purpurea	Giant hazel	Europe, Asia	D
CANNABACEAE				
20.	*Celtis australis* L.	Mediterranean hackberry	Europe, Asia, Africa	D
CAPRIFOLIACEAE				
21.	*Lonicera caprifolium* L.	Perfoliate honeysuckle	Europe, Asia	D

GYMNOSPERMAE				
Number	**Botanical name**	**Popular name**	**Geografic origins**	**D/E Deciduosus/ Evergreen species**
22.	*Lonicera fragrantissima* Lindl. & J. Paxton	Winter-flowering honeysuckle	Asia	E
23.	*Lonicera nitida* E.H.Wilson	Box honeysuckle	Asia	E
CELASTRACEAE				
24.	*Evonymus japonicus* Thunb.	Japanese spindle	Asia	E
CORNACEAE				
25.	*Cornus sanguinea* L.	Common dogwood	Europe	D
ELAEGNACEAE				
26.	*Elaegnus angustifolia* L.	Russian olive	Asia	D
FABACEAE				
27.	*Robinia pseudoacacia* L.	Black locust	North America	D
28.	*Gleditschia triacanthos* L.	Honey locust	North America	D
FAGACEAE				
29.	*Quercus robur* L.	English oak	Europe, Asia	D
30.	*Quercus frainetto* Ten.	Hungarian oak	Europe, Asia	D
31.	*Quercus cerris* L.	Turkey oak	Europe, Asia	D
32.	*Castanea sativa* Mill.	Sweet chestnut	Europe, Asia, Africa	D
HAMAMELIDACEAE				
33.	*Liquidambar styraciflua* L	American sweetgum	North America	D
HIPPOCASTANACEAE				
34.	*Aesculus hippocastanum*	Horse chestnut	Asia	D
HYDRANGEACAE				
35.	*Hydrangea arborescens* L	Smooth hydrangea	North America	D
36.	*Philadelphus coronarius* L	Sweet mock orange	Asia	D
JUGLANDACEAE				
37.	*Juglans regia* L.	Domestic walnut	Asia	D
LYTHRACEAE				
38.	*Lagerstroemia indica var.Alba* Ram. Goyena	Crape myrtle	Asia	D
MAGNOLIACEAE				
39.	*Liriodendron tulipifera* L.	Tulip poplar	North America	D
MALVACEAE				
40.	*Hibiscus syriacus* L.	Rose of sharon	Asia	D

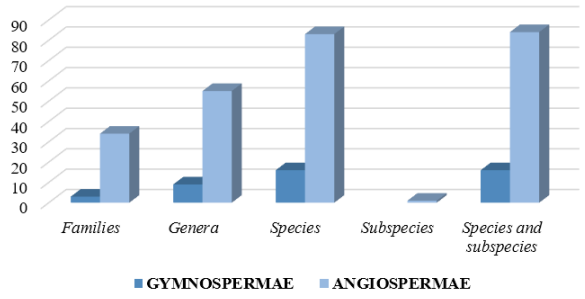
GYMNOSPERMAE				
Number	**Botanical name**	**Popular name**	**Geografic origins**	**D/E Deciduosus/ Evergreen species**
MORACEAE				
41.	*Morus nigra* L.	Black mulberry	Asia	D
42.	*Morus alba* L.	White mulberry	Asia	D
43.	*Maclura pomifera* (Raf.) C.K.Schneid.	Osage orange	North America	D
OLEACEAE				
44.	*Buddleja davidii* "Franch"	Butterfly-bush	Asia	D
45.	*Lygustrum vulgare* L.	Common privet	Europe, Asia, North Africa	D
46.	*Fraxinus pennsylvanica* Marshall	Green ash	Europe	D
47.	*Fraxinus ornus* L.	Flowering ash	Europe, Asia	D
48.	*Fraxinus excelsior* L.	European ash	Evrope, Asia	D
49.	*Fraxinus angustifolia* Vahl.	Narrow-leaved ash	Europe, Asia	D
50.	*Syringa vulgaris* L.	Lilac	Europe	D
PAULOWNIACEAE				
51.	*Paulownia tomentosa* (Thunb. Ex Murray) Steud	Princess tree	Asia	D
PLATANACEAE				
52.	*Platanus acerifolia* (Aiton) Willd.	Oriental plane	Cult.	D
POLYGONACEAE				
53.	*Reynoutria japonica* Houtt.	Japanese knotweed	Asia	D
ROSACEAE				
54.	*Chaenomeles japonica* (Thunb.) Lindl. Ex Spach	Japanese quince	Asia	D
55.	*Cotoneaster horizontalis* Decne.	Rockspray cotoneaster	Asia	D
56.	*Crataegus monogyna* Jacq.	Common hawtorn	Europe, Asia	D
57.	*Crataegus oxyacantha* L.	Hawtorn	-	D
58.	*Kerria japonica* (L.) DC.	Japanese rose	Asia	D
59.	*Malus domestica* Borkh.	Domestic apple	Evrope, Asia	D
60.	*Mespilus germanica* L.	Medlar	Asia	D
61.	*Prunus armeniaca* L.	Siberian apricot	Asia	D
62.	*Prunus avium* L.	Wild cherry	Europe, Asia	D
63.	*Prunus cerasifera* Ehrh.	Cherry plum	Europe, Asia	D

