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MODERN POSSIBILITIES FOR GREEN SPACE MANAGEMENT THROUGH GIS TECHNOLOGY

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Abstract

This paper aims to highlight a practical way to map the Nicolae Titulescu Park in Brasov. The surface of this park (over 5 ha) was measured using the total station and GNSS technology, by mapping both utilities from this space (green space – with flowers, green space – with trees, green space – with shrubs, alleys, playground for children, recreation space), as well as the details (trees, shrubs, spaces for agricultural species, benches, traffic signs, lamps). The topographic data were rigorously compensated, by further processing in the GIS program, in which the related database was created and a series of GIS analyzes were performed such as: the ratio between major parks utilities (green space versus alleys), the ratio between the effective surface occupied by the projection of the trees and the green space surface, the control of the trees crown grooming, etc. It has thus been shown that the use of GIS is not only timely, but also extremely efficient for a modern management of green spaces.

Key words*: green space, shrub, total station.*

INTRODUCTION

Pollution has always been a harmful factor and has intensified with the evolution of civilization, becoming increasingly problematic for both the environment and humanity.

In order to minimize the effects of pollution, local public institutions must monitor all the time the development of vegetation lands and manage it strictly because green spaces have an important role in reducing pollution.

The aim of this paper is to verify whether GIS systems have the ability to be used in efficient management of green spaces.

Unlike previous studies conducted by the Institute of Forestry Research and Development that focused on monitoring the pollution degree of green spaces in urban areas, studies conducted for this paper are mainly based on the methods of administration and management of green spaces.

MATERIALS AND METHODS

Nicolae Titulescu Park is located in the center of Brasov and dates back to the nineteenth century, being one of the main green spaces of the city due to its special characteristics.

For the most part, the basic shape of the park has been preserved to this day, but its size has undergone various changes due to uncontrolled urban development (Marcus, 1958).

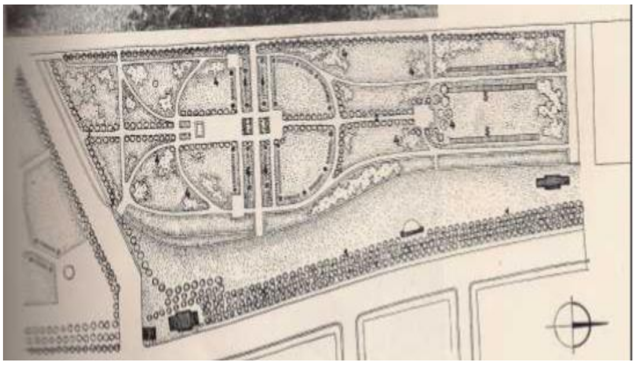

Figure 1. First shape of the park

Because the park is located in one of the most crowded and polluted areas of the city, the identified fruit species play a very important role in absorbing pollutants from the atmosphere. Over time, with the development of the area, the plants in the park have changed; at first the poplars predominated, but they were replaced by the maple species, which are more resistant to pollution factors.

For a good organization and management of green spaces there are several methods that can be used, but the use of GIS technology is among the most efficient because unlike the others it has different possibilities for querying, locating the searched data, and also their graphical display.

The main materials on which the study was conceived are represented by old maps and plans, orthophotos and archive photographs.

The equipment used for measurements were the total station South A1 and the Trimble R4 GPS. The A1 total station uses the Android operating system, the 5-inch LCD screen displays a large amount of information and makes the measurement operations easy and clear to read (https://www.cadsolutions.ro/total-station-surveying-a1-%E2%80%93-android-_355).

Figure 2. Total station South A1

The Trimble R4 Model 3 GNSS receiver is a compact system that operates on 220 channels. The antenna, receiver and battery are embedded in the same case. Equipped with Trimble R-Track technology allows the reception of signals from GLONASS satellites that improve the GPS system solution and thus better results can be obtained in hostile conditions to satellite measurements (https://www.giscad.ro/aparatura/iesite-din-productie/receptor-gnss-trimble-r4-model-3).

Figure 3. Trimble R4 Model 3 GNSS

The research methods used in this paper are direct measurement method, data processing method, GIS methods and analysis.

The direct measurement method, in which the considered physical size is compared directly with the unit of measurement (https://www.ct.upt.ro/studenti/cursuri/musat/Masuratori_Geodezice.pdf), was applied in the field by making a main route closed at the point of departure.

