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USING GIS FOR THE PROTECTED AREAS MANAGEMENT IN THE CONTEXT OF INSPIRE NATIONAL SPATIAL DATA FRAMEWORK AND THE ROMANIAN ACCESSION TO THE EUROPEAN UNION

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Key words: GIS, protected areas management, national spatial data infrastructure, INSPIRE.

Résumé: Les problèmes spécifiques avec lesquels se confrontent la gestion des aires protégées sont et doivent être liées aux opportunitées offertes par les infrastructures des informations spatiales conformes à la directive européenne inspire (infrastructure for spatial information in europe) dans laquelle l'utilisation des systèmes informationnels géographiques a un rôle très important. Inspire vient intégrer les infrastructures nationales de données spatiales déjà existantes, contribuere leurs à leur développement dans un cadre cohérent, fonctionnel, capable d'assister le développement et l'implémentation des politiques européennes, en général, et de celles concernant l'environnement, plus en particulier.

1. Spatial data infrastructures and G.I.S. for environmental governance in Europe

1.1. Spatial data infrastructures and information systems

Information and spatial analysis are two main necessities of the contemporary world. The governmental agencies, all the organizations and institutions involved in the environmental governance face the challenge of taking fast decisions as response to crisis situations, in an economical efficient manner, involving the integrated analysis and spatial modelling of geographical data.

The role of reliable, easy accessible information, organized in shared data bases, is recognized at a global level, in the decision making, policy making and implementation processes for different activity sectors. Due to this contemporary needs, in this purpose, there are created, permanently updated and improoved spatial data infrastructures, informational systems, spatial analysis methods at national, international and global level. The geographical information systems (known as GIS) play an increasing role in the decision making at different

governmental and private levels, by its facilities for data management and spatial analysis of the spatial information.

In the same time, the reliability of GIS analysis is strongly related to the availability, quality and compatibility of geographical data, whose acquisition often implies high costs for the data users. Some other times, the existent data available for analysis are redundant, hardly accessible, in incompatible formats, being produced and used by different institutions and organizations, which makes the data gathering, preparation and analysis time consuming and costly. In this respect, there is a high acknowledgement of the necessity and especially important role of data sharing means for an increasing efficiency of the data base creation and structuring, available facilities for the data use, linking the data users and producers or a higher quality of the decisional process.

National Spatial Data Infrastructures (NSDI) designate *a set of technologies, policies and institutional agreements facilitating the availability and access to spatial data, offering the framework for the exploration, evaluation and use of spatial data for information end-users and providers, for all the levels of governance, the commercial sector, private and non-profit, the academia and citizens in general.* (EEA Implementation Plan, *Building the EEA spatial data infrastructure,* may 2005).

NSDI offers the base or the relational structure between data providers and users, facilitating their sharing. The development of such a network involves: the creation of an electronic network linking the data users and providers by internet, the development of appropriate standards for the data documentation, collection and exchange (between different hardware platforms and using different software) and the development of policies, procedures and partnerships for the creation of a national geospatial electronic data framework.

The GSDI Association sets **six main steps** needed **for a spatial information infrastructure** to work: the creation of the data base for multiple users, the spatial data description (metadata), data accesibilization, the development of on-line mapping services, facilitating the open access to data and services.

NSDI links different data bases, sets the structural framework for their organization on the same criteria, using standard formats, facilitating their interoperability, the exchange of quality, reliable information between different users.

