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UPDATING A MAP OF VÁROSLIGET WITH VEGETATION DATA

BSC THESIS

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1. DATA ABOUT THE AUTHOR

The project was carried out by:

Jon Oroz Santamaría, student of Topography Engineering at the Engineering University of Vitoria-Gasteiz, an institution member of the University of the Basque Country.

This Degree Project is a research made on the scope of the ERASMUS agreement between the above mentioned university and the Eotvos Lorand University. It was developed in the Department of Cartography and Geoinformatics of the Faculty of Informatics, located in Budapest, Pázmány Péter sétany 1/a.

This project was implemented under the supervision of:

José Jesús Reyes Núñez, Associate Professor (Department of Cartography and Geoinformatics)

2. INTRODUCTION

2.1. Objectives

The idea of this thesis was based on the previous thesis done by Adriana Cuesta Pou (ERASMUS student from the University of the Basque Country). In her thesis she proposed different future tasks for the continuation of the project.

The work done by Adriana Cuesta was the creation of the map of Városliget Park situated in Budapest, using GPS techniques. The main objective of this project is to create a MapInfo based system completing the Városliget map with a database containing information about the more characteristic vegetation within the park. Most of the vegetation data are about the more important genera of trees but also about the genera of shrubs. The Városliget map was divided into different areas, where you can click to display the data related to the vegetation, e.g. its' scientific denomination and photo. Other aim of this project was to create some thematic maps representing the stored data according to different categorizations.

Analyzing the theme of this project, first of all it can be interesting for the specialists working in research fields related to Botany, but people from other areas (e.g. tourism) can also find valued information to popularize the largest park placed in the Hungarian capital.

2.2. General work plan

This work is divided in seven main processes:

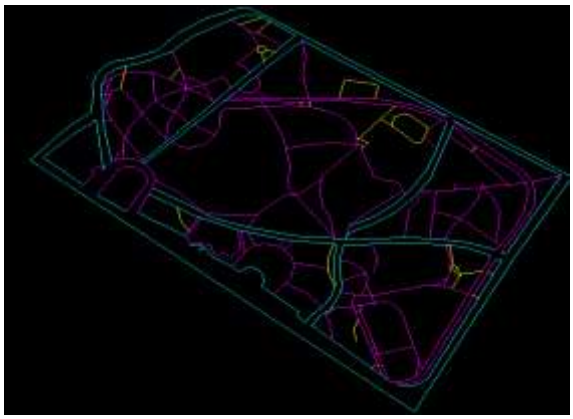
- Reception of previous data
- Study of previous data
- Correction of the received information
- Addition of new information
- Creation of thematic areas
- Edition of all the information
- Making of the thematic map

3. MAP AND DATA SOURCES

The first step beginning this work was to study the map made during the previous research, other map of the area made for orienteering competition and a final one containing the thematic information, all of them in digital format.

3.1. Original map

The main map was the map done by Adriana Cuesta Pou. This map contains all the streets limiting and all the paths inside the park, but the buildings and the lake were only represented by a scanned Hungarian topographical map. The drawing of these elements is other of the main goals of this project.



The map received from Adriana.

3.2. Thematic data

One of the maps to be used as source for my work was a scanned orienteering map at scale 1:5000, made by XXX. In this map are represented in detail the situation of trees, grass plots and shrubs. Some versions of this map have been made since 1990, but the version used in the present research was the version from 2002.

Orienteering map (version 2002).

The last map was the vegetation map of the Városliget, published in the book entitled XXX. This is a thematic map showing the genera of trees that can be found in the different zones within the park. Each zone of this map includes numbers and their meaning can be read in the legend: first the Hungarian name and its scientific denomination in Latin. This map was the main one used to determine the thematic content of my map.

Vegetation map

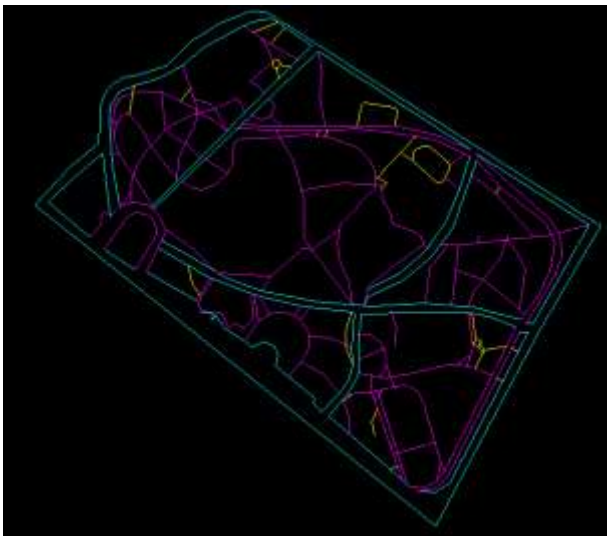
4. CHECKOUT OF THE DATA

The next step was the checkout of the received data. This is an important step because not always the information received is correct. Some of the problems to work out were that the source maps were made in different dates and in different scales, it was very important to check the differences of the generalization applied during the making of these maps, to avoid any mistake reading the content of the maps.

4.1. Checkout of the original map

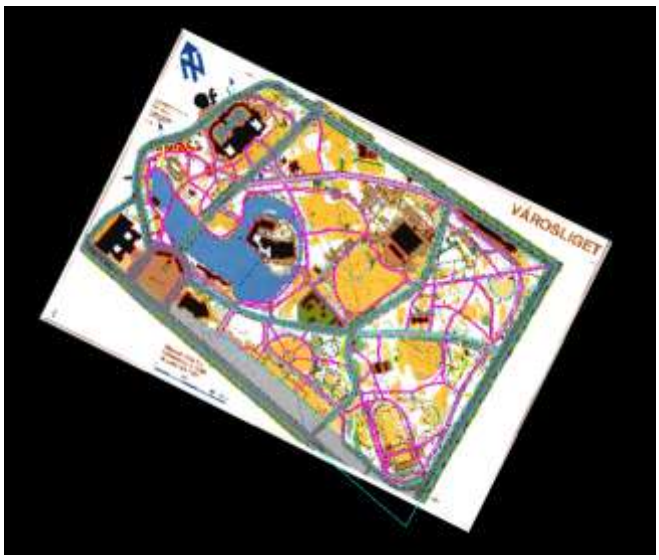
The first corrections were made in the map of Adriana Cuesta, because this was the most important source map used in this work.

