Significance of specially protected nature areas in protection of resource potential of urbanized regions (the case of Volgograd region)

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Abstract. Strengthening of the functional role of cities in the development of regions is always associated with a change in local geographical characteristics connected with the joining of the areas beyond the fixed boundaries of urbanized territories. As a result of this process, the areas occupied by natural ecosystems are reduced, new resources are involved into the technogenic use, and the natural potential of the neighboring territories is exhausted and depleted. That is why such a method of resources’ protection as conservation of nature areas is of a particular importance for the regions with a high level of urbanization, for example, Volgograd region. The main idea of the article determined the logic and methods of research. The cartographic analysis made it possible to distinguish specially protected nature areas of the region according to their location in respect of urbanized administrative entities. On the basis of the statistical processing of the data found in the reports of the authorized regional authority, the current state and dynamics of development of specially protected nature areas are found according to categories, level of subordination, number, areas, types of resources’ diversity. Particular attention is paid to the degree of vulnerability and to the threats of the impact of human activity on nature and resource potential of specially protected nature areas when the cities are spatially planned. Attention is also paid to the ways of protection from negative effects. The study showed that the limitation of anthropogenic processes within the boundaries of specially protected nature areas makes it possible to preserve thousands of biological resources from destruction, protect hundreds of water sources from pollution, and provide a compliance of “friendly” human habitat to industrial and technological requirements. As a result, the article proves high importance of specially protected nature areas as a way of conservation of the natural potential of Volgograd region. It also determines the relevant tasks of security activities and methods for its effectiveness growth.

Key words: specially protected nature areas, urbanized territories, anthropogenic effect, resource potential, nature protection, efficiency, Volgograd region

1. Introduction

The methodology of territorial nature protection in Russia has been formed for a hundred of years [1], beginning from the establishment of the first sable reserve in January 1917 in Buryatia to the present day, when the area of protected areas occupies more than thirteen percent of the territory of the Russian Federation and they are today a heterogeneous mixture of areas of various levels of...
administrative subordination.

In the opinion of A. A. Tishkov, the asymmetry in the distribution of specially protected nature areas and the frequency of their establishment were significantly affected by the resource component. The dynamics and direction of spatial influence of global commodity markets, changes in human motivation concerning consumption and use of resource potential are reflected in the geographical location of specially protected nature areas determining their specific place in the territorial structure of the country's regions. A. A. Tishkov carried out the analysis of the programs for the organization of specially protected nature areas in recent decades and found their relatively low efficiency [2].

One of the reasons explaining this conclusion is violation of usual hierarchy in the interaction between the federal government and regional executive authorities resulting in the decentralization concerning the arrangement of specially protected nature areas, the conservation and their resource potential use. At the same time the shift of managerial functions towards the constituent entities of the Federation took place, which made the regional authorities solve independently the contradictions in the system "resources – their use – challenges". The solution of the problem is complicated by the fact that the specially protected nature areas within the boundaries of the largest part of the regions of the Russian Federation present a collection of dissipated conservation areas of various types. The specially protected nature areas of regional level of administration have the largest share among all specially protected nature territories in Russia. Their total area exceeds one half of the total area of all specially protected nature areas in Russia. Hence, in each region, the "destiny" of the most part of specially protected nature areas depends on the subjective ideas of authorized persons about the real value of the resource potential of specially protected nature areas and very often the variants for the conservation of natural resources are less profitable than the options for their use in economically viable industries.

The problem of choice is especially urgent in the regions with a high level of urbanization. The strengthening of the function of cities in the development of such regions is accompanied by a change in local geographic characteristics [3] through the use and joining of suburban areas. As a result, the natural state of the territories involved into the urbanization process is changing, the areas occupied by natural ecosystems are reduced, new resources are exploited, the region’s resource potential is exhausted and depleted.

In the view of the foregoing, the main purpose of the article is to determine special importance of the protection of nature areas as a way of protection of the resource potential of urbanized regions.

Volgograd oblast was chosen as the object of the study as a region with a high level of urbanization, in which the ratio of the area of specially protected nature areas to the region’s surface does not reach the average all-Russian level (10%).

The study is based on the idea of the correlation of settlement patterns in the territories of the constituent entities of the Russian Federation and the world experience in the design of specially protected nature areas, when the total surface of protected areas should be at least 20% of the total area of the territory which is being designed.

