Assessment of the condition of the multifunctional green area of Voronezh "Park named after Sherstyuk"

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Abstract. The article is devoted to the current environmental problem of the urban environment - the presence and condition of public green areas. The article presents the results of an environmental assessment of the state of the multifunctional green area of the city of Voronezh "Park named after. Sherstyuk." The main goal was to determine the qualitative and quantitative state of tree plantations by species, as well as an inventory of emissions from vehicles to determine the state of ground-level atmospheric air. When conducting research, standard methods of environmental research were used, followed by desk processing. The tables below reflect data on the species composition, average diameter and height of plantings, as well as the number of tree species by condition category. The tables also reflect the content of harmful substances in the atmospheric air, calculated in accordance with GOST R 56162-2014.

1 Introduction

The active pace of development of urban areas is transforming urban green areas - they are negatively impacted by anthropogenic environmental factors. Green areas, which create the basis of the urban ecological framework and have a beneficial effect on the health of the population, are of great importance in solving emerging environmental problems at the local level [2].

Increasingly, city residents are receiving feedback that trees in the city are being cut down, and developers are trying to take over parks and squares, taking away green urban islands of vegetation from people. This problem arose especially acutely in the Left Bank district of the urban district of Voronezh, where the total area of green areas does not exceed 130 m^2, and in terms of the number of people living - 6.9 m^2 per person, with a norm of 10-12 m^2 (according to SNiP 2.07.01 -89).

The Left Bank district of the city of Voronezh is the main industrial zone, where a huge number of production sites have accumulated, the share of which is already 27% in the regional output and 44% in the city. These enterprises, mainly of hazardous production, cause irreparable damage to the environment.

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The two largest green multifunctional areas are Yuzhny Park named after. L.D. Kudryavtseva (Novosibirskaya St., 5v), with an area of 89,721 m2 and a park named after. Sherstyuk (Rostovskaya St., 39v), with an area of 43,007 m2. Since July 8, 2011, Yuzhny Park has been assigned to the EcoCenter MCP, in accordance with Decree No. 470-r "On the assigned individual green areas of public use to the municipal government-owned enterprise of the Voronezh city district "EcoCenter." In turn, the park named after. Sherstyuk was transferred under control of this enterprise only in 2023. Until 2023, the park was maintained by the local cultural center, which is why it was neglected and practically abandoned. At the moment, the park named after. Sherstyuk is a territory with development prospects, it is being improved and transformed. Thus, in 2023, with the help of the EcoCentre MCP, flower beds with a total area of more than 650 square meters were laid out on its territory, with perennial and annual ornamental plants.

Having examined the park in detail. Sherstyuk, we determined that the area of the park area, that is, excluding paths, buildings and structures, is about 34,000 m^2, including sports and children's playgrounds. The same area includes shrubs with a total area of about 2288 m^2 (Spiraea Vanhouttei), Cotoneaster lucidus and Physocarpus opulifolius. Paths and various types of structures occupy 9000 m^2. for organizing leisure activities for local residents, there are 58 small architectural forms (38 benches and 20 garbage bins) located in the park.

The soils of the park are anthropogenically transformed, and therefore the ground cover is a very sparse herb that undergoes constant trampling [5].

The main problem of the park is the high anthropogenic load, which increased sharply with the beginning of the demolition of "Stalin" buildings in the areas adjacent to the park and the construction of large-scale residential complexes at the demolition sites. In addition, massive construction of residential complexes took place on Korolkovaya and Rostovskaya streets (BAM microdistrict). On the territory of the village. Maslovka, new industrial territories have appeared, where thousands of Voronezh residents have found their jobs, whose route to work now runs through congested streets. Novosibirskaya and st. Rostovskaya, which are daily drowned in ten-point traffic jams.

With the increase in anthropogenic load, the deterioration of the condition of the park's tree plantations began to noticeably increase [4]. Increasingly, emergency situations involving trees falling down from their roots, as well as falling trunks and skeletal branches, when a tree breaks in half, have begun to occur.

Due to the fact that the park is an integral and necessary green area for local residents, located in an environmental risk zone, we examined it and the adjacent streets to identify the reasons for the deterioration of the plantings.

2 Methods

During the research work, local monitoring of tree plantations in the park named after. Sherstyuk using the visual method of diagnosing trees. This method allows you to assess the viability of trees through visual identification of external signs of various types of pathology. The results obtained were entered into a database and processed mathematically and statistically. Using the collected data, it becomes possible to determine the fatality of damage, as well as establish the category of tree viability:

- category 1 – trees without signs of weakening;
- category 2 – weakened trees;
- category 3 – severely weakened trees;
- category 4 – drying out;
- category 5 – dead wood of the current year;
- category 6 – dead wood from previous years [1].

To determine the content of substances in the atmospheric air, we used the GOST R 56162-2014 methodology, during which an inventory of pollutant emissions from motor vehicles was carried out.

To identify the dependence of the condition of tree plantations on the intensive traffic of cars along Rostovskaya Street, the park territory was divided into three sections by us using a curvimeter.

3 Results

Based on the research results, the following data were obtained.

Table 1. Sheet for assessing the condition of trees in the park named after. Sherstyuk

№	Name of the breed	Average diameter, cm	Average height, cm	Number of tree plant species by condition categories					
				1	2	3	4	5	6
1	Small-leaved elm	27±0.5	14±0.3	31	16	5	62	12	-
2	Common ash	22±1.3	18±1.1	-	-	-	5	3	-
3	Poplar black	40±0.8	25±0.5	3	12	16	19	-	-
4	Poplar pyramidal	32±0.6	35±0.7	5	13	7	2	0	0
5	Silver birch	25±0.7	23±0.7	-	4	5	3	1	-
6	Ash maple	35±1.0	13±0.4	5	8	3	-	1	-
7	Robinia pseudoacacia	25±0.7	12±0.4	2	5	-	4	1	-
8	Small-leaved linden	25±0.5	16±0.3	11	17	1	8	-	-
9	Norway maple	40±0.9	17±0.3	37	9	2	1	-	-
10	Apple tree	21±0.1	4±0.2	-	1	1	-	-	-
11	Norway spruce	15±0.9	3±0.2	-	-	1	-	-	-
Total:				94	85	41	104	18	-

As a result of the distribution of the tree stand of the park named after. Sheryustka into qualitative groups, the results shown in Figure 1 were obtained.

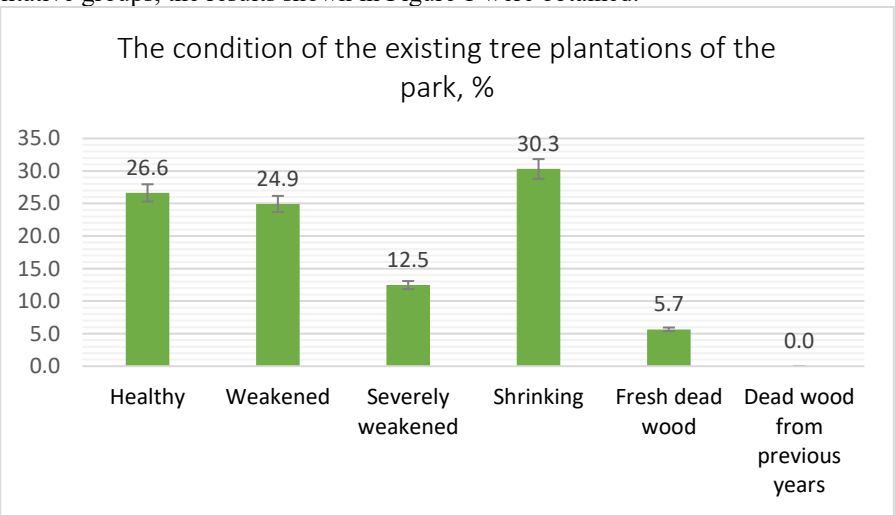

Fig. 1. Categories of viability of tree plantations in the park named after. Sherstyuk (in percentage terms).

Source: author's own composition

Analyzing the figure, it was determined that 27.5% of healthy trees. The bulk of the plantings are weakened (24.9%), severely weakened (12.0%), drying out (30.4%) and fresh dead wood (5.3%). Not a single tree was classified into condition category 6 (dead wood from previous years). Trees of categories 2, 3 and 4 include trees with obvious signs of bacterial diseases, such as bacterial dropsy, fruiting bodies of polypores, black cancer, as well as trees with drying skeletal branches. Such specimens are observed mainly along the periphery of the park (near roads) [1].

To identify violations of the state of the ground layer of atmospheric air, we carried out an inventory of emissions from motor vehicles in accordance with GOST R 56162-2014. The following results were obtained.

Table 2. Content of harmful substances in the air

Pollutant (mg/m3)	Cars	Trucks	Bus	Total, mg/m3
CO	16.3	20.5	0.4	37.2
				MPC 3
NO_2	1.1	1.3	0.6	3
				MPC 0.04
C	0.7	0.1	0.1	0.9
				MPC 0.05
SO_2	0.1	0.04	0.1	0.24
				MPC 0.05

Analysis of the data obtained allows us to conclude that trucks make the largest contribution to environmental pollution from the traffic flow. Total carbon monoxide pollution exceeds the average daily MPC by 12.4 times; nitrogen oxide – 75 times, carbon – 18 times, and sulfur oxide – 4.8 times [6].