The elements to checkout were the avenues, the asphalted roads and the paths, because the majority of them simultaneously were going to be the limits of the thematic areas in the new map. The actualization of this map was made in the Városliget park, using also the more accurated orienteering map. The steps followed during the actualization were:



Adriana's map before the actualization

- First, correction of the situation of the roads and paths in the map made by Adriana Cuesta, to control if all the ways are represented on her map. This process was made first using the orienteering map, and later the actualization visiting the park.



Correcting Adriana Cuesta's map with the orienteering map.

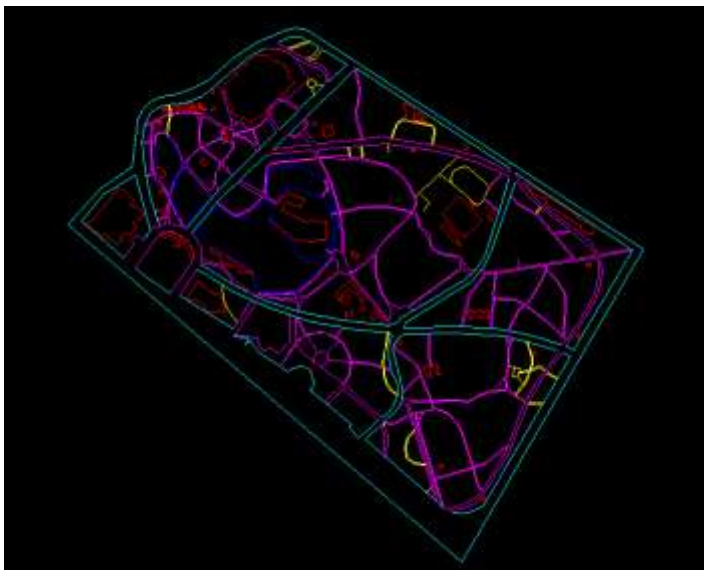
- Second, the supervision of the exact shape of roads and paths on the map. This step was made using the more detailed orienteering map at scale 1:5000. Both maps were superposed in AutoCAD, and using the appropriate commands (pline, edit pline, etc) the incorrect polylines were fixed.

Sometimes were drawn new ways because they were not represented in the original map, but not all the paths represented on the orienteering map can be found actually on the field. The ambiguous cases were checked by me in the Városliget park.

In the original map the ways were represented using two polylines the system used by Adriana Cuesta to make the GPS based survey (following the both sides of the ways). It resulted in more stored data by each way, but I did not simplify it, only modified the shape using the orienteering map when needed.

In this phase all the buildings and the lake were also edited using the information contained in the orienteering map. This process was also completely made in AutoCAD.

Finishing this last task, we had all the elements of the Városliget park represented in our main map of the project. The next figure shows the final result in AutoCAD:



Corrected map of Városliget park.

4.2. Checkout of thematic data

Within this task was checked the data represented on the *vegetation map of Városliget park.* The genera of trees and shrubs distributed by zones can be found in this map. This map was a little old (published in 2001) and I considered necessary to checkout the information.

The first step was to take the scientific denominations of the trees from this vegetation map and to search on pictures of these trees by Internet. With this information was made a graphic catalogue of the trees to identify them on the field.

With this catalogue and the vegetation map were checked all the zones in the Városliget park. As result the existing information was modified and new information was added into the correspondent areas, considering the differences between the printed thematic map and the real actual situation in the Városliget park.

The final result was a table with two main columns:

- One containing the numbered areas of the park and
- A second column containing the genera of trees by areas. Each genus was numbered to make easier its' identification and usage in MapInfo, as we can see in the next figure:

Area Name	Tree type
22	2, 7, 12, 16, 25, 26, 29, 31
23	2, 6, 8, 13, 16
24	6, 11, 31
25	2, 7, 10, 14, 17, 20, 25, 26, 31
26	6, 9, 10, 13, 23, 25, 26, 31, 33
27	1, 2, 3, 7, 14, 17, 25, 26, 31
28	2, 7, 8, 9, 18, 29
29	6, 7, 11, 15, 19, 23, 25, 31, 33
30	15, 18, 24, 25, 26, 31, 33
31	2, 6, 13, 14,24, 31
32	7, 8, 12, 25, 31
33	2, 6, 22, 31, 33
34	8, 18, 19, 22, 31, 33
35	7, 8, 9, 16, 18, 19, 22, 24, 31
36	1, 4, 7, 8, 13, 19, 22, 25, 29

Area and tree type table.

1 Abies cephalonica
2 Abies concolor
3 Abies normandiana
4 Abies Pinsapo
5 Acer platanoides ˝Crimson King˝
6 Acer platanoides ˝Schwedleri˝
7 Aesculus hippocastanum
8 Aesculus octandra
9 Aesculus pavia
10 Betula daecarlica
11 Broussonetia papyrifera
12 Carya ovata
13 Celtis australis
14 Cercis siliquastrum
15 Cladrastis lutea
16 Fraxinus fajok
17 Ginkgo bilpoba
18 Gymnocladus dioicus
19 Juglans nigra
20 Larix deciduaú
21 Liquidambar styraciflua
22 Ostrya carpinifolia
23 Parotia persica
24 Pterocarya fraxinifolia
25 Platanus hybrida
26 Pinus cembra
27 Pseudotsunga menziesii
28 Populus robusta
29 Quercus fajok
30 Taxodium districhum
31 Tilia fajok
32 Tsuga canadensis
33 Ulmus fajok

5. WORKING WITH THEMATIC AREAS

The start point of this step of the work is the corrected original map, and the corrected thematic data of the vegetation in the Városliget park.

