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TREE INVENTORY ANALYSIS IN VĂCĂREŞTI NATURAL PARK

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Abstract

The present study comprises a tree inventory analysis in Văcărești Natural Park from Bucharest. It aims to deepen the research regarding the vegetation habitats mapping conducted in Văcărești in 2019. The inventory has been realized by analyzing each tree over 4 m high. The analyzed aspects included: identification of the species and cultivars, (DBH) diameter at breast height, land use, tree height, health status etc. A database comprising those aspects was created through a specialized software, including also the spatial distribution of all the analyzed trees in the natural park. A total of 4676 trees have been inventoried, covering 29 different species from 18 genera. The results revealed: a high percentage of native species, a low presence of invasive species, the dominant species identified in each habitat and the relationship between the local pedoclimatic conditions and the spatial distribution of tree vegetation. This study helps us to analyse the evolution of vegetation in this natural urban area. Considering also the continuous extension of palustrine and tree vegetation, we can observe a tendency of the development of an urban forest in the next decades.

Key words*: tree inventory, vegetation mapping, urban wetland, Văcărești Natural Park Bucharest.*

INTRODUCTION

The study is exploring the identification and inventory of the mature trees of Văcărești Natural Park, declared the first urban natural area of Romania in 2016, by government decision (Guvernul României, 2016).

Urban green spaces offer many ecosystem services to the community: clean and fresh air, regulation of high temperatures in summer, balancing airflow, attenuation of precipitation, healthy recreation areas etc. Văcărești Natural Park is a good example of green space that, in addition to the ecosystem benefits offered, due to its natural character and biodiversity, also offers thematic spaces for education, information and awareness about the importance of nature in cities.

Thus, the evaluation of the ecosystem benefits offered by the tree vegetation, which also contributes to the well-being of the local community and the city, is an important future objective. Starting with November 2019, until March 2021, comprising a total of 16 months, data were collected on tree vegetation (Figures 1 and 2). This paper is an in-depth analysis of the structure of tree vegetation that completes the initial mapping study of plant habitats in the Văcărești Natural Park (Boc et al., 2020) (Figure 3).