The processing of the data collected in the field was performed automatically by the application from the GPS controller as well as by the one of the total station. However, due to the fact that the lifting network was very dense and not all station points could be determined by GPS technology, main road sections were established that were compensated using the Toposys program.

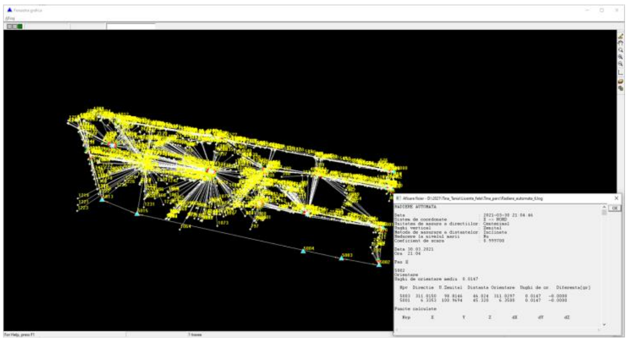

Figure 4. Radiated points in Toposys program

The aforementioned compensation was made at the office. GIS methods and analyzes were used to create the project in AutoCAD Land and finalize it in ArcGIS by organizing it in a series of stages, phases and logical steps (Tereşneu and Vasilescu, 2012, 2013; Tereşneu et al., 2013).

RESULTS AND DISCUSSIONS

The data resulting from the measurements were processed (compensated) after which the situation plan was made in AutoCAD. This was, in fact, only an intermediate stage that was meant to group the data both by type (point, line, polygon) and by the use within the same type. (for point type data, aboriginal and shrub species were differentiated, for polygon data the various uses were differentiated etc.

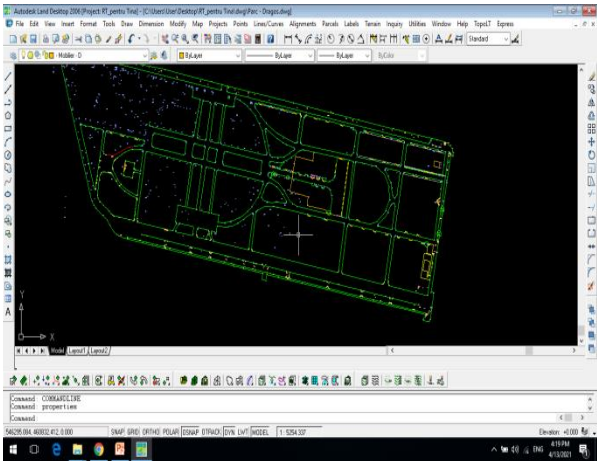

Figure 5. The situation plan in AutoCAD

After the execution of the situation plan that included the main details in the field, the data were processed in ArcGIS where the corresponding databases were created.

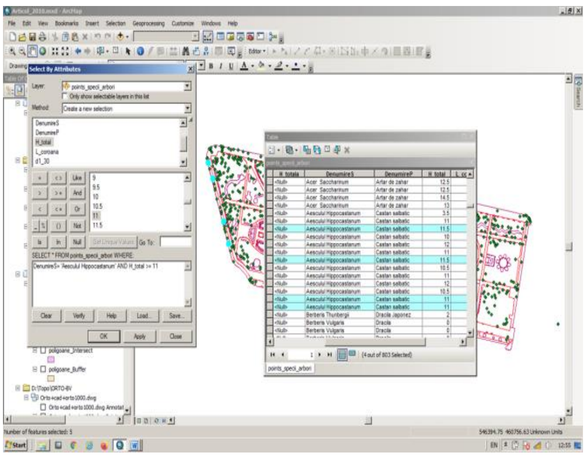

Figure 6. Completing the database in ArcGIS

For aboriginal species, the database included the following fields: the popular name and the scientific name of each tree, the total height, the length of the crown, the diameter of the crown and the diameter at 1.30 m.

Unlike these species, in the case of shrub species, the database included the same fields, excluding the diameter at 1.30 m, which was impossible to measure.

For the flower rounds, the component species and the surface afferent to each round were registered in the database, and for the alleys we registered the length, the width and the space.

After completing the GIS project, we proceeded to the stage of performing GIS analyzes (Tereşneu et al., 2011).

