

## USING GEOGRAPHICAL INFORMATION SYSTEMS IN THE MANAGEMENT OF PROTECTED NATURAL AREAS

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### ABSTRACT

Aspects of the use of Geographical Information Systems in management of the natural protected area. In Romania, biodiversity conservation concerns has lasted since the beginning of the 21 century, so as nowadays are using some methods, techniques and new instruments as a good management support. GIS are instruments that helps the specialists to analyse and identify natural protected areas from the environment point of view. Mapping database and a vector dataset achievement, which represents natural protected areas boundaries, are the support for a better management of the territory, but also as a basis for some normative documents on the biodiversity conservation management.

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The equilibrium reached in time between natural and socio-human systems is a prerequisite for the normal evolution and progress of society. However, 20th century man used to tamper with the natural systems, often in a brutal manner, and the impact of his unfriendly behavior to nature has increased with the advance of society and civilization. Technology and human intelligence have joined hands in inducing global environmental change whose future effects are hardly predictable. We have a good knowledge of the constructive and destructive power of technology, but sketchy insights into the number of species making up the Planet's biodiversity. Only 10% of the approximately 1,400,000 animal species and 400, 000 plant species are well-known to and analyzed by science.

Man's impact on the natural systems has made very many plant and animal species lose their habitat and living conditions, becoming extinct long before their genetic potential and usefulness could be assessed. The result of human intervention in the landscape has often led to the fragmentation or destruction of some valuable ecosystems and implicitly of the species constituting them, thus depriving the natural heritage of much of its value.

In time, the study of biodiversity covered several stages: the 1960s featured only local studies with highlight on endangered, endemic or rare species (Red List), materializing in a Convention on the International Trade with Endangered Species (CITES); in the 1980s studies focused on the regional level; in the 1990s, a global perspective on biodiversity emerged finalized with the establishment of the UN Global Environmental Fund and the convening of the Rio de Janeiro Summit in 1992.

A special interest for biodiversity conservation, promoted and sustained by various specialist, has been manifest also in Romania, where a national network of various categories of areas has been put in place.

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As early as 1928, at the first National Congress of Natural Scientists in Romania debates focused on the issue of nature protection and the enactment of a law for the creation of nature reserves, monuments of nature and national parks (the first being "Retezat" Natural Park, 100 km<sup>2</sup>, set up in 1935).

However, there are lots of other problems beside biodiversity, in such fields as speleology, karst phenomena, geology and geomorphology, fossiliferous sites and landscape ensembles which ought to be addressed and areas protected from the negative anthropic impact. So, responsible action at all and every level is necessary in order to identify, study and put forward alternatives and solutions for sustainable development, including nature protection in the equation, to the benefit of ourselves and of future generations.

Although the need for environmental protection had been acknowledged in the 1930s (when the first bill for the protection of the monuments of nature was passed into law and the Commission for the Monuments of Nature was set up), yet no significant progress was recorded. Important steps forward were made in the 1990s when Environment Laws were enacted in 1995 (No.137) and 2000 (No. 5) sanctioning the 827 protected natural areas (134 lying inside parks and the Danube Delta Biosphere Reserve). Though imperfect, Law No. 5/2000 represented a landmark in environmental protection efforts. Thus, in 2003, a number of 17 natural and national parks (627121 ha) minus the Danube Delta Biosphere Reserve had already been in place (under Annex 1, Law No. 5/2000), subsequently nine new parks and 152 nature reserved were legislated.

*Natural and National Parks - 2006*

Nr. crt.	The name of the park	Type	Area (ha)
1	DELTA DUNĂRII	rezervația biosferei	580.000,00
2	DOMOGLED-VALEA CERNEI	național	60100,00
3	RETEZAT	național	38.047,00
4	PORTILE DE FIER	natural	115.655,80
5	CHEILE NEREI-BEUȘNIȚA	național	37.100,00
6	MUNȚII APUSENI	natural	75.784,00
7	MUNȚII RODNEI	național	46.399,00
8	BUCEGI	natural	32.663,00
9	CHEILE BICAZULUI-HĂȘMAȘ	național	6.575,00
10	CEAHLĂU	național	8.396,00
11	CĂLIMANI	național	24.041,00
12	COZIA	național	17.100,00
13	PIATRA CRAIULUI	național	14.800,00
14	GRĂDIȘTEA MUNCELULUI-CIOCLOVINA	natural	10.000,00
15	SEMENIC-CHEILE CARAȘULUI	național	36.664,80
16	MUNȚII MĂCINULUI	național	11.321,00
17	BALTA MICĂ A BRĂILEI	natural	17.529,00
18	VĂNĂTORI NEAMȚ	natural	3.018,00
19	LUNCA MUREȘULUI	natural	17.166,00
20	LUNCA JOASĂ A PRUTULUI INFERIOR	natural	8.247,00
21	COMANA	natural	24.963,00
22	GEOPARCUL DINOZAUROILOR ȚARA HAȚEGULUI	natural	102.392,00
23	MUNȚII MARAMUREȘULUI	natural	148.850,00
24	GEOPARCUL PLATOUL MEHEDIȚI	natural	106.000,00
25	PUTNA – VRANCEA	natural	38.204,00
26	BUILA – VĂNTURARIȚA	național	4.186,00
TOTAL			1.585.201,60

