Monitoring Biodiversity in a romanian protected area using GIS Desktop, Mobile and Server technologies

Esri Romania – Staiculescu Simona

Abstract

GIS technologies, integrating *desktop, mobile* and *server* components, offer a lor of posibilities, functionality and analysis capabilities for developing a data model for the conservation of biodiversity in a protected area. Here we demonstrate the way these features togheter, made possible the development of a monitoring system for the biodiversity conservation status in the romanian NATURA 2000 protected area - ROSCI0229 SIRIU. Thus, starting with inventoring and data capturing process, and continuing with data processing as well as the application of different methods of spatial analysis, we end the project with an optimized data model and some qualitative geografic information systems for monitoring biodiversity in protected areas.

Topics, covered by the the applied methodologies, include *Advanced geovisualisation and cartography*, *Advanced spatial analysis and knowledge extraction* as well as *GIS Science.* **Contribution** is based on the theme *Vulnerability – Spatial Assesment and Analysis*.

1 Introduction

Biodiversity – the variety of ecosystems, species and genes – is the world's natural capital and its conservation is a key environmental priority for the EU.

In the face of this alarming decline, people all over Europe have expressed increasing concern over the loss of their natural heritage and of the biodiversity upon which we all depend for our health and prosperity. European legislation sets the standard for nature conservation across the European Union and enables all 27 Member States to work together within the same strong legislative framework in order to protect our most vulnerable species and habitat types. The cornerstones of Europe's legislation on nature conservation are the **Birds and Habitats Directives -** the most ambitious and largescale initiative ever undertaken to conserve our natural heritage across the European Union.

In this context, our study is based on a project of monitoring the nature conservation status in a protected area. The *main foscus* in this project is on extracting and analyzing biodiversity data and developing solid tools and methods to explore and effectivly use this data, using GIS technologies. A further objective is the optimization of the data model and tools, to effectivly support the necessary workflows for monitoring the biodiversity conservation status in the protected area.

The site under investigation is a 11.300 Ha protected area, located in the north part of Buzau county. The studies involved the following phases: *data capturing* using mobile devices, GIS mobile technologies and specialized survey techniques for different kind of species (mammals, ihtiofauna, amphibians, plants) and habitats, *data model development* – geodatabase schema and migration workflows development*, data processing and analysis techniques development, cartographic products development* – maps, mapbooks, *geoportal and viewer* web applications development, using GIS technologies.

2 Input Data, Data Processing and Analysing Methods

The capturing and pre-processing of the data was performed by the Esri Romania company, using GIS technologies and software applications. *Data capturing* was realized using mobile devices, specialized experts on monitored species and optimized GIS techniques. *Data processing* included data migration into an optimized geodatabase schema compliant with INSPIRE Directive – Annex *INSPIRE_DataSpecification_PS_v3.1,* as well as a QA /QC process applied to data*. Data analysis* was the most time costly process, including different GIS spatial analysis methods applied to obtain the distribution area for each kind of species, and habitat in the protected area. Thus, to obtain the distribution and the conservation status for mammals, we used techniques like GIS Spatial Analyst Extension as well as RAMAS Red List 3.0. capabilities. The most complex and elaborate analysis was realized for determining the *distribution of habitats* in the protected area, which was realized by establishing different phytocoenoses in the field.

For this purpose, first the ***data captured from the field (regarding habitats) was divided into two subsets***: the first set was used on the satellite image classification activity and the second was used for the validation of the estimated distribution of habitats in the site.

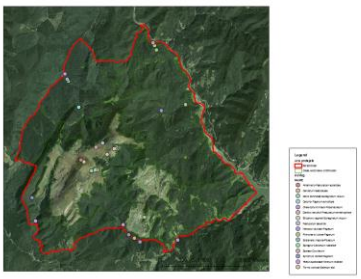

Figure 1 Identification of habitats throught the identification of the related plants in the field

The next step was the ***satellite image classification*** using ENVI software and other remote sensing techniques, as well as different supervised (SOM)/ unsupervised (ISOCLUSTER, KMEAN, MACSET) classification systems, wich conduct the studies to 18 different classes for land cover.

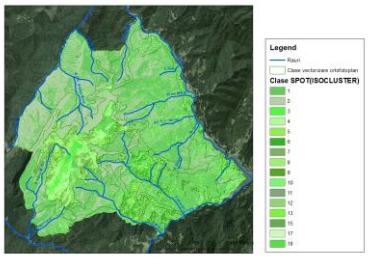

Figure 2 Distribution Classes form the satellite image classification (SPOT – classification method ISOCLUSTER)

The project continued with the **digitization of orthofoto image** wich allowed visual classification of the hight resolution image to identify the boundaries of different elements that can be distinqueshed on the image. So, in this first phase, it was possible the classification of habitats into some main categories.