Figure 1. *Salix alba* in the natural park

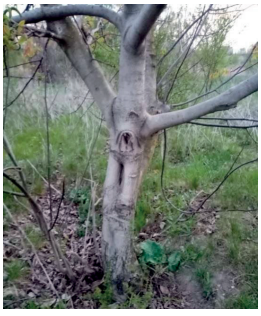

Figure 2. *Juglans regia* in the natural park

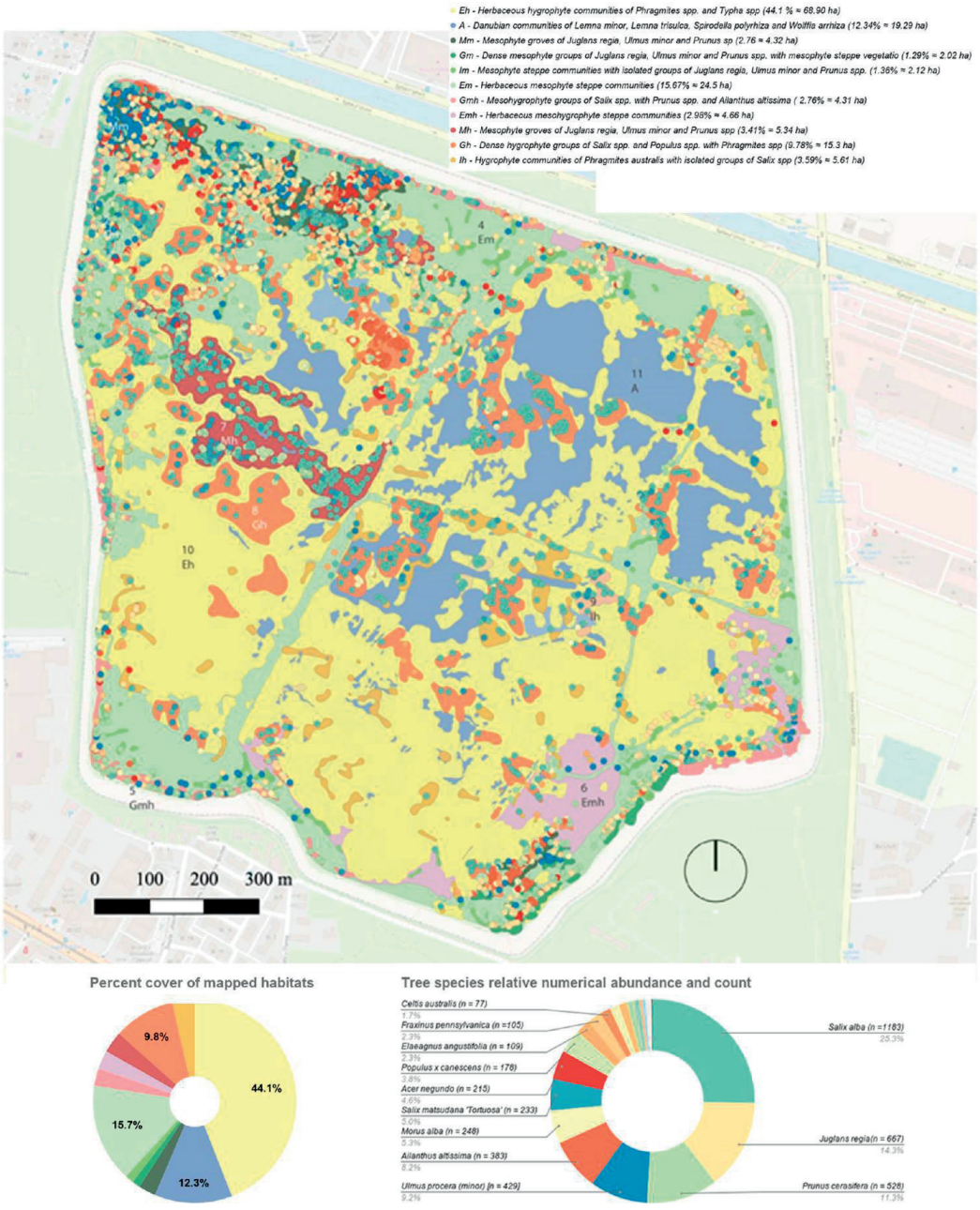

Figure 3. Tree vegetation overlapping the habitats

MATERIALS AND METHODS

The inventory of tree specimens and the ecosystem services offered by them was made with the help of the TreePlotter™ Inventory application (support.treeplotter.com), in the following 3 stages:

1. Species identification - the species and cultivars were identified using local scientific literature (Ciocîrlan, 1990; Iliescu, 2003; Pârvu, 2006) and previous studies conducted in Văcărești Natural Park (Anastasiu et al., 2017; Doniță et al., 2005; Stoican et al., 2014);

2. Field identification of the location of trees with a height of at least 4 m by GPS and registration of taxonomic and biometric data characteristic of each specimen with the help of the digital application TreePlotter™ Inventory. These data include: species and cultivars (if applicable), common name, height, trunk DBH (Diameter at Breast Height - about 130 cm), health. Health condition was determined upon visual inspection, classified according to the following four categories based on the observations list provided in the survey form of the TreePlotter app (support.treeplotter.com):
- excellent: no observations or only minor observations about the tree's condition;
- good: few observations that may include: cavity decay, crown dieback, frost cracks, pests, mechanical damage, and/or poor root system. This category should only have 1-2 observations which should affect < 10% of the tree;
- fair: same criteria applicable for "good" category, including also: poor structure; maximum of 1-4 observations which may affect 10-60% of the tree;
- poor: same criteria applicable to "fair" category, including also serious biological decline. There should be one or all of the observations reported which may affect >60% of the tree.
Where appropriate, additional observations which were not included in the original survey, such as the degree of burns or creeping vines, were made. In addition, recommendations were made for the future management of the specimens but the results are not included in this study.
Regarding DBH, since most of the trees were multi-stem trees (had more than 1 stem), their trunk DBH was calculated by taking the square root of the sum of each stem diameter squared. The specific tools used for measuring the DBH were tree calipers and measuring tapes. For height determination the Hagloff EC II electronic clinometer was used.
3. The last stage consisted in centralizing the data and interpreting the database resulting from the field inventory, by using specific software for statistical data. (R Core Team) and QGIS 3.4 for plotting thematic maps. At this stage, depending on the data collected in the field, the following results were identified regarding the structure of tree vegetation: species relative numerical abundance, percentage of native species, distribution of mesophytes, mesohygrophytes and hygrophytes species, tree condition, DBH range classes.
For the characterization of the tree community we calculated the relative abundace and derived the species domeninance (Preda, Rusti & Cogalniceanu, 2020). The species were sorted in descending order by relative abundances and dominance thresholds were chosen arbitrary by the researchers. If the relative abundance is above 10%, the species are considered frequent, while if it is beteween 1% and 10%, the species are classified as ocassional. If the relative abundance is below 1%, than the species are rare (Gomoiu & Skolka, 2001).

