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Supporting Regional Nature Park Management in Russia

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Abstract. *This paper describes the preliminary results of a research which aims to assess the possibilities for GIS as a supporting tool to improve regional nature park management in Russia. The paper presents a case study concerning the application of GIS in the land use planning of the Nature Park Eltonsky, located in a rural landscape. The results show that GIS-techniques can support nature park management, especially with multiple land use planning within the park area.*

Keywords. GIS-based support, Land-Use Planning, Nature Park, Protected Area, Russia

1. Introduction

Nature parks are protected areas (PAs) designed for the protection of natural and cultural landscapes, recreation and tourism development, sustainable land use and environmental education. This concept of multi-purpose protection is commonly used in conservancy practice nowadays. Regional nature parks and similar PA categories play an important role in conservation at landscape/seascape level in many countries, for example Germany (Naturparken), France (Parcs Naturel Regionaux), The Netherlands (Nationale Landschappen) and Canada (Provincial/Territorial Parks) (see e.g. Phillips, 2002; Bishop et al, 2004; Dudley, 2008). However for Russia it is a relatively new category of protected areas, which has only recently been implemented, after the reform of land-use and environmental laws and the reorganization of the federal authorities engaged with environmental management (Shestakov, 2003). The introduction of nature parks in Russia has considerably stretched the opportunities of provinces to protect and use important landscapes in a more sustainable way. The procedure of establishing nature parks is much simpler compared to national parks. Since 2000, more than 50 regional nature parks have been established, totaling 16,000 km^2 or 1.5% of the country, which is twice the area of Russian national parks (Kalioujnaia, 2007).

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However, the multifunctional use of nature parks and the numbers of stakeholders involved cause severe management problems, concerning the strategic and operational planning of the park area. Local authorities and park managers have a general lack of data and information to support decision-making processes.

This paper describes the preliminary results of a research which aims to explore the possibilities for GIS-based tools to support the nature park management in Russia, and presents a case study for the nature park Eltonsky, in the Volgograd Province, Russia. The research has been carried out in the framework of several conservation and scientific projects. Section 2 presents some basic information on nature park management in Russia. The structure and contents of a general geo-database for nature park management is described in section 3, and its application in the Eltonsky nature park in section 4. The results are discussed in section 5.

2. Nature park management in Russia

Nature parks are classified as IUCN Category V Protected Areas. These are defined as protected landscapes or seascapes "… where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic values; and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values" (Dudley, 2008). It means that the management of nature parks aims to find ways for harmonious interaction between nature and culture by implementing sustainable land use practices, and by involving stakeholders to co-manage and enhance the integration into the socio-economic life of regions (e.g. Eagles et al., 2002; Phillips, 2002; Bishop et al., 2004; Dudley, 2008).

A review of data and literature on Russian protected areas in general and nature parks in particular shows that there are a number of problems hampering the effective management and development of these areas (e.g. Shestakov, 2003; Kalioujnaia, 2007). The majority of problems concern the strategic and operational land use planning by park managers and local authorities, as well as dealing with the functional zoning and multiple land uses within the park area. Despite some successful experiences with nature park management, for example in Kamchatka, Altai and Volgograd, the actual decision making on land use developments and environmental protection depend mainly on the political agenda of regional authorities, while the priorities stated in strategic documents and park management plans are hardly taken into consideration. The concept of multiple land uses in nature parks is used very flexible, resulting in areas where even the most valuable natural areas are multifunctional used, only protected by functional zoning and management regimes. On the one hand this facilitates the easy establishment of these areas; on the other hand it neglects potential conflicting interests of stakeholders as well as environmental conflicts. Most of these conflicts reveal themselves only after the establishment of the park. The authorities and park management are usually lacking supporting information and tools for more well-founded decision making. They are also unaware how environmental research and monitoring, including the use of geo-databases, may contribute to a more sustainable park management and decision-making, especially in the complex context of multiple land uses and stakeholders. The gap in the information support of nature park management includes:

- A lack of unified standards of data collecting, storage, processing and presentation, a shortage of relevant data, and heterogenic or conflicting data caused by the large number of authorities and stakeholders involved.
- A lack of reliable statistic data, especially regarding the present land use, often caused by conflicting interest of the different authorities.
- A lack of up-to-date large-scale maps of protected areas, in particular land-use maps.
- A lack of specific guidelines to develop area-based objectives and measures for nature park management.

