

3. О некоторых мерах по повышению эффективности ведения охотничьего хозяйства и рыбохозяйственной деятельности, совершенствованию государственного управления ими [Электронный ресурс] : Указ Президента Респ. Беларусь, 8 дек. 2005 г., № 580 II ЭТАЛОН. Законодательство Респ. Беларусь / Нац. центр правовой информ. Респ. Беларусь. — Минск, 2022.

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УДК 504.064

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ECOLOGICAL CONDITION OF GREEN SPACES IN THE FRUNZENSKY DISTRICT OF MINSK

Introduction. A propitious ecological condition of the environment is an essential part of the sustainable development in modern cities. Meanwhile, for the successful functioning of urban areas it's quite necessary to execute a comprehensive study of its components. And urban green spaces are among them as well. Based on the data of the research implemented in the winter of 2022, the report presents the results of the assessment of the ecological condition of public green spaces in the Frunzensky district of Minsk.

Main body. Main research methods included field, descriptive and mathematical ones. The methodology is focused on the assessment of dendrometric characteristics of coniferous tree species: crown density, drying and color of needles, the presence of mechanical damage and etc. These parameters were evaluated in accordance with ecological status category scale developed by V. A. Alekseev (table 1).

Table 1 — Ecological status category scale of V. A. Alekseev [1]

Status class	Description
1 — no signs of weakening	A dense crown, shiny green needles; the growth of the current year is of normal for this breed, age, season and environment conditions.
2 — weakened	A tracery crown, green and light green needles, may be burned by no more than 1/3; the growth is reduced by no more than half of the norm; individual branches are drying; individual root paws are damaged; local trunk damage.
3 — severely weakened	Severely tracery crown, pale green or matte needles, may be burned by more than 1/3; the growth is less than 50 % of the norm; drying up to 2/3 of the crown; root paws or trunk damage up to 2/3 of their circumference; local settlements of pests and fungi.
4 — drying up	Severely tracery crown, yellowish or yellow-green needles, falling off; the growth is very weak or absent; drying of more than 2/3 of the branches; trunk and root paws damage more than 2/3 of the circumference; populated by pests.
5 — fresh deadwood	Gray, yellow or red-brown needles, partially fell off; partial bark abscission; populated and damaged by pests.
6 — old deadwood	No alive needles; partial or complete bark and small branches abscission; pest holes; the presence of mycelium under the bark.

Further assessment is based on the calculation of the tree stand condition index, herewith the number of randomly selected trees must be at least 30. The calculation is made according to the following formula

$$L_n = \frac{(100n_1 + 70n_2 + 40n_3 + 5n_4)}{N}, \quad (1)$$

where L_n — the relative tree stand condition; n_1 — the number of healthy (without signs of weakening) trees, n_2 — weakened, n_3 — severely weakened, n_4 — drying up; N — the total number of trees (including deadwood).

Ecological condition of trees is determined by attributing obtained results to a defined category of an ecological status based on the modified scale of V. A. Alekseev. Tree stands with a condition index equal to 90—100 % belong to the category of healthy, 80—89 % — healthy with signs of weakening, 70—79 % — weakened, 50—69 % — damaged, 20—49 % — severely damaged, less than 20 % — destroyed [1].

Nevertheless, ecological condition of urban green spaces may change due to the influence of a diverse anthropogenic influence. Primarily, it's represented by pollution of the city from mobile and stationary sources. The impact of various pollutants can lead to a violation of metabolic processes, decrease in the development and decorative indicators of plants and other condition deteriorations of green territories [2]. During the research it was revealed that the main

sources of pollution on the territory of the Frunzensky district are: transport and the road system, energy industry enterprises and building materials plants [3]. Emissions of energy enterprises are divided into several types according to their structure: gaseous (oxides of sulfur, carbon, nitrogen, etc.), liquid and solid (soot and ash) [4]. Building materials plants are considered to be even more deleterious. The main amount of their pollutants is emitted into the atmosphere in the form of dust [5]. Despite a huge number of stationary polluting sources, the major one for the Frunzensky district is transport. The most dangerous impurities contaminations are sulfur dioxide and chlorine, which burn the leaves and shoots of trees [6]. Also, plants are affected by salt pollution caused by the use of deicing reagents — halite. The toxic effect is manifested in the occurrence of necrosis on the leaves and the withering away of different plant organs [7].

Nonetheless, unfavorable conditions of the urban environment affect various green spaces of the district in different ways. In green area structure of the Frunzensky district there are plantings of public, limited and special use. And among them it's the public ones, represented by the forest park, parks and squares, that are exposed to the greatest anthropogenic pressure. Their total area is about 241 hectares, most of which is concentrated in the eastern part of the district [3].

The only forest park in the Frunzensky district is the Medvezhino Forest Park, the ecological condition assessment of which was realized in the winter of 2022. 136 coniferous trees were examined in the area described, where the vast majority of plants are characterized by: the density of the crown in the range from 100 to 70%, natural green color of needles, the absence of drying needles, availability of various mechanical damages, for example, trunk cracks. Condition of parks and squares' plants was determined by 158 trees from 5 parks and 6 squares. The main part of the surveyed trees is characterized by: the density of the crown in the range from 100 to 80%, lightened and natural green colors of needles, the presence of either completely, or half-dried needles. Among the mechanical damages a bark abscission, trunk cracks and etc. are spread.

Thus, in order to determine ecological condition of public green spaces in the Frunzensky district of Minsk, in total 294 trees were examined. In order to do this, they were combined into 9 tree stands, the calculation of their condition indexes was carried out according to the previously mentioned formula (1). According to the obtained results, the plants were divided into three groups: healthy with signs of weakening (22 %), weakened (67 %) and damaged (11 %). But an individual assessment of each plant identified 4 groups of ecological conditions (figure 1).

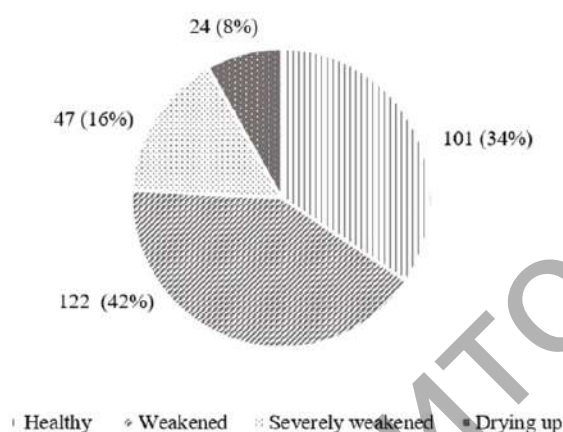


Figure 1 — Ecological condition of public green spaces in the Frunzensky district of Minsk

Summing up, the general ecological condition of public green spaces in the Frunzensky district of Minsk can be described as acceptable. The healthiest green areas are concentrated in the north-western part of the district. Especially polluted public green territories are squares, because these are the smallest green zones with the absence of a large number of trees that can protect non-peripheral plants from anthropogenic pressure. In general, trees located in the proximate neighborhood of major roads or industrial enterprises are subject to the strongest negative impact of urban area.

In the future, such monitoring should be carried out not only in order to maintain, but also to improve the indicators of urban green spaces ecological condition. Also, in order to prevent the widespread deterioration of green areas ecological indicators, a special assortment of plants should be used in urban landscaping. Such plants do not

only reveal strong resistance to adverse conditions of the urban environment, but also demonstrate high indicators of decorative and sanitary-hygienic abilities, for example: black poplar, norway maple, blue spruce and etc.

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