

Research Article**Methodology for Developing a Geographic diversity Information Resource for the Purposes of a Comprehensive Assessment of Specially Protected Areas (Based on Materials of the Tyumensky Nature Reserve of the Nizhnetavdinsky District of the Tyumen Region)****Marina PODKOVYROVA^{1,a*} and Ekaterina SHUMILOVA^{2,b}**¹Industrial University of Tyumen, Tyumen, Russia²Tyumen Institute of Engineering Networks "Innovation", LLC^apodkovyrova.54@mail.ru, ^beashumilova@bk.ru

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ABSTRACT.

The state of the environment becomes a relevant problem in developed regions of Russia. The means of objective control and long-term observation data indicate that negative dynamics of environmental indicators occur everywhere and this process is irreversible. In this regard, there is a need for systematic tracking of the dynamics of the state of natural territorial complexes (NTCs) and the implementation of an objective assessment of the processes occurring in ecosystems of specially protected areas (SPAs). Modern geo-information technologies provide the ability to analyze and synthesize source data, allow assessing the state of all components of the natural territorial complex from the geological basement to the state of the atmosphere, including water and air basins, soil, flora, and fauna. For this purpose, geo-information resources are developed. In the conditions of some shortage of scientific research on SPAs, the authors propose the development of a geo-information resource for the purposes of a comprehensive assessment of a nature reserve of federal significance. This geo-information resource is an interconnected set of databases of cartographic and thematic information that will allow creating an information resource available for scientific analysis, monitoring the status and functioning of SPAs.

Keywords: Geographic information system, Geographic information resource, Methodology, system approach, Geographic database structure, Integrated assessment, Specially protected areas.

INTRODUCTION

Specially protected areas (SPAs) support the ecological balance of geosystem territories, preserving their biological and landscape diversity, contribute to their restoration and further development. Under the influence of anthropogenic and technogenic factors, SPAs are transformed, losing their importance. In this regard, there is a need to conduct a comprehensive assessment of the state of these territories after their organization, the results of which allow predicting negative changes and determining the necessary environmental

measures to optimize the state of SPAs. The Tyumensky Reserve of Nizhnetavdinsky District (hereinafter referred to as the Reserve) is a unique territory with a total area of 54,025.0 hectares, which consists of three state natural monuments: the Orly tract, the Shaitansky Lipnyak, the Ishimbay lacustrine-boggy complex.

RESULTS

The Method of Creating a Geographic Information Resource for the

Implementation of a Comprehensive Assessment of the State of the Reserve. A geographic information resource for the implementation of a comprehensive assessment of the state of the Reserve's territory was developed by the authors on the ArcGIS Desktop 10.3 platform using materials from Earth remote sensing, as well as materials from special types of surveys. The development methodology includes:

1. The process of drawing up cartographic material (processing of data obtained from the study of geographic systems when interpreting satellite images).
2. Designing a geographic database consisting of a number of stages:
 - 2.1 Preliminary stage (drawing up the database structure (Table 1), containing basic information about feature classes (structure – fields and types) and creating a geographic database file).

Table 1: Geographic database structure

Dataset name	Class name	Fields list	Field type	Alias
Landscape diversity	Border	SHAPE_Length	Double	Length
		SHAPE_Area	Double	Area
	Landscape	Cikl	Text	Cycle
		Type	Text	Type of terrain
		Name	Text	The name of the natural boundary
		Index	String	Landscape index
		SHAPE_Area	Double	Area
	Rivers	SHAPE_Length	Double	Length
		SHAPE_Area	Double	Area
	Lakes	Name	Text	Name
		SHAPE_Length	Double	Length
		SHAPE_Area	Double	Area

According to the structure of the database, the geographic database file Reserve.gdb was created. To display the territory with minimal distortion, an equal-angle projection of Gauss Kruger Pulkovo 1942 zone 11 was selected.

2.2 The stage of the physical design of the database schema development. At this stage, to create a database schema for the spatial object class Landscape.

2.3 Topology verification: conducted to ensure data integrity. The topology was attended by two spatial object classes, Landscape and Hydrography. During the topology check, two topological errors were revealed in the rule "Landscape – should not have gaps", which were marked as "Exception" [1].

3. Pilot project stage: at this stage, methods for creating an interactive map were applied to the created geographic database file:

- 1) Tips: for the spatial object classes "Landscape", "Hydrography", "Anthropogenic Objects", tips were set (Fig. 1). This method allows the user to visually distinguish one spatial object from another, not only by using different symbols but also by describing the object.

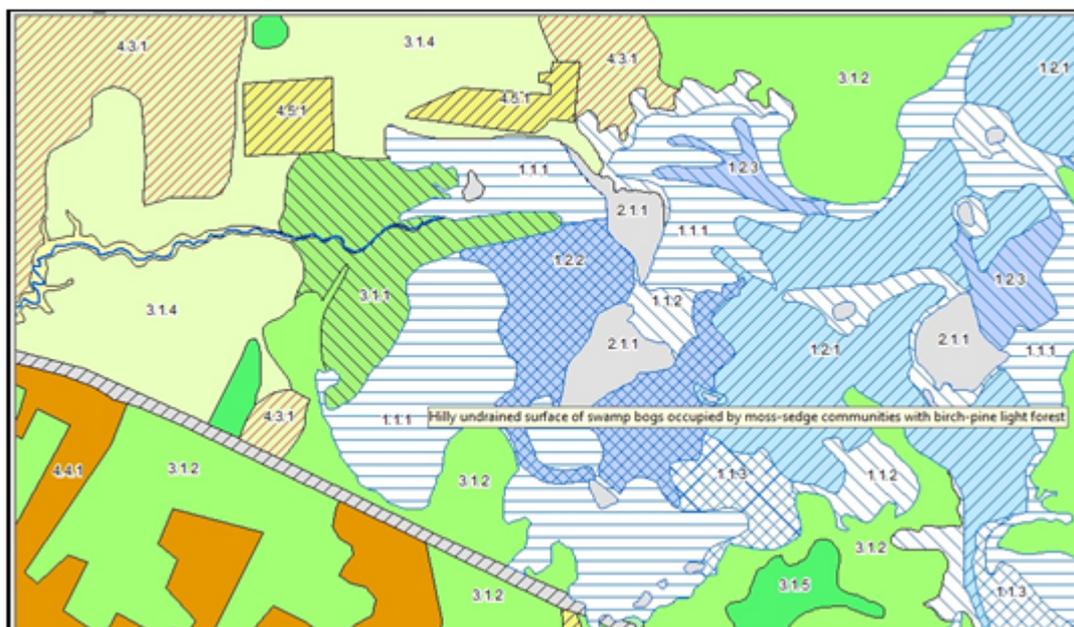


Fig. 1 Application of tips on a fragment of the landscape map.

2) Attachments: attachments are created for each object in the jpg format for the spatial object class Landscape. After the attachment is created, a table (Landscape_ATTACH) and a relationship class (Landscape_ATTACHREL) are formed, containing the relationship between the Landscape spatial object class and the table.

For an interactive display of attachments, the HTML POPUP tool is used, which allows a pop-up window to display the presentation of attributes and attachments added to this object (Fig. 2).



Fig. 2 Application of attachments on a fragment of a landscape map (author's development).

3) Hyperlinks: for the "Border of the reserve" spatial object class, there is a hyperlink to the document "Cadastral case of the Tyumensky Reserve in the Nizhnetavdinsky District"). This way of interactivity allows the user to obtain additional and more extensive information about the area of study: its location, land fund structure, land use, regulatory documents.

The developed file base of geographic data was used to construct a landscape map of the territory on a scale of 1:100,000 and to analyze its functioning (Fig. 3).

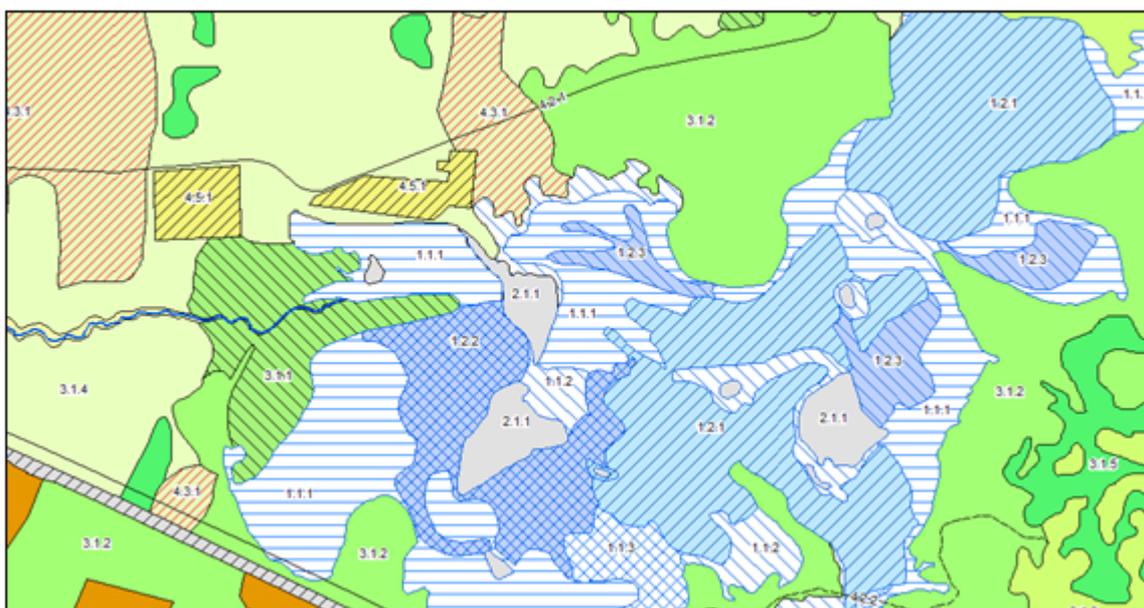


Fig. 3 Fragment of a landscape map of the Tyumensky Reserve (author's development).

In order to increase the readability of cartographic material, the legend of a landscape map is framed by a separate application in the form of a landscape table. The main methods of cartographic mapping are selected as a method of qualitative background, icons and linear signs [1-3].

As a result of the study, typical landscapes of the reserve are well-drained gently undulating plains with pine-birch and birch park grass forests on the sod-podzolic soils on the right bank of the Tavda River and well-drained high interfluvial plains. Swamp complexes occupy about 48.4% of the total area of the territory. The Reserve includes a powerful system of lakes (Big Tarman, Shaitanskoe), which is 7.3% of the reserve, which confirms the strong influence of this system on the territories adjacent to the Reserve [4].

Settlements in the Reserve and the transport network have a negative impact on the state of natural components.

This effect is manifested in the distribution of exhaust gases not only to the nearby NTCs but also through the circulation of matter and energy and the presence of interconnections between the components, the metals that make up the gas, extend to the Reserve from the roads over 100 meters.

CONCLUSIONS

According to the results of the analysis of the Reserve territory, the following conclusions can be made:

1. Comprehensive assessment of the state and functioning of the Reserve territory, development of a landscape map, formation of functionally vital areas in the development of a given area will reduce possible anthropogenic impact and reduce its level, while preserving the state of the unique components of this Reserve.
2. Developed geographic information resource on the territory of the Tyumensky Reserve:
 - possesses the capabilities of managing the SPA infrastructure, registering and taking into account violations of the conservation regime, predicting dangerous natural and anthropogenic phenomena, collecting and analyzing scientific information, and drawing up specialized maps;
 - provides access to various spatial objects and greatly simplifies the search for the necessary information within the boundaries of the object under study;
 - expands the possibilities of environmental education and tourism activities.

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