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# VEGETATION HABITATS MAPPING IN VĂCĂREȘTI NATURAL PARK

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***Abstract***

*The study aims to identify and map the types of vegetation habitats with the indication of tree and palustrine species which had spontaneously developed in the last 30 years in Văcărești Natural Park in Bucharest. The park is surrounded by a concrete dam. The research was carried out on the surface of 156 ha within the dam. The vegetation mapping was done through visual analysis and interpretation of the satellite maps. The classification of the 11 identified habitats was made according to 2 major criteria: the tree coverage (groves, dense groups, isolated groups, herbaceous layer) and the percentage of soil moisture, evaluated according to the type of vegetation encountered (mesophytes, mesohygrophytes, hygrophytes). The results present the spatial distribution and percentage cover of each type of plant habitat and also their percentage cover regarding specifically soil moisture and vegetation structure, the value and the variation of EVI (Enhanced vegetation index) and NDVI (Normalized difference vegetation index). The mapping provides data for future studies regarding the ecological effect and for developing a conservation management plan for one of the largest urban wetlands in Europe.*

***Key words****: Urban wetland assessment, Văcărești Natural Park, Vegetation habitats mapping.*

## INTRODUCTION

The main interest of the study is to identify and map the typologies and vegetation units of Văcărești Natural Park, declared the first urban natural area of Romania in 2016, by government decision (Guvernul României, 2016).
This naturally young ecosystem, located in South-Eastern Bucharest, has been formed inside a concrete dam of an abandoned reservoir during the last 30 years. The area is also one of the largest urban wetlands in Europe. The main objective of this study is to provide a basis in the developing of the park's management plan. The study will provide a zoning of the vegetation habitats found in Văcărești Natural Park. The management plan will use this mapping to include other elements, such as a tree inventory, plant species identification, management of the existing water covered areas, animal habitats and other necessary works to conserve and develop the biodiversity of this protected area.
This study provides the first mapping in a protected urban wetland in Romania of the distribution of two main types of vegetation: tree and swamp vegetation. The results will be useful for a closer evolution monitoring of the dendrological and palustrine vegetation, as well as of the ecological succession in general.

## MATERIALS AND METHODS

The mapping of the areal of Văcărești Natural Park regarding the trees and palustrine vegetation was developed on the basis of the retrieved information from several similar studies. (Anastasiu et al., 2017; Doniță et al., 2005; Stoican et al., 2014). Therefore, 11 habitat types were identified, each of them include 1 to 3 dominant species of trees/palustrine herbaceous plants. This means that individuals belonging to these species occupy a significant land coverage compared to the other species identified in a specific habitat.
The study comprises the following components:
1. Main habitats general mapping plan;
2. Individual sheets for each habitat;
3. Inventory statistic with the habitat data (areas and statistics);
4. Differential plans of habitats and statistics (vegetation structure, soil humidity, EVI, NDVI, vegetation dispersion).

The habitats were classified by 2 main axes:
A. Vertical axis - the land cover degree (groves, dense groups, isolated groups, herbaceous layer)
B. Horizontal axis - the degree of soil moisture, evaluated according to the type of vegetation encountered (mesophytes, mesohygrophytes, hygrophytes) (Figure 1).

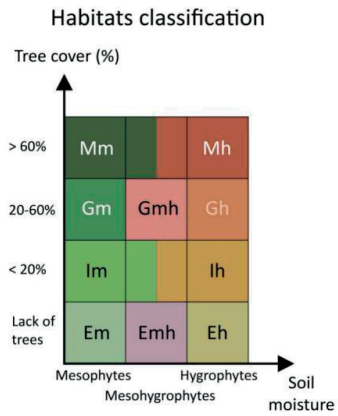


Figure 1. Habitats classification in Văcărești Natural Park according to tree cover and soil moisture degree