RESULTS AND DISCUSSIONS

As a consequence of the undertaken field inventory a **total of 29 tree species from 18 genera are identified** (Figure 4). Table 1 illustrates the number of individuals for each species and their relative abundance and their dominance. The total number of individuals is **4676**. The research was carried out on the surface of 156 ha within the concrete dam surrounding the park. The most frequent species identified are: *Salix alba* (25.30 %), *Juglans regia* (14.26 %), *Prunus cerasifera* (11.29 %) and *Ulmus procera* (9.17 %). These cover 60% of the park`s total tree population.
All the four species are native tree species that are expected to be present in an urban wetland habitat and have emerged in the last 20-25 years. This is the average age estimated for the oldest individuals. The dead individuals were not inventoried.
There are other 11 occasional species which cover an abundance interval between 8.19% and 1.20%. *Ailanthus altissima,* an invasive species of Community interest (*Handbook of Alien Species in Europe*, 2009) is the most abundant. Because of its fast vegetative reproduction through suckers it threatens the adjacent communities therefore management control is required.

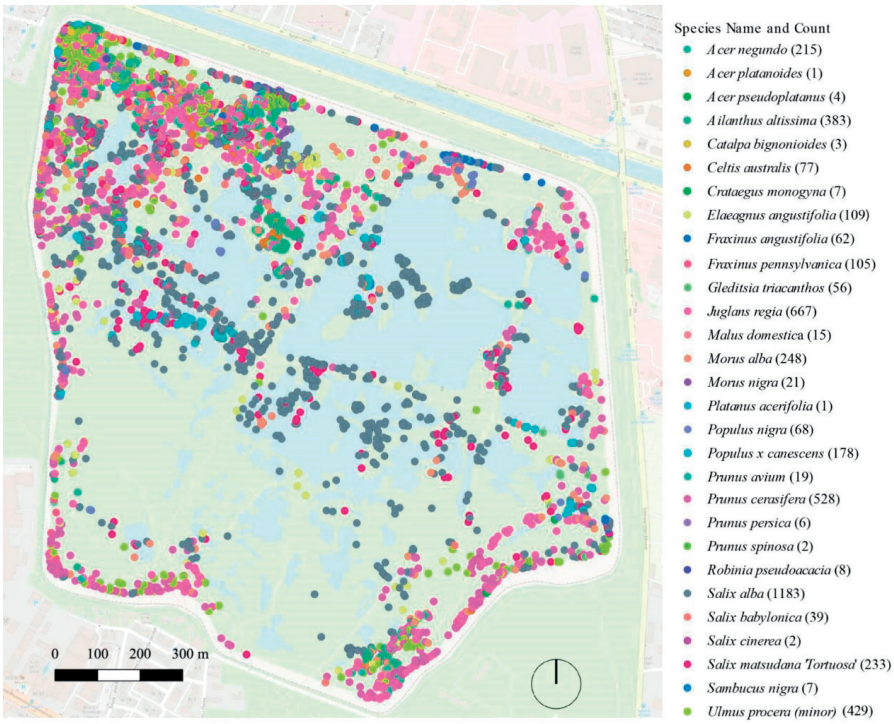

Figure 4. Tree species distribution

Table 1. Number of individuals and relative abundance of the tree species from the Văcărești Natural Park

