Geosystemal approach of the optimising of biosphere reserves’ network spatial organization (by the example of Ukraine)

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ABSTRACT

The modern conception of the biosphere reserves is giving the basis for forming of the entire and coordinated planetary framework of the biosphere reserves, which should play significant role in providing sustainable development. Hereof the increasing of the effectiveness of the biosphere reserves functioning is one of the key questions nowadays. The geosystemal approach using enable us to take into account the whole complex of the natural and anthropogenic environmental factors and their interrelations. The in-depth analysis of the biosphere reserves’ spatial organisation and functioning in Ukraine, the investigation of the international experience in this field allowed us to elaborate the methodology of the biosphere reserves’ network designing for the optimization of their functioning, which can be used both on national and international levels.

RESUMO

A concepção moderna de reservas da biosfera tem fornecido as bases para a formação de toda uma estrutura planetária completa e coordenada das reservas da biosfera, que devem desempenhar um papel significativo para o desenvolvimento sustentável. Assim, Ora o aumento da eficácia do funcionamento das reservas da biosfera é uma das principais questões de hoje. O uso da abordagem geossistêmica nos permite levar em consideração todo o complexo do patrimônio natural antrópico e suas interrelações. A análise em profundidade da organização espacial e funcionamento das reservas da biosfera na Ucrânia, a investigação da experiência internacional neste campo permitiu a elaboração de uma metodologia para as reservas da biosfera que possa otimizar o seu funcionamento, tanto a nível nacional quanto internacional.

1 INTRODUCTION

By the present time the concept of the biosphere reserves evolved from the idea of virgin territories protection and exploring to the tool for solving nature management conflicts and simultaneous protection of biodiversity, geodiversity and cultural diversity. In this way they have to become peculiar laboratories of sustainable development (UNESCO, 2008a).

According to the Seville Strategy (1995a), the modern biosphere reserves concept entrust them with three complementary functions: 1) a conservation function, to preserve genetic resources, species, ecosystems and landscapes; 2) a development function, to foster sustainable economic and human development and, 3) a logistic support function, to support research and monitoring, demonstration projects, environmental education and training, related to local, national and global issues of conservation and sustainable development.

Polyfunctional character of the biosphere reserves in combination with environmental complication demand carrying out complex analysis to harmonise initial conditions and biosphere reserves’ functions for their efficient functioning. One of the means to achieve this aim is spatial planning, that is in the focus of
international community’s attention as an effective approach in the sphere of resource management.

The basis of the biosphere reserves spatial planning is laid by main MAB documents, first of all by The Seville Strategy and The Statutory Framework of the World Network of Biosphere Reserves. So, it is determined that the biosphere reserve’s territory has to be devoted into three zones: 1) one or more core areas, which are securely protected sites for conserving biological diversity, monitoring minimally disturbed ecosystems, and undertaking non-destructive research and other law impact uses (such as education); 2) a clearly identified buffer zone, which usually surrounds or adjoins the core areas, and is used for co-operative activities compatible with sound ecological practices, including environmental education, recreation, ecotourism, and applied and basic research, and 3) a flexible transition area, or area of cooperation, which may contain a variety of agricultural activities, settlements and other issues and in which local communities, management agencies, scientists, non-governmental organizations, cultural groups, economic interests and other stakeholders work together to manage and sustainable develop the areas resources.

Fig. 1 – The World Network of Biosphere Reserves (UNESCO, 2008b)

Such division doesn’t constrain creation of complementary zones or division of existing zones into subzones. In the course of our research three zones determined by Seville Strategy were defined as regiminal, as the nature management is regulated within them, and the functional subzones are recommended to separate within regiminal zones. The generalized model of biosphere reserve interior spatial organisation was elaborated by the author.

Also MAB documents determine creation of the World network of biosphere reserves that will provide key landscapes protection at the whole Planet and integral planetary system of monitoring and research as the base of sustainable development (SEVILLE, 1995b).

But analyses carried out showed that biosphere reserves’ spreading around the world is very heterogeneous.

For example there are 38 biosphere reserves in Spain and only 14 in Australia in spite of the fact that its territory is 15 times larger then the territory of Spain. Then in Brazil that is for 1 million square kilometers larger then Australia there are only 6 biosphere reserves. And in Bulgaria that is 76 times
smaller than Brazil there are 16 biosphere reserves (UNESCO, 2008b).

From the Figure 1 it is easy to see that The World Network of Biosphere Reserves doesn’t cover the north part of Canada and the Canadian archipelago, the territory from the Eastern Siberia to the Chukotski peninsula, Arabian Peninsula, central part of India, more then 4.5 million sq. km of the Southern Africa, and so on.

Also the areas of the biosphere reserves vary greatly. For example there is a biosphere reserve in USA with the area of 15195341 hectares (Southern Appalachian Biosphere Reserve) and at the same time the Biosphere Reserve Taynish in Great Britain has the area only of 353 hectares.