Each habitat was marked with a specific symbol e.g. Gm for dense mesophyte groups. The uppercase letters indicate the tree cover degree, while the lowercase show the type of vegetation according to the level of soil moisture. Based on this classification, the resulting habitats (Figures 1 and 2) are:
1. Mm - Mesophyte groves of *Juglans regia*, *Ulmus minor* and *Prunus* spp.;
2. Gm - Dense mesophyte groups of *Juglans regia*, *Ulmus minor* and *Prunus* spp. with mesophyte steppe vegetation;
3. Im - Mesophyte steppe communities with isolated groups of *Juglans regia*, *Ulmus minor* and *Prunus* spp.;
4. Em - Herbaceous mesophyte steppe communities;
5. Gmh - Mesohygrophyte groups of *Salix* spp. with *Prunus* spp. and *Ailanthus altissima*;
6. Emh - Herbaceous mesohygrophyte steppe communities;
7. Mh - Hygrophyte groves of *Salix* spp. and *Populus* spp. with *Phragmites* sp.;
8. Gh - Dense hygrophyte groups of *Salix* spp. and *Populus* spp. with *Phragmites* sp.;
9. Ih - Hygrophyte communities of *Phragmites australis* with isolated groups of *Salix* spp.
10. Eh - Herbaceous hygrophyte communities of *Phragmites* sp. and *Typha* spp.;
11. Aquatic habitat - Danubian communities of *Lemna minor, Lemna trisulca, Spirodella polyrhiza* and *Wolffia arrhiza*;
The herbaceous mesophyte and mesohygrophyte communities will be mapped in a further study.
The methodology comprised the following steps:
- Field studies for habitat type identification, taking into account the dominant species encountered in each area; the species were identified using local scientific literature (Ciocîrlan, 1990; Iliescu, 2003) and previous studies conducted in Văcărești Natural Park (Anastasiu et al., 2017; Doniță et al., 2005; Stoican et al., 2014);
- Tree canopy and palustrine vegetation mapping through satellite images from 2019;
- Classification and mapping of the habitat types, based on field and satellite assessment, considering the dominant species found in each area, the vegetation covering degree and the moisture level of the soil (Figure 1);
- Checking of the preliminary mapping results on the field and final editing of the general mapping plan (Figure 2);

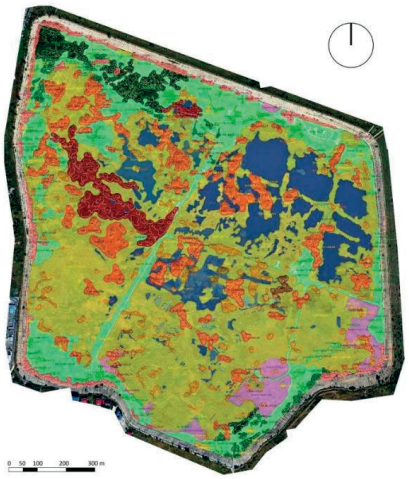

Figure 2. Habitats distribution in Văcărești Natural Park. General plan

- Elaboration of the habitats percentage cover sheet (Figure 3);

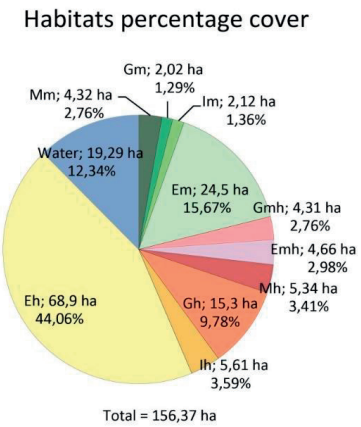


Figure 3. Habitats percentage cover in Văcărești Natural Park

In order to present the results of the study, the following specific mapping plans were elaborated:

a) Tree canopy cover (stratification and structure of the vegetation) (Figure 4);

