Features of ecological formation and development of the forest park "Medvedkovsky"

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Abstract. The forest park landscape is a cultural "anthropogenic landscape", which assumes optimal and rational use of natural resources in order to create favorable conditions for mass recreation in the natural forest environment. The impact of recreation on the forest park areas, as well as on the territory of all protected areas, has a number of regularities. In cases where the number of visitors significantly above the acceptable level, and resistance is relatively low, the anthropogenic impact is not only visible, but can be damaging to the individual components of the environment, and sometimes to the whole complex in general. Such an impact causes a response from the natural environment. The analysis of the state of the Medvedkovsky forest park was carried out to recognize the main determinants of the negative repercussions on this territory. For this purpose, the flora and fauna, the road and path network, the degree of recreational digression of the territory, as well as the noise impact exerted on it due to its proximity to the MKAD (Moscow ring road) were taken in account.

1. Introduction

The planned nature reserve "Medvedkovsky" is a small forest area within Moscow, created for recreation of the population, as well as to maintain an ecological balance. In order to maintain the functioning of the nature reserve, it is necessary to analyze its condition so as to understand what impact in one way or another has a negative impact on forest [1]. The territory understudy has a number of obvious and hidden problems, which will be discussed further in this article.

Systematic visits to city parks by a large number of people cause various changes between the interconnected components of the natural environment, which can later lead to its complete destruction. It is the recreational impact that is most detrimental to forest biogeocenosis [2].

The impact of recreation on protected areas has a number of regularities. When visiting natural territories that are essentially almost untouched by economic activity, people unknowingly exert a certain influence on them. In cases where the number of visitors significantly above the acceptable level, and resistance is relatively low, the anthropogenic impact is not only visible, but can be damaging to the individual components of the environment, and sometimes to the whole complex in general [3, 4]. Such an impact causes a response from the natural environment.

The main factor in the strength and nature of the impact in most cases is trampling [5-7]. The process of trampling the area affects, first of all, the soil cover: mechanically disturbs the top layer of the litter; reducing the reserves of organic and minerals that plants need to feed; The thermal, water and air regimes...
of the soil are disrupted; changes the physical and chemical properties of soils (density, hardness, acidity, organic carbon content, electrical conductivity, and others); decreases the number and biomass in the living phase of the soil, reduces microbiological activity [8].

Changes in the natural environment under the influence of humans occur gradually [9]. But to determine the permissible capacity, several stages are distinguishable in the process of trampling, which is easily distinguishable on the ground. From the stage when the forest floor is not touched, and the greens are typical for this type of forest, to the stage of the partial or complete absence of soil cover, undergrowth, and overgrown weeds.

The second indirect effect may be noise. High level of noise exposure can negatively affect the animal body, for instance, disrupt their life cycles, spatial disorientation, which can become a strong source of stress for them, and, subsequently, the violation of the ecological balance of the territory.

2. Flora and fauna

Before analyzing the state of the forest park, it is necessary to get familiar with its flora and fauna. Birch trees (lat. Betula) with an admixture of aspen (lat. Populus tremula) predominate in the composition of the vegetation, phytocoenosis, and forest park. Subdominants in the plant community are Pines (lat. Pinus), Maples (lat. Acer), and Willow (lat. Salix). The undergrowth is represented by Mountain-ash (lat. Sorbus) and bird cherry, (lat. Prunus padus). Also on the territory of the reserve grows a huge number of species of vascular plants, among them there are representatives that are listed in the Red book of Moscow: Suffolk lungwort (lat. Pulmonaria Obscura), Yellow iris (lat. Iris pseudacorus), Bird-in-a-bush (lat. Corydalis solida), and others. Within the territory under consideration, amphibians listed in the Red book of the city of Moscow live Common frog (lat. Rana temporaria) and Moor frog (lat. Rana arvalis). The following species of animals are included in the Appendix to the Red book of Moscow: European mole (lat. Talpa europaea), Common shrew (lat. Sorex araneus), Lesser spotted woodpecker (lat. Dryobates minor), Common chiffchaff (lat. Phylloscopus collybita), Eurasian bullfinch (lat. Pyrrhula pyrrhula).

