THE USE OF GEOGRAPHIC INFORMATIONAL SYSTEMS FOR THE MANAGEMENT OF NATURAL PROTECTED ELEMETS

UTILIZAREA SISTEMELOR INFORMAŢIONALE GEOGRAFICE PENTRU MANAGEMENTUL ELEMENTALOR NATURALE PROTEJATE

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Abstract. *The present paper work refers to the opportunity of GIS use in relation with the management of natural protected areas along with their wild vegetation and fauna elements within the counties of Botoşani, Iaşi, Vaslui, Galaţi. Special attention is given to the Iaşi county. The use of ArcGIS 9.3 and the integrated spatial data prove important tools for environmental decision making by gathering and extracting spatial information for natural protected areas and endangered species or insuring a more precise expertise and more efficient response for large amounts of collected data. In brief, the environmental decision toward the management of biodiversity becomes more efficient with the help of spatial modelling techniques.*

Key words: natural protected areas, GIS, biodiversity, endangered plants, management.

Rezumat. *În cadrul lucării de faţă atenţia noastră se îndreaptă spre utilizarea tehnicilor S.I.G. pentru managementul ariilor naturale protejate şi a elementelor protejate de vegetaţie şi faună sălbatică din cadrul judeţelor Botoşani, Iaşi, Vaslui, Galaţi, cu privire specială asupra judeţului Iaşi. Utilizarea soft-ului ArcGIS 9.3 şi a datelor spaţiale integrate, permite coroborarea şi extragerea informaţiei spaţiale în vederea luării deciziilor de mediu, cu referire strictă la rezervaţiile naturale şi speciile periclitate sau, asigurând o expertiză mai precisă, un răspuns efectiv mai prompt şi o gestionare corespunzătoare a unei cantităţi mari de informaţie la nivelul intregii arii de acoperire. În linii mari decizia de mediu, în ceea ce priveşte biodiversitatea poate fi eficientizată cu ajutorul tehnicilor mai sus amintite.*

Cuvinte cheie: arii naturale protejate, SIG, biodiversitate, management, plante vulnerabile

INTRODUCTION

The use of GIS techniques in the field of Earth Sciences became more important since 1950, when their efficiency was emphasized by the first relevant models applied on the cereals production in relation with weather conditions. These models were introduced, initially, by Von Neumaann from U.S. Army (Charles L., 2001). Henceforth, the application of GIS modelling spread between related fields of study, comprising environmental protection, land-use planning, agriculture, demography and so on. In nowadays Romania spatial modelling is wide known and

largely applied in a variety of studies (soil science, environmental protection, geomorphology, climatology, plant ecology, land-use etc.)

Our paper aims to emphasize the opportunity of spatial modelling use in environmental decision making and the role of these methods in managing detailed and large information quantities pertaining to natural frame and human induced conditions in order to sustain efficient coordination measures toward biodiversity protection. For concrete exemplification we bring into attention a certain rare plant from the Romanian Flora Red List and try to study it in a complex manner, combining the botanical systematic studies with spatial modelling.

MATERIAL AND METHOD

The GIS database, constructed within a PHARE CBC project, implemented by the Local Environmental Agency in Iaşi, comprises:

1) the ESRI support spatial dBase for the counties of Botoşani, Iaşi, Vaslui, Galaţi, in Stereographic projection.

This infrastructure network includes the spatial data present on the 1: 100 000 topographic maps and contains rivers and lakes, settlements polygons, roads, railways, administrative boundaries at the level of counties and communes, all in a vector format.

2) the LEPA spatial database which includes: prior documented information, GPS Trimble Geo XM collected data, tabular data with associated information for the natural reserves, vectorial and tabular data for the Natura 2000 sites (Figure 1), detailed ortho-rectified raster images and metadata for the description of natural protected areas.

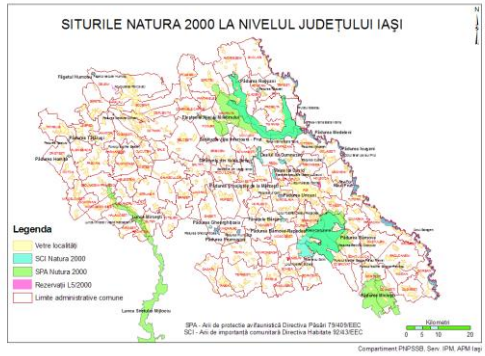

Fig. 1. Natura 2000 Sites and Natural Reserves of Iaşi County

The general utility of the above mentioned spatial database resides in decision making for the various investment projects in relation with environmental law enforcement and focuses, mainly, on natural protected areas. The practical outcome of the database maintaining and updating with terrain collected information serves for better and faster environmental decision groundwork. Within this general frame one distinctive feature refers to rare plant conservative measures through an interdisciplinary approach pertaining to systematic botanics and GIS.