5.1. Graphic edition of thematic areas in AutoCAD

The creation of the thematic areas was done taking the vegetation map of Városliget as base map. Areas are delimited by the ways of the park (avenues, roads and paths), the different in some cases, but by the buildings and the lake of this park.

The first step, was to build these areas defining the polygons thematic work. Those later were exported to MapInfo.

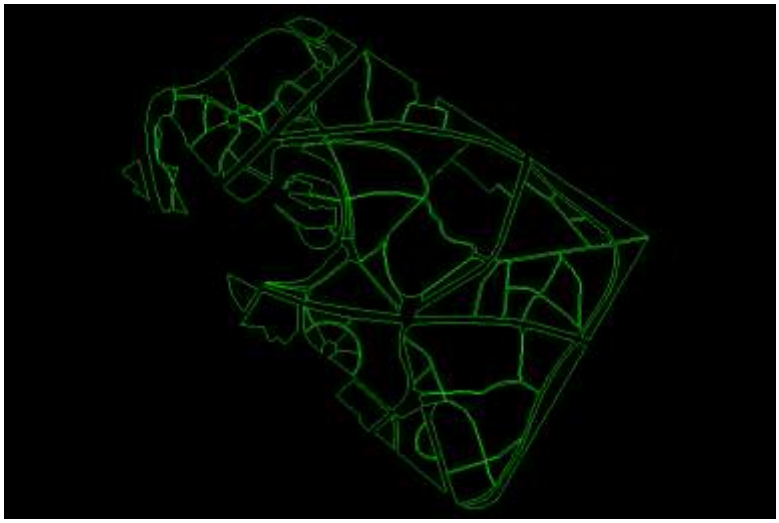
In this work was used the corrected original map in .dwg format and the corrected vegetation map of Városliget park. The program used was AutoCAD, version 2008.

These areas were supposed to closed, but there were not closed polygons in Adriana Cuesta's map, because this map contained only the polylines created using GPS coordinates, organized in different layers. Two main AutoCAD commands were used to create then thematic areas: one for closed another for open areas. These commands were:

- Polyline command: to complete the drawing of polygons and to create new bound areas.
- Editpol command: for the editing (joining) of boundary lines and to close polygons
- Boundary command: for the automatic of closed polylines.

All this work was done in the original corrected map using a new layer. When was finished the edition of the map, it was ready to be transferred to

MapInfo and to start working with the thematic data. Here you can see final map contending the thematic areas:



Map of Városliget Park areas.

6. EXPORTING THE GRAPHIC DATA TO MAPINFO

Once the map was corrected and the thematic areas were created, then it was the time to start the thematic analysis. Using GIS software: MapInfo version 8.5.

MapInfo logotype.

The first step was to export all the layers of the map to MapInfo. The final base map was divided in six different layers:

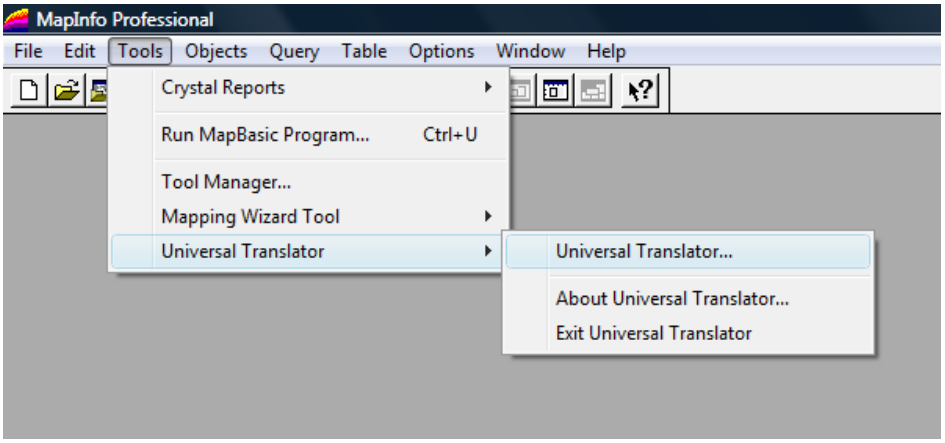
- Avenidas: main streets in the park and around it.
- Calles asfaltadas: are important streets smaller than “avenidas”.
- Paths: little ways going throw the areas.
- Edificios: the buildings of the park are drawn there.
- Lago: the lake of the park is drawn there.
- Areas tematicas: thematic areas are drawn there.

Before exporting, the layers to MapInfo files it was needed to save them separately to a generic CAD format, DXF, the Drawing eXchange File format.

After the layers were saved in DXF format, the work with the MapInfo software was started. There are two commands to import an AutoCAD file to MapInfo:

1.) Using the Universal Translator tool, that can be found in the tools menu.

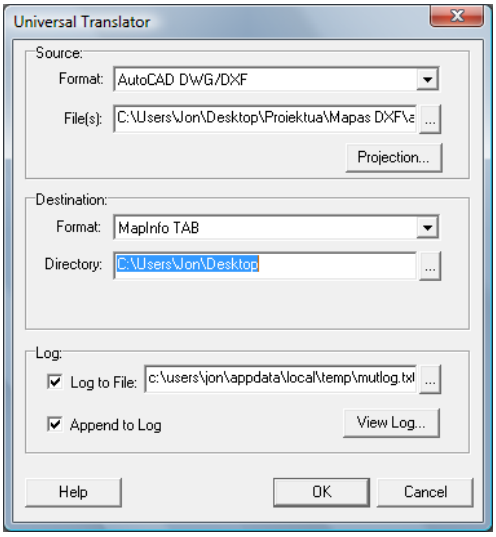
2.) Using the Import command from the table menu in the tool menu.