The great number of the biosphere reserves in the not great territory of Bulgaria is authorized by their small areas, which vary in the range of 1 – 4 thousands of hectares. But in Spain where the quantity of the biosphere reserve is very numerous for its territory too their average areas are 20 – 60 thousands hectares and some biosphere reserves have the areas more then of 100 thousands hectares; for example, Las Dehesas de Sierra Morena has the area of 424400 hectares (UNESCO, 2008b).

Also the status of the biosphere reserves differs: in some countries a separate category of the nature reserved areas conforms to biosphere reserves; in other there is no appropriate national category of the nature reserved areas and it is very hard to believe that they have enough permissions to execute the whole variety of functions entrusted them by the international community.

2 METHODOLOGICAL BASIS

Reasoning from MAB documents it is possible to conclude that there are three ways of picking up territories for designing biosphere reserves: 1) selection of representational sites of biomes and their main subsections and transitional areas; 2) selection of unique territories, such as the centres of rare and threatened species spreading, coast areas, islands and so on and, 3) selection of territories transformed by man, among which two types can be devoted: territories of traditional, harmonized with environment, natural management and territories of greatly transformed and degraded landscapes that have to be restored as a result of biosphere reserves functioning.

It is necessary to mention that biogeographical analyses and selection of representational sites of bioms don’t meet the modern requirements regarding biosphere reserves’ functioning. At the present it is mistakenly to centre the biotic component in the system. The realization of biosphere reserves’ functions determines exploration of the environment as the system that composes of equivalent components.

Just so the geography science defines the term “goesystem” – geographical formation of different scale (from local to global) which consists of a number of interrelated and interacting equal components of the environment and includes both natural and anthropogenic components.

In this way it is appropriate to carry out goesystemal analysis and select representational sites on the base of the geosystemal approach to assure the whole diversity of functions entrusted to the biosphere reserves. Consequently concerning the first way of picking up territories for biosphere reserves it is possible to speak about natural landscapes instead of bioms.

So, the concordance of biosphere reserves’ functions, determination of the configuration of each biosphere reserve’s territory and of their Network demand carrying out of deep complex researches on the different levels from planetary to the local while creating and further functioning of the biosphere reserves.

In that way spatial analysis is required to elaborate optimal planetary biosphere reserves Network. To achieve the aim it is necessary to carry out analysis of the landscape structure at the levels of types and subtypes; to separate unique natural formations that are of significance for the biosphere reserves’ Network, and also define main important conflicts in the sphere of nature management that have to become the objects of the research in biosphere reserves.
3 RESULTS AND DISCUSSION

Such analysis was carried out by us for the territory of Ukraine as the local example of The World Network of Biosphere Reserves designing.

Biosphere reserves are the separate category of the nature reserved areas in Ukraine (UKRAINE, 1992). According to Ukrainian law four territories have the status of the biosphere reserve:

- **Chernomorskiy** which is covering the Black Sea northern coast landscapes with significant conditions for waterfowl (1984).
- **"Askaniya-Nova"** within which there is the part of virgin steppe land, unique dendropark and the zoo, the researches in the sphere of sustainable agriculture and building parks in dry steppe regions are held there (1985).
- **Carpathian** which cover the Eastern Carpathian mountain landscapes, the landscapes of mountain river valleys, the researches in the sphere of forestry and preventing flooding are held there (1992).
- **Dunaisky** which cover the landscapes of Danube delta and the problems of fish industry and water transport are exploring there; it is a part of the mutual with Romania transboundary biosphere reserve (1998).

Moreover **Shatskyj** and **Uganskyj** (as a part of transborder **East Carpathians** Biosphere Reserve) National Parks are designed as biosphere reserves by the International Co-ordinating Council of the MAB Programme, but they still don't have corresponding status according to Ukrainian law (Fig. 2).
There is the same spatial heterogeneous of biosphere reserves' spreading in Ukraine as in the whole World. It is easy to see that three of them are situated in the South of the country, then two in Carpathians, the West part of the Ukrainian territory, and Shatskiy is in the NorthWest. In that way the large territory of Ukraine with the whole diversity of its landscape conditions and nature management types is devoid of biosphere reserves.

As it was mentioned before first of all it is necessary to analyse the landscape structure of the territory. Ukrainian scientists classify landscapes on the base of the landscape-genetic principle and pick out two classes: of plain landscapes and mountain landscapes; within mountain landscapes there are two types: the Eastern-Carpathian meadow-forest mountain landscapes with five subtypes and Crimean meadow-forest mountain landscapes with four subtypes. Within plain landscapes there are four types: of mixed deciduous-coniferous forest; of coniferous forest; of forest-steppe; and of steppe landscapes. Within the last one there are three subtypes: of northern-steppe; of middle-steppe and of southern- or arid-steppe landscapes. (Fig.3)

Separate types are formed by the subtropical landscapes of the Southern Coast of Crimea and the landscapes of river flood-lands.

We consider that the landscape analysis on the level of type of landscapes is corresponding with biosphere reserves’ designing and further functioning demands.

As it is possible to see from the scheme (Fig. 3), there are no biosphere reserves which are covering the types of coniferous forest landscapes, of forest-steppe landscapes, Crimean mountain landscapes, subtropical landscapes of the Southern Coast of Crimea and the landscapes of river flood-lands.