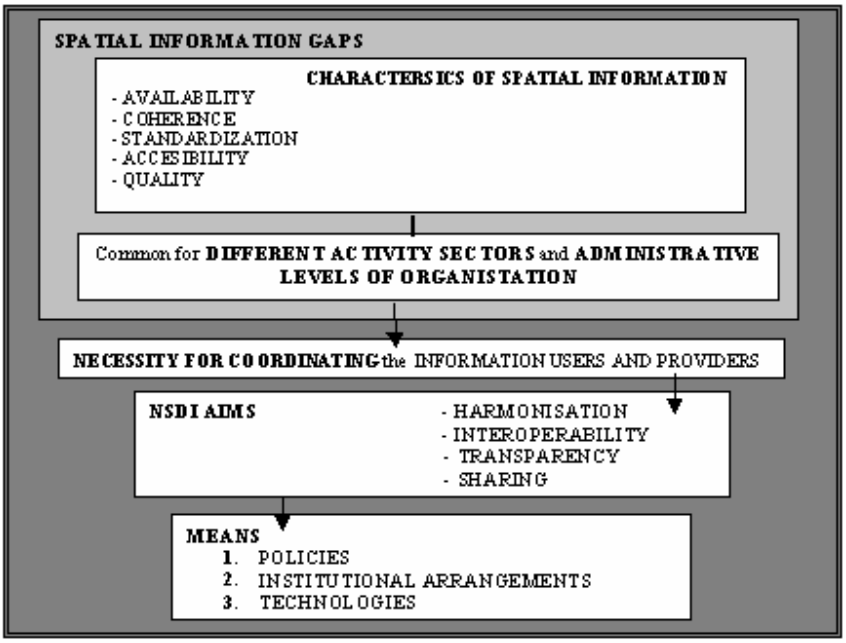

Fig. 1 - Correlating the necessities with objectives related to spatial information in a NSDI

By their capacities, the geographical information systems (GIS) have a multiple role: contributing to the spatial data bases formation, data manipulation, visualization and management and offering the spatial analysis capabilities.

For the systemic approach of the environmental and sustainable development problems and for a supplementary, interestingly clarifying vision upon difficult quantifiable phenomenon, the new informational technologies and the geographical information systems have become and presently represent indispensable tools.

1.2. The European context of spatial data infrastructure for environmental decision

The strategic role of geographical information in the European policy making with significant spatial implications (agriculture, regional policy, transports, environmental protection) represents a permanent concern for numerous governmental and non-governmental organizations at global and European level (GSDI[7], GINIE[8], EUROGI[9]) supporting the large scale use of GIS, promoting the research in this filed, monitoring the impact of such technologies.

[7] Global Spatial Data Infrastructure
[8] Geographical Information Network in Europe

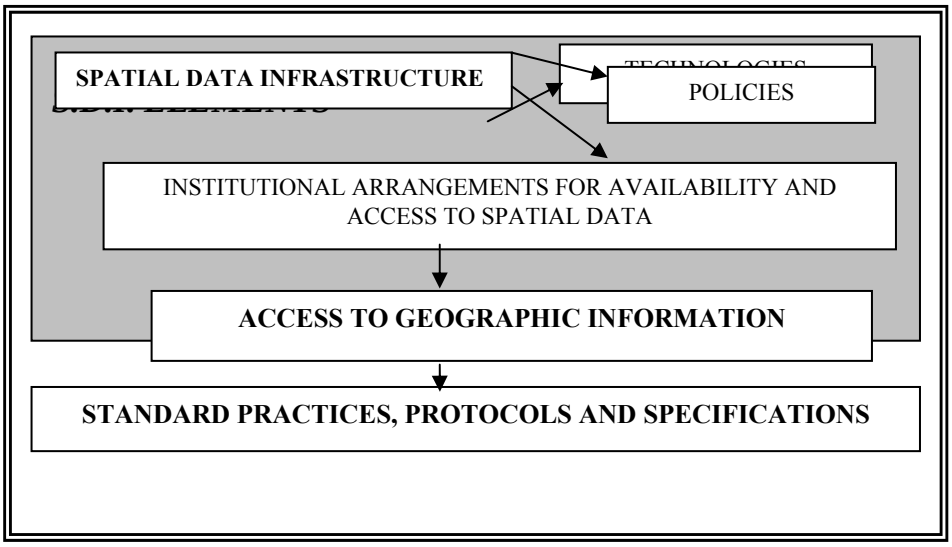

Fig. 2 - The structure of a Spatial Data Infrastructure (S.D.I.) and its connections with the geographical information

Many of them are affiliated ore have strong connections with the European Environmental Agency (EEA) which supports the development of its own spatial data infrastructure or information network for the environment (EUNIS[10], EIONET[11]). One of the most important objectives of the European Community is to reach a high level of environmental quality, answering to diversity of problems and specific situations determined by the natural and socio-economical diversity, the diversity of administrative structures and environmental governance types etc. Several programmes and projects at national or Community level are meant to ensure the best monitoring and data collection technologies, data analysis methods and information systems, in different parts of Europe, having specific objectives and results aiming for the same general objective: environmental quality.