The rare plant monitoring programme tackles the study of the Turkish dock - *Stemmacantha serratuloides* (Georgi) M. Dittrich *(Leuzea altaica, L. salina, Rhaponticum serratuloides* (Georgi) Bobr.) (fig. 2.).

The specific ecologic conditions of the studied taxon are encountered in humid spots of river meadows on alluvial soils with weakly acid to neutral pH values and low saline content. The bioecology of this plant describes it as a Ponto – Balcanic hemicryptophyte with meso-hydrophilic and moderate thermophilic requirements. *Stemmacantha serratuloides* is classified as a critically endangered species in the Republic of Moldavia (Negru A., Sabanov G., Cantemir V., Ganju Gh., Balcanov V., 2002) and endangered for Romania (Oprea A., Davideanu A., Davideanu G., Popescu I. E., Iordache I., Gache C., 2008) and described as enlightner of Sarmatic saline meadows habitats or (Ponto-sarmatic salt steppes and marshes) in the EUNIS database of EEA (Devillers, P., Devillers-Terschuren, J., and Vander Linden, C., 1999, Royal Belgian Institute of Natural Sciences).

Fig. 2. *Stemmacantha serratuloides* in the Bahlui River meadow (D. Stoica)

As specified in the recent dedicated literature, the vegetation studies ought to start from the basic level of taxonomic knowledge and systematic botanics and, further, proceed to the systematization of spatial distribution, through populational observations and complex information processing for synthetic interpretation (Cristea V., Gafta D., Pedrotti F., 2004).

Consequently, a proper management of endangered plants through interdisciplinary evaluation requires connected approaches in the Natural Sciences domain including spatial relations modelling and statistics in order to obtain proper results to lead to viable protection measures.

The main goal of our study is to collect filed data for a detailed taxon evaluation within the Iaşi county and our attempt is meant to continue the results of the *Mutual Management – Romania - Republic of Moldavia for the Conservation of Biodiversity in the Border Region 2004* – project, implemented by the Local Environmental Protection Agency in Iaşi which ended up with the publication of the *Wild Flora and Fauna Species Red List in the Border Region*.

The targeted result is the documentation of increased anthropic pressure and the conservation status of *Stemmacantha serratuloides* in the Bahlui hydrographic basin in order to propose viable protection measures.

The Bahlui River flows in the hilly region of North-Eastern Romania and occupies the central and north-eastern part of the Moldavian Plateau at the intersection of 47°13’ parallel with the 27°15’ meridian, running into the Middle Prut River via its emissary, Jijia River, in a joint meadow pertaining to the three mentioned rivers. The Bahlui River hydrographic basin covers 1639 sq. kilometres.

The geology of this region has Quaternary, recent features with alluvial deposits placed only meters above the present river beds and consisting of various petrographic types going from sands to loessoid loams (figure 4).

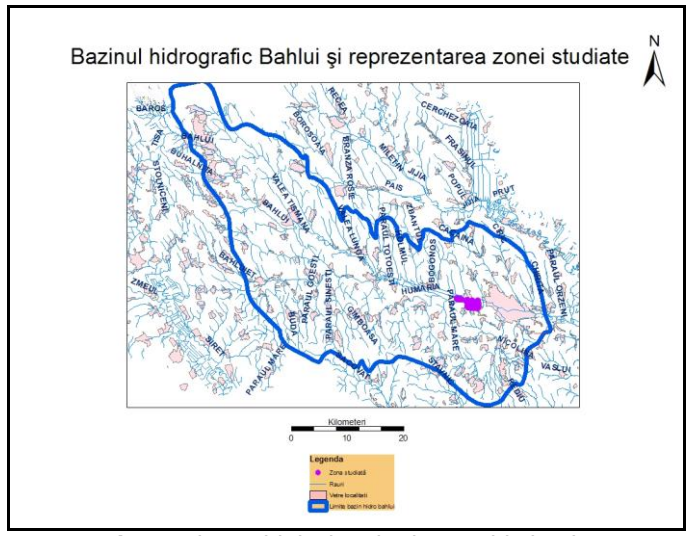

Fig. 4. The Bahlui River hydrographic basin

The accumulative relief is well represented, especially along the water channels with wide meadows (0,2-2,5 m), annual average temperatures of 9,6 ^{o}C (Podu Iloaiei) and annual average precipitations of 525 mm (Podu Iloaiei). The soil cover consists in hydrosols and presents different ecologic conditions compared with the less humid neighbouring tracts through a higher specific heat. This results in a different thermic regime less prone to heating processes compared with the neighbouring areas where humidity is lower.

