CREATING AND USING GIS DATABASES FOR THE INVENTORY OF TREE SPECIES FROM CAMPUS OF BUSAMV "KING MICHAEL 1st OF ROMANIA" FROM TIMISOARA

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Abstract. *This study want to present how to achieve a geodatabase useful in the management of tree inventory projects. Inventory of trees from a certain area is part of the law of green spaces included in the law number 24 from 15 of January 2007 (the law follows the administration and the regulation of the urban green spaces). The green space is represent like a green area consisting of territories which have a significant value of natural heritage, which require protection. In another definition, the green space is seen as unique biodiversity ecosystems, what are threatened by the pollution. The local register of the green spaces is made up of all data (plans, maps, types of land) about the green space of a locality. It is an assembly of information collected using specific methods and procedures, then properly processed with the help of programs and finally end up with a database (GIS). The purpose of this work is to achieve a geodatabase which will included all the trees that are existing in Banat University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" from Timisoara. Tree inventory will be done using the GNSS and GIS last generation technology , the attributes will be taken from the ground and will be created an online GIS map, which can be continually update and will allow trees to be monitored to protect them .*

Keywords: *campus, GIS, geodatabase, green cadaster, trees*

INTRODUCTION

The special feature of a GIS is how to organize managed information. Thus, there are two types of information: a graphical one, which indicates the spatial distribution of the studied elements and another in the form of a database to store the attributes associated with them.

The potential of a geographic information system can materialize in very many ways from engaging in solving current problems to specific planning activities from an organization.

A good GIS project can be accomplish only if the project can answer the following questions:

- *Who is or should be responsible for data maintenance:*
- *Who is or should be responsible for data maintenance?*
- *How can GIS technology be implemented to streamline the technological flow within the organization or to change the ways to solve problems by making them more efficient?*
- *What are the data that will bring the greatest benefits to the organization?*
- *What are the data that can be shared?*

Effective implementation of a GIS allows understanding its potential by providing effective operations, storing and sharing data across and between different compartments and, last but not least, facilitating integration with other technologies.

The GIS implementation project begins, like any other design activity, with the correct understanding of the intended purposes and advances gradually, with increasing degrees greater detail as information is collected and structured.

Designing is a process that defines objectives, identifies, analyzes and evaluates different solutions, and adopts an implementation plan. The project enables decision-makers to have an overview and a tool to control the status of the works in any moment of their deployment. More and more detailed problems can be formulated during the implementation of the project, new types and data structures will be defined. Any GIS project must comply with the INSPIRE guidelines introduced for the uniformity of the collection and storage of geospatial data in the land.

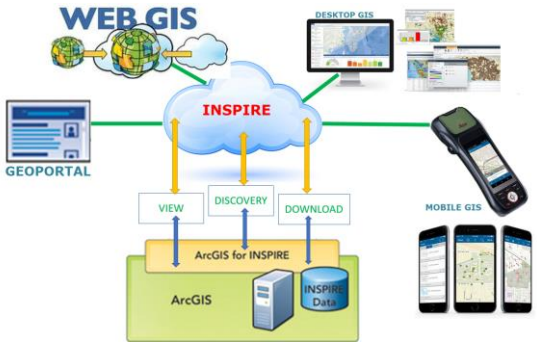

Figure 1. GIS & INSPIRE
(*http://www.esriuk.com/software/arcgis/arcgis-for-inspire/whats-included*)

The database project fully describes its architecture. The project also offers the opportunity to embrace all technical aspects related to the spatial database both as a whole and in terms of the interdependencies between its components. Expenditure on design actually means savings during implementation and, in the absence of a project, problems can become insurmountable.

MATERIAL AND METHOD

For this project, which involves the inventory of the trees from the BUSAMV Campus Timisoara, the following workflow is to be followed:

1. Creating a Space Database in ArcGIS Desktop.
   a) Defining domains in the Database.
   b) Defining the point class feature feature for trees.
   c) Set the fields in feature class
2. Sharing data in a cloud service
3. Creating a WEB Map where data created in ArcGIS will be uploaded.
4. Sharing WEB Map to certain users to collect data using mobile tools