The present challenge of policy making and implementing for an increasing number of European states with different specific problems and unequally developed spatial data infrastructures is the need for appropriate information from diverse, sometimes unrelated sources and authorities. There are some specific spatial information related problems faced by the decision makers: the availability, quality, organization, accessibility, and sharing influencing the efficiency of decisions. These are common to a large policy and information

[9] European umbrella organisation for Geographical Information
[10] European Nature Information System
[11] European Environment Information and Observation Network

themes and are experienced across the various levels of public authority. Regarding the spatial information, there are initiatives taken to collect, harmonize or organize the dissemination or use of spatial information. Taking into account these aspects, there is a high need for maintaining the coherence between various existing and future data sources and information initiatives at Community level, for establishing a data policy and operational framework for both the users and the providers of information.

As response to these problems, the sixth Environmental Action Programme sets the development of a spatial data infrastructure for the European Union, of an operational platform for the exchange, modeling and analysis of georeferenced data as one of the main objectives, whose achievement will be related to the INSPIRE (Infrastructure for Spatial Information in Europe) directive and the European GMES (Global Monitoring for Environment and Security) initiative. The INSPIRE initiative brings some coherence for the EU environmental policies and the related activity sectors, facilitates the decisional transparency and the public access to information, being correlated with the global initiatives level, as formulated in the 40th chapter ("Information for decision making") of the Local Agenda 21, at the Rio de Janeiro Earth Summit. The INSPIRE Directive complements the existing initiatives at the Community level concerning spatial information for the environmental sector, such as the implementation of the EPER (European pollutant emission register), the Forest focus (the monitoring of forests and environmental interactions), established by Councils legislation or programmes funded by the Commission (CORINE, European Transport Policy Information System) and ensure their interoperability.

INSPIRE has it coherence ensured at the European level by its strong connections with other related European and global initiatives, such as: GALILEO (the European satellite navigation system) and GMES (Global Monitoring for Environment and Security), completing them and making them interoperable and has the support and assistance of the European Environmental Agency (and its information and observation network: EIONET) and the GSDI Association (Global Spatial Data Infrastructure).

INSPIRE is also linked to the Directives of the European Parliament and of the Council 2003/4/EC on the public access to environmental information and Directive 2003/98/EC on the re-use of public sector information by their complementary objectives regarding the efficient public data use, the transparency in decision making and the free access to public information.

The INSPIRE Directive of the European Parliament and Council number 2007/2/EC establishing an Infrastructure for Spatial Information in the European Community has been adopted and is now into force. It sets some general rules for the creation of the spatial data infrastructure in Europe using the already existing

national spatial data infrastructures and databases, especially those held by or on behalf of public authorities, across the different levels of government, in electronical format, containing data classified into 21 thematical areas. There are necessary specifical provisions for the main operational components of the infrastructure: metadata, interoperability of spatial data sets and services, network services and data-sharing.

The member states have to take the necessary measures in order to adopt legislative measures for the reinforcement of the INSPIRE Directive in the national legislation, take all the technical and non-technical measures needed to create or adapt their own structures and mechanisms in order to coordinate the implementation of the Directive's provisions and make the infrastructure functional for the local, national and European levels. This means that the multitude of interactions between different institutions producing or using different kinds of spatial data sets as parts of more or less structured, transparent and open to public national spatial data infrastructure has to be coordinated. The aim is to identify the appropriate data, create metadata, identify the user needs and satisfy them by ensuring the interoperability, creating and operating network services and ensuring that these are partially available for public free of charge.

The network services offered by the INSPIRE initiative allow the responsible factors in the public sector to search for spatial data sets (by multiple searching criteria which shall be available) on the basis of metadata (discovery services), visualize and manipulate the data (view services), totally or partially download it (download services), transform it in order to make it interoperable (transformation services) and invoke it.