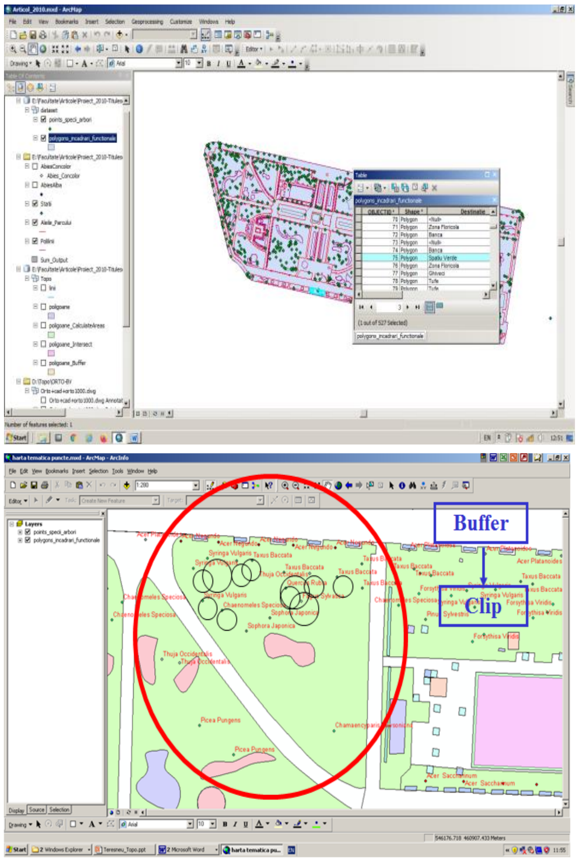

Figure 7. GIS analyzes

The management of a park requires both the existence of a correct and constantly updated database, as well as an analysis tool that will answer any query at any time; for this reason ArcGIS was used as a tool because it has all the advantages of managing a green space properly through its ability to identify problems, monitor changes, make prognosis, etc.

Table 1. Species identified in the park

No.	Species name	
1	Abies alba	3
2	Abies concolor	1
3	Acer negundo	19
4	Acer platanoides	35
5	Acer pseudoplatanus	6
6	Acer saccharinum	80
7	Aesculus hippocastanum	13
8	Berberis thunbergii	1
9	Berberis vulgaris	7
10	Betula pendula	11
11	Biota orientalis	9
12	Buxus sempervirens	14
13	Carpinis betulus	9
14	Catalpa bignonioides	4
15	Chaenomeles speciosa	28
16	Chamaecyparis lawsoniana	21
17	Colutea arborescens	2
18	Deutzia scabra	14
19	Duglas albastru	2
20	Fagus sylvatica	2
21	Forsythia viridis	64
22	Fraxinus pennsylvanica	1
23	Hibiscus syriacus	1
24	Juniperus sabina	1
25	Liriodendrum tulpifera	12
26	Lonicera xylosteum	1
27	Magnolia kobus	9

Table 2. Species identified in the park

No.	Species name	
28	Malus sylvestris	9
29	Malus x purpurea	7
30	Morus alba	5
31	Philadelphus coronarius	9
32	Picea abies	3
33	Picea pungens	33
34	Pinus nigra	16
35	Pinus silvestris	5
36	Pinus strobes	1
37	Prunus avium	2
38	Prunus cerasifera	3
39	Prunus mahaleb	1
40	Quercus rubra	19
41	Robinia pseudocacia	2
42	Rosa canina	1
43	Salix babylonica	1
44	Sambucus nigra	1
45	Sophora japonica	3
46	Spirea vanhouttei	12
47	Symphoricarpus rivularis	5
48	Syringe vulgaris	67
49	Taxus baccata	49
50	Thuja occidentalis	17
51	Thuja plicata	1
52	Thujopsis dolabrata	1
53	Tilia cordata	2
54	Tsuga Canadensis	3

The management of a park requires both the existence of a correct and constantly updated database, as well as an analysis tool that will answer any query at any time; for this reason ArcGIS was used as a tool because it has all the advantages of managing a green space properly through its ability to identify problems, monitor changes, make prognosis, etc.

Among the countless possibilities that this modern tool can make available to the user, we can talk about the quick visualization of the location of any species and any specimen and also about the control of grooming the crowns of trees and shrubs. This aspect was achieved by creating a VBA sequence that will automatize the indication of the optimal time for the next intervention in each species that is suitable for such an intervention (Teresneu et al., 2011).

Determining the area of various uses and determining the number of specimens of the same species are also examples of GIS applications for modern management of green spaces.

CONCLUSIONS

Following the results obtained, it was found that a modern management of green spaces cannot be designed today without the use of a GIS tool. The ArcGIS program was used, which facilitates both a very strict management of the spaces and species in such an area, as well as a proper management of the park in a way that permanently responds to the purpose for which it was created.

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