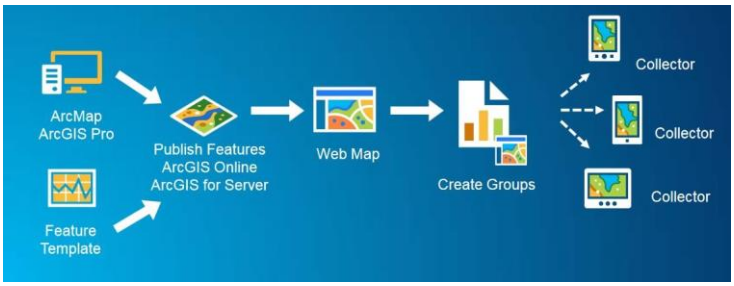

Figure 2. Workflow of a Mobile GIS Project
(https://resources.esri)

SOFTWARE AND INSTRUMENTS FOR GIS

In this project were used the software ArcGIS Desktop, the solution GIS Mobile Leica Zeno 20 with Android operating System, the mobile solution of ESRI Collector for ArcGIS together forming the device **Zeno Collector** and the platform of cloud ArcGIS Online.

ArcGIS, the world leader of the software GIS, perases various tools for spatial analysis. These tools allow information data and automation of any GIS project. Offering support for more than 70 data formats, ArcGIS for Deskotp enables very easy integration of various types of data for viewing and analysis. ArcGIS has a broad set of tools for managing geographic, tabular and metadata data, and is also a data management tool. ArcGIS offers the ability to produce high-quality maps without encountering difficulties with other cartography software.

The Leica Zeno 20 is a high-precision double frequency GNSS receiver based on the ANDROID Operating System, dedicated to the acquisition of GIS data on the ground. Zeno Collector is a "portable" tool that combines Esri's Collector for ArcGIS application with the precision of a Zeno 20 geodetic tool, produced by Leica Geosystems.

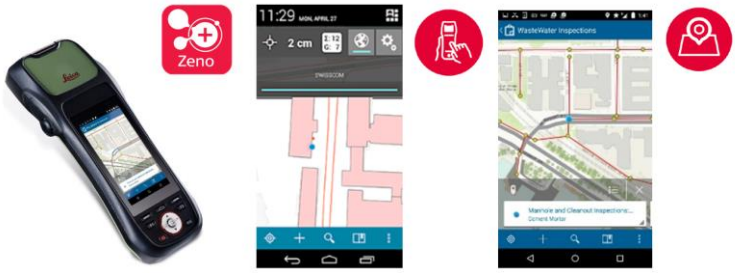

Figure 3 Zeno Collector

THE ARCHITECTURE OF A GEODATABASE

The effectiveness of implementing a GIS is due to the quality of the data base design. The ArcGIS software solution works with databases called Geodatabase. Geodatabase is a component of ArcGIS software created to define and have access to geographic objects called GeoObjects. Geodatabase encompasses spatial data, attributes, and behavior. Basically, a Geodatabase is a "container" used to hold a collection of datasets.

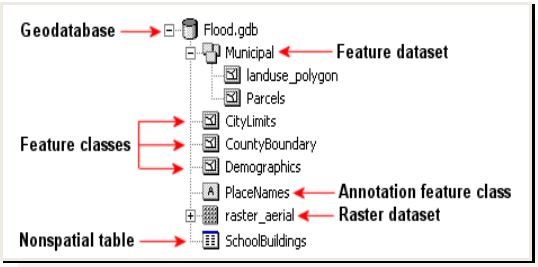

Figure 4 Structure of a Geodatabase

A Geodatabase provides a common framework for accessing and managing geospatial data in ArcGIS. Allows GIS functionality to be distributed on any desktop, server, or mobile platform, and also allows GIS data to be stored in a centralized location to provide easy access and management

Creating a geodatabase is a process that involves several steps, namely:

- uploading spatial data
- creating a geodatabase structure
- creating an empty geodatabase
- designing geodatabases

A geodatabase has the following **functions**:

- storing complex collections of different types of data in a centralized location.
- applying complex rules and relationships to geospatial data
- integrating spatial data with other IT databases
- multiple simultaneous access to data by multitasking.
- maintaining the integrity of spatial data.
- defining advanced geospatial network models (ex. topologies, networks).