Loading the Universal Translator a new command window appears with three options to complete.

The first option asks about the source of the information, from where it has to take the information to modify. There are two fields: one asks about the format of the file to import and the second field asks about the name of the file.

In the second option to be filled was the destination: first we need to specify the format that was wanted to transform the file (in this case was in MapInfo TAB) and second to specify the directory, where we want to save the new file.



After the transformation of the layers in DXF format to the TAB format, there were created six layer file tables. We were ready to begin the next step of the work: to complete these tables with the thematic information of the trees in the park.

7. EDITION OF DATA IN MAPINFO

During this task were created the following layers using Adriana Cuesta's map and the information collected by me related to the base map and to the main theme:

- Thematic areas
- Lake
- Buildings

All the layers were originally in DXF format (thematic areas map, lake map and buildings map), and they were imported to MapInfo as it was explained in the previous chapter.

All the maps opened in MapInfo.

A thematic table was created in MapInfo, including the numbered areas (stored graphically as closed polygons) of Városliget park and a code (a number from 1 to 33) to identify the genera of trees existing in each area.

1 Abies Cephalonica
2 Abies Concolor
3 Abies Normandiana
4 Abies Pinsapo
5 Acer Platanoides "Crimson King"
6 Acer Platanoides "Schwedleri"
7 Aesculus Hippocastanum
8 Aesculus Octandra
9 Aesculus Pavia
10 Betula Daecarlica
11 Broussonetia Papyrifera

AreaName	Tree type
22	2, 7, 12, 16, 25, 26, 29, 31
23	2, 6, 8, 13, 16
24	6, 11, 31
25	2, 7, 10, 14, 17, 20, 25, 26, 31
26	6, 9, 10, 13, 23, 25, 26, 31, 33
27	1, 2, 3, 7, 14, 17, 25, 26, 31
28	2, 7, 8, 9, 18, 29

Genera of trees with their corresponding code and the table with the number of area and the number of he specific genera of trees (Pgs.9-10).

With all this information stored in MapInfo, the GIS analysis could be started. The next step was to organize the defined layers, giving them specific styles in interest of creating a better map from a cartographic point of view.

1 Abies Cephalonica
2 Abies concolor
3 Abies Normandiana
4 Abies Pinsapo
5 Acer Platanoides "Crimson King"
6 Acer Platanoides "Schwedleri"
7 Aesculus Hippocastanum
8 Aesculus octandra
9 Aesculus Pavia
10 Betula Daecarlica
11 Broussonetia Papyrifera

AreaName	Tree type
22	2, 7, 12, 16, 25, 26, 29, 31
23	2, 6, 8, 13, 16
24	6, 11, 31
25	2, 7, 10, 14, 17, 20, 25, 26, 31
26	6, 9, 10, 13, 23, 25, 26, 31, 33
27	1, 2, 3, 7, 14, 17, 25, 26, 31
28	2, 7, 8, 9, 18, 29

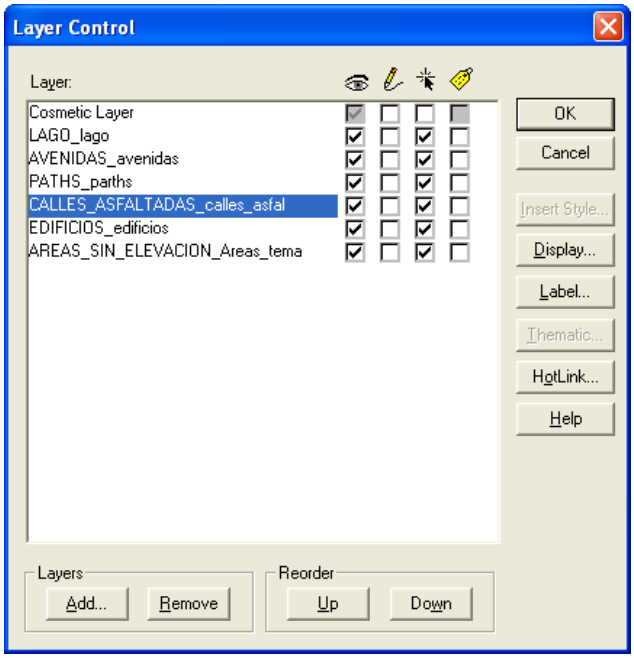
7.1. ORGANIZING THE LAYERS

Our main aim was to order all the layers by their role and importance in the project. First the TAB files were opened together in MapInfo. This step could be made activating the Layer Control option in the “Map” menu.

Map menu opened and layer control selected.

After all the TAB files opened together, we began to organize them. In interest of a correct visualization, the order to follow is planning, first to the bottom of the list the areas (areas tematicas), followed by the buildings and at lasts the lineal objects (streets):

1. Avenidas
2. Calles asfaltadas
3. Paths
4. Buildings
5. Lake
6. Thematic areas



Layers after opening the map without any order.

If the layer control is selected we can order the layers in the order mentioned in the previous page. In the Layer Control window we should select the name of the layer and click the option ˝Up˝ or ˝Down˝ to put the layer into its previously determined position.

Layers of the map ordered.

After following these steps all the layers are ordered and we can begin the more important task of this project: the creation of the thematic maps.