The lack of supporting data and information hampers a more integrated and area-based park management. In 1999, the Regional Center on Biodiversity Study and Conservation, a NGO in Volgograd province, took the initiative to improve the large-scale regional nature conservation development, which resulted in the establishment of 7 nature parks in the province. Several research and conservation projects were started, under the framework of Russian-Dutch cooperation on nature conservation and water management. The largest of these projects was the PIN-MATRA Project (2003-2005) with the aim to strengthen the cooperation between organizations involved in sustainable use of natural resources, such as NGOs, regional and local authorities, nature park administrations, and research institutes. One of the objectives was to support the exchange of data and information, relevant for the nature park management. The activities in the project included field surveys, workshops with authorities and stakeholders, collecting and processing data, and the development of educational materials. A personal Grant of the Academic Council of Faculty of Geography of Moscow State University for young researchers (2004-2006) allowed stretching the research to reveal the relationship between landscape and land use, identifying the land use changes in time and the effect to natural and cultural heritage.

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One of the results of the PIN-MATRA project was a general list of relevant data for nature park management, which will be described in the next section. The list of data allowed constructing a geo-database for the Eltonsky case study area and producing maps to support decision making processes, as will be described in Section 4.

3. Geo-information support of protected areas management

Geo-information systems are widely used in daily practice of nature park management in many countries, for example in inventories and cadastral mapping of nature resources and biodiversity, studying long-term dynamics of ecosystems, optimizing PA's zoning and land use regimes, assessing recreational loads, and working out nature protection and restoration measures (e.g. Boteva et all, 2004; Litwin & Guzik, 2004; Pedersen et al., 2004; Boers & Cottrell, 2007; Geneletti & van Duren, 2008). GIS has only been introduced recently in Russian PA's management. At present, less than a half of the state nature reserves and national parks are using GIS in daily practice, and only few nature parks (Alexeenko & Drozdov, 2006; Solntsev et al, 2006). Consequently, only a part of required data exists in numerical form. Spatial data of varying format and quality can be obtained from different sources, such as maps, remote sensing, statistics, field surveys, and literature. Alexeenko & Drozdov (2006) proposed to evaluate the different spatial data required for land use purposes by the following indicators: source, presence of geo-reference, distribution character, frequency of receiving, technical type and availability. According to Alexeenko & Drozdov, the most reliable and credible data sources in Russia are maps, topographical (terrain) maps, land tenure and forest inventories, as well as field data and aerial and satellite images.

A literature review of Russian and European experiences in protected areas management (e.g. Hockings et al., 2000; Eagles et al., 2002; Phillips, 2002; Bishop et al., 2004; Brockington et al., 2008; Dudley, 2008) and GIS-based tools in nature conservation and land use planning practice (e.g. Boteva et al., 2004; Litwin & Guzik, 2004; Alexeenko & Drozdov, 2006; Solntsev et al., 2006; Vorobyova et al., 2007; Geneletti & van Duren, 2008) allowed constructing a list of data relevant to nature park management. The basic assumptions for the geo-database development were: (1) to contribute to the design and operational decisions, the input data should comprehensively describe the park area and human activities within the park area; and (2) the information should not be redundant, but address the park objectives and specific management problems (Vorobyova et al., 2006; Dudley, 2008). Table 1 presents the list of data and sources, divided in nine thematic groups.

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Table 1. Information essential for nature park management.