There are **three types** of Geodatabase with the following features:

- Personal geodatabases:
  - Some readers, one writer
  - Microsoft Access database-format - .mdb
  - Storage of 2 Gb of data
- File geodatabases
  - More readers, one writer per feature dataset, stand-alone feature class, or table.
  - A file geodatabase is a file folder that holds its dataset files.
  - Storage of 1Tb of data
- Enterprise geodatabases = multiuser geodatabases
  - Multiuser: many readers and many writers
  - DBMS

RESULTS AND DISCUSSIONS

In this paper, a Geodatabase File was created and used, following the following steps:

- **Creating a Database** - File Geodatabase in ArcMap, the Catalog window

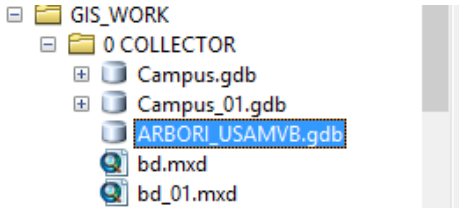

Figure 5 Creating the Geodatabase (ARBORI_USAMV.gdb)

➢ **Defining Domains**

Some fields in the database can be populated with a set of options. By creating domains in the database can be provide some lists of options that can be selected in the field (Ex. creating a list of the species in the database or creating a list of nature tree species, indigenous or exotic trees).

From these, some can be automatically completed in the field by selecting the desired value from a predefined list.

Table 1

Structure of the data base

Information from the land	**Selection from the list of values / Entering Manual Field**	**Field Type**
Unique identifier	The common identifier for each spindle will be entered manually for each spindle	Short integer
Emplacement	The Input Shaft Location will be entered manually for each spindle	Text
Species	Species will be selected from a list of species 69 species (popular names) were identified	Text
Family	The tree of origin of trees will be selected from a family list 29 families were identified	Text
Scientific name	The scientific name is selected from a list of scientific names 73 names (+1 for every unknown species)	Text
Species nature	The nature of the species will be selected from a list of 2 digits	Text
Vitality	The vitality of each tree will be selected from a list of 10 values, namely 1, 2, ... 10	Short integer
Diameter	The diameter of each spindle will be entered manually for each spindle	Short integer
Height	The height of each spindle will be entered manually for each spindle	Short integer
Inventory date	The date when the inventory was made	Date
Remarks	Various observations in the field (eg dry shaft, need intervention etc.). These will be manually entered	Text

