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Geocological atlas of the nature reserve fund of Ukraine as a geoinformation system: a methodological approach to content development

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SUMMARY

The publication presents a methodological approach to creating a geo-ecological Atlas of the nature reserve fund of Ukraine. It is defined as a modern specialized atlas electronic cartographic work and a cartographic service of wide application. It is implemented through geographic information systems (GIS) and acts as such a system.

The general structure is substantiated, which has three parts (introductory, substantive, additional), purpose and composition of each of them.

It is proved that the development of the content of the geocological Atlas of the Nature Reserve Fund of Ukraine as a computer GIS makes it possible to minimize the existing individual contradictions to ensure its internal unity through the use of existing functionality of relevant software products.

The functions of the content part and the Atlas as a whole (informative, evaluative, methodical, methodological, organizing) are determined; criteria of value and fundamentality.

Methodological principles of formation of the substantive part of the geocological atlas of the NRF of Ukraine on the possible presentation of various thematic maps in it are formulated: consistently traditional; block-problematic; combined. The latter principle is the most optimal for use in this cartographic work.

Introduction

The cartographic method has long been rightly considered one of the effective tools that are practically used in various fields and industries. In our country, within a separate problem-oriented area of thematic cartography – geoecological mapping – it has shown its special effectiveness. Its use affects the qualitative positive changes and the real improvement of geoecological research, involves the development of various cartographic models in the form of individual maps, their series, as well as thematic atlases, the task of which is, in particular, for nature reserve areas (NRF) special environmental, aesthetic, scientific, recreational and other value and allocated to preserve the natural diversity of landscapes, gene pool of fauna and flora, maintaining the overall ecological balance, can be logically implemented in the environmental direction of geoecological mapping. Such works have a significant variety of indicators (as elements of content).

Only a system of maps, created under a single program as a holistic cartographic work in the form of a geoecological atlas of the NRF of Ukraine, can indicate the current state, composition, dynamics, relationships of nature reserves, anthropogenic load on it relevant territories.

The geoecological atlas of the nature reserve fund is a complex cartographic model of its main properties, the defining advantage of which is the presentation of information on maps in a systematic, formalized and uniform form. Due to this, the specified atlas in its essence, as well as practical implementation is a geographic information system (GIS).

Method and / or Theory

In the process of conducting this study, the authors used general and special methods, the main of which are: analysis and synthesis, used to study the experience of geoecological mapping and its environmental direction in terms of developing atlases containing NRF maps; analysis of information support for the development of the atlas, outlining the main principles of creating its individual maps of different possible types; scientific classification, comparative, modeling - for the implementation of the outlined tasks for the creation of the atlas of the NRF as a geographical information system; informational, cybernetic - for systematization of primary knowledge about NRF objects in the form of GIS database and its use in the methodical scheme of development of separate maps and atlas as a whole; geoinformation mapping - for the direct creation of cartographic models of the atlas, which are visual spatio-temporal means and specific scientific cartographic results of the study of NRF.

The unifying method of research is a systematic approach, which is applied at all stages and considered in interrelated aspects through: the conceptual basis of creating and applying a single system of maps included in the atlas, as well as the scientific method of computer technology and effective practical organization job on creating an atlas as a GIS (when considering GIS as an information system) and; based on GIS (when considering GIS as software with appropriate functionality); methodology and methods of developing individual cartographic models in GIS and electronic atlas as GIS as a whole.

Examples

Based on the analysis of existing atlas cartographic works that reflect certain aspects of the nature reserve fund of Ukraine or the NRF as a whole, it is advisable to point to three main groups of such developments created in different periods, starting with the emergence of ecological-geographical (geoecological) mapping in the former USSR.

The first group includes complex, geoecological (specialized) and thematic (narrowly specialized) atlases of Ukraine, which are material geographic information systems and contain maps of nature reserves. Such works were developed in the period from the 1970s to the end of the 2000s. These include: "Atlas of natural conditions and natural resources of the Ukrainian SSR" (Atlas of natural conditions and natural resources of the Ukrainian SSR, 1978); "Ecological Atlas of Ukraine" (Baranovsky, 2000), "Ukraine. Ecological and geographical atlas" (Baranovsky, 2006); "Ecological Atlas of Ukraine" (Ecological Atlas of Ukraine, 2009); Atlas of objects of the nature reserve fund of Ukraine (Leonenko et al., 2003). All these atlases serve as a prototype of modern GIS.