GYMNOSPERMAE				
Number	**Botanical name**	**Popular name**	**Geografic origins**	**D/E Deciduosus/ Evergreen species**
64.	*Prunus domestica* L.	Plum	Europe, Asia	D
65.	*Prunus serulatta* Lindl.	Japanese cherry	Asia	D
66.	*Pyrus communis* L.	Common pear	Europe, Asia	D
67.	*Rosa canina* L.	Dog-roose	Europe, Asia, North Africa	D
68.	*Rubus caesius* L.	European dewberry	Europe, Asia	D
69.	*Rubus fruticosus* L.	Bramble blackberry	Europe	D
70.	*Spirea x bumalda* Burv.	Japanese meadowsweet	Asia	D
71.	*Spirea x vanhouttei* (Briot.) Zabel	Vanhoute meadowsweet	Asia	D
SALICACEAE				
72.	*Salix alba* L.	White willow	Europe, Asia	D
73.	*Salix babylonica* L.	Weeping willow	Asia	D
74.	*Salix fragilis* L.	Crack willow	Europe, Asia	D
75.	*Salix integra* Thunb.	Dappled willow	Asia	D
76.	*Salix matsudana var. tortuosa* Vilm.	Corkscrew willow	-	D
77.	*Populus nigra* L.	Black cottonwood	Europe, Asia, North Africa	D
SAMBUCACEAE				
78.	*Sambucus nigra* L.	Elderberry	Europe, Asia, Africa	D
TILIACEAE				
79.	*Tilia cordata* Mill	Small-leaved lime	Europe	D
80.	*Tilia platyphyllos* Scop.	Large leaved lime	Europe	D
81.	*Tilia tomentosa* Moench	Silver lime flower	Europe, Asia	D
ULMACEAE				
82.	*Ulmus glabra* Hudson	Wych elm	Europe, Asia	D
83.	*Ulmus minor* Mill.	Field elm	Eropae, Africa, Asia	D
VITACEAE				
84.	*Vitis vinifera* L. *subsp. sylvestris* (C.C. Gmel.) Hegi	European wine greape	Europe, Asia	D

Flora analysis - Analiza flore

The analysis of the dendroflora of the urban part of the municipality of Srebrenik included 100 taxa (Table 1). The dendroflora is determined to the level of the cultivar. Taxonomic and phytogeographic analysis was performed.

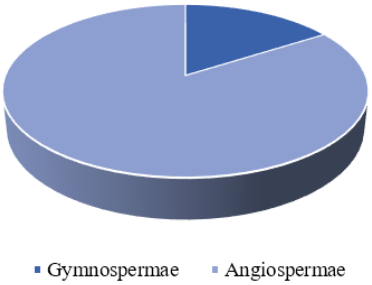
The taxonomic analysis of the dendroflora of the urban part of Srebrenik municipality included 100 taxa classified into 37 families and 64 genera (Graph 1). Out of 37 families, only one is represented by more than 10 taxa. The families Rosaceae (18 taxa; 18%), Pinaceae (8 taxa; 8%), Aceraceae (7 taxa; 7%), and Cupressaceae (7 taxa; 7%) stand out with the largest number of taxa. In their research, Tafra et al., (2012), and Huseinović et al., (2020) also list the Rosaceae family as the most represented. The most represented genus is *Acer* (7 taxa), followed by *Prunus* (5 taxa), *Pinus* (4 taxa), *Salix* (4 taxa), and the genera *Fraxinus, Juniperus, Lonicera, Quercus*, and *Tilia* (all 3 taxa).



Graph. 1: Taxonomic analysis woody plants of the urban part of Srebrenik municipality

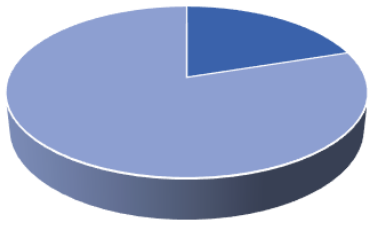
Grafikon 1: Taksonomska analiza drvenastih biljaka urbanog dijela općine Srebrenik

Out of a total of 100 taxa identified by this study, gymnosperms were represented by 16 taxa (16%), while angiosperms were more numerous and represented by 84 taxa (84%) (Graph 2). The dominance of angiosperms was also recorded in the area of the park "University City" in Banja Luka (Stupar, 2009) of the city park in Tuzla (Dervišević et al., 2017), as well as in other research areas in the region (Tafra et al., 2012; Pandža, 2016).



Graph 2: Percentage representation of Graph.