3. Analysis of the road and path network (RPN) and recreational digression of the territory

The analysis method is based on the work of Y.A. Nasimovich [10, 11]. This is a compilation of the RPN of the territory and the calculation of its area from the total area of the site. The road and path network obtained with the help of a GPS tracker was built and displayed based on the map-scheme of the Medvedkovsky nature reserve. The map diagram shows the border of the park, the road and path network, and places of unauthorized campfires marked with red signs on the map. Each of the roads were measured in width. According to GPS tracker data, the total length of the road and path network for the Medvedkovsky reserve was 6.68 km (figure 1). The total area of the reserve (according to the site mospriroda.ru) is 21.49 ha.

![Figure 1. Map of ranking of the road and path network by width of the Medvedkovsky forest Park. Yellow-marked paths from 1 to 3 m wide; blue-paths up to 1 m wide; circles – places of unauthorized bonfires.](image-url)
Summing up the area of all roads, the area of the road and path network of the "Medvedkovsky" reserve was 1.6 hectares.

The percentage of the area occupied by the road and path network is calculated as a percentage of the total area of the park [12]. The share of the area occupied by the road and path network from the entire area under study for the Medvedkovsky Forest Park is 7.6%. These indicators significantly exceed the norm [13].

There are very few organized recreation areas within the forest park, resulting in a large number of unauthorized bonfires with a large radius of trampling areas. A table of bonfires has been drawn up.

**Table 1. Area of fire pits and trampling windows.**

| No. Bonfire site | Fire pit area, cm² | Area of windows trampling around the fire pit, m² | The presence of debris |
|------------------|--------------------|-----------------------------------------------|------------------------|
| 1                | 1500               | 38                                            | +                      |
| 2                | 2000               | 302                                           | +                      |
| 3                | 800                | 189                                           | +                      |
| 4                | 700                | 24                                            | +                      |
| 5                | 1500               | 50                                            | +                      |
| 6                | 1500               | 43                                            | +                      |
| 7                | 700                | 27                                            | -                      |
| 8                | 1000               | 32                                            | +                      |
| 9                | 1200               | 42                                            | +                      |
| 10               | 1400               | 56                                            | +                      |
| 11               | 400                | 15                                            | +                      |
| 12               | 2500               | 286                                           | +                      |
| 13               | 600                | 40                                            | +                      |
| 14               | 500                | 26                                            | +                      |
| 15               | 500                | 32                                            | +                      |
The total area of bonfires is 2.1 m², which is approximately 0.001% of the total area of the park. The total area of trampling territories is 1247 m², which is 0.6% of the total area. The territory is littered with household waste.

Starting unauthorized fires in protected areas is strictly prohibited under article 20.4 of the Administrative Code of the Russian Federation "Violation of fire safety requirements" and is subject to a fine of 2000 to 3000 rubles.

The undergrowth is trampled down, separate parts of the undergrowth begin to form, limited by paths, and meadow grass species are introduced.

Due to the proximity of the reserve to the MKAD, the park is quite noisy, which can negatively affect the life of plants and animals. The values of noise exposure in the forest Park are kept in the range from 60 to 80 DB, near the Moscow ring road they exceed 80 DB. Such high values adversely influence the life of animal organisms living in the park, leading to the disruption of their biological cycles and increases stress. I recommend creating acoustic screens on the border of the park adjoining the Moscow ring road [14, 15].

4. Conclusion
The Medvedkovsky nature reserve has a number of pressing problems, such as severe recreational digression, trampling of the territory, and its littering, which is a consequence of the illogical arrangement of the road and path network of the park and places for recreation of the population. This
is particularly apparent in a large number of trampling zones and unauthorized campfires. Also, due to the peculiarities of its location (proximity to the MKAD), the park is subjected to a high level of bedlam, although no measures to minimize this impact have been implemented. It is necessary to perform a number of works to neutralize the recreational impact and noise insulation. If these suggestions are not carried out, the situation in the park will only exacerbate over time.

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