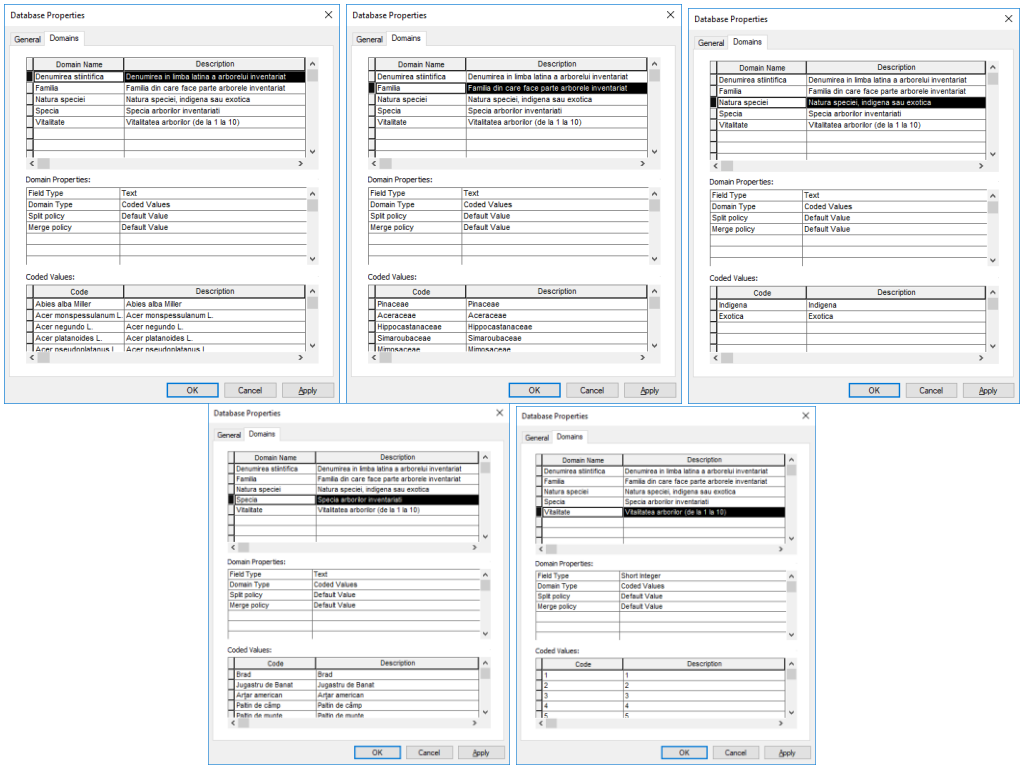

Figure 6 Defining domains in ArcGIS

- **Defining the feature class**

The next step is to create a feature class that is populated with the information gathered. Feature classes are similar to those in which information is stored, which has the same characteristics, that is, the same geometry (point, line or polygon) or the same attributes. In this paper was created a POINT type class, for the inventory of trees in USAMVB Campus Timişoara.

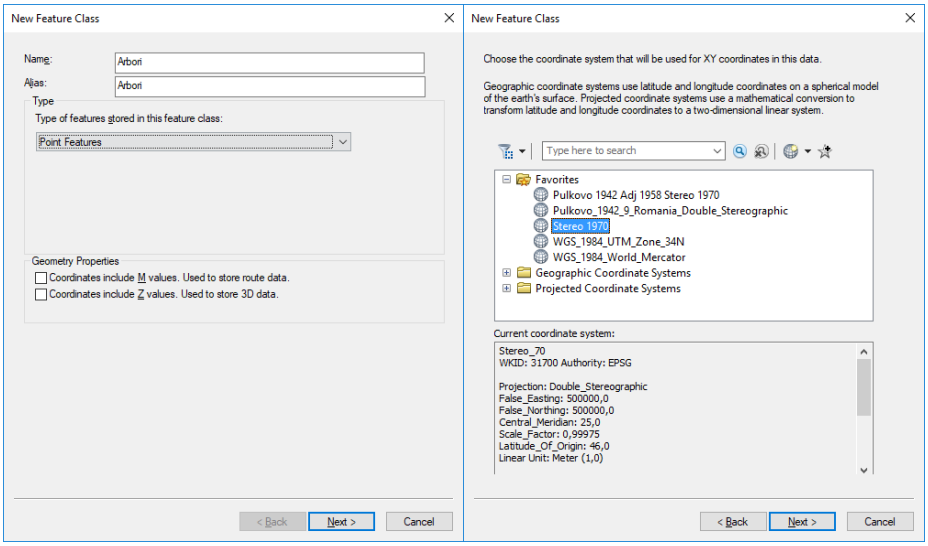

Figure 7 Define a point class feature – ARBORI

- **Setting Fields**

Fields are an essential part of the model. They provide the structure of the information that will be collected on the field and provide rules for the types of information gathered on a feature.

A new field will be created for each information that we collect from the field:

1. Unique identifier
2. Emplacement
3. Species
4. Family
5. Scientific name
6. Species nature
7. Vitality
8. Diameter
9. Height
10. Date
11. Remarks