Species name	n	Relative abundance (%)	Cumulative abundance (%)	Dominance
Salix alba	1183	25.30	25.30	Frequent
Juglans regia	667	14.26	39.56	Frequent
Prunus cerasifera	528	11.29	50.86	Frequent
Ulmus procera (minor)	429	9.17	60.03	Occasional
Ailanthus altissima	383	8.19	68.22	Occasional
Morus alba	248	5.30	73.52	Occasional
Salix matsudana 'Tortuosa'	233	4.98	78.51	Occasional
Acer negundo	215	4.60	83.11	Occasional
Populus x canescens	178	3.81	86.91	Occasional
Elaeagnus angustifolia	109	2.33	89.24	Occasional
Fraxinus pennsylvanica	105	2.25	91.49	Occasional
Celtis australis	77	1.65	93.14	Occasional
Populus nigra	68	1.45	94.59	Occasional
Fraxinus angustifolia	62	1.33	95.92	Occasional
Gleditsia triacanthos	56	1.20	97.11	Occasional
Salix babylonica	39	0.83	97.95	Rare
Morus nigra	21	0.45	98.40	Rare
Prunus avium	19	0.41	98.80	Rare
Malus domestica	15	0.32	99.12	Rare
Robinia pseudoacacia	8	0.17	99.29	Rare
Crataegus monogyna	7	0.15	99.44	Rare
Sambucus nigra	7	0.15	99.59	Rare
Prunus persica	6	0.13	99.72	Rare
Acer pseudoplatanus	4	0.09	99.81	Rare
Catalpa bignonioides	3	0.06	99.87	Rare
Prunus spinosa	2	0.04	99.91	Rare
Salix cinerea	2	0.04	99.96	Rare
Acer platanoides	1	0.02	99.98	Rare
Platanus acerifolia	1	0.02	100.00	Rare
Total	**4676**	**100**	**100**	-

Other 14 species are classified as rare, because their abundance in the park is less than 1%. *Platanus acerifolia* is a notable presence, with only one individual being identified. In addition, *Acer pseudoplatanus,* a species most common in the mountainous region has four individuals present in the park while *Acer platanoides* which is more common in the plains region only has one presence.

In Văcărești Natural Park, most of the specimens of trees inventoried are native species (69%) and less than a third (31%) are non-native species (Figure 5). Among the most common native species are *Salix alba* (Figure 1), *Ulmus procera*, *Prunus cerasifera* and *Juglans regia* (Figure 2). The most common alien species are *Ailanthus altissima*, *Morus alba*, *Salix matsudana 'Tortuosa'*, *Acer negundo*. Among the non-native species there are several groups of *Ailanthus altissima* and *Acer negundo* that have an invasive potential, and monitoring the evolution of those trees should be a priority for the management of the natural area.

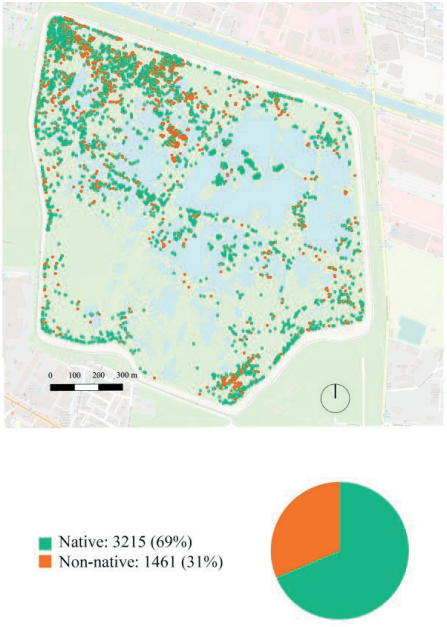

Figure 5. Tree classification by origin

Both the native and the non-native species frequently found in the park are representative for the spontaneous flora in the peripheral and ruderal areas of Bucharest.