Thematic group	Data	Sources
1. Environmental and socio-economic features	Land cover, biological and landscape diversity (e.g. rare species and their habitats), forest survey, location and state of preservation of valuable natural and cultural objects, sensitivity and capacity of the areas etc	Thematic mapping, satellite images, inventory research and environmental monitoring reports, scientific literature
2. Cadastre information	Characteristics of the different objects and constriction, including the borders, location, geo-references, land tenure and ownership, etc	Cadastres registries, digital topographic maps, government reports
3. Recreation and tourism, environmental education	Characteristics of the recreation areas and facilities, figures of visitor analysis, quantity and quality of service provided, visitors demands etc	Registration of visitors, park statistics, marketing services, statistics from stakeholders involved
4. Protection and control	Types of offenses, their spatial and temporal distribution, protection and restoration measures implemented and their results etc	Reports and control charts of the ranger staff
5. Land use and other human activities	Land use types, structure, allocation and relationships with landscapes, rotations, impact zones, dynamics, data on current and potential stakeholders involved, figures of stakeholders analysis etc	Satellite images, maps, official statistics, statistics from stakeholders and authorities
6. Legal base	Objectives, measures, regimes, limits and standards for land use and other types of human activities within the park area	Legal and other official documents and reports (internal and external), cadastre registries, reports
7. Administrative and financial issues	Personnel, figures and charts on current financial and economic activities, investments and expenses, etc	Park and authorities statistics
8. Other attributive information	Lists of valuable natural and cultural objects: typical, unique and endangered habitats; unique a-biotic objects; protected plant and animal species (endemic, rare and endangered, listed in Red Lists and covered by international conventions and agreements); species of high economic and social value; valuable objects of historical and cultural heritage, etc	Databases, Internet, scientific reports, government reports
9. Biblio-references	Available literature describing the park area, park reports and publications	Libraries, biblio-databases, research institutes, etc

The thematic groups 1 and 2 address the park management objectives and include the background information for the planning and management process - the natural, social and economic parameters of the area; the groups 3 to 5 include the data reflecting the planning decisions and supporting the implementation and monitoring of the framed measures; the groups 6 and 7 provide the data on legal, administrative and financial management issues; the groups 8 and 9 involve additional supporting information, necessary for nature conservation and land use planning.

Based on Table 1 a general geo-database structure was proposed, which consists of three thematic groups of maps and layers (see Table 2): basic maps; traditional thematic maps and layers; and special thematic maps and layers. The special thematic maps are divided into four sub-groups: biodiversity, land use, state of the environment, and management. The composition and content of the proposed database needs to be adapted to the specific park objectives and the needs of the park managers, the specific features of the park area, as well as the availability of the information from several sources. The selected maps of the Eltonsky case study are underlined (see also Section 4).

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Table 2. General structure of a geo-database for the nature park management.

Basic maps & layers	Traditional thematic maps & layers	Specific thematic maps & layers			
		Biodiversity	Land use	State of the environment	Management
Administrative units & borders*	Elevation	Digital elevation model (DEM)	Modern land use	Anthropogenic changes of landscapes & habitats	Recommended land use / Development plan
Topographies	Geology	Landscapes	Land use in time	Ecological conditions map	Functional zoning
Hydrographic system	Geomorpho-logy	Sensitivity of the areas	Protected natural & cultural areas & objects	Risk areas	Zones & routs of protection for ranger staff
Settlements	Pedological (Soil)	Wetlands	Recreation & tourism infrastructure		Environmental monitoring network
Transport infrastructure	Vegetation	Habitats of key plant and animal species, including: rare & endangered species; endemic species; commercially valuable species			
Data points: soils, vegetation, landscape, land use	Forest surveying				
	Land tenure				
	Population				

* Maps and layers created for the Eltonsky case study are underlined.

4. The Eltonsky case study

This section describes the development of a geo-database to support the management of the Nature Park Eltonsky, Volgograd Province, Russia (see Figure 1). The area is located in the rural environment, rather far away from the main cities. In 1970-1980 the area suffered under intensive agricultural development. Since 1990 the situation has been significantly improved. The environmental impact has been gradually decreasing due to the crisis of the agricultural industry. At the same time, the interest for recreation development and biodiversity conservation issues grew, resulting in the establishment of the nature park in 2001, with a total area of 1060 km^2. The area was selected for:

- The high importance of the area to maintain the regional, national and global biodiversity. The park area hosts the largest salt lake in Europe, Lake Elton, a unique natural object with surrounding saline landscapes and large areas of well-preserved (quasinative) desert-steppe landscapes. The area is located at bio-geographic borders and along global migratory routs, with a high biological and landscape diversity and abundance of rare and endangered species (37 plant and 69 animal Red List species, and over 60 species protected by international conventions, such as CITES, Bonn and Bern conventions). The area is extremely important for the protection of

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birds (245 species, 48% of the European bird diversity) and declared as the Globally Important Bird Area.