7.2. INTRODUCING THEMATIC DATA

During the introduction of the thematic data were used:

- The thematic map.
- Table with areas name and number of genera of trees.
- List containing the code of tree genus and the name.

```
1 Abies Cephalonica
2 Abies Concolor
3 Abies Normandiana
4 Abies Pinsapo
5 Acer Platanoides "Crimson King"
6 Acer Platanoides "Schwedleri"
7 Aesculus Hippocastanum
8 Aesculus Octandra
9 Aesculus Pavia
10 Betula Daecarlica
11 Broussonetia Papyrifera
```

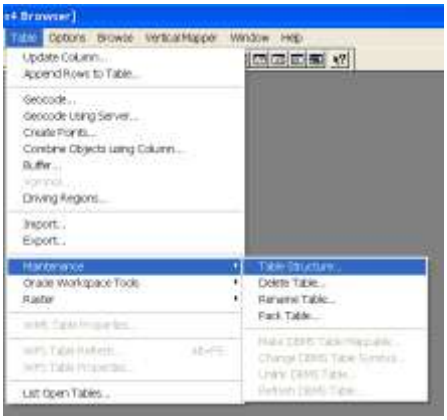
AreaName	Tree type
22	2, 7, 12, 16, 25, 26, 29, 31
23	2, 6, 8, 13, 16
24	6, 11, 31
25	2, 7, 10, 14, 17, 20, 25, 26, 31
26	6, 9, 10, 13, 23, 25, 26, 31, 33
27	1, 2, 3, 7, 14, 17, 25, 26, 31
28	2, 7, 8, 9, 18, 29

Data used for the introduction of thematic data.

Thematic data was stored in the table created in MapInfo including the list with codes and Latin names. The steps followed to import the thematic data were:

First, where counted how many genera of trees were in each area, to create the thematic columns in the table. The maximum number of genera of trees in only one area was 12 different genera, and in consequence, 12 columns had to be added to the table of the map.

The next step was to create the columns (fields) in the table. For that, was needed to select the option ‘Table’ in the toolbar of MapInfo, clicking on ‘Maintenance’ and later selecting the ‘Table structure…’



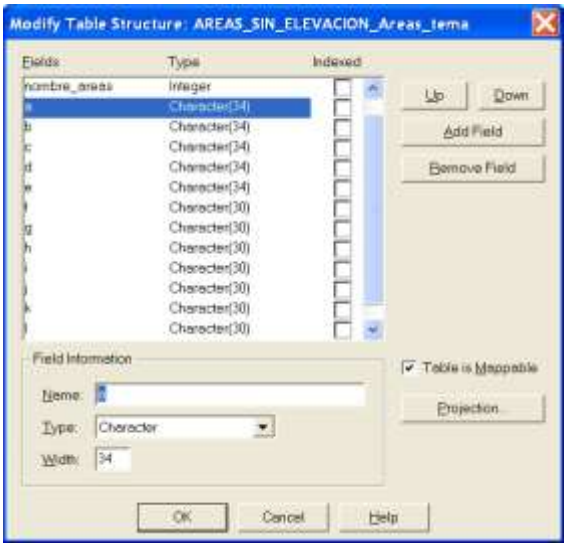
Opening the table structure option.

In the opening menu we have some choices to select:

- Create new columns in the table.
- What type of column we want to create (number, characters etc.)

In our case I created a field of integer numbers and 13 fields of characters (twelve for the trees genera and one for the link to the pictures).

After deciding the type of field, it is necessary to specify its name too. The integer field was created to store the numbers of the areas and was called “nombre_areas”. The fields for the name of the trees genera were called alphabetically from “a” to “l”. The field defined for the link to the pictures was named “m”. The length of the columns was also specified, in this menu defining 34 characters for the trees genera and 50 characters for the link of the pictures.



Modifying the structure of the table.

After the definition of the structure of the table the fields were automatically created empty. The first field I filled was the names of thematic areas, using numbers ordered according to a logical tour on the map. They were not ordered in the table.

In the next figure can be seen a fragment of the table with some of the filled fields:

AREAS_SIN_ELEVACION_Areas_tema Browser

nombre_areas	a	b	c	d	e	f
70	Acer Platanoides _Schwedler	Aesculus Hippocastanum	Gymnocladus Dioicus	Juglans Nigra	Larix Deciduaü	Liquidambar
74	Kis Botanikuskert					
72	Abies Cephalonica	Acer Platanoides _Schwedler	Cercis Siliquastrum	Gymnocladus Dioicus	Platanus Hybrida	Quercus fa
71	Abies Cephalonica	Acer Platanoides _Crimson K	Aesculus Pavia	Cladrastis Lutea	Fraxinus fajok	Gymnocla
69	Acer Platanoides _Schwedler	Fraxinus fajok	Gymnocladus Dioicus	Quercus fajok	Ulmus fajok	
50	Gymnocladus Dioicus	Platanus Hybrida	Ulmus fajok			
49	Abies Concolor	Ginkgo Bilpoba	Gymnocladus Dioicus	Platanus Hybrida	Pseudotsunga Menziesii	Taxodium D
54	Abies Cephalonica	Abies Concolor	Gymnocladus Dioicus	Platanus Hybrida	Ulmus fajok	
53	Cercis Siliquastrum	Gymnocladus Dioicus	Platanus Hybrida	Ulmus fajok		
52	Platanus Hybrida	Tilia fajok	Ulmus fajok			
51	Platanus Hybrida	Ulmus fajok				
56	Aesculus Hippocastanum	Aesculus Octandra	Aesculus Pavia	Betula Daecarlica	Cladrastis Lutea	Gymnocla
55	Carya Ovata	Platanus Hybrida	Ulmus fajok			
57	Platanus Hybrida					
4	Acer Platanoides _Schwedler	Cladrastis Lutea	Parotia Persica	Platanus Hybrida	Quercus fajok	
15	Acer Platanoides _Schwedler	Betula Daecarlica	Celtis Australis	Cercis Siliquastrum		
14	Ginkgo Bilpoba	Platanus Hybrida				
13	Acer Platanoides _Schwedler	Ginkgo Bilpoba	Juglans Nigra	Platanus Hybrida	Tilia fajok	
9	Acer Platanoides _Crimson K	Betula Daecarlica	Celtis Australis	Juglans Nigra	Pterocarya Fraxinifolia	Pinus Cemb
10	Aesculus Octandra	Aesculus Pavia	Juglans Nigra	Quercus fajok		
11	Acer Platanoides _Crimson K	Acer Platanoides _Schwedler	Aesculus Octandra	Cercis Siliquastrum	Platanus Hybrida	Populus Ro
8	Abies Concolor	Acer Platanoides _Crimson K	Aesculus Octandra	Aesculus Pavia	Juglans Nigra	Quercus fa
7	Abies Concolor	Acer Platanoides _Crimson K	Aesculus Hippocastanum	Aesculus Octandra	Aesculus Pavia	Celtis Austr
20	Abies Concolor	Acer Platanoides _Schwedler	Ostrya Carpinfolia	Tilia fajok	Ulmus fajok	

Numbered areas and trees genera by area.