The data about the administrative and territorial structure, size and share of the urban population and economic structure were obtained from the official electronic sources of executive authorities and the Federal Service for State Statistics in Volgograd region. The analysis of location, ratio of the number and area of the specially protected nature areas of the region was carried out according to the territorial planning schemes of the region, municipal areas, general lay-out of rural settlements. The cadastral documents of the specially protected nature areas of the region, reports of authorized executive authorities [4] in the field of ecology and use of natural resources of different years became the source of the information on the availability and the state of natural resources.

2. Results and Discussion

Since late 1970s of the twentieth century, Volgograd region has been one of the regions with a high level of urbanization. A favorable geographical location, rich resource potential ensured an active industrial development of the region and the concentration of the population in urban settlements next to industrial facilities. Between 1979 and 2016, the share of the urban population of the Volgograd
region grew by five percent from 71.5 to 76.66 percent. The administrative and territorial units of the region include six cities of regional significance (among them is the city with one million of inhabitants, i.e. Volgograd), thirteen cities of regional subordinance and seventeen industrial townships, which are centers of economic activity, concentration of industrial production, consumption of resources, goods, services, exchange and distribution. The statistical data show that in the cities the economic growth is 20-30% faster than in the rest of the region. In the region about 70% of the revenues of the regional budget and gross regional product are formed in large cities.

Like any process, the urbanization, along with the pros, has its cons. The spatial planning of cities and the development of infrastructure which depend on industrial and technological imperatives quickly led to the destruction or reduction of qualitative characteristics of the human environment by reducing the area of natural ecosystems. The depletion of natural biological diversity, displacement of native flora species by alien components in the process of the emergence of anthropogenic corridors of agglomeration and artificial gardening of cities, the loss of certain structural elements of plant and animal communities, the appearance of urban landscapes (wastelands, landfills, solid waste landfills and abandoned fields) are observed. All the factors mentioned above negatively affect the assimilation potential of the territory of the region and, as a result, the living conditions of the population and their health condition. That is why the protection of nature areas as a way of protection of the natural resource potential is of particular importance for the region with a high level of urbanization.

The issues of effective spatial organization of protected areas are widely discussed in the scientific community. So, in his studies of A.A. Chibilev [5] reveals the integrated nature of the natural resources of protected areas, their social and economic importance, problems of identification, location and concentration of the basic frames of ecological networks as a basis for spatial planning in steppe regions. A group of Perm scientists under the aegis of S.A. Buzmakova [6] determined the numerical efficiency of the development of the network of specially protected nature areas of the Perm region and analyzed the concept of "geographical diversity". An obvious achievement of many years of the work of the authors is a comprehensive methodology for the calculation of an optimal share of the territory of protected areas in order to ensure the protection of various types of valuable resources. The scientific paper by O. A. Klimanova, E. Yu. Kolbovskiy, O. A. Illarionova [7], in which the specially protected nature areas, as an object of ecosystem services play a key role and a promising place in the construction of ecological frames of the largest cities of Russia is especially relevant. The deep theoretical research does not reduce the seriousness of practical problems in the areas of spatial distribution of specially protected nature areas and their targeted use. In other words when speaking about the level of concentration of specially protected nature areas in urbanized regions, one should take into account the already existing ratio of transformed areas and nature areas, individual climatic features of the region under analysis, the specificity of anthropogenic impact and a qualitative assessment of the nature areas under protection.

2.1. Analysis of the modern state of specially protected nature areas of Volgograd region

By the end of 2018, 58 specially protected nature areas of three levels of administrative subordinance are situated in Volgograd Region (Figure 1). Among them, the share of the number of specially protected nature areas of federal subordinance is 8.62%, the share of areas referring to local administration level is 1.72%, and percentage of territories belonging to the regional level of administration is 89.66%. The total area of all specially protected nature areas is 999.4 thousand hectares, which amounted to 8.85% of the area of the Volgograd region (11290 thousand hectares). At the same time, the share of areas of federal specially protected nature areas is 0.21% (2078.4 ha), the share of regional areas is 99.74% (996850.1 ha) and the percentage of local areas is 0.05% (508.6 ha) [8].
Taking into account the predominant number of regional specifically protected nature areas, we limit our efforts by the analysis only of their structure and location. The total number of specially protected nature areas of regional subordination in 2018 amounted to 52, the total area is 996.85 thousand hectares. The nature parks are the largest among the specially protected nature areas. The weight of the areas of seven nature parks amounted to 71.42%; the share of the areas of eight nature reserves is 25.64%; the most numerous categories are especially valuable territories (18 units) and natural monuments (18 units) which have shares of 2.66 and 0.27%, respectively; the area of the only natural landscape does not exceed 0.01% of the total area of regional specially protected nature areas.