The INSPIRE directive implementation in Romania is coordinated by an inter-ministerial working group (gathering most of the ministries, national agencies and experts from research institutes) coordinated by the Romanian Space Agency and responsible for the preparation of its implementation. The inter-ministerial group organized information sessions in order to raise the awareness of the stakeholders, prepared and discussed short and midterm action plans in order to attract best experts and involve the decision and policy makers and supported the creation of projects meant to support its activity: INSPAM, LUCIUS, TITOS, GEOINT. The group shared the specific responsibilities for the implementation of INSPIRE in Romania, defining some subgroups responsible for creating the metadata, defining specifications and geospatial data models, the architecture for communication and services, setting rools for the data and services sharing, the coordination of the implementation, the monitoring and the report of the progresses being ensured by the Romanian Space Agency.

As a new member state, Romania will have to adopt the Directive and respect the timetable set for the Directive Annexes. This involves financial and

institutional efforts but will increase the ability of building partnerships in the environmental field, stimulate and facilitate research and raise public awareness and transparency for decision making process.

The directive establishes timetables for the compliance of the spatial data themes with the needed requirements (concerning creation of metadata and ensuring the interoperability of data and services), terms for the adoption of the directive by specific laws and for reporting the progresses.

The spatial data themes preparation represents a challenge and an opportunity for Romania, setting the basis of a functional informational system with great benefits for the environmental field and related sectors. The main of the 21 spatial data themes are: coordinate reference systems and geographical grid systems, geographical names, administrative units, addresses, cadastral parcels, transport networks, hydrography and protected sites (according to Annex I) elevation, land cover, orthoimagery, geology (Annex II) and buildings, soil, land use, environmental monitoring facilities, production, industrial and agriculture facilities, population distribution and demography, natural risk zones, habitats and biotopes, species distribution etc (Annex III).

The emergency governmental ordinance No. 95/2005 abrogating the environmental protection law already defines the national spatial data infrastructure and sets the identification and establishment of the environmental spatial information infrastructure for policy making as one of the main attributions of the national central public authority responsible for the environmental management.

2. Protected areas management and the need for spatial data

The policy related to protected areas is part of the European biodiversity policy, one of the major components of the environmental policies, as emphasized in the 6th Environmental Action Programme, its four thematic areas being: climatic changes, the loss of biodiversity and its spatial modifications analysis, the quality of human life and the management of natural resources and waste.

A protected area represents a terrestrial or marine area dedicated to the conservation and protection of the biological diversity, of natural and cultural associated resources, having a management based on legal instruments and some other effective means.

Considering the management objectives and the maximum degree of human intervention allowed for a certain protected area, there is a generally accepted classification system elaborated by the I.U.C.N. (The International Union for Nature Conservation) and adopted by countries worldwide, covering a large spectrum of minimal to extensive use of habitats for the human communities, including: scientific reserves (strict nature reserves), national parks, natural monuments (natural landmarks), managed nature reserves, protected landscapes,

resource reserves, natural biotic areas/anthropological reserves and multiple management areas.

Natural protected areas represent complex, dynamic systems, including valuable and fragile natural elements, as species of flora and fauna, ecosystems of special interest by their uniqueness, whose existence or viability is threatened by natural or human factors, one or more geological, paleontological, geomorphologic elements, land forms of ecologic, scientific, educational or recreational interest, with an intrinsic value or representing habitats for some valuable species, human settlements, with a unique value for their cultural significance, where the traditional relation between nature and society created landscapes with a high esthetic value and the maintenance of these traditional relations is vital for the preservation of these areas.

Such areas usually associate the great level of biodiversity, having a great ecological and esthetic value with human communities practicing traditional activities, keeping traditional values alive, due sometimes to their relative isolation and economically subsistent rural character.

The necessity of integrating the sustainable conservation objectives with the socio-economical ones without prejudices and with added benefits to the local communities, determines the necessity for complex management objectives, especially for the natural and national parks where the support for the development of local communities by tourism and traditional economical activities is part of their specific. Each natural protected site has its specific needs, the management representing a great challenge and responsibility involving cooperation between different stakeholders and decision factors, from governmental agencies to civil society or private sector for the assessment of all the aspects characterizing the present situation, the threats to the conservation objectives and anticipating the evolution of the current situation for an appropriate planning. The generally accepted management tool is the management plan. On its basis, the managers have to accomplish one of the most challenging responsibilities of balancing the internal and external pressures generated by the society.