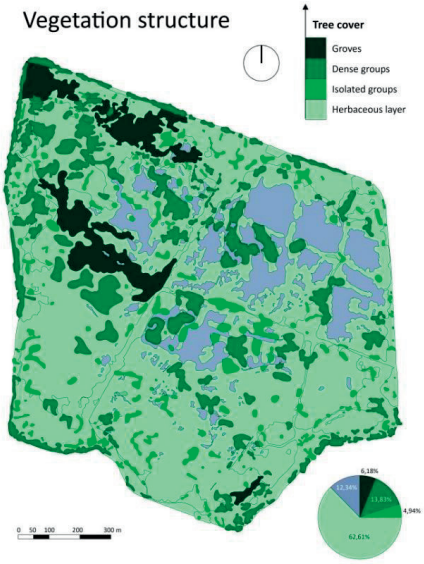


Figure 4. Vegetation structure in Văcărești Natural Park

b) Classification of vegetation zones according to soil moisture (Figure 5);

c) EVI analysis (Enhanced Vegetation Index - evaluation of the density of vegetal biomass mapped by remote sensing - minimum 0; maximum 0.7) (source: agrimonitoring.com, July 2019) (Figure 6);

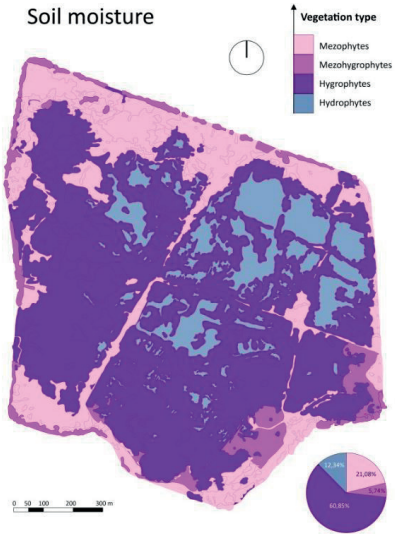


Figure 5. Vegetation type depending on soil moisture in Văcărești Natural Park

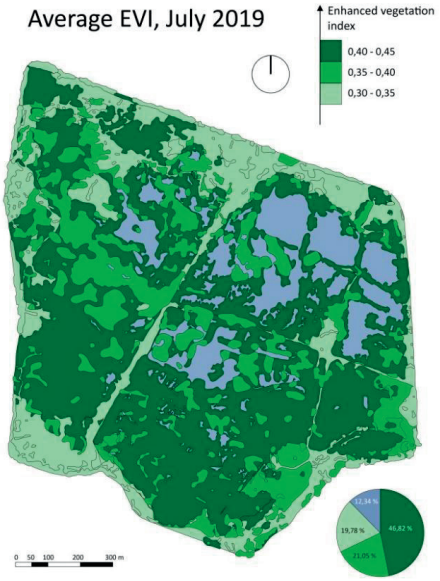


Figure 6. Average EVI in Văcărești Natural Park, July 2019

d) NDVI analysis (Normalized Difference Vegetation Index - evaluation of the amount of chlorophyll mapped by remote sensing - minimum 0; maximum 0.9) (source: agrimonitoring.com, July 2019) (Figure 7);

e) Vegetation dispersion (the predominant type of plants propagation encountered in each habitat) (Figure 8).