The difference that can be seen when comparing the structure of regional specially protected nature areas by categories, number, size of areas in 2018 with the same indicators of 2013 (Figure 2, 3) arose as a result of the work of the state environmental control services and the harmonization of regional regulatory legal acts with the requirements of federal law. The main transformations took place due to some measures: exclusion from the borders of the nature parks “Ust Mdeveditskiy”, “Volgo and Akhtuba flood plain”, “Eltonskiy” of several settlements (town of Serafimovich, Krasnoslobodsk, Elton settlement); replacement of ten residential plots within the “Ust-Medveditskiy” nature park with three well-preserved plots that were not previously part of the park; temporary exclusion and then inclusion into the list of specially protected nature areas of seven hunting reserves after the addition of species; exclusion from the regional areas of the health and recreation area (deposit of mineral waters...
“Gornaya Polyana”) from regional specially protected nature areas.

![Figure 3. Ratio of the area of specially protected nature area of Volgograd region according to categories in 2013 and 2018 are as follows: MA&R – Medical areas and resorts; PL – Protected landscapes; EVS – Especially valuable territories; NLs – Nature Landmarks; SNS – State Nature Sanctuaries; NPs – Nature parks](image)

As for the relative position of specially protected nature areas in space, the cartographic analysis showed their scattered, uneven distribution in twenty-five municipal districts and two cities of oblast subordination. The borders which are adjacent with urban areas were identified at the following sites: “Volga-Akhtuba floodplain” nature parks (Volgograd, Volzhskiy, Krasnoslobodsk, Lensk, the towns of Srednyaya Akhtuba and Svetly Yar), nature park “Donskoy” (the town of Ilovlya), Ust-Medvedetskiy” (town of Serafimovich); “Razdorsky hunting reserve” (Mikhailovka); natural monuments “Chernichkin Garden” (Uryupinsk), “Iris” (Kalach-on-Don). The especially valuable territories are the “Green Ring” of the city of Volgograd (industrial township Gorodishche). The total area of these specially protected nature areas made up 363.84 thousand hectares, the total area of specially protected nature areas located next to rural settlements (villages, towns, villages, farms) was 632.88 thousand hectares. As practice shows, the location has a significant impact on the degree of exploitation of the nature resource potential of specially protected nature areas.

2.1.1. Resource potential of nature parks: threats and factors of negative impact.

The organization of regional nature parks in the early 1900s is explained by the need for legal protection of unique natural, historical and cultural resources, which were subject to such an impact which by that time was so serious and its consequences could not be ignored any longer. The resources under protection in the territories of nature parks are systematized in Table 1. The table is compiled according to the cadastral documents and annual reports of budgetary institutions which were created in each park for operational management.

The information mentioned above is not full, as it is subject to regular corrections in accordance with the results of scientific studies of the Volgograd scientists [9] and the systematic monitoring of the status of areas taken under protection. That’s why the values of most indicators are approximate. But it is already obvious that the nature parks have a high resource potential, however, the conservation status does not guarantee their full protection against the anthropogenic pressure. The threats and negative impact factors are associated with the location of nature parks, the specifics and intensity of the economic development of neighboring territories.

So, on the territory of the nature park “Volgo-Akhtubitskaya floodplain”, the level of negative impact on individual elements of the ecosystem and floodplain as a whole is evaluated on a scale from moderate to significant and critical. The reduction in area and productivity of forests, meadows, and wetlands is affected by the transformation of the hydro regime after the construction of the Volga
Hydroelectric Power Station [10], intensive agricultural development, forest cutting, road construction, hydraulic structures, mass unorganized tourism and recreation. The floodplain as a whole suffers from an increase in traffic load on the bridge across the river Volga, air pollution, soil, emissions from mobile sources, biological pollution during the operation of the storage ponds of Big Liman, fires, burns, loss of floodplains of fishery significance by many reservoirs. The poaching leads to a decrease in the population of certain types of biological resources. The high level of anthropogenic influence is explained by the border location of the Volga-Akhtuba floodplain with the territory of the Volgograd-Volga agglomeration where about 40% of the territory is broken by anthropogenic landscapes. Some scientists [11] consider the Volga-Akhtuba floodplain as an object of evolution of a technogenic and natural system, the vital activity of which depends on human control.