From the point of view of ecological requirements, the species are divided into 3 categories: mesophytes, hygrophytes and mesohygrophytes. (Figure 6) Mesophyte specimens are generally located in the peripheral areas of the park, where the soil moisture is lower. These represent 63% of the total number of trees found in the park. The main mesophyte tree species encountered are: *Juglans regia*, *Prunus cerasifera*, *Ulmus procera*, *Ailanthus altissima* and *Morus alba*. Hygrophytes represent 31% of the total and are found in the wetland, on the banks of water mirrors and in floodplains covered with *Phragmites australis*. The predominant species in this type of habitat is *Salix alba*, along with *Salix matsudana 'Tortuosa'*. The third category - mesohygrophytes are adapted to both soil conditions with high humidity and soils with moderate humidity. They occupy 6% of the total individuals, and the two species that fall into this category are *Populus x canescens* and *Eleagnus angustifolia.*

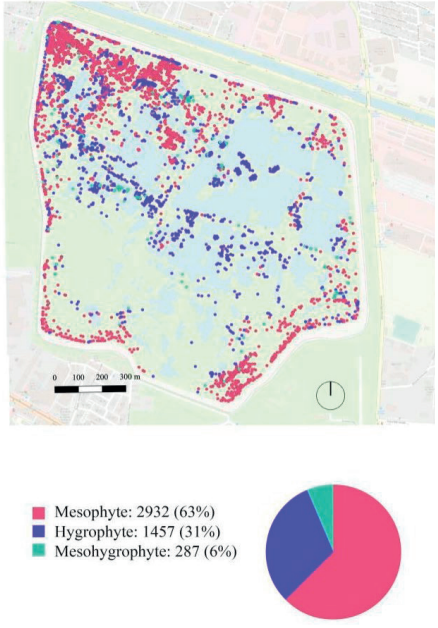

Figure 6. Tree classification by ecological requirements

Regarding DBH, it was found that mature trees with a diameter of over 30-45 cm are located mainly in the center of the park and close to the marsh areas. (Figure 7). In general, the most common specimens with high DBH, up to over

75 cm, are those of *Salix alba* (Figure 8) which are both the most mature trees, being the first to appear in the park about 20-25 years ago, but also characterized by a rapid growth rate when compared to other species found in peripheral areas, such as the genera *Juglans* or *Ulmus*. The analysis of the tree condition reveals a high percentage of trees in good (49.89%) and excellent (34.94%) condition (Figure 9) (the framing classes are described in materials and methods). Therefore, the young vegetation within the park may not be too affected yet by biological or anthropic factors.

The exceptions are the fair and poor tree individuals. The main reasons for these conditions are caused by observations of mostly mechanical damages, cavity decays or pests usually associated with each of the species.

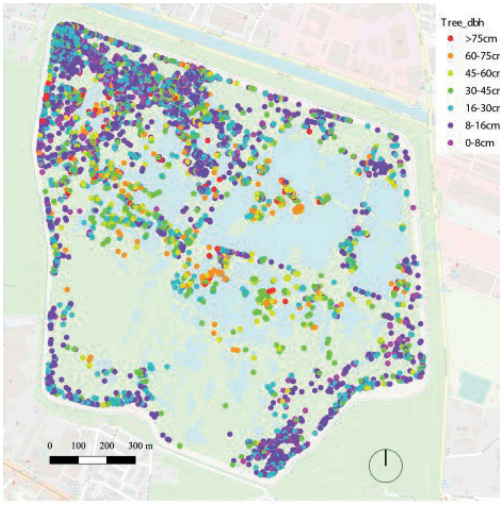

Figure 7. DBH range

Mechanical damages occur mostly due to natural phenomena, such as cracks from freezing rain, or fire damage.

There is also identification of mechanical damage such as tree cuttings observed especially in old *Salix alba*, or *Salix matsudana 'Tortuosa'* individuals, probably done mostly by the former unofficial inhabitants of the park. Other recorded observations in the trees condition are poor root system or poor structure, due to the improper growing conditions of some of the trees.