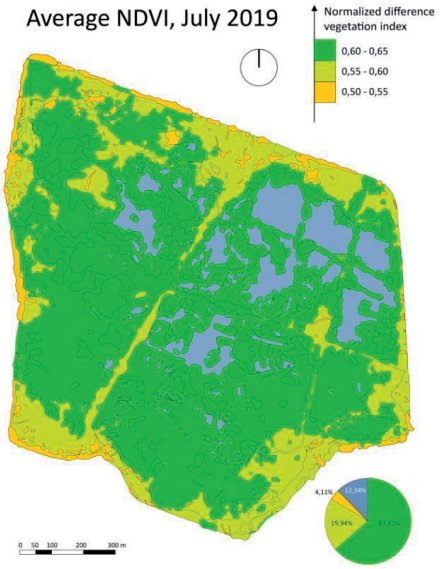


Figure 7. Average NDVI in Văcărești Natural Park, July 2019

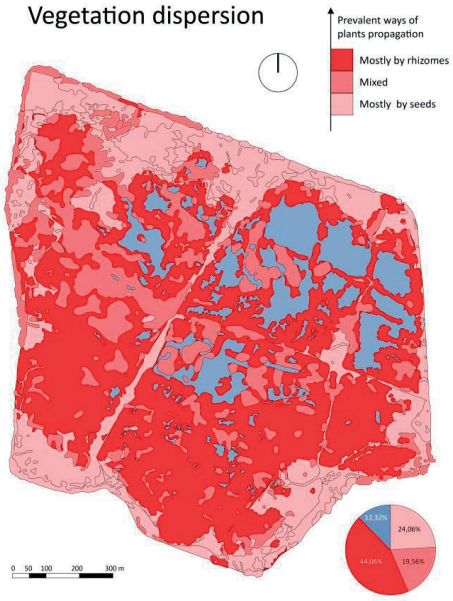


Figure 8. Vegetation dispersion in Văcărești Natural Park

## RESULTS AND DISCUSSIONS

The results following the analysis, revealed data about the main native and exotic species, the main invasive dendrological species and data about EVI and NDVI indices, regarding the layering of the vegetation levels.

The main native species are: *Ulmus pumila, Juglans regia, Prunus spinosa, Prunus cerasifera, Fraxinus angustifolia, Acer pseudoplatanus, Acer platanoides, Populus alba, Populus nigra.* Other notable species*: Populus × canescens* and *Malus domestica.*

The main exotic species are: *Ailanthus altissima, Acer negundo, Salix babylonica, Salix matsudana 'Tortuosa', Elaeagnus angustifolia, Gleditsia triacanthos, Morus alba, Fraxinus pennsylvanica, Fraxinus americana, Celtis australis.* Other notable species*: Catalpa bignonioides, Celtis occidentalis, Prunus armeniaca, Prunus persica, Prunus cerasus, Robinia pseudoacacia.*

Invasive arborescent species were identified in isolated groups inside the park and are mainly composed of *Ailanthus altissima* and *Acer negundo*. Other present species with invasive behaviour, but who do not form isolated groups yet, are: *Elaeagnus angustifolia*, *Salix babylonica* and *Salix matdusanda 'Tortuosa'.*

The palustrine vegetation is predominantly composed of two native water grasses species: *Phragmites australis* and *Typha angustifolia* located mostly in the Eh habitat, which has the highest coverage in the park's area: 68.9 ha (44.06%) (Figures 2 and 3)

More than 90% of this surface is covered with *Phragmites sp.* Although this, we can identify also palustrine vegetation of hygrophyte grasses that are found at the base of the tree groups in the Mh, Gh, Ih and Gmh habitats. The predominant species as a component of these groups is *Phragmites australis*, which is also prevalent in the rest of the park.

In terms of vegetation stratification, the herbaceous level is the prevalent layer (over 62%), the tree layer being divided into different components like: groves, dense groups or isolated groups occupying less than 25% of the total area of the park (Figure 4).

The EVI and NDVI analysis between 2015 and 2019 reveals that these indicators have maximum values in the summer (June-July) and shows insignificant differences, due to the comparison of this situation in the last 4 years in the studied months. The values obtained in July 2019 on most of the park's area are above average (NDVI > 0.60, EVI > 0.35), which confirms a high density of biomass and a good state of vegetation health. The values are higher

especially in the areas covered with *Phragmites* sp. and in the case of dense groups and groves of trees (Figures 6 and 7).

## CONCLUSIONS

As a general conclusion, there is a high level of plant biodiversity, with a high share of palustrine vegetation composed mainly of *Phragmites australis.* We also observed a tendency of expansion of the dendrological vegetation, which mainly includes species of *Salix, Ulmus* and *Juglans*. Also, the emergence of new isolated groups and the extension of the mature groups reveals a tendency to increase the dense deciduous trees habitats in the detriment of the grassland vegetation. The species identified in the park are mainly native, representative for the spontaneous flora encountered in urban environments in South-Eastern Romania.

In order to continue the research of the young and atypical ecosystem of Văcărești Natural Park and to carry out an integrated management plan for the area, we consider that the following studies should be conducted:

- Analysis of the evolution of the identified habitats (with emphasis on the groves and groups of tree vegetation and palustrine vegetation) over the last 30 years based on satellite maps;
- Assessment of the evolution of water surfaces and level differences by seasons and years;
- Individual inventory of tree specimens;
- Mapping of the herbaceous flora in the Emh and Em areas;
- Soil studies throughout the park;

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