- The need for land use changes and communication process development. Despite the significant environmental importance, a part of the area is characterized by complex ecological and socio-economic problems, caused by unsustainable forms of land use which occurred in 1970-1980s, such as the plowing of marginal lands and overgrazing. The declaration of the area as a nature park asks for a proper balancing of the nature conservation objectives and the land use developments within the park and adjacent areas in compliance with the interests of stakeholders involved.
- The park management has a general lack of representative data on natural, land use, socio-economic and management characteristics. Although most of these data are available, it required cooperation with the scientific and conservancy institutes and regional authorities, literature review and workshops with representatives of stakeholders and additional field surveys to retrieve all the necessary data.
- The administrative and financial support from several scientific and conservancy projects allowed the additional field surveys, data collection and processing.

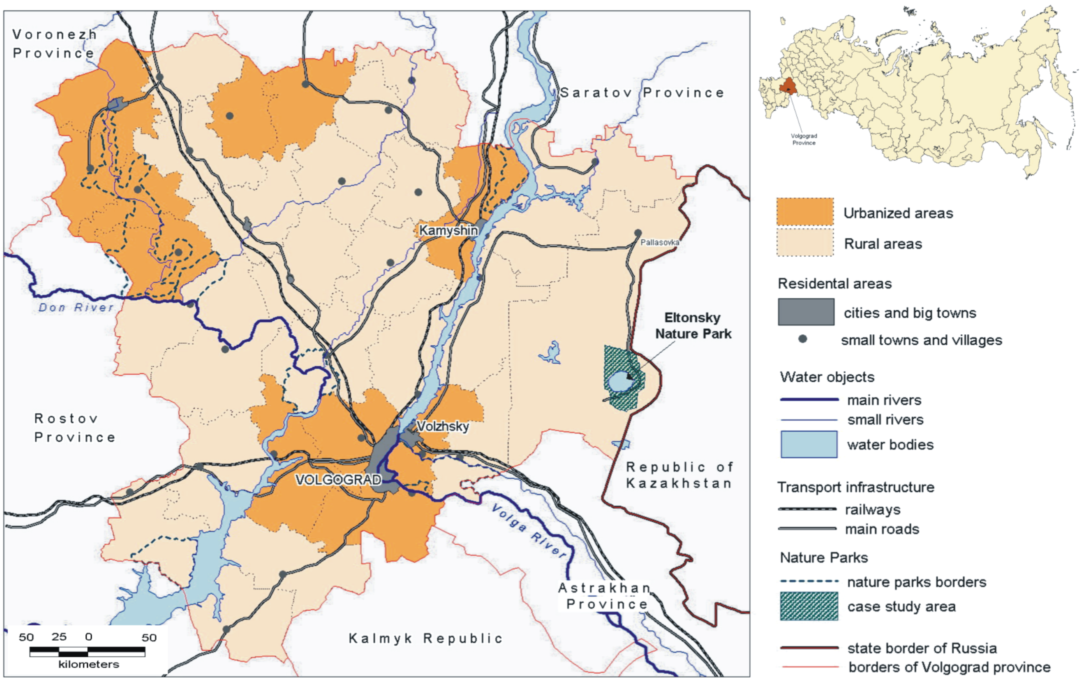

Figure 1. Location of the Eltonsky nature park

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The objective of the case study research was to develop a geo-database and to produce a series of thematic maps. These should support park managers to arrive at recommendations for the park functional zoning, conservation and land use development measures, and thus supporting the decision making process and management plan development. Based on the principles mentioned in Section 3, the research included the following steps: (1) Creating a basic digital topographic map; (2) Data collecting, analyzing and synthesizing; (3) Creating traditional and special thematic maps; and (4) Come to recommendations for conservation and land use measures.

The first step involved creating a large-scale (1:100 000) digital topographic map based on the available topographic maps and actualized by Landsat satellite images. The topographical map was digitalized in MapInfo, and consists of separate layers for administrative borders, the hydrographic system, hypsographs, settlements and roads.

The second step involved collecting data on the natural, social and economic characteristics of the area and generating a geo-database. Data were obtained from different sources, including satellite and aerial images, available maps, field data, statistics, scientific reports and papers collected in the regional authorities, municipalities and several scientific institutes.

The thematic output maps and layers were created based upon integrated data analysis and synthesis, using elevation, land cover, landscapes, distribution of rare plant and animal species, location of valuable natural & cultural objects, wetland types, land tenure and other data. The choice of the maps and layers was determined by the specific problems and requirements of park managers, and the availability and reliability of the information. Special attention has been paid to the mapping of land use changes in time (1985-1990 and 2001-2005), revealing the relationships between the land use types, landscapes and the zones where environmental impacts occur (see Figure 2).

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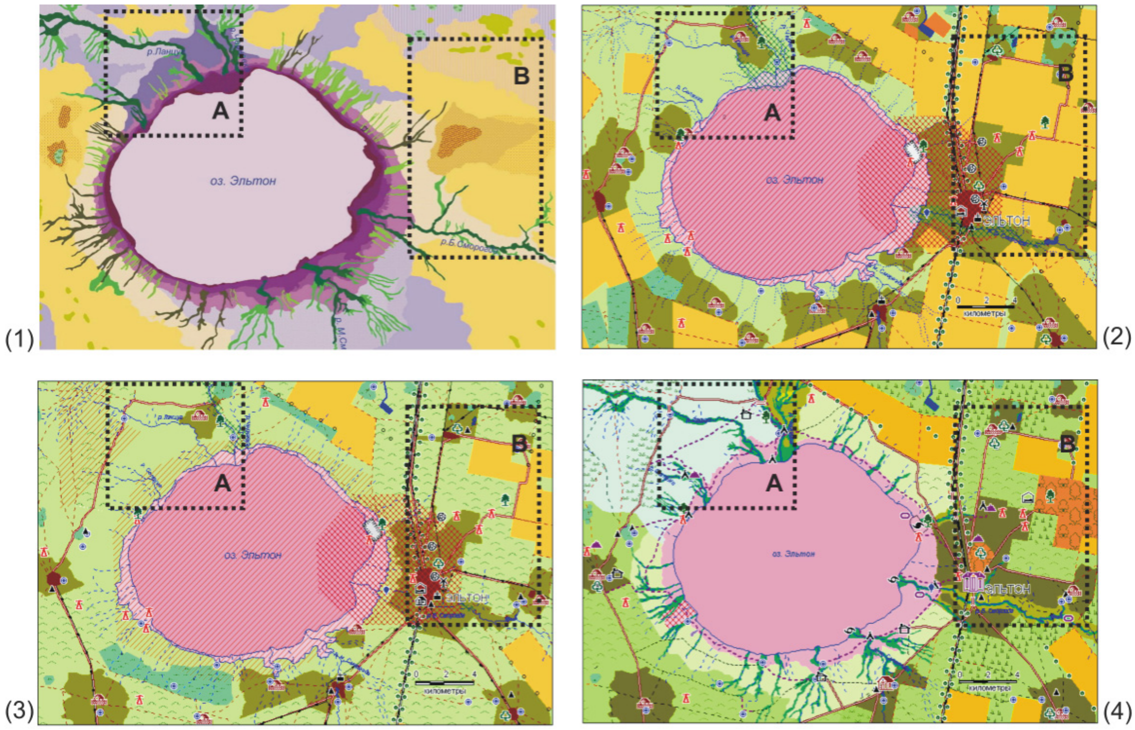

Figure 2. Some examples of created maps: (1) landscape, (2) land use 1985-1990, (3) land use 2000-2005, (4) recommended land use and regimes. The limited size of the paper does not allow to present details of the maps and legends. As an example: Section A includes intact and low-disturbed saline and typical desert-steppe landscapes of lake shores, benches and watershed sides, extensively used for grazing, recommended mainly for the conservation purposes. Section B includes impacted and disturbed desert-steppe landscapes of the watershed plains, which were intensively used in the past. Recommended multiple land use (see example 4) development of this area includes protection regimes (light green), arable lands (orange) and intensive and extensive pastures (olive and green), settlements (brown) together with recreation, and special restoration and conservation measures (reallocation of the arable lands, rotational grazing and stock routs, phyto- and forest melioration, removal and sanitization of pollution sources, recreation infrastructure development).

The integrated analysis and overlay the different maps and layers allowed:

- To reveal the area’s landscape structure, to calculate the areas occupied by the different landscape types and units, and to assess their suitability for the different land uses;

- To identify the key habitats of rare species of plants and animals, their relationships to the different landscapes, and intensively and extensively used areas;
- To identify the different types of land use and their relationship to the different landscapes, to calculate the actual areas in order to show the land use dynamics and compare these with official statistics, and to map the eco-risky and eco-friendly forms of land use;
- To classify the areas by the environmental and historical values and ranges of anthropogenic loads, and to identify the environmental conflicts zones in the area.

A comparison of the empirical data with the official statistics demonstrated the low credibility of the official statistics, especially concerning the agricultural land use. The map of recommended land use was produced by overlaying the different layers of geo-database and meetings with park managers and stakeholders. The map is the result of technical overlays and a participatory process. The map includes four categories of areas with the different characteristics:

- Areas with unique ecological values, intact and low-disturbed, mostly recommended for the conservation purposes (such as nature areas, including the well-preserved typical zonal and unique intrazonal landscapes, habitats of rare and endangered species, cultural monuments);
- Impact areas, appropriated for the further land use development: extensive use strictly regulated (for example, pastures within the lake headwaters, old abandoned fields); extensive use followed by the conversion to intensive use (such as fallow buildings), intensive use (agricultural and recreation areas)
- Impact and destroyed (disturbed) areas, requiring the ecological restoration measures (such as marginal fields, over-grazed and eroding pastures, waste dumps etc.)
- Infrastructure development areas (settlements, farms, recreation facilities, roads).

The results allowed coming to recommendations on the improvement of the functional zoning of the Eltonsky park and outlining the major directions of further multifunctional development in the park management plans. The maps and recommendations can be used as a tool to support decision making and to arrive at a more sustainable land use planning. Interviews with park managers and authorities showed that the produced maps are helpful in their daily practice and raising public awareness. All maps were produced by the researchers.

Currently, the park managers and authorities are unable to produce and modify the maps themselves, because they lack the technical capacity and equipment, as well as the institutional and financial support for the further development of the geo-database.

5. Discussion

The research produced an indicative list of data that are considered relevant to nature park management (Table 1) and a geo-database structure (Table 2). The availability and reliability of these data showed to be a key issue in the Eltonsky case study. Building the geo-database proved to be labor-intensive, consuming much time and money, due to the large number of data owners and stakeholders involved. Although most data were available at the different institutes, collecting these data showed to be difficult, as only a part of the required data could be easily obtained and for free. The remainder of the data could only be retrieved by cooperating closely with the data owners or third parties involved, or by personal contacts with different experts. Setting up databases for other nature parks in Russia will most likely experience the same difficulties. These problems might be solved by governmental and financial support, and setting up a cooperation network with key data holders and stakeholders.

The resulting maps and recommendations for the Eltonsky nature park were produced at the right moment: in the initial phase of decision making on the management and land use planning of the recently established park. This situation improved the assimilation of the results by park management and authorities to arrive at a more sustainable perspective on the future development of the park, and the major directions of further development of the park management plan. As most of the nature parks in Russia were established only recently, the results of this research can be a useful basis to support a more sustainable land use planning and environmental monitoring in other nature parks as well. The results of the case study are useful for other types of multifunctional protected areas as well, since PA managers in Russia tend to focus primarily at conservation and educational issues, without considering multifunctional land uses alike. Obviously, the geo-database needs to be adapted to the specific context of a PA.

The research demonstrates the importance of communication and cooperation between the park managers, authorities, experts, local citizens and other stakeholders. This concerns the provision of required input data, the identification of key issues in the planning and analysis process, as well as the implementation of the results. The results are a starting point for a comparative research with other international experiences in applying GIS in protected area management.

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