As well Shatskyj biosphere reserve is in the utmost West of the region of mixed forest landscapes and this territory isn’t really representational of mixed forest landscapes for which are typical wide waterlogged territories. It’s rather the territory of unique nature object – Shatski lakes which were formed as a consequence of karst and glacial processes. Also Shatskyj Biosphere Reserve may play a significant role in Ukrainian transborder nature reserving and rational nature management cooperation with Poland and Belarus.

Fig. 3 – The landscape structure of the territory of Ukraine (UKRAINE, 2007)
The next step of analyses is picking out natural processes and objects which have unique significance for the region. For the territory of Ukraine the processes of waterlogging, karst, coast abrasion, ravine-forming are of importance. The most significant natural objects are the Kara-Dag – ancient Jurassic volcano; and Podilski Tovtry – ancient Cretaceous coral reef.

Speaking about human activities that have great environmental influence it is necessary to mention mining; agriculture (it is appropriate to mention that more then 70% of the territory of Ukraine are agricultural lands); melioration that is aimed to drain in the North of Ukraine and irrigate in the South; forestry; reservoirs on the rivers, especially the cascade of reservoirs on the Dnieper River; tourism and transport corridors. And the greatest influence that ever had the Ukrainian environment was the radioactive pollution as a result of the disaster on the Chornobyl nuclear power-station in 1986.

As a result of the analysis outlined above the possible biosphere reserves’ network in Ukraine was elaborated by us. Further to the existent on the territory of Ukraine biosphere reserves we propose to set up several more (Fig.4).

Thus it is proposed to design biosphere reserve on the base of the National Park Podilski Tovtr, which will cover coniferous forest landscapes, landscapes of Dniester River valley, karst processes and the ancient coral reef; it is to be aimed to solve the variety of nature management problems in this landscape region.

Fig. 4 – The possible biosphere reserves’ network in Ukraine

Another one can be designed on the base of Kanivskyj natural reserve and will cover forest-steppe landscapes, the landscapes of Dnieper River valley; on its base will be held researching of processes connecting with reservoirs (there is Kaniv reservoir beside) and of agriculture in the forest-steppe zone. Vorskljanskyj biosphere reserve might be aimed to preserve forest-steppe landscapes of the Dnieper plain, the landscapes of river valleys and in particular flood-lands; to explore nature management in this region, especially the gas-extraction field and agriculture. Also this region is very rich with trade traditions which might be preserved in modern globalised world to save our authentic culture.
To explore the processes of coast abrasion and analyse human activities in coastal region it is appropriate to design a biosphere reserve within short distance from big port on the Sea of Azov – Mariupol. Perhaps it is possible to form there mutual with Russian Federation transborder biosphere reserve for cooperation concerning the questions of coast preserving and nature management optimising in this region.

Next one can be designed on the base of the Crimean natural reserve. It will cover the whole diversity of subtypes of Crimean mountain landscapes and the subtropical landscapes of Southern Coast of Crimea; the scientific researches will be concerned the problems of agricultural activities, tourism, transport, water supply and so on in this mountainous region. It might be reasonable to include into this biosphere reserve the territory of the ancient Jurassic volcano Karadag which now is the separate nature reserve and includes unique for the whole European territory landscapes.

Taking into account the globality of Chornobyl nuclear-power disaster influence on the environment of the whole Planet it is reasonable to organize on the radioactive polluted territory a biosphere reserve. It has to be aimed to explore the modern processes on the appropriate territory, to analyse the disaster consequences and the ways of potential human activities in this region and around it. Moreover it will also carry out preserving mixed forest landscapes, exploration of the results of melioration, studying functioning of Kyiv reservoir on the Dnieper river and the processes at the short reach of natural river-bed of Dnieper along the border with Belarus. This biosphere reserve might to be a part of the transborder biosphere reserve with Belarus because the environmental problems and styles of nature management on the both sides of the border are similar and interconnected.

The biggest open-cast mines are within the Kryvorizkyj iron-ore basin, there are a lot of industrial units. This region is of the most hard environmental situation in Ukraine. That's why it is necessary to design there a biosphere reserve which will goal to find the ways of sustainable development for this region and to provide inhabitants with fitting for life conditions.

Also Donbas region with high distribution of mining, especially coal mines, and heavy industry works. To study nature management peculiarities and its optimising in the region, preserving key landscape complexes it is expedient to design a biosphere reserve on the base of regional landscape parks "Donetskyj Krjag" and "Zuivskyj" including several coal mines to its transition zone.

4 CONCLUSIONS

So, as a result, we can see that designing the biosphere reserves network in such way we divided the territory of the country into several regions within which each biosphere reserve is charged with exploring peculiarities of the human activities and providing the sustainable development. In the same time the results of their scientific activities have to be realized in respective nature management spheres in other regions particularly of the country and generally of the world.

We consider that similar analyses have to be held around the whole Planet to form complete and effective The World Network of Biosphere Reserves.

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