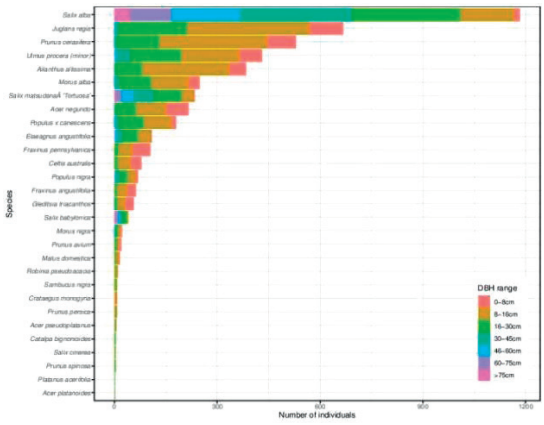

Figure 8. Species numbers by DBH

Figure 9. Proportion of tree condition

CONCLUSIONS

The diversity of tree species in the park is very high with a species richness of 29 tree species and 4676 individuals. The native species are dominant, but the non-native ones that were acclimatised here in the last century also occupy significant surfaces in the park.

Some of them have the tendency to be invasive: *Ailanthus altissima* - 8.19% (5th place) (Figure 12), *Acer negundo* - 4.6% (8th place) (Figure 10) and *Fraxinus pennsylvanica* - 2.25% (11th place).

The presence of a lot of young stems around the main trunks, because of the reproduction through suckers, is assuring a fast covering of the herbaceous areas and a limiting of the species depending on them (Figure 11). Thus, the necessity of maintenance works and control of the invasive species is required.

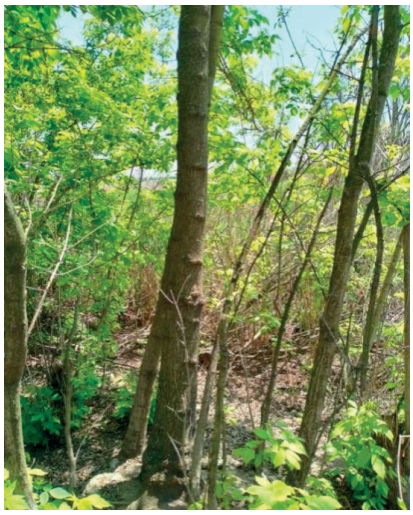

Figure 10. *Acer negundo* in the natural park

Figure 11. Future grove formed by suckers of *Fraxinus pennsylvanica* and *Acer negundo*. Medium height: 3-4 m

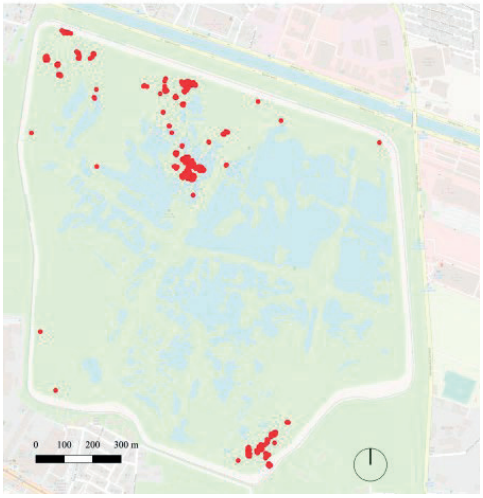

Figure 12. Invasive species (*Ailanthus altissima*) map

Future studies may look at the evolution of the different types of vegetation using different control plots. Some control plots can be maintained with this kind of vegetation, while in others it can be cut down.

An additional future study could investigate the succession of the vegetation and of its dynamic, through the repetition of the tree inventory every 5 years and comparing the results, to observe its evolution.

Another recommendation is that the inventory and mapping of the herbaceous species and areas in the park is done in order to find out their ecological benefits, but also for highlighting their relationship with the dendrological species. The extension of the study for the exterior zones of the park is also recommended.

A further study will be conducted in order to present the ecological benefits synthesized in the TreePlotter ™ Inventory application.

The species legend, visualisation of the satellite map and GPS coordinates of each tree can be found at: https://uk.pg-cloud.com/Văcărești/?utm_medium=email&utm_source=sharpspring&sslid=

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