8. ADDING MULTIMEDIA DATA

In this part of the work was added some multimedia information to the map, mainly pictures taken about the trees that can be found in the park. Pictures were added to two layers of the map in MapInfo: First to the thematic areas layer and second to the buildings layer.

8.1. Making of the pictures

The first step was to take the pictures of all the areas of the park.

In interest of optimizing the time needed to take these photos, I planned in detail a tour to the park, defining the way to follow, taking photos of the trees in each area represented on the map.

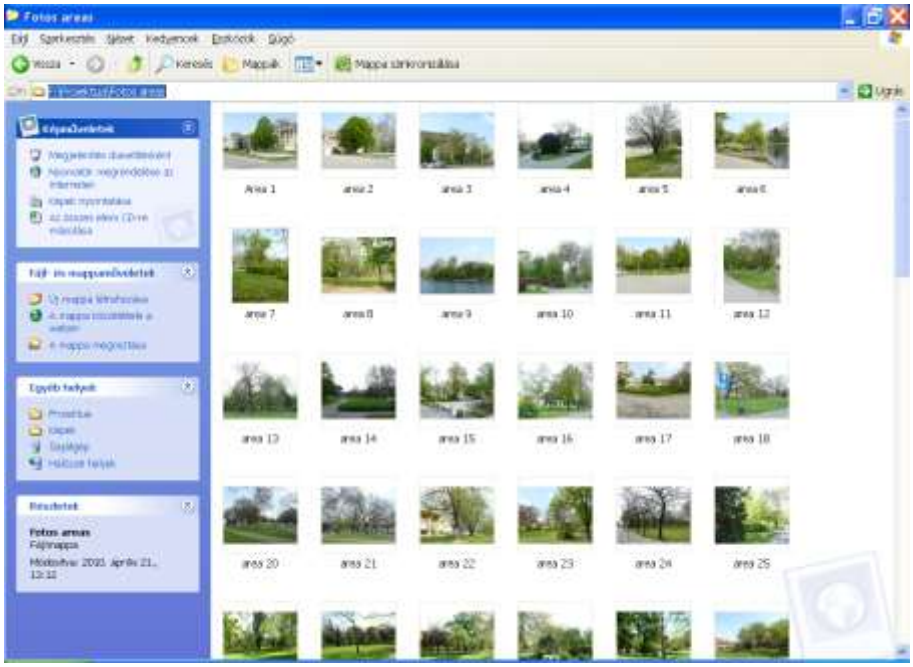
The pictures were taken on spring, when the foliage of the trees is growing, in interest of best and correct identification of each genus of tree.

The pictures of the areas give us a general view of vegetation in each area. Only one picture of each area can be displayed in MapInfo. Some areas are so large and, sometimes it was difficult to take a panoramic photo of the whole area. By this reason, in some cases we can see only a representative part of the area in the photo.

8.2. Adding the hotlink to thematic areas

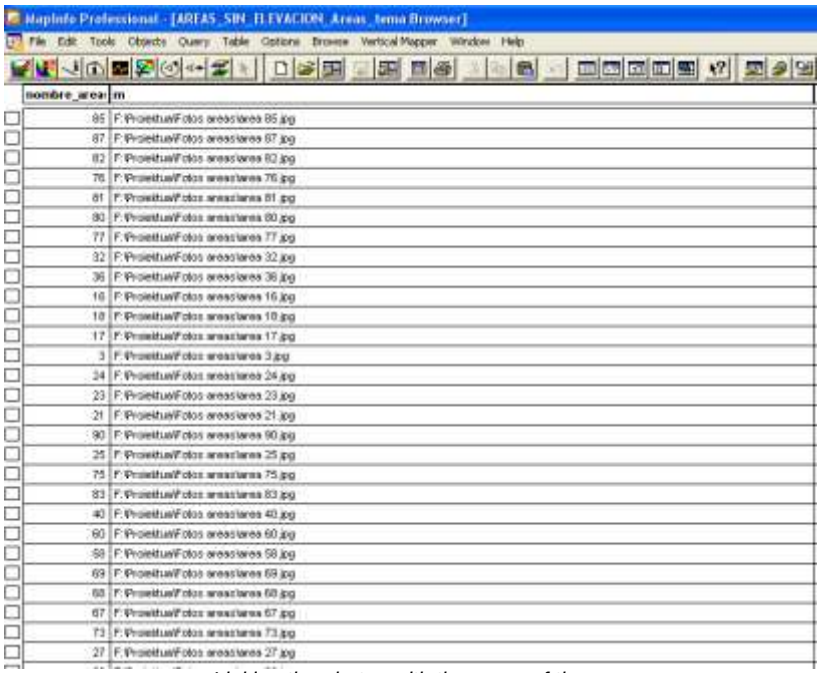
The next step after the taking the pictures was to link them to the thematic areas in the map as follows:

- The first step was to name each picture with the number given to the areas in the MapInfo database (thematic map task).



Digital photos taken in Városliget.