Our research falls in line with the preoccupations of the Ministry of Environment and Water Management to localize and trace the boundaries of protected natural areas in order to improve their management. The succession of research stages had to observe also the international conventions Romania is a party to and harmonize nature protection issues to profile developments mainly in Europe. Our aim was to work out a Cadastre of Protected Natural Areas as reference tool for the complex management of these areas. This task was partly attained by the following steps:

- the elaboration of the methodology outlining protected natural areas in terms of a unique corresponding system of codes assigned in the data-base;
- the creation of a standard descriptive geographical model of the boundaries of protected natural areas (parks and reserves);
- the opening of training sessions with county agency inspectors to familiarize them with the use of GPS equipment and the basics of GPS knowledge;
- the elaboration of a map on the scale of 1:25 000 for all the communes having protected natural areas on their territory. In this way the bounds of protected natural areas can be mapped out in conformity with the documentation received from county inspectorates, the Institute of Spelaeology, Romsilva Company, from other specialists, etc.

By means of GIS-based data processing using the above-mentioned methodology, a number of 772 protected natural areas were delimited and described (under Annex 1, Law No. 5/2000). The boundaries of the remaining areas (up to 827) could not be established either for lack of identification acts or the depreciation of the site (usually by human activity) or again for having been listed in the high-protection category (special areas within parks or the Danube Delta Biosphere Reserve).

In order to facilitate identification, the coordinates of the polygon center of each reserve, as well as its surface-area would be calculated and, in the event of a reserve having several bodies, calculations would include the coordinates of each body center so as to obtain greater location accuracy.

All the drafts of these reserves (STEREO 70 projection) were appended to each county, their electronic variant ([http://www.mmediu.ro/dep\\_mediu/biodiversitate.htm](http://www.mmediu.ro/dep_mediu/biodiversitate.htm)) being available now for the public at large.

Apart from the documentation received from County Environmental Protection Agencies, the elaboration of the Cadastre resorted also to the information and data published in various works or periodicals which in many cases (particularly of caves), completed existing information. Whenever necessary, the documentation received from county agencies was supplemented with aerophotogrammes and remote sensing pictures in order to assess boundaries or trace them more accurately.

A data-base of management and/or cadastral units for each protected area was worked out, with mention of the respective production units and forest ranges, also associating the data to GIS-related information levels.

The results thus obtained focus on some essential aspects such as:

- Concordance between the topographic survey and the methodology of tracing the geographical bounds on specific landforms (summit, hill, over thrust, watershed, etc.);
- Accurate presentation of the draft of topographic elements, with mention of synonyms and elimination of landmarks liable to generate confusion;
- Verification of forest management and/or cadastral units with protected areas.

Planimetric elements and the information on forest management and cadastral units were accepted in order to facilitate orientation and overall localization. The data were confronted with forest management lists provided by Romsilva Company.

The elaboration of this project was based on the following cartographic documents provided by the Ministry of Environment and Water Management and our partner institutions:

- Topographic maps on the scale of 1:5 000, 1:10 000, 1:25 000 and 1:50 000;
- Landsat 7 TM and Landsat 7P images;
- Forest maps on the scale of 1:20 000;
- Cadastral maps supplied by Environmental Protection Agencies;
- Geological maps, cave maps, etc.

Since the 1:50 000 topographic maps have few elements of detail and are not accurate enough to allow correct assessment of digitized areas, the solution was to start from the eight-color topographic maps on the scale of 1:25 000 issued over 1979 – 1982.

Analyzing the documentation and the respective data-base pointed out some particularities in the distribution of protected natural areas in Romania and of surfaces occupied or listed under Annex 1, Law No. 5/2000.

