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The Terrestrial Vertebrate Fauna of Valuable Natural Areas in Kazan.

Renat I. Zamaletdinov ^{1*}, Rinat R. Mingaliev ², and
Anastasia A. Kiseleva ³.

¹Kazan (Volga) Federal University, Institute of Management, Economics and Finance, Department of Environmental Engineering and Water Management, Assistant Professor, Cand. Sc. [Biology]

²Institute of Management, Economics and Finance, Department of Environmental Engineering and Water Management, research assistant.

³Kazan (Volga) Federal University, Institute of Management, Economics and Finance, Department of Environmental Engineering and Water Management, graduate.

ABSTRACT

This article presents the results of studies the biological diversity of terrestrial vertebrates within five valuable natural areas in Kazan. Works were carried out by the Department of Environmental Engineering and Water Management of Kazan University during three field seasons. Such works duration allows to fix the maximum number of species, using the standard methods of research. In the process of study, it was found that the examined areas are characterized by high species diversity of terrestrial vertebrates. This allows to consider these areas as valuable for a large city. Biological diversity of considered by us areas has a particular value for studying and monitoring the state of biotic components of the ecosystem. The valueableness of territories is in high level of biodiversity within relatively limited areas. Giving them the status of Special Protected Natural Areas will allow maintaining a satisfactory state of the environment and preserving the biological diversity of plants and animals. Giving these areas the status of Special Protected Natural Areas and fulfillment its conservation status will allow to preserve species diversity of amphibians and reptiles in urban environments, as well as to facilitate the development of ecological and natural framework of the city. Presented and discussed in the article materials, allow to identify the main scientific and practical directions of activities to implement the optimal relationship between the man and terrestrial vertebrate species under condition of intensive anthropogenic impact on natural systems.

Keywords: urban areas, Special Protected Natural Areas, biodiversity, ecological and natural frame.

**Corresponding author*

INTRODUCTION

The reduction of biodiversity, under the influence of anthropogenic factors, is the urgent problem of our time, which is particularly acute in urban areas, where the natural environment meets with complex increasing exposure [1]. It is widely accepted, that urbanization would eventually lead to the loss of biodiversity [2; 3].

Urbanized areas for animals are the specific ecosystems that combine as weakly modified, as significantly changed biotopes. The share of the latter in the cities is constantly increasing, threatening the conservation of biological diversity of particular groups. Currently, there are sufficiently large numbers of publications, devoted to the problem of existence terrestrial vertebrates in urban ecosystems. The prospects for the conservation of this group of animals, under the condition of urban areas development, are determined mainly by economic conditions [4].

The rapid development of Kazan in recent years has led not only to the development of the city infrastructure, but to the economic investments. As a result of construction of the Universiade-2013 facilities, there were completely destroyed significant areas, suitable for locality of amphibians and reptiles. The largest facilities were built on the right bank of the river Kazanka. The territories of terrace above flood-plain were used for building construction, and the part of water area was covered. All this had a negative impact on the prospects for the conservation of the city wildlife [5; 6].

The effective method of biodiversity conservation within specially protected natural areas and the method of state improvement is the inventory of the fauna. The study assessment of the terrestrial vertebrates biological diversity and areas, perspective for creating specially protected natural areas on the territory of Kazan, are given in this paper.

MATERIALS AND METHODS

The material for this work is the data, collected during 2014-2016.

The researches were conducted on the territory of five areas, which in prospect are planned for the organization of urban protected areas in Kazan. They are the following: Akinsky forest, Belyankinsky forest, Victory Park wetlands, forest area near the Blue Lake, "Komsomolskoe" lake with the woodland.

Field works were carried out to determine the presence of terrestrial vertebrates over the studied areas. The fauna of terrestrial vertebrates was studied by multiple route censuses within areas with varying degree and nature of anthropogenic transformations.

The work with stock materials included data analysis of five reports on carrying out comprehensive environmental survey of Kazan territories, justifies the attribution to these territories or their parts the legal status of specially protected natural territories of local importance (Akinsky forest, Belyankinsky forest, Victory Park wetlands, forest area near the Blue Lake, "Komsomolskoe" lake with the woodland).

The calculation of the level of anthropogenic load on natural complexes of studied areas was made using expert numerical scores, where:

- 1 point corresponds to a very low level of anthropogenic load;
- 2 points - the average degree of anthropogenic load;
- 3 points - the high degree of anthropogenic load.

We have taken into account the following factors of negative anthropogenic load within the studied areas:

- 1) recreational use, including the presence of unauthorized parking and fireplaces;
- 2) storage of household waste, building activity;
- 3) economic use: fishing, illegal felling of trees; picking of mushrooms, herbs and deadwood.

Statistical processing was carried out using MS Excel 2010. Ability to compare objects by multiple components, not just by analyzing the fauna, necessitates the use of Statsoft Statistica v 10.0.

RESULTS AND DISCUSSION

Commonly believed, that increasing of biodiversity in urban ecosystems can have a positive impact on the quality of citizens' life. The same aspect can contribute toward the conservancy of natural ecosystems biodiversity, outside of urbanized territories [7]. In this regard, it is appropriate to maintain the biological diversity of urban ecosystems, as unique and specific communities of flora and fauna.