The nature park “Ust-Medveditskiy” is situated in the central part of the Serafimovich district along the Don and Medveditsa rivers and a significant part of the park is occupied by forests. The main sources of air pollution are: road transport, agricultural machinery, heating boilers, service plants and facilities and civil buildings. An unsatisfactory state of water resources is determined by the discharge into the water of untreated sewage from settlements, production sites and personal subsidiary plots, pollution of the banks of rivers, especially in places of spontaneous public recreation, and solid household waste.

| Table 1. Resources of nature parks of the Volgograd region |
|----------------------------------------------------------|
| **Type of resource** | Nature parks |
|----------------------|--------------|
|                      | Volgo-Akhtubinskaya floodplain | Donskoy | Eltontskiy | Nizhnekhoperskiy (Lower Khoper) | Tsimlyanskie peski | Scherbukovskiy | Ust-Medveditskiy |
| **Types of biological resources** | Number of biological resources |
| Birds | ≈230 | ≈100 | ≈85 | ≈164 | ≈140 | ≈182 | ≈130 |
| Mammals | ≈30 | ≈80 | ≈32 | ≈30 | ≈50 | ≈50 | ≈50 |
| Insects | ≈1400 | ≈300 | ≈3000 | ≈500 | ≈600 | ≈1800 | ≈900 |
| Fishes | ≈52 | ≈50 | ≈12 | ≈52 | ≈50 | ≈50 | ≈25 |
| Plants | ≈800 | ≈700 | ≈562 | ≈1500 | ≈400 | ≈600 | ≈638 |
| Reptiles | ≈5 | ≈10 | ≈8 | ≈30 | ≈10 | ≈11 | ≈8 |
| Other | ≈8 | ≈74 | ≈3 | ≈34 | ≈4 | ≈4 | ≈4 |
| **Number of types of biological resources included into the Red Book of Endangered Species of the Volgograd region** |
| Flora | 19 | 37 | 24 | 88 | 19 | 46 | 28 |
| Fauna | 62 | 43 | 47 | 37 | 35 | 57 | 35 |
| **Types of hydrological resources** |
| Rivers and brooks, number/length, kilometers | 3/165 | 4/92 | 7/95 | 22/1253 | 1/62 | 12/46 | 3/133 |
| Lakes, number/surface, km² | 2827/104 | 9/32.3 | 1/17480.3 | 958/48.3 | 4/53 | 12/4.58 | 2/0.3 |
| Shallow rivers, number/surface, km² | 178/53 | - | - | - | - | - | - |
| Ponds, number/surface, ha | - | 2/2.7 | 5/145 | 28/1.8 | - | - | - |
| Water reservoirs, number/surface, ha | - | - | - | - | 1/2700 | - | - |
| Marshes, number/surface, km² | 2/2.06 | - | - | 1/10.2 | - | - | - |
| Springs, number/capture, litres per second | - | 7/0.3-1 | 6/0.1-1.6 | 20/0.8-1.6 | - | 13/0.1-3.7 | 40/3-0.3 |
| Forest resources, surface, hectares | 41852.9 | 9608.7 | 89.2 | 69808.3 | 23529.9 | 10424.2 | 23403.6 |
Particular environmental importance was assigned to Nature Park “Donskoy” due to its location in the area with a low population and weak economic development. The landscapes and natural ecosystems of the park are well preserved and serve as a biological reserve for the Red Book of Endangered Species of flora and fauna.

Relative purity of water bodies is observed. The threats of a negative impact are associated with unorganized activities of residents of several rural settlements and rural areas including the Ilovlya settlement for cattle grazing, waste disposal in residential and recreational areas, harvesting and deforestation, the use of technologies that reduce the soil fertility.

The list of threats mentioned above is also typical of other nature parks which take into account the types of threats that are typical of specific kinds of resources which are not reflected in Table 1. For example, in the “Tsimlyanskie Peski” nature park, the greatest threat is the violation of hunting and fishing rules, as the numerous reservoirs of the park serve as the habitats for waterfowls and spawning grounds for valuable fish species. The Nature Park “Nizhnehoperskiy” has deposits of sample and rare soils, so an unauthorized plowing of land by local residents threatens with the loss of unique elements of the ecosystem. The environmental objective of the “Scherbakovskiy” nature park is to prevent the degradation of rare nature complexes representing a combination of various landforms with plant groups. The anthropogenic threats are associated with a violation of the sanitary condition in places of recreation of the population, in highway rest stops, viewing platforms, fishing and bivouac places. The destruction also occurs under the influence of climatic factors. The features of the Nature Park “Elton” are its location in the semi-desert zone, contrasting landscapes which have no analogues within the region (desert steppes, grass-wormwood semi-deserts, salt-dome landscapes, sors and silted estuaries).