Considering these aspects, the integration of remote sensing, GPS and GIS technologies for the achievement of different management objectives could raise the efficiency in a sustainable way.

The use of spatial information within geographical information systems represents an opportunity for some major applications: the assessment of the biotic and a biotic resources of the natural protected areas, the human impact assessment in the protected areas and their proximity, the conservation status assessment for habitats and species of special interest, planning and implementing the management measures, the specific programmes (as territorial planning for tourism), their monitoring and revision etc. The sometimes wide areas covered by

national and natural parks, the variation of its geographical features, having a sometimes restrictive role (as the limited accessibility of some areas) represent weaknesses in the management process, where GIS by offering the opportunity for correlating the multiple spatial analysis tools with the field data and the integration of data from different sources and sometimes held in different formats could minimize the efforts and bring the needed accuracy.

One of the most challenging objectives is the touristic planning subprograms, successfully supported by the GIS means for determining complex indicators as the terrain suitability and the carrying capacity.

Considering the complexity of habitats and ecosystems, the specific interactive relations between different ecological and human society related components, informational systems for the biodiversity management have to gather in a structured, organized, compatible functional way as much relevant information as possible.

In order to manage the interactions with the socio-economical system in a sustainable way, a national reserve administration has to set the management objectives thinking in a global way and acting local. This integrating view needed in order to apply the sustainability principles has to be reflected in the informational data base and system created for management, its reliability being one of the indicators for the management capacity.

A database for **the biodiversity assessment** in the nature protected areas has to comprise information allowing: the geographical and ecological characterization of plant and animal species, the characterization of stationary conditions for each interest specie, the classification and the analysis of the species conservation status and the identification of listed species (in protection lists as the Red List), the classification of species by their biogeographically native area, the analysis of species distribution by different criteria.

Considering the need for **geographical landscape analysis**, especially for natural and national parks and biosphere reserves, having as targeted output the thematical maps (geological, geomorphologic, soils and vegetation maps), the role of GIS and remote sensing technologies is both to facilitate the separate analysis of landscape components for the inventory and assessment of the natural landscape resources and to find and describe the features of the landscape as a complex entity.

The system designated to assist the achievement of general and specific sustainable management objectives has to include accurate, compatible sets of spatial data generally related to: the geographical position and the limits of the natural reserve, the natural capital (geological, geomorphologic, climatic, hydrological components). It also needs to include data concerning: the number of natural reserves (for natural and national parks), socio-economical data (the human

settlements network, demography, economy), land cover and land use, communication network, the repartition of administrative units. The basis of such analysis is the digital terrain model (DTM), describing the elevation variation and offering valuable parameters as slope, aspect, shade and representing one of the characteristic primary outputs of GIS.

The identification of the main environmental impact sources, their correlation with the up to date and historical information concerning the natural and socio-economical system allow the analysis of **the human intervention degree upon the environment** for natural protected areas and the elaboration of appropriate measures for its mitigation and stimulation of those activities with a minimum negative impact.

The need for such a great variety of thematic spatial data for the protected areas management at local, regional, national or international level links the management, as part of the natural heritage and biodiversity policy implementation to the policies and initiatives of creating spatial data infrastructures.

Another linking aspect is the need for data exchange and sharing between different decision factors for policy implementation and decision making. The European integration involves some changes in the governance mode, some changes in the reports between different levels of governance. In this case, to a certain extent, the role of national level in policy making is no more direct and decisive, being subordinated to the European Commission. The national policy became a transposition of the European one, which tries to answer to as many particular aspects as possible. The implementation of policies involves, on the other hand, a supplementary level for coordination: the communitarian, European one. In all this complex relations, the main aspect regarding the spatial information is the intrinsic need for data exchange, sharing and transfer, the need for finding a "common language" and common means of communication for coherence.