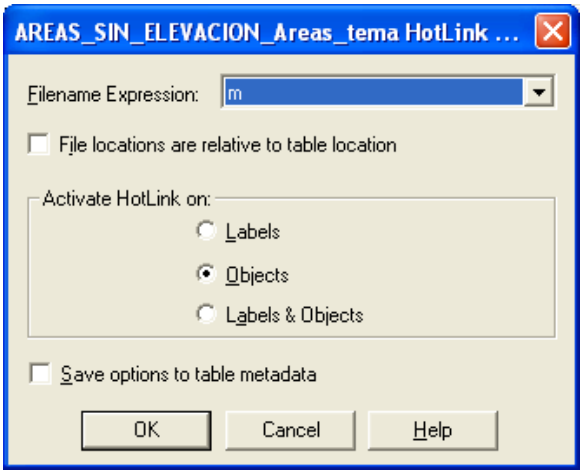
- The next step was to link the images to the table of the map. In this table the column for the links was identified as “m”. For linking the pictures to the map I had to copy the URL address of the images folder (E.g.: *G:\Proiektua\Fotos areas*). After copying it I also added the picture name with the extension .jpg. Finally, the address in the column was like this example: *“F:\Proiektua\Fotos areas**area 25.jpg**”*



Linking the photos with the areas of the map.

Then to open the links clicking in the thematic area of the map we have to say what we want to do. For that was opened “Hotlink…” option from “Layer Control”. This have to be done with the thematic areas layer selected.

After finishing the two steps above we should define the link from a thematic area on the map to the image file in the “m” column (field). Having selected the thematic areas layer we opened the “Hotlink” command from the “Layer Control” menu. The name of the column containing the URL address to the pictures is selected in the “Filename Expression”. After it we defined what kind of link will be in the column: if it is a label, an object or both. In this specific case we were working with pictures, so our selection was the “objects” option.



Window for the definition of a hotlink.

Once the hotlink is defined the user can activate it clicking a symbol representing a beam clicking in the toolbar, and to see the pictures only have to click on the areas of the map.

The cursor changes and clicking on the areas of the map we can open the related picture.

Button to activate the Hotlink option.

9. MAKING OF THEMATIC MAPS

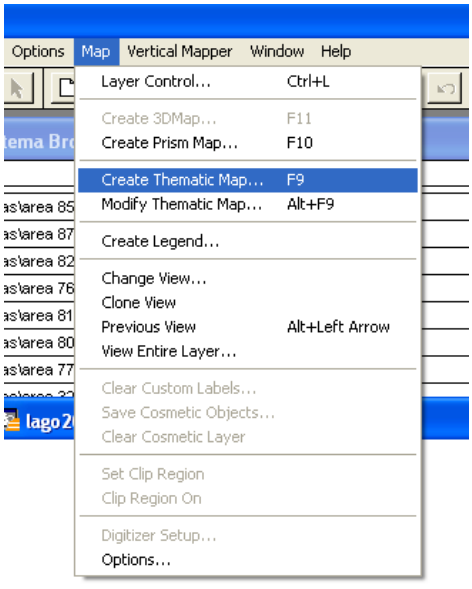
After having the thematic data stored in the table I began to create thematic maps. Some thematic maps were created, each of them including a specific tree genus that can be found in the park.

To create a thematic map, first it is necessary to choose the themes that are going to be represented there. In this case were selected six trees genera to be represented on the thematic maps. The genera of the trees selected are:

- “Aesculus octandra”
- “Aesculus pavia”
- “Cercis siliquastrum”
- “Platanus hybrida”
- “Tilia genus”
- “Ulmus genus”

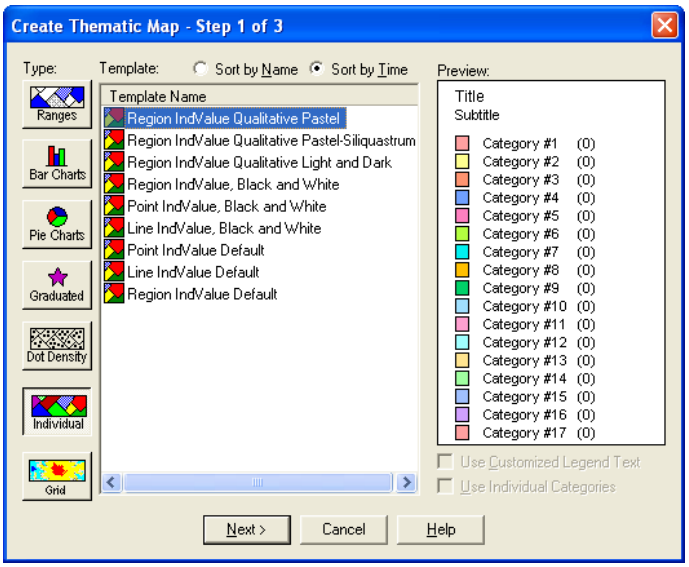
The steps followed during the creation of the thematic maps were:

1- The “Map” option was selected in the toolbar. After clicking there are some options to choice and we have to click on “Create Thematic Map…”.



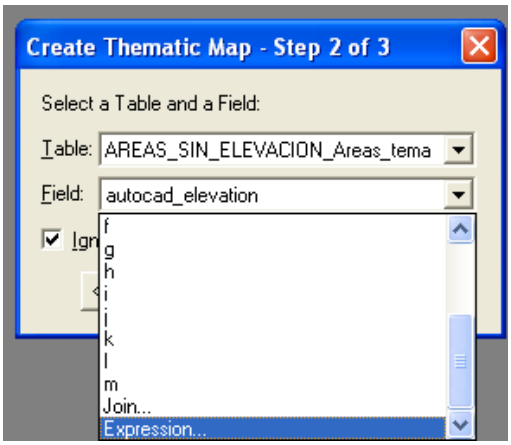
First step to create a thematic map.

2- After clicking a new window is opened and we should select what type of thematic map we are going to create. In this specific case the data to be used is qualitative, so the “Individual” type was selected specifying the option “Region IndValue Qualitative Pastel”.