As far as the plant's phylogeny is concerned, the Bahlui hydrographic basin belongs to two important genetic regions: the Euro-Siberian Region (comprising the European East-Carpathian and the Balcano – Moesic regions) and the Irano – Turanic Region (comprising the Ponto – Sarmatic Region) (Borza, Boşcariu, 1965).

Specific objectives:

- accumulation of a very detailed information material to enhance elaborated investigation of *Stemmacantha serratuloides*;
- release of spatial distribution maps with GPS collected data and ArcGIS techniques to enhance populational evaluation;
- biotope spatial modelling and emphasis of anthropic negative impact;
- correlation of the obtained results with the geomorphologic, climatic hydrologic and pedologic factors;

These steps are meant to achieve a better understanding of the studied taxon ecology and the particular phytosociological features in the Bahlui River basin, for conservative purposes.

RESULTS AND DISCUSSIONS

Our study is meant, first, to bring into attention evaluation of this particular taxon and the interdisciplinary approach that results in a better understanding of present conservative efficiency upon endangered plants. The field stage brought the first results contributing to spatial distribution maps in relation to human activities and infrastructure. The plant ecological conditions are obscured by the intense activity in this area (passing through, grazing, soil intake, unauthorised plant ingathering, surplus water evacuation canals, agricultural and zootechnical activities, unsafe waste deposits etc.).

Filed expertise emphasis the distribution of pure populations in remote places, displaying circular shapes with tens and even hundreds individuals, and scattered individuals in association with common, nitrophil or steppe taxons. Healthy, well grown populations appear in spots where access is difficult (canals bordered areas, long distances from settlements, along railways). This shows that ecological conditions are prone to *Stemmacantha serratuloides* flourish but intense human and human induced activities force its retreat in secluded places. Places with intense human and cattle activity display few, scattered and less grown exemplars.

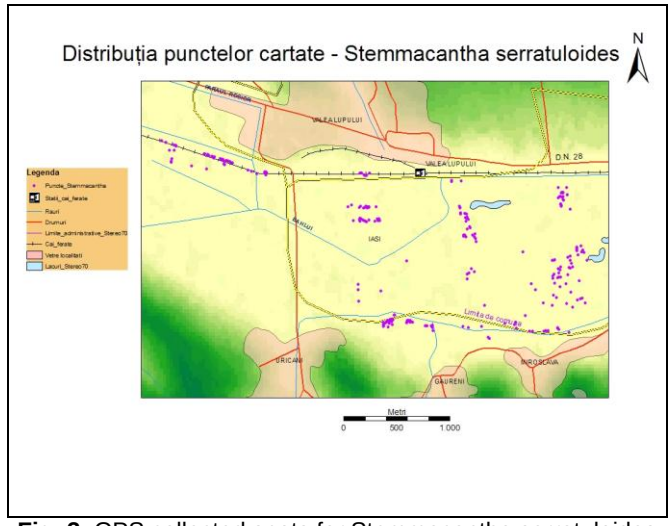

Fig. 3. GPS collected spots for Stemmacantha serratuloides

The initial study stage covers a 9 sq. km tract and includes 264 GPS collected points representing, in average, 15-20 individuals. A total number of 4000 individuals can be estimated for the 9 sq. km which can lead to the conclusion that the above mentioned taxon is abundant. On the other hand if we consider that the biotope of this plant is strictly restricted to few square kilometres in the river's meadow, where almost all human activities are present, then we can withdraw the idea that *Stemmacantha serratuloides*, the *Sheep's tongue*, as popularly called is an endangered plant in this region.

CONCLUSIONS

1. The Geographic Information Systems enhance efficient management of natural elements and supports short time cover of vast areas in decision making;

2. As stated in the recent, dedicated literature, vegetation studies should start from the taxonomic approach and the systematic botanics and, further, achieve systematic territorial distribution patterns and populational observations and, finally, become integrated in spatial distribution models that depict biotope and anthropogenic factors as controlling parameters;

3. The present paper work starts from the general context, of GIS use in the field of biodiversity protection and depicts a concrete, endangered taxon – *Stemmacantha serratuloides* – and manages to demonstrate the interdisciplinary side of our attempt and the vulnerability of the target taxon even if there is much to be done in this sense;

4. Vectorial analysis show that the Bahlui's meadow covers less than 20% (227,8 km^2) percent of the total basin area (1639 km^2). GPS collected data account for less than 15 % of *Stemmacantha serratuloides* population's presence in the meadow area which means that proper flourish conditions are within no more than 34 km^2, representing no more than 2,07 % of the total basin surface.

5. Further, approaches foresee the enlargement of evaluation area in the Bahlui hydrographic basin, more detailed description and processing of spatial information. On the way, the study aims to integrate the aspects of biotope factors at local level and better spatial patterns for the studied taxon.

Acknowledgements

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