3. New challenges and opportunities for the future of natural protected areas in Romania

3.1. The European policy for biodiversity – a new approach for Romania

As a consequence of its geographical position and relief which determines a large variety of ecological conditions, the Romanian territory is characterized by a great bio-geographical diversity, with a great number of ecosystems and species of great scientific interest at national and European level.

The natural and semi natural ecosystems represent approximately 47% of the national territory (The National Strategy for the Biodiversity Conservation, 2000). The CORINE Biotopes Programme has identified 783 habitats listed in the European Birds and Habitats Directives (EEC 79/409 and EEC 92/43) annexes, adopted in the national regulation framework by the emergency governmental

ordinance no. 57/2007 for the regime of natural protected areas, the conservation of natural habitats ,wild flora and fauna.

The Romanian accession to the European Union meant implementing the European legislation, formulating and implementing environmental action plans for different levels and taking part in the European environmental projects. The implementation of the EU directives for the conservation of the national biodiversity faced different kinds of problems: financial, technical, conceptual, human resources relate difficulties.

At the very begging, the main problem was related to the lack of a unique classification system for the natural habitats. The different systems existing in agriculture, forestry, ecology were partially overlapping but still didn't cover the entire national territory. The list of designated areas were still the same with the one established by the former Law for the Environmental Protection in Romania (Legea mediului, nr.91/1973), almost unchanged considering its content and methodology for the natural protected areas designation, using codes which were not compatible with the ones established by the national Law 426/2001 for the natural protected areas regime, the conservation of natural habitats, flora and wild fauna, lacking a description of each designated site and thus making impossible a correlation with other classification systems used in Romania. (PHARE RO 9907-02-01B – Studii privind impactul preaderarii, Studiul nr.B7: *Impactul implementarii directivelor habitate si pasari*, Raport final, septembrie 2002).

The implementation of two projects establishing the framework for the classification of the habitats in Romania: the *Biotopes* component of CORINE (Coordination of Information on the Environment) programme and *The Vegetation Map of Romania* came to bring all the national and international classification systems used in Romania to a common point and establish a framework for the implementation of the European Directives concerning the biodiversity (The Habitats and Birds Directives).

In order to fulfil its objectives related to the protection and conservation of habitats, the Habitats Directives initiated the creation of an ecological network named *Natura 2000*, integrating the special conservation areas, established by the Birds and Habitats Directives for the maintenance or reestablishment of an appropriate conservation status for the species and habitats representative for the European bio-geographical regions. The implementation of the European biodiversity policy required a complete inventory at a national scale for the species and habitats listed in the Birds and Habitats Directives annexes and a comprehensive assessment for the designation and integration of the natural protected areas in the Natura 2000 European network. In this respect, none of the projects for the Romanian territory offered sufficiently accurate information. In this situation, the EMERALD Network project, developed in 2000, identified and

characterized the natural habitats and some wild species of the Romanian territory. The most important result of this pilot project was the elaboration of the *List of designation sites with European equivalent for the nature conservation in Romania*, representing a "common sense" for the classification of the natural protected areas in Romania.

In all these projects realized during the pre-accession period and the present ones the use of GIS and remote sensing technologies in order to obtain accurate information and update the existing data offered an integrant support, proving the need for extensive use of spatial data. The international projects developed the capacity and contributed to the development of an infrastructure for the specific spatial information required, opening the ways to the integration in the European structures.

On the way to integration, some of the main objectives have already been accomplished at governmental level: the adoption of the European legislation, the creation of the major institutional framework, the global assessment of biodiversity, the establishment of the national protected areas network and the implementation of the Natura 2000 ecological network in Romania.

The present Romanian network of protected areas includes: 3 biosphere reserves, 13 national parks, 13 natural parks, 55 scientific reserves, 234 natural monuments and 648 natural reserves. All the parks and biosphere reserves have their own administrations, designated on contractual basis according to the national laws and their management plans are on the way of being approved by the Commission for the Protection of Nature Monuments of the Romanian Academy. The responsibility for the natural parks and reserves is shared between the national forestry authority, public authorities (as county councils), universities and non-governmental organizations. The Natura 2000 network in Romania includes 108 Special Protection Areas and 273 protected Sites of Communitarian Importance, including habitats and species characteristic for the five bio-geographical regions on the national territory.