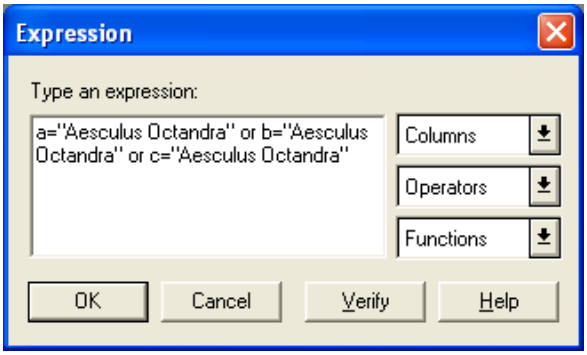


Selecting a template for the creation of a thematic map.

3- After clicking “Next” other dialog window appears. Here we should select from which table will be selected the information to make the thematic map. After selecting the table, we should choose a column (field) or define an expression that we want to use to select the data to represent on the map. In this case an expression was used to seek for a specific genus in the table.



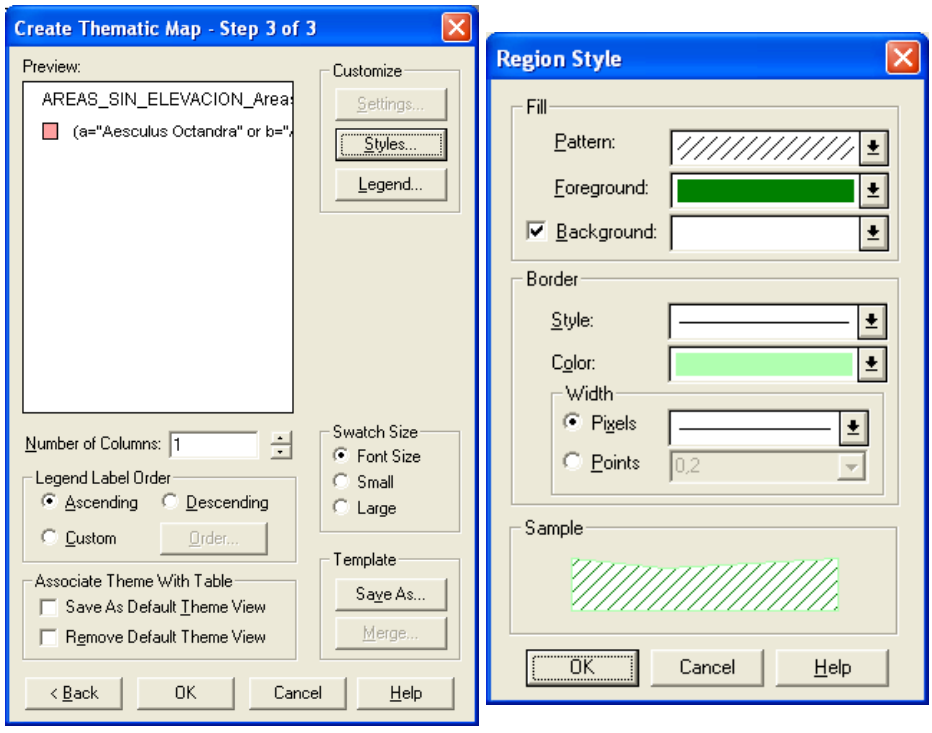
Second step during the creation of thematic map.



Defining the conditions to select the thematic data.

After writing the expression and clicking on “Ok” and “Next”, the given tree genus was searched in the columns of the table specified typed in the expression (E.g., the “Aesculus octandra” was checked in the columns “a”, “b” and “c” of this table).

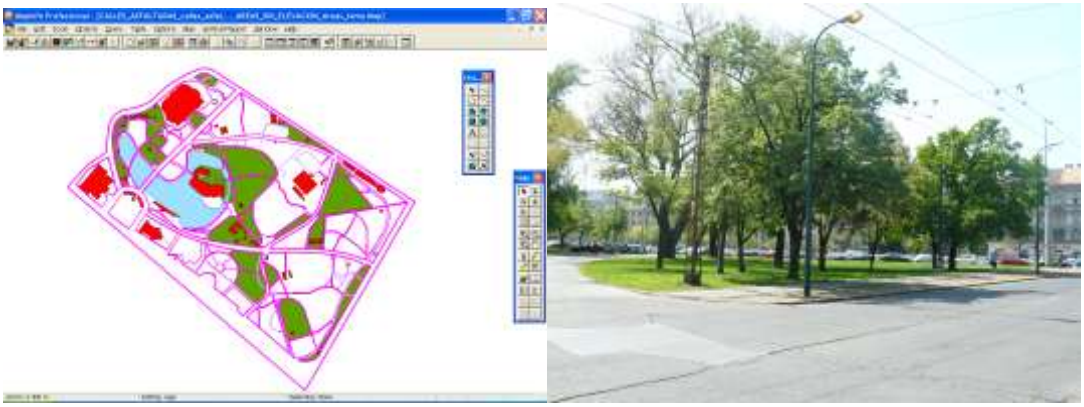
4- When the selection was done in the table, it was the time to define the style of the areas selected in the map. In the “Step 3 of 3” window we should click in the option “Styles…” to define the colour and the pattern of the fill and the style, colour and width of the border. In this case the pattern defined are continuous green lines with an angle of 45 degrees.



D

Defining fill and border of the thematic areas.

Once the thematic maps were created, they were edited to be printed and be added to the annexes, creating a legend and adding some pictures of the areas. A total of six layouts were printed.



Annexes created with thematic maps and photos

10. BIBLIOGRAPHY

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K. Hlatky, Katalin, 2001. Budapesti zöldkalauz – parkok, közterek, szobrok, zöldterületek, Magyar Almanach Kiadó, Budapest.

MapInfo Reference, 2010 [Online] Available at: http://www.pbinsight.com/products/location-intelligence/applications/mapping-analytical/mapinfo-professional/#resources-tab [Accessed 14 May 2010]

11. ANNEXES

Printed layouts:

1. Tilia in Városliget

2. Aesculus pavia in Városliget

3. Ulmus in Városliget

4. Cercis siliquastrum in Városliget

5. Aesculus octandra in Városliget

6. Platanus hybrida in Városliget