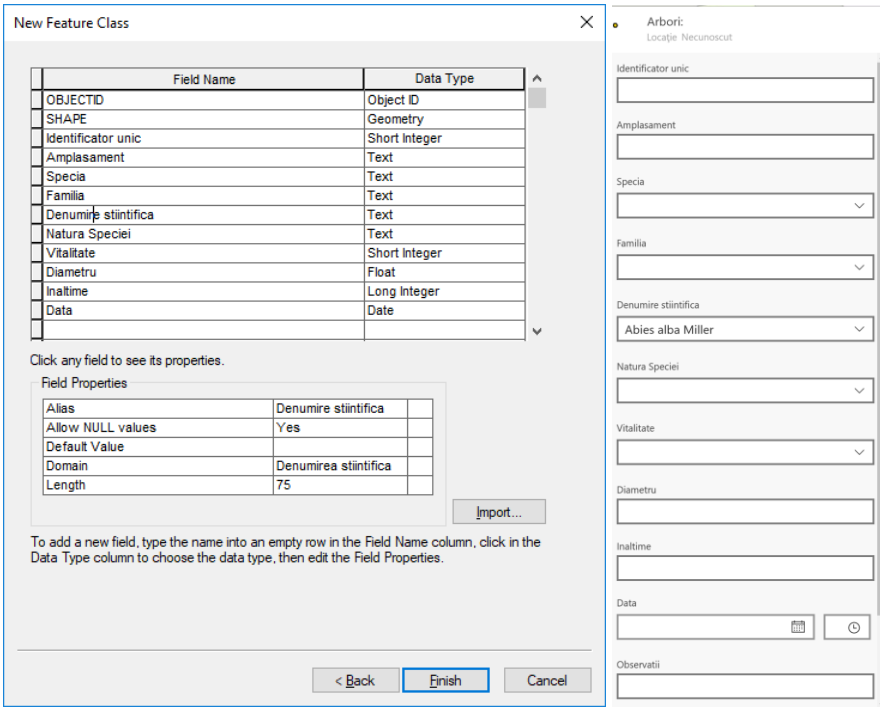

Figure 8 Setting up spatial database fields and the Form that will be used in the field

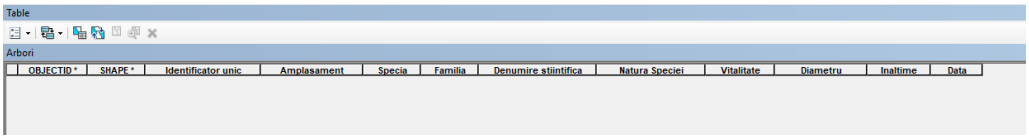

Figure 9 The data base structure for this project

Next we will define the map viewing and symbolizing the map data that will be performed with the data collected in the field.

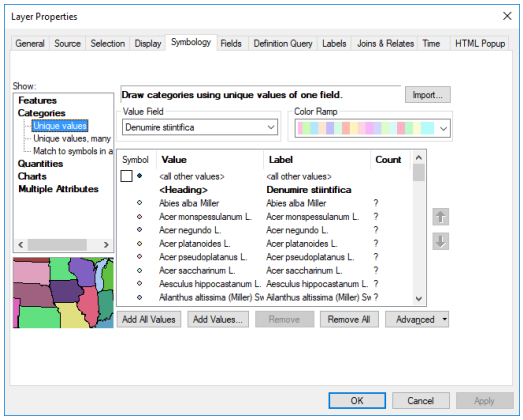

Figure 10 Setting up the vizualizing mode of the trees

For using the data in the field, they must be shared. Data can be transmitted either to an ArcGIS server or ArcGIS Online account.

ArcGIS Online will create a map that will be used in the field to collect the necessary data and information. In this case a map for tree inventory. The map will be built from a basemap over a layer will be added, the layer of the trees, which was defined and created in ArcGIS Desktop.

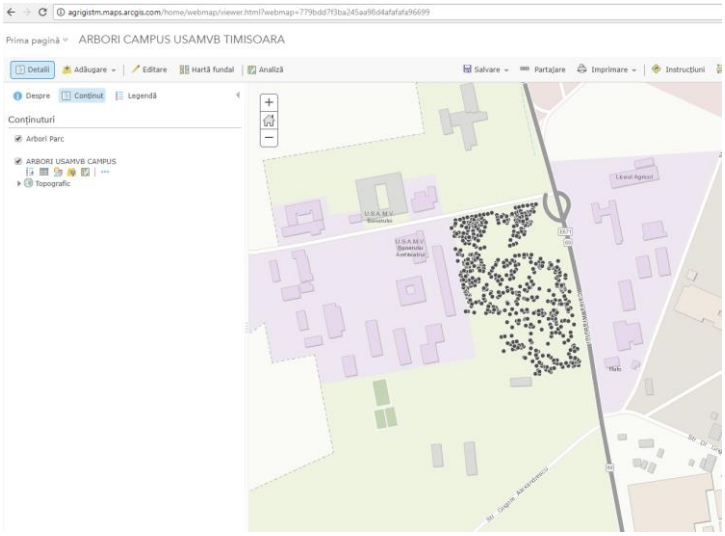

Figure 11 The WEB Map of Study Area

We can configure the data collection mode and customize the collection application settings. Finally, the map created will be distributed to field users who will collect and populate the data base with the collection information. For this study, the ArcGIS account of USAMVB Timisoara was used.