Protected natural areas in this country cover 232,188 hectares. Distribution is uneven and unbalanced in terms of territorial administrative units, big relief steps and representative ecosystems. Looking at the distribution at county level it appears that most protected areas (83) are in Alba County next in line standing Bihor (60), Caras-Severin (47) and Hunedoara (42), followed by a group of 13 counties with 36 – 21 reserves, and a similarly large group with 18 – 11 reserves. Another 10 counties register fewer than 10 reserves, while two counties (Ialomița and Teleorman) have none.

The spatial distribution shows that the counties situated in the west of Romania have more areas protected than those located in the east and south of the territory (Olt 6, Giurgiu 4, Brăila 2 and Călărași 1), whereas some counties have no protected areas of national importance at all.

In terms of the summated area of reserves by county, the situation looks altogether different. For example, if Tulcea County with its Danube Delta Biosphere Reserves is not taken into the equation, then Caraș Severin with its 32,100 hectares of protected natural areas ranks first. Next come Neamț (24,600 ha), Sibiu (18,700 ha), Argeș (17,000 ha), Mureș (14,100 ha) and Constanța (12,700 ha). There are 17 counties with small protected area (6,500 – 1,000 ha), 12 counties with between 1,000 and 100 hectares protected and three counties with under 100 hectares of protected areas. There are cases when, despite the great number of protected areas, their overall surface is pretty small, e.g. Alba County, which ranks first in terms of number of reserves, liss on position 25 in regard of overall area (782 ha) given that 32 of its protected areas have under one hectare each. In other counties, updating the documentation and digitizing the information revealed protected areas to be larger than reported in Law No. 5/2000. For example, boundary digitization of the 18 reserves in Vrancea County added 2,634 hectares to the previously reported 2,877, raising their surface to 5,511 hectares.

The protected area of the Vâlcea County reserves listed in the law with 614 hectares reached more than twice that figure (1,458 ha) after boundary processing. A similar situation has Brașov County (from 5,400 ha to 8,476 ha) and other counties, too. It follows that this approach has substantially enlarged protected natural areas by making a new delimitation and harmonizing the documentation received from the Environmental Protection Agencies, County Forest Direction, Local Bodies and Research Institutes.

In the big relief units – mountains, hills and plains, the highest proportion of protected areas (both in respect of number and surface) is found primarily in the mountainous region, next in hills and plateaus, and very little in the plains. A drawback in securing true protection and development for protected species, irrespective of territorial biodiversity is the fact that numerous protected areas (20% of the total) are very small (under one hectare), 244 cover between 1 – 10 hectares and only 155 are larger than 155 hectares. Creating buffer zones around these small areas would be a good idea. Looking at spatial distribution it appears that the southern and south-eastern parts of the Romanian Plain have few or no reserves at all (two counties).

There is little, if any, interest in biogeographically important zones such as the steppe and the sylvo-steppe known for their ecosystems of great scientific value, ecosystems in which the natural vegetation has been almost completely replaced by human action. Therefore, the duty of research is to identify and make proposals for the delimitation of areas representative for these types of ecosystem, while the Ministry of Environment has the task to protect them.

The Ministry's initiative to increase the number of protected natural areas and natural and national parks is welcome, indeed, moreover so as it is in these very areas that areal protection to representative ecosystems can be ensured by adequate management. As known, biodiversity is best maintained and developed in large enough spaces.

The exchange of data and information with the other groups of specialists involved in the Biodiversity Information Management System (BIMS) has largely been facilitated by the Ministry of Environment and Water Management with a view to bringing together the facilities held by each partner. The thematic workshops and the course in using GIS and remote sensing techniques to manage biodiversity information enabled the exchange of information with county-based Environmental Protection Agencies.

The various stages of the project provided basic information for the elaboration of a series of normative acts among which we would recall the following:

The Government Decision No. 230/2003 for the delimitation of the biosphere reserve, of national and natural parks and the setting up of their administration (Official Monitor No. 190/26.03.2003) contains GIS-produced color maps of protected areas (Fig. 1).

The Minister's Order No. 552/2003 approving inside zoning of natural and national parks for the conservation of biological diversity (Official Monitor No. 648/11.09.2003) contains black and white maps of inside zoning.

The Government Decision No. 2151/2004 institutes a protected natural area regime for new zones (Official Monitor No. 38/12.01.2005).

The Government Decision No. 1581/2005 institutes a protected natural area regime for new zones (Official Monitor No. 38/12.01.2005).