On the territory of Akinsky forest, the studies revealed the presence of four amphibian species and three reptilian species. Thus, the herpetofauna of this area is represented by 7 species.

Avifauna is formed by 42 species of birds. There are as the typical synanthropic species, as the species, that are typical for the area with a low level of anthropogenic load. The richness of the ornithofauna is associated with the surrounding of the forest by allotment gardens and block territories. Within the studied area, it was found 9 species of mammals.

On the territory of Belyankinskiy forest, it was noted the presence of 9 representatives of herpetofauna, 6 species of which belong to the class Amphibia, 3 species belong to class Reptilia. All species are typical for the territory of the Republic of Tatarstan.

Within this area, there is the presence of 74 species of birds. It was found high abundance of raven birds. The presence of large amounts of rock pigeon (*Columba livia* Gemelin, 1789) and house sparrow (*Passer domesticus* Linnaeus, 1758) is observed near the forest borders.

Nesting at this area of goshawk (*Accipiter gentilis* Linnaeus, 1758) and Ural Owl (*Strix uralensis* Pallas, 1771) limits the dispersal and activity of crows and rooks.

It was found 17 species of mammals. Such species as common dormouse (*Myox usglis* Linnaeus, 1758), European hares (*Lepus europaeus* Pallas, 1778), common marten (*Martes martes* Linnaeus, 1758) actively settle in close proximity to people, and often catch the eyes to the locals.

According to carried out researches, the species diversity of the Victory Park wetland is also characterized by rich and diverse nature. Four species of amphibians and two species of reptiles inhabit this area. Herpetofauna of the Victory Park wetland is unique to a certain extent. Rather rich complex of amphibians and reptiles remained in the conditions of strong urbanization up to the present day.

The ornithofauna of the Victory Park wetland is rich enough for intensive urban area. There are 30 species of birds within this area. A notable point is the habitation here a large amount of waterbird species and wetland species. There is also mass nesting of waterfowls.

Within the water body, sided to the southern border of the wetland, is currently focused the gulls' colony, one of the largest in Kazan and its suburban areas. Probably, black-headed gulls (*Larus ridibundus* Linnaeus, 1766) moved here after the destruction of the gulls' colony on the lake Bolshoe Chaikovo near the maternity clinic № 1 (within 2-3 km from the Victory Park), in 2012.

There is no many species of mammals, inhabited this area. It was found 6 species.

Herpetofauna of the forest area near the Blue Lake is characterized by high species diversity. It was found four species of amphibians and three species of reptiles. It is noteworthy, that a relatively small area is inhabited by species, typical as for open dwelling places (sand lizard (*Lacerta agilis* Linnaeus, 1758)), as well as for forest habitats (common lizard (*Zootoca vivipara* Jacquin, 1787)).

The territory of the planned protected area is characterized by a wide range of conditions for nesting, feeding of 40 species of birds, found on this territory.

Nine species of mammals were found. Overall, biodiversity of theriofauna can be characterized as rather rich.

On the territory of the Komsomolsk basin, there is the presence of three amphibian species and one type of reptiles.

Avifauna is represented by 31 species, one of which is listed in the Red Book of the Republic of Tatarstan (2006): Green Peak (*Picus viridis*, Linnaeus, 1758). In the condition of proximity to urban areas, large gatherings of dabbling ducks were observed within this territory.

On the semi-aquatic territory of the Komsomolskoe lake, it was found the dwelling of 8 mammals species. The species composition of mammals is typical for residential areas. It should be noted the dwelling of muskrat (*Ondatra zibethica* Linnaeus, 1758), which inhabits only the aquatic environment.

Faunal assemblages of the territory near the Komsomolsk basin can be characterized as a transformed forest. This is stated by significant number of synanthrope species. This fact is explained by the presence of multi-storey building zone within easy reach. However, despite this fact, a significant number of species, belonging to the category of forest species are conserved on this area.

Taking into account the existence of different open and wet spaces within the area under consideration, with the presence of typical faunal representatives, this biotope should be considered more broadly than simply preserved forest. Faunal assemblages of the territory near the Komsomolsk basin, despite the significant transformation should be regarded as a valuable natural resource.

15 species listed in the Red Book of the Republic of Tatarstan [8] need the protection on the territory of Kazan and its suburban areas. Among them, 13 representatives of the class Aves and 2 representatives of the class Amphibia, one of which belongs to *Anura* (tailless amphibians), the second to *Caudata* or *Urodela* (tailed amphibians).

Statistical cluster analysis, using Statsoft Statistica v 10.0 allows to compare the objects, promising to create a protected area, generally for several characteristics.

Five objects, advanced for creating protected areas, have been investigated using the original data on the total number of species, the number of species listed in the Red Book of the Republic of Tatarstan [8], the square of land areas in hectares, as well as the human impact on each object (Table 1).

These characteristics were the basis for a multi-component analysis and comparison of facilities in Kazan and its suburban zone.

Figure 1 shows the dendrogram of similarity of vertebrate wildlife within the considered territories (for all groups of tetrapods).