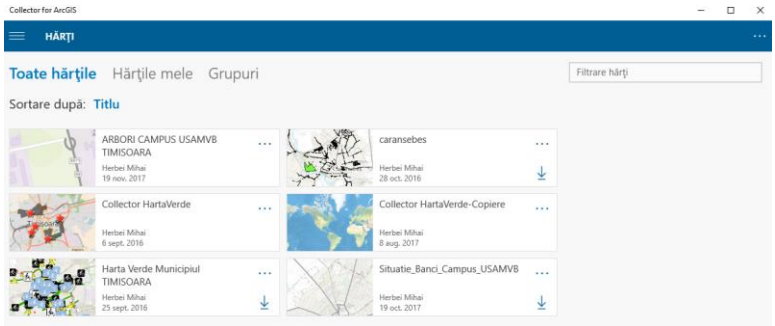

Figure 12 The Main Screen of the Collector Aplication

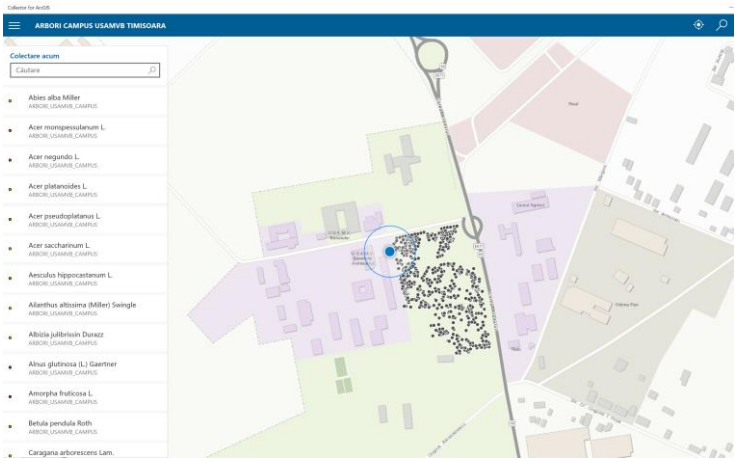

Figure 13 The Collector Aplication from the Mobile Device

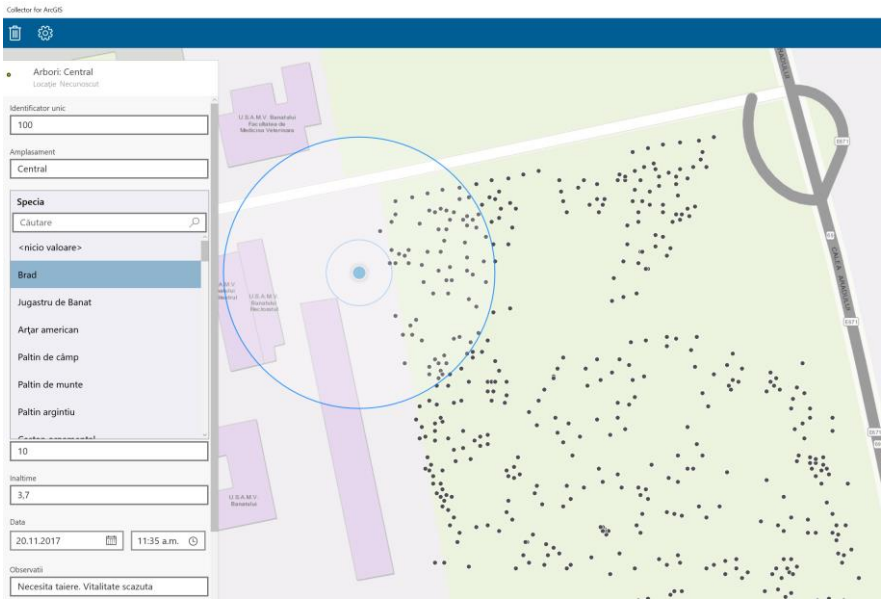

Figure 14 Example of collecting data

CONCLUSIONS

This study want to present how to achieve a geodatabase useful in the management of tree inventory projects. Inventory of trees from a certain area is part of the law of green spaces included in the law number 24 from 15 of January 2007 (the law follows the administration and the regulation of the urban green spaces).

Due to the realization of the geodatabase we can invent the trees from USAMVB TIMISOARA. By making this database anyone can access the online site and can use this work.

Advantages of using a GDB are:

- Relations between layers: feature datasets
- Labels: saved as annotation feature class
- Drop-down lists
- Domains for attribute values
- Field Properties: more parameters (eg. Default value for a field)
- Surface and perimeter: automatic calculation if objects edited

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