While at governmental level the projects realized by the national authorities contributed to the national policy and decision making, establishing the nature protected areas network and its administrative framework, formulating action plans for their management, at the local level, the accomplishment of specific management objectives for each protected area, especially for the biosphere reserves, the natural and national parks need more detailed and comprehensive data bases. This involves gathering specific data from different sources, in different formats (usually in an analogical format) transforming them and setting the same spatial framework, establishing a flexible and updatable structure of the data base and the appropriate data format, completing the spatial and attribute data base in order to prepare the data for analysis.

These tasks represent a challenge for the administrations of nature reserves, in the context of the lack of qualified human resources, financial resources and the present level of national spatial data infrastructure development.

GIS offers the opportunity of an integrated approach of the entire problem complex, when being assisted by a complete, coherent, updatable database, allowing the data sharing and exchange with the other authorities responsible for their management (as the National Forest Department, Forest Research and Management Institute, national, regional and local environmental authorities, public administrations, universities and research institutes, as the Danube Delta National Institute for Research and Development for Romania).

The existent local initiatives of developing geographical information systems for the management of protected areas could be considered rather incoherent, being encouraged by local factors as the access to data and financial resources, the capacity of the natural reserves administrations of creating projects in order to get the financial and technical support by accessing European or national funds offered by the existent programmes: LIFE Nature, the Global Environment Facility (GEF), the World Wild Fund for Nature (WWF), United Nations Environment Programme (UNEP), The National Administration for Environment Funds (AFM), etc.

Some of the geographical information systems for the protected areas management where developed during the elaboration of the management plans, in the framework of the pilot project: The Biodiversity Conservation Management Project, with the support of the GEF, in 2001, when there were elaborated the management plans for the Vânători Natural Park, Piatra Craiului and Retezat National Parks and a guiding manual for the elaboration of management plans for protected areas in Romania. The information systems offered the administrations the means for the preliminary assessment necessary in order to formulate and further accomplish the management objectives. Such projects offer the base for developing projects related to more specific objectives as the conservation management of habitats and species, one of the examples in this respect being the Conservation management of alpine habitats as a Natura 2000 site inside Retezat National Park project, developed by the national park administration with the support of the European Commission by the LIFE Nature Project.

As response to specific necessities, most of the national and natural parks developed information systems with their own means, by their own vision (as Calimani Natural Park) or in cooperation with universities, encouraging research projects (Apuseni Natural Park – Land planning in Apuseni Natural Park), or research institutes. The increasing interest for the management of the nature protected areas in reflected by the increasing number of research works and study cases supporting the management.

Some of the most important projects in this sense, funded by the Life Nature Programme in Romania are: The integrated management plan for Insula Mica a Brailei Natural Park (1999), The consolidation of Piatra Craiului National Park (1999), Habitats conservation in Bucegi Natural Park (1999), Portile de Fier Natural Park – the conservation of habitats and management (2000), Natura 2000 sites in Piatra Craiului National Park (2003), Conservation management of alpine habitats as a Natura 2000 site inside Retezat National Park (2005).

Without any intention of making an exhaustive list of the multiple projects realised for the nature reserves management, the given examples support the idea of the obvious necessity of using spatial information in this field and the significant progresses made at national and local level in order to implement this means for the accomplishment of the general objectives of the biodiversity conservation policy in a sustainable way.

The Natura 2000 project in Romania could be considered one of the most coherent initiatives of using spatial information for biodiversity, considering its national scale and its output. The existence of the Natura 2000 portal enabling the public access to specific spatial information related to the Natura 2000 sites and the national protected areas represents not only a tool for decision makers but also a way to the dissemination of public environmental related information, as an objective of the communitarian policy stated by the specific directives and national laws.

3.2. The INSPIRE framework: necessity, challenge, and opportunity

The INSPIRE Directive offers the flexible, trans-scalar, continental coherent framework for different policies where spatial information is needed. The main advantage of implementing INSPIRE in Romania related to the management of protected areas is the opportunity of bringing the information together, establishing common standards and facilities for exchange and sharing which will enable the decision factors to accomplish their responsibilities in a sustainable way.

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