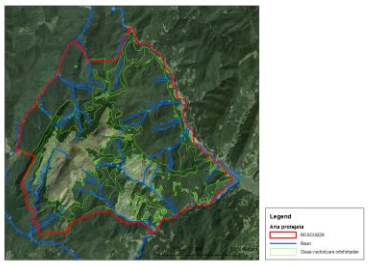

Figure 3 Digitizing distinqueshed spatial objects on orthofoto

Another phase in this process, supose **collecting all the existing specialized information** regarding the chorology of fauna and flora species. This activity allowed our experts to identify and integrate in their analysis for each group of species and habitat, some of the currently available information. This was correlated with direct observations into the field, allowing an estimation of trends in evolution, relative to the citation point, considered a reference state. An intermediate phase was the ***morphometric analysis of land*** – the differentiation of 1th order parameters (slope, aspect, flow direction) and those

derived, of 2nd order (flat curvature, profile curvature, total curvature)- realized with GIS techniques wich allows meshing. Next step was the **differentiation of hydro-geo-morphological units.** The overlapping GIS techiniques (*Intersects*), applied to the layers containing the distribution of abiotic parameters (*geology, curvature, slope*) established in the previews activities, will allow the fragmentation of the investigated site into homogeneous units in terms of associations with abiotic parameters.

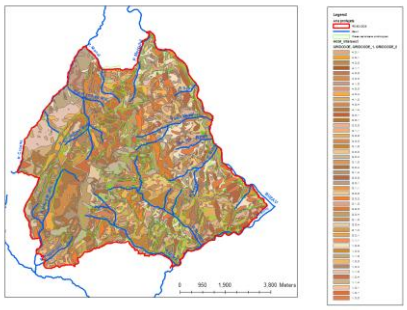

Figure 4 Distribution of hydro-geo-morphological units on protected area

Finally the ***differentiation of potential habitats*** ends this analysis. Spatial association of hydro-geo-morphological units with land cover and species distributions, allowed differentiation of potential habitats, which were further validated in the field using GIS technologies. The main results consist of the current distribution of habitats in the studied protected area.

3 Results

The results obtained into this analysis oriented project, consists in a geodatabase model for storing, exploring and administrating spatial biodiversity data, the additional maps of species and habitats distribution in the protected area and a monitoring system for biodiversity conservation status in the protected area. The monitoring system was implemented trought a geoportal application based on Esri ArcGIS Geoportal Server Extension (www.geoportal-mediu.ro), a free open source product that enables discovery and use of geospatial resources including datasets, rasters, and Web services. Toghether with this system we developped an flex viewer application which allows resources vizualization and exploration, and enables the user to locate and explore Natura 2000 romanian monitored sites at the press of a button (www.geoportal-mediu.ro/Siriu/viewer).

4 Conclusion and Outlook

The European Biodiversity indicators and EU 2010 Biodiversity Baseline are based on best available information. The results of this project reprezent a semnificant start in romanian strategy for biodiversity conservation. However, addressing the complexity of biodiversity remains a challenge and it is acknowledged that there are still significant knowledge and data gaps in many areas.
Conservation objectives will be prepared for each specific element of the protected area. Each feature of interest will have one or more measurable characteristics or attributes that together can be used to define favorable conservation conditions. Further investigations are needed to estimate the degree of correctness for this data, but until now automated and visual checks of the spatial data aquired into this project, promise an accuracy above 95 %. The methods developed are further applied to many other currently in development projects having the main objective nature conservation.

References

http://www.jncc.gov.uk/page-2217-Common monitoring standards;

http://inspire.jrc.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_PS_v3.1.pdf

http://www.eea.europa.eu/data-and-maps/data/corine-biotopes;

Birds Directive (Directive of 30 November 2009 on the conservation of wild birds (2009/147/EC);

Habitats Directive-Council Directive 92/43/EEC of 21 May 1992;

1964 – Brau-Blancquet J. – Springher Verlag, Berlin;

1965 – Introduction in land cover study – Romanian Academy - Borza Al. , Boscaiu N;

1975 – Practical methods for ecological and geographical study of vegetation - Ivan D., Donita N. – University of Bucharest;

1988 - Vegetation analysis – David Causton;

2004 – Phytosociology – Cristea V., Gafta D. , Pedrofi G. Cluj University Press, Cluj Napoca;

2006 – Habitats in Romania - Donita Nicolae, Aurel Popescu, Mihaela Pauca-Comanescu, Simona Mihailescu, Iovu-Adrian Biris;

2007 - Interpretation Manual of European Union Habitats - EU 27, July 2007;

2009 – Interpretation Manual of habitats - Dan Gafca, Owen Monford