

Evaluation methods of urban trees along the Danube in Budapest

Ildikó Réka Báthoryné Nagy, Katalin Takács

Szent István University, Department of Garden Art and Landscape Technique

Introduction

Defined by national Hungarian legislation (National Act 1997. LXXVIII.), the evaluation of urban green spaces is required as part of an urban planning process. Such evaluation includes the analysis of dendrological features. In 2014 the procedure of urban planning regarding the river banks of the Danube at Budapest was started. The development of the Building Code of the river banks was based on numerous basic studies and researches in varying fields. The dendrological evaluation area was on both sides of the Danube River including 465 neighboring real estate lots, and also islands. We participated in a research which was meant to complete a tree evaluation assessment on the concerned urban open spaces in public use excluding forests³⁷ of any kind, in order to provide supplemental data for decision makers while choosing the proper sites for development.

Background and literature review

Several methods are published to analyse and evaluate ecosystem services of urban trees. Most of them declare the importance of analysing each single tree to have the most accurate result (Nowak et al. 2008, Soares et al. 2011, Roy et al. 2012, Dale 2013). Most of the methods are quantitative, implementing natural science methods, preferring field work but also remarks the advantages of remote sensing and GIS (Roy et al. 2012.) Less frequent methods use qualitative descriptions or methods of social sciences (Roy et al. 2012.) Each method deals with individual trees and all kinds of composition of trees such as tree groups or rows. The ecological approach (Nowak et al. 2008) basically states urban trees as important factors of urban ecosystems and modifies values by ecological parameters. The evaluation of the potential of urban trees to ameliorate the harm of urbanization (Roy et al. 2012) is a common approach in each method, which we were also meant to focus on.

Our evaluation is concerned to be a mixed approach, depending highly on existing digital and manual, spatial and also descriptive databases. Data collection and evaluation process were managed in cooperation with 9 municipalities, and the Capital's Public Green-space Management Company

³⁷ In Hungary forests are excluded from development by National Forest Act, no development zone can be marked out in forests.

(FŐKERT) and the Capital's Water Supply Company (FŐVÁROSI VÍZMŰVEK) as primary landscape managers of particular territories.

Our hypothesis was that each tree manager institution has some kind of a register of the trees and/or orthophotos available for the research. Our hypothesis on existing data failed. Only 2 out of 9 municipalities have tree register data relevant for the site. One made all GIS data available for the research, the other had data only according the geographical position of the trees of the site without descriptive data. Other 6 municipalities had no relevant data available. One municipality we did not manage to interview within the research period. FŐKERT could share only descriptive data according to about 50 % of the tree alleys managed by the company. About the public parks, public gardens and squares of the Capital's interest we received only oncoming numbers of existing tree population, non detailed data according to the position, taxa, age, condition etc. We started our analysis and investigation in December, in the inactive period of trees and we had 50 days to complete it.

Our research faced several challenges.

- There were only a few data which described individual trees. Basically there is no standard tree register of the evaluated individual trees or tree population.
- The transition between different geographical and descriptive databases of the differing owners and managers were not defined. The protocol of data collection and management was undefined in many cases.
- There were variant registers according to the same territories. Owners register green wealth according to the real estate's lot number. Landscape managers register data according to the name of the public space or any other local identity. Due to the lack of GIS descriptive data of landscape managers could hardly match to real estate lots.
- To complete the research in December was adverse in two terms. Municipalities are busy at the end of the year. According to continental climate and the geographical situation trees are in rest so that few parameters of present conditions could be visually observed.

While there exist several known methods and approaches to evaluate urban tree benefits and services, we worked out a method which combines the benefits of different methods, which could manage the few data of different kind and also the case of no data. The lack of data pushed our quantitative approach towards a qualitative and descriptive method, including different experts of trees and of the sites to help our work. Although Nowak et al. (2008) warn us not to use field work in such large territory to estimate

ecosystem services we choose to have field work to check existing data and also to make descriptive evaluation on site.

Goals and objectives

Our objective was to define the proper value for as many individual trees as possible, and also to emphasise values for tree stands, listed and marked on an official real estate map of the investigated area. We projected to provide values for trees by evaluation methods matching to existing data or winter field survey ascertainment. We focused on creating a descriptive value that could reflect their potential to provide urban ecosystem services.

Method

In order to meet our objective we had to work out an evaluation method for the project, concerning results of relevant current evaluation methods. In our case the objective was not to serve an urban forestry strategy but the other way around, serve spatial planning – find places where to meet lower ecosystem services, where to build.

As we experienced few quantitative and descriptive data we developed a mixed approach to use individual tree register data, field survey, field interview, background descriptive literature of the sites and also remote sensing using regular orthophotos and Google Earth Street Views.