The lake Elton has unique deposits of mud and salt brine that are unique in composition and balneological properties. This park also has river systems belonging to Elton basin. The negative factors of influence in this nature park are land reclamation systems, arable land, soil cover deflation, dirt and unauthorized collection of healing mud from the Lake Elton; unauthorized development of clay and sand, steppe fires; spring and autumn hunting, poaching; uncontrolled recreation.

According to the set of target functions, the nature parks are the most integrated natural-territorial entities and play a sensible environment stabilizing role. The natural resources located within their borders are limited in civilian circulation; change of the purpose of land under nature parks is prohibited; lands under valuable nature territories are not subject to privatization.

2.1.2. Target functions of specially protected nature areas of small and medium size.

According to the size of the occupied areas, natural monuments, protected landscapes and especially valuable territories can be attributed to small specially protected nature areas of Volgograd region, their total area is about 25259 hectares, the total number of small and medium sized areas is 37 units. According to the specification, the natural monuments are divided into integrated areas (protection of artificially created forest massifs and places of high concentration of species included into the Red Book of Endangered Species); geological areas (protection of geological exposure with outcrops of Neogene and Paleogene rocks, landscapes with species of Cretaceous flora, objects of quartz sandstone with imprints of ancient flora); paleontological areas (protection of places of accumulation of the remains of ancient animals); biological and botanical areas (protection of places of accumulation of the remains of ancient animals); biological and botanical areas (protection of the habitats of species included into the Red Book of Endangered Species, nature massifs of rare and endangered tree species, communities of floodplain meadows and forests, areas of virgin steppes).

Especially valuable territories and protected landscapes provide the natural living conditions for animals and plant communities in systems of lakes, floodplain forests and meadows, estuaries, in natural and artificially created forests, steppe, sand massifs, isolated terrain features and oak forests.

Seven from all state nature reserves have a hunting specialization and are intended for the conservation, reproduction and rational use of hunting resources. The faunal area "Drophiyn" was created in order to preserve bustards, their habitat and migration routes.

The largest part of small and medium-sized specially protected nature areas is situated within the boundaries of municipal areas with the agricultural specialization. The main threats for them are
illegal fishing, hunting, cattle grazing, building of bonfires, plowing, deforestation and hay-mowing. The anthropogenic influence of ecosystem communities in these territories can be qualified as weak or moderate. The hunting reserve “Razdorsky”, the natural monuments “Chernichkin Garden” and “Iris Garden”, the “Green Ring” area of Volgograd, which are located near urban settlements, in addition to the listed threats, are used intensively for recreational purposes.

3. Conclusion
A characteristic feature of the economic development of the Volgograd region is a high level of urbanization and anthropogenic changes in the environment under the influence of agro-, urban- and technogenic imperatives. The methodology of territorial protection in such conditions is of particular importance if it helps to prevent threats, reduce the negative impact, protect and restore the natural potential of the region. On the basis of this statement, the presented study uses a certain sequence of research.

The analysis of the current state of the system of specially protected nature areas of Volgograd region revealed the presence of objects of various types of subordination and categories. The size and structure of specially protected nature areas over the past five years remain stable. The main elements are the specially protected nature areas of regional importance, among them the largest ones are the nature parks. The nature parks operate in the form of budgetary institutions as economic entities. In relation to natural complexes, flora and fauna objects, landscapes, the management of nature parks carry out the following stages of work: “accounting-protection-monitoring-assessment-conservation-restoration-supervision”. In the absence of specially protected nature areas of a higher administration level in the region, the tasks of scientific research, environmental education, and the provision of conditions for regulated recreation were given to nature parks [12]. As the most integral natural and territorial formations with multifunctional targets, they have a high environmental and stabilizing value.

Within the boundaries of small (natural monuments, protected landscapes, especially valuable territories) and medium sized (nature reserves) specially protected nature areas, the analysis showed a rich species diversity of valuable natural resources. However, an uneven distribution, territorial fragmentation, remoteness from the center for the protection and monitoring of these elements of the systems of specially protected nature areas enhance their vulnerability to threats and negative impact factors.

The following measures are relevant for the increase of importance of specially protected nature areas in the protection of the natural resource potential of Volgograd region. They are: toughening of the regimes of individual zones of nature parks, creation of buffer and transit zones and other elements of environmental protection having compensatory and sanitizing properties at their periphery provides the corridors which ensure the environmental links to specially protected nature areas of various levels of administration and subordination. It will be possible to implement the suggested measures without the damage to the economic development of the region only if an integrated scientifically justified management of all parts of the system is ensured.

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