Grafikon 2: Procentualna zastupljenost Graf



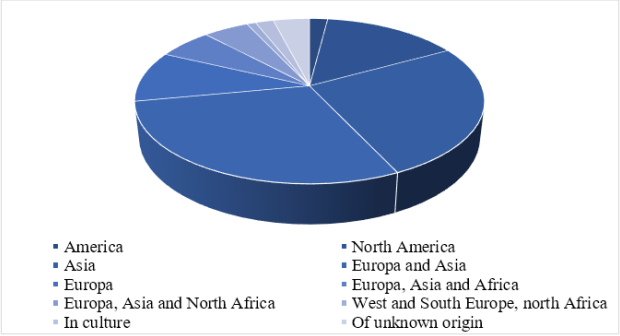
Graph 3: Percentage representation of gymnosperme and angiospermae deciduous and evergreen taxa

Grafikon 3: Procentualna zastupljenost golosjemenjača i skrivenosjemenjača listopadnih i zimzelenih svojti

The dendroflora of Srebrenik is dominated by deciduous plants with 80 taxa (80%), while 20 taxa belong to the evergreens (20%) (Graph 3). The results of our research deviate from similar research in other areas (Stupar, 2009; Dervišević et al., 2017; Delić, 2018) where evergreens were dominant in the number of taxa.

Out of the total number of taxa, 50 are allochthonous, 48 are autochthonous, while other taxa have been left out of the analysis because they are varieties or cultivars. The dominance of allochthonous plant taxa was also recorded in the flora of Vukovar (Rauš, 1969), Rijeka (Karavla et al., 1997), Omiš (Tafra et al., 2012), Knin (Dorbić et al., 2014), Mostar (Mešić et al. et al., 2017) and Brčko (Huseinović et al., 2020).

Analysis of allochthonous dendroflora by geographical origin (Graph 4) shows the highest representation of taxa of Eurasian origin (29 taxa), followed by taxa from Asia (26 taxa), North America (15 taxa), Europe (10 taxa), while all others are represented by less than 10 taxa.



Graph. 4: Representation of introduced dendro taxa in relation to their natural distribution

Grafikon 4: Zastupljenost dendrosvojti u odnosu na prirodnu distribuciju

CONCLUSION – Zaključak

From all the above, the following conclusions can be drawn:

- A survey was conducted in the urban area of Srebrenik Municipality identified 100 taxa. All taxa are classified into 37 families and 64 genera. The family Rosaceae stands out with the largest number of taxa, followed by Pinaceae, Aceraceae, and Cupressaceae.
- In the area of Srebrenik, 84 taxa belonging to angiosperms and 16 taxa belonging to gymnosperms were recorded. Of the 100 taxa in the dendroflora of Srebrenik, 50 are allochthonous and 48 autochthonous. Other taxa have been omitted from the analysis because they are cultivars.
- The analysis of the presence of deciduous and evergreen elements shows that in the dendroflora of Srebrenik deciduous prevail over evergreen taxa.
- Allochthonous dendroflora shows the largest representation of taxa of Eurasian origin, followed by taxa from Asia, North America, Europe, while all others are represented by less than 10 taxa.
- The results of this research can be useful to urban planners in selecting trees that are successfully tolerated by the urban environment. Further studies are needed on a larger scale to assess existing and future needs for green spaces, improve air, water, and other ecosystem services provided by urban biodiversity.

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SAŽETAK

U radu se iznose rezultati istraživanja urbane dendroflore općine Srebrenik. Općina Srebrenik nalazi se u sjeveroistočnom dijelu Bosne i Hercegovine i pripada Tuzlanskom kantonu. Površina općine je 249 km², a prosječna nadmorska visina je 199 metara. Istraživanje je provedeno u razdoblju ožujak-kolovoz 2020.2021. godine. Na području istraživanja identificirano je 100 svojti koje su razvrstane u 37 porodica i 64 roda. Sa najvećim brojem svojti ističe se porodica Rosaceae, zatim Pinaceae, Aceraceae i Cupressaceae. Analiza zastupljenosti listopadnih i zimzelenih elemenata pokazuje da u dendroflori Srebrenika prevladavaju listopadne u odnosu na zimzelene svojte. U dendroflori Srebrenika zastupljenije su alohtone svojte (50 svojti) od autohtonih (48 svojti). Prema broju svojti dominiraju skrivenosmjenenjače (84 svojte) u odnosu na golosjemenjače (16 svojti). Analiza alohtone dendroflore prema geografskom porijeklu pokazuje najveću zastupljenost svojti evroazijskog porijekla (29 svojti), zatim iz Azije (26 svojti), Sjeverne Amerike (15 svojti), Evrope (10 svojti), dok su ostali zastupljeni s manje od 10 svojti. Rezultati istraživanja dendroflore Srebrenika pokazuju nedostatak parkovnih površina i urbanog zelenila, pa je potrebno posebnu pažnju posvetiti uređenju postojećih i formiranju novih zelenih površina.