Table 1: The characteristic of objects, advanced for creating protected areas.

<i>Special Protected Natural Areas</i>	<i>The number of species</i>	<i>Species listed in the Red Book of the Republic of Tatarstan</i>	<i>S, in hectares</i>	<i>Human impact</i>
Akinsky forest	58	3	7,8228	2
Belyankinsky forest	100	13	425	2

Victory Park wetlands	42	1	26,05	3
Blue Lake	56	8	1915,351	1
Komsomolskoe lake	43	1	27,265	1

The visualization of data, involving statistical methods, showed the similarity of such areas as Akinsky forest and Victory Park wetlands, according to the four presented parameters.

The Komsomolskoe lake and Victory Park wetlands are close to the same value, which is explained by the presence of identic species and almost the same characteristics for other indicators.

The most specific, according to our research, is the biotope of Blue Lake. This circumstance is due to the uniqueness of the species diversity of terrestrial vertebrates within the considered territory, in comparison with the other objects, as well as individuality of characteristics. The most significant factor, defining the dissimilarity - is the square of land area.

The multi-component analysis of objects, advanced for creating special protected natural areas, was carried out by us for all groups of tetrapods separately (herpetofauna, ornithofauna, theriofauna). Dendrograms, obtained as a result of the research of specific systematic groups are identical to the above dendrogram, obtained in the process of analyzing the collection of classes (Figure 1).

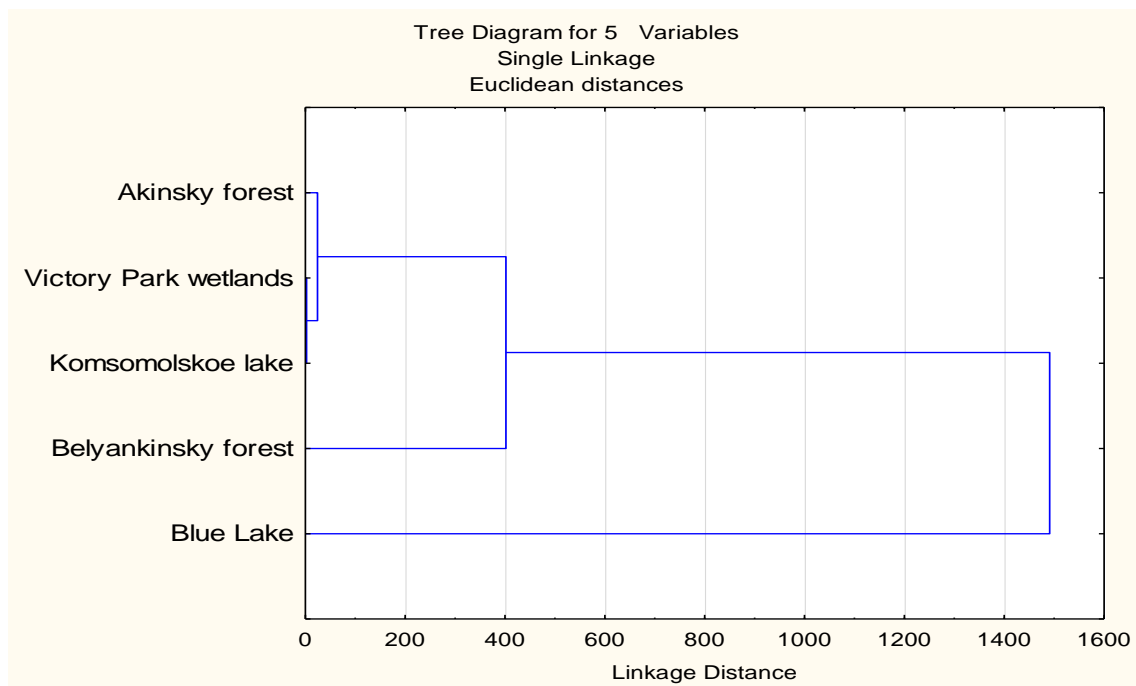


Fig. 1. The dendrogram of similarity of vertebrate wildlife within the considered territories.

15 species listed in the Red Book of the Republic of Tatarstan [8] are found within five of these areas. Belonging of these types to all four groups of terrestrial vertebrates is the evidence of existence within these areas the appropriate conditions for their habitat. The conservation of given areas can contribute to the conservation of these species.

Further urban planning should be directed to the preservation of areas with high biodiversity [9; 10].

Optimization of urban landscapes is feasible on the basis of creation and conservation of ecological and natural framework of the territory. This is one of the preconditions and prerequisites of sustainable urban development [11].

Presented and discussed in the work materials, allow to identify the main scientific and practical activities to implement the optimal relationship between people and terrestrial vertebrates under condition of intensive anthropogenic impact on natural systems.

CONCLUSION

Obtained results can be used for the development of the system for regional monitoring of terrestrial vertebrates of Tatarstan, populations of amphibians, reptiles, birds, mammals and their separate species. For the sustainable development of urban areas, the special territories should be allocated, and they can be considered as refugium for biodiversity conservation. Areas, investigated by us, meet these requirements. Also, these areas can be considered as elements of ecological and natural framework of Kazan.

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