First we asked territorial and descriptive data from the owners and managers of the real estates. Second we divided the evaluation territory into 119 smaller units according to the land use, landscape character and the supposed owner. Within each unit we predefined the public green spaces, lessen the evaluation territory. Based on the prior data we selected supposedly the most valuable and also the invasive trees. Third we completed field survey and evaluation in order to specify prior data and also to collect data in territories where prior data was not arrived or not valid. During the field survey, orientated to the season, we defined a potential value by visual assessment in inactive period. If there was no data neither for the geographical position nor the conditions of the tree we defined the place of the tree in case we could mark it precisely on a map. Any other cases position marked as an indication. In case of no descriptive data we defined a potential descriptive value which could be reached, concerning the actual condition of the tree and the supposed management.

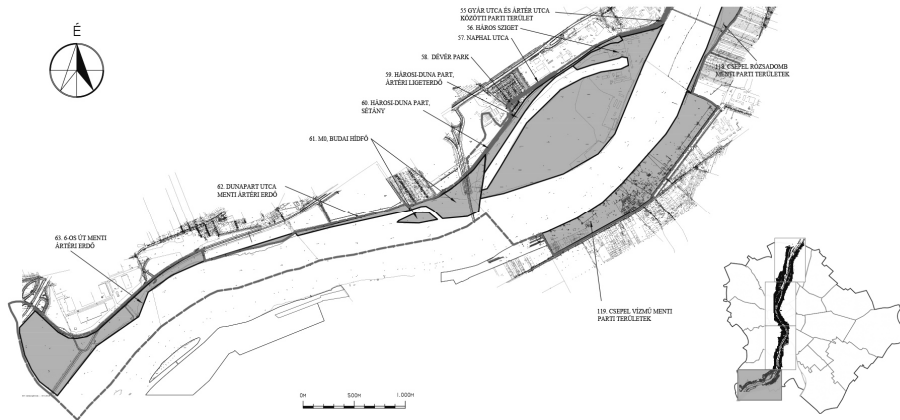


Figure 1. Detail of the of the assessment area – southern parts of Budapest

We articulated 3 different types of dendroflora elements to evaluate: individual tree, alley and group of trees. Types were defined so as to match basic GIS requirements. The results of the evaluation were listed in data sheets of the evaluation units in which, besides basic data of the unit, a summing description of the unit was also given, including green coverage, dendrological character, typical and/or specific taxa, age, supposed condition, recreational, ecologic, aesthetic, culture-historical potential. In each data sheet invasive and surpassingly valuable trees were highlighted.

As a GIS base we used the official real estate map of Budapest in a scale of 1 to 4000, which is the scale of urban planning defined by National Building Act and its executive decrees. We did receive GIS data for the exact position of trees, derived from the public utility maps so called the Technical Information System, which were relevant for the streets and could show position of individual street trees. Other 13 separate sections of digital land surveys which were made for the recent development of public open spaces were used and merged to be able to position park trees and park tree population. We received the digital borderlines of forests (polygons) as official data release. Altogether 18 sections of digital maps of different origin and structure were merged to obtain relevant spatial data.

We defined principal statements as a base for evaluation. First of all we considered all urban trees as values being the most long lasting and also valuable element of urban green infrastructure, providing the most benefits of ecosystem services. We stated that invasive trees threaten urban ecosystems so that we mark invasive plants separately. Adaptive capabilities were concerned

and preferred. Healthy and stable tree populations were outlined as values. Existence of species referring to the natural habitats was outlined also as a value. We defined several features in favour such as high age, good health conditions, Hungarian variety, a historic urban taxon, climate adaptive variety, unique variety or legendary tree.

We defined 5 different categories to show the value of the element: First we selected invasive species listed by National Decree of 346/2008 about the Protection of Denroflora, such as *Amorpha fruticosa*, *Robinia pseudoacacia*, *Fraxinus pensylvanica*, *Ailanthus altissima*, *Eleagnus angustifolia*, *Padus serotina*, *Acer negundo*, which we evaluated on the lowest value and mark with a bright red color in the map.

Besides invasive trees we defined 4 other value categories by attributes differing in each three dendroflora types: outstandingly valuable, character defining, valuable and temperately valuable. Other four categories were explained by the maturity, potential health, its role played in urban ecosystem, landscape character and leisure. Outstandingly valuable trees in the urban ecosystem were all healthy trees above the age of 40, fitted well to climatic, soil and hydrological conditions and also the plant use tradition of the city or carrying extra additional culture-historical value, such as being the oldest *Acacia* tree in Budapest or the tree with the biggest trunk in Budapest's Danubian Riparian forest. Character defining trees were the healthy ones between the age of 20 and 40 years or the less healthy aged ones (majority) which could reach a higher standard by proper maintenance. Valuable trees were the young and healthy trees with a high potential to reach character defining status or elder trees in a relatively bad status. Temperately valuable trees were the ones with a low potential to rich a higher status due to their health conditions or other physical parameters or potential ones of new plantations.

Results

Evaluation work covered ca. 100.000 m² of tree clumps, 1734 individual trees and ca. 23 km tree alleys. Characteristics of the evaluated sites varied from historical squares and parks to segments of riparian forest. As a result of the evaluation we concluded that the Danube river banks and islands have highly valuable woody substances both from settlement ecological and dendrological point of view, which are also the most fragile populations in terms of building actions. The present arborea of post industrial sites on both Northern and southern coastline are significantly less valuable, highly infected by invasive species and less sensitive to investments. The more natural and relatively

unused and unbuilt coastline strips are characterized by post-riparian vegetation with a mixture of valuable natural trees such as *Populus* and *Salix*, invasive species and ornamental plantations. These strips are the most valuable tree populations in all terms but also the most attractive and most sensitive to development.

Most of the inner districts are characterized by historically significant ornamental horticulture species in a relatively good condition, while towards the outer districts the floodplain forests or some preserved specimen trees are increasingly present in the remains of natural vegetation. Several small public gardens and pocket parks such as the small green spaces along the Slachta Margit Quai on the Buda side have outstandingly valuable trees reflecting a very poor level of maintenance. The evaluation clarified the potential of these unique plantations by raising the level maintenance.

The evaluation outlined the outstanding value of the tree population of Óbudai (Hajógyári) Island, which can be divided basically into three parts: riparian forest strips, public park and historic post industrial sites. The post industrial sites show a contrast. On the one hand, there is a veteran ornamental plantation of *Platanus*, *Tilia* and *Aesculus* and *Populus nigra* 'Italica' trees defining the strong dendrological character of the site. On the other hand invasive and weed tree species spread in large numbers on the neglected industrial sites. The 40-year old public park had several outstandingly valuable clumps such as the fruit tree, the *Tilia*, the *Betula* and the evergreen collection. Most of the trees show better condition than an average public park of the capital which due to its position and recent use. The island carries a high potential and also interest in development.

Discussion

The evaluation of trees showed the coastline strips of the highest potential in urban ecology. The territories with the highest dendrological values and also with the highest potential in climate adaptation and urban ecological aspects are the most attractive areas for urban development – for new housing, business and leisure centers. There are several settlement planning tools to preserve such landscape potential of the site while development can occur.

Conclusion

Evaluating urban trees could attract many research fields, concerning services and disservices of urban arboriculture. There is a high need of ecological approach in evaluation even in spatial planning. The process and scale of settlement structure planning could implement both remote sensing and field

work methods. Combining the two, there should be developed a mixed approach to evaluate urban trees' ecosystem services even in a small-data environment which should be adaptable to mark development zones and also compensation areas to reach a higher ecological standard.

References

- Albrecht, U. et al., 2014: *Budapest Főváros Településszerkezeti Terve* [Zoning Plan of Budapest], Budapest, 2014
- Báthoryné Nagy I.R., Takács K., Dimitrievics D. 2014: Dendrological evaluation for Danube Bank Building Code. Research and Study.
- Dale, M.J. 2013: Evaluation of methods for quantifying carbon storage of urban trees in New Zealand, Department of Civil and Environmental Engineering University of Auckland, Auckland, New Zealand
- Nowak, D. J.; Crane, D. E.; Stevens, J. C.; Hoehn, R. E.; Walton, J. T.; Bond, J. 2008: A Ground-Based Method of Assessing Urban Forest Structure and Ecosystem Services, *Arboriculture and Urban Forestry*, Vol. 34 (6) pp. 347-358.
- Radó, D., 1981: *Fák a betonrengetegben* [Trees in the concrete jungle], Budapest
- Roy, S.; Byrne, J.; Pickering, C.; 2012: A systematic quantitative review of urban tree benefits, costs, and assessment methods across cities in different climatic zones, in: *Urban Forestry & Urban Greening*, Vol.11, (2012) pp. 351–363
- Soares, A.L; Rego, F.C; McPherson, E.G.; Simpson, J.R.; Peper, P.J.; Xiao, Q. 2011: Benefits and costs of street trees in Lisbon, Portugal *Urban Forestry & Urban Greening* Vol 10 (2011) pp. 69-78.

Local legal acts:

- 47/1998. (X. 15.) Főv. Kgy. rendelet a Budapesti Városrendezési és Építési Keretszabályzatról [Metropolitan Decree of the City Planning Framework and Construction Rules in Budapest] (operative until 18 March 2015)
- 5/2015. (II. 16.) Főv. Kgy. rendelet - Budapest főváros rendezési szabályzatáról. [Metropolitan Decree on the settlement regulations and planning policy of Budapest]