The second group consists of complex atlases of Ukraine with NRF maps, which were published during this period on traditional media, which also act as a prototype of GIS, but also have a simplified implemented electronic version, comparable to modern computer GIS, whose database is periodically updated. An example of a cartographic work of this group is the National Atlas of Ukraine, where 12 maps of the analytical type are devoted to the mapping of the nature reserve fund (National Atlas of Ukraine, 2007).

The third group is domestic thematic developments of the national territorial level. The authors know the electronic Atlas of objects of the nature reserve fund of Ukraine (Grachov, 2020), which in fact can be the subject of discussion in this publication, because on its same type (inventory, author) maps mainly with localized icons and areas (the latter the method of cartographic image is updated with increasing scale) the location of NPF objects according to the existing classification is separately presented (nature reserves, biosphere reserves, national nature parks, regional landscape parks, protected tracts, reserves, natural monuments, botanical gardens, dendrological parks, parks-monuments of landscape art), as well as some additional information from the database in the pop-up window (name, year of creation). This indicates the simplest option of mapping the provision of information about the NRF through the use of GIS capabilities by web mapping.

In general, the analysis of the content of selected atlases indicates the existence of a number of unresolved issues of theoretical, methodological and methodological direction, the main of which is the definition of the actual geocological atlas of the NRF, the main methodological principles of determining its content and practical aspects of implementation as a geoinformation system.

Results

The Geocological Atlas of the NRF of Ukraine as a geographic information system is an electronic cartographic work in the form of a systematic collection of maps created by a single program, logically and thematically interconnected and placed in order to supplement previous maps, as well as a cartographic service.

In general, structurally it should consist of three consecutive parts: introductory (begins with a text foreword, includes an administrative map and a map of the physical surface), substantive (reveals the name of the atlas) and additional (lies outside the cartographic images, accompanying them with metadata).

The main part reflects the current state of the country's nature reserve fund and the degree of anthropogenic pressure on them, features and measures aimed at preventing environmental degradation, including the functioning of the relevant infrastructure through various mapping indicators, indicating at the same time its reasons. The latter statement essentially defines the created atlas as a cartographic work of geocological orientation and in general outlines the necessary types of maps comparable to those defined in (Bondarenko and Kyryliuk, 2020), the content of which is consistent with the functions of protected areas according to (The nature reserve fund of Ukraine, 2021).

The creation of a geocological atlas of the NRF as a specialized cartographic work should be based on the theory and methodology of atlas mapping (Svatkova, 2002) on compliance with certain conditions as a source of consistent spatial information and geosystem model: use of a minimum number of cartographic projections; use of one or more scales for all atlas maps; formation of connections between atlas maps with the help of mathematical basis, typical symbols of general geographical content, which are used on all thematic maps and their single geographical basis; observance of the quantitative balance of types of maps that will ensure the purpose of the atlas through reasonable blocks of maps of the content part; coordination of a single level of generalization of the geographical basis for all types of thematic maps; ensuring the same detail of the depicted objects on the maps of different types; consistency of maps with each other; bringing the information basis of atlas development to one time interval; consistency of map design principles.

These conditions when creating an atlas can't always be fully met, but its development as a computer GIS allows to minimize the existing individual contradictions through the use of existing functionality of relevant software products that are geographic information systems: GIS allows the use of unified cartographic projection for all atlas maps and conversion of various projections is carried out automatically; the use of one basic scale of maps is justified; the opportunities of using standard

symbols of general geographical content are coordinated with the formed library in the database of pictorial means; the use of typical geographical bases of crowdsourcing services on all thematic maps is possible; ensuring through multilevel generalization the same detail of the elements of the geographical basis and thematic content; updating the database of NRF objects of Ukraine on request or in real-time; creation of thematic maps of different types, which act as a dynamic information system of the object of mapping, using the whole arsenal of methods of mapping.

The substantive part of the geocological atlas of the NRF performs various functions, which are set out in (Bondarenko, 2007) in relation to ecological and geographical atlases of different territorial levels and improved by the authors in relation to the developed work: *informative* solving the tasks and in further research; *evaluation*, which is associated with the ability to present on the basis of the characteristics of the NPF ideas about the ecological condition of the territory of Ukraine as a whole with the selection of regions (territories) with extreme indicators; *methodical*, which involves the use of acquired experience in mapping in the development of satin-type cartographic works in the future; *methodological*, related to the consideration of the whole set of atlas maps as models that reflect the worldview of nature reserves in a certain period of development of society; *ordering*, which is manifested in the purposeful separation of different types and types of thematic maps in the structure of the atlas, despite its internal heterogeneity, which allows to identify relatively homogeneous parts.

The information basis for the formation of the GIS database for the creation of maps of the content of the atlas of the NPF of Ukraine is the data on the relevant objects and territories of the national level and their distribution by region. As of 1.01.2020 (such latest data are available to the authors at the time of preparation of the manuscript) according to the State Cadastre of Territories and Objects of the Nature Reserve Fund of Ukraine, it includes 8512 territories and objects with a total area of 4.418 million hectares within the land area of Ukraine (actual area 4.085 million hectares) and 402.5 thousand hectares within the Black Sea. The ratio of the actual area of the nature reserve fund to the area of the state (“reserve indicator”) is 6.77%.

During 2019, the number of objects and territories of the nature reserve fund of national and local significance increased by the total area, which amounted to 94224.2 hectares. In 2019, 116 territories and objects of the nature reserve fund were created (announced), 9 were expanded, the area was reduced by 3, status 1 was abolished and the category of 13 objects was changed.

The value and fundamentality of the created atlas are due to the significant informative saturation due to the use in its development of a significant amount of both actual material and the possibility of direct use (without significant transformations) in building a database as an essential attribute of modern geographic information mapping.

An important component of the methodological approach to the development of the content of the geocological atlas of the NRF of Ukraine as a GIS is the formulation and application of the principles of its formation, namely the sequence of presentation of various thematic maps, Figure 1.

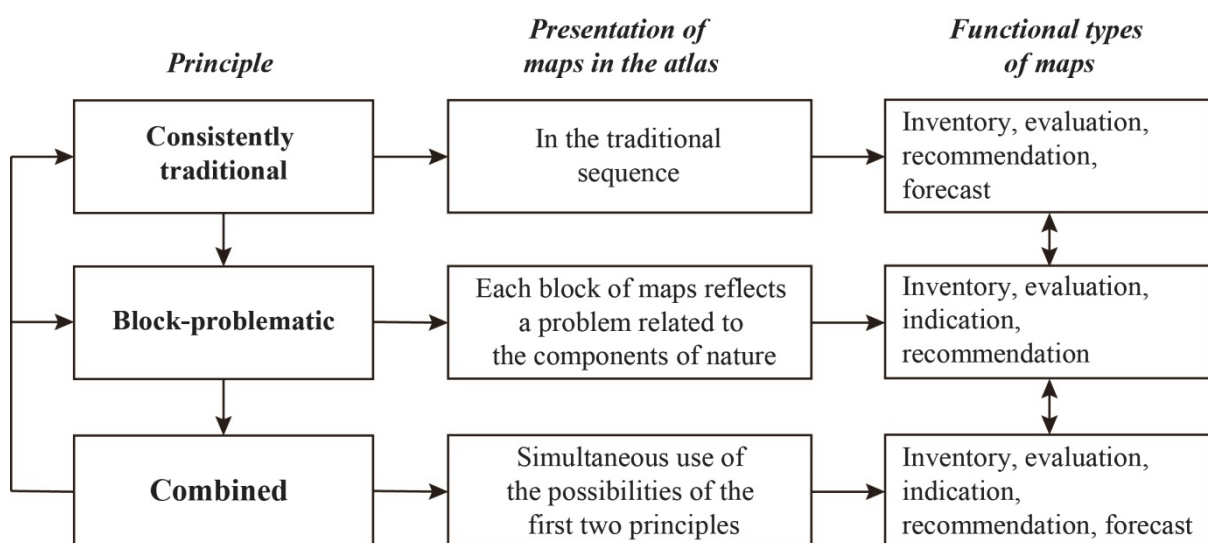


Figure 1 Methodological principles of forming the content of the geocological atlas of the nature reserve fund of Ukraine

The content of the atlas, which consists of about 40 thematic maps, provides for the implementation of a wide range of tasks, in particular, related to the implementation of sustainable development goals in accordance with (State strategy of regional development for 2021-2027, 2020), defined by the UN in 2015 year, including numbers (positions): 11 (sustainable development of cities and communities); 14 (conservation of marine resources); 15 (protection and restoration of terrestrial ecosystems) regarding the creation of a network of territories and objects of nature reserves.

These tasks are also comparable to the environmental monitoring tasks defined in (Bondarenko and Yatsenko, 2020).

Conclusions

The content of the proposed geocological atlas of the NRF, formed from logically and thematically interconnected maps of different types, as well as placed in order to supplement the previous maps with the following, significantly distinguishes it from existing works, and thanks to modern GIS fully ensures the internal unity of heterogeneous blocks atlas maps as a source of coordinated spatial information and cartographic model of objects and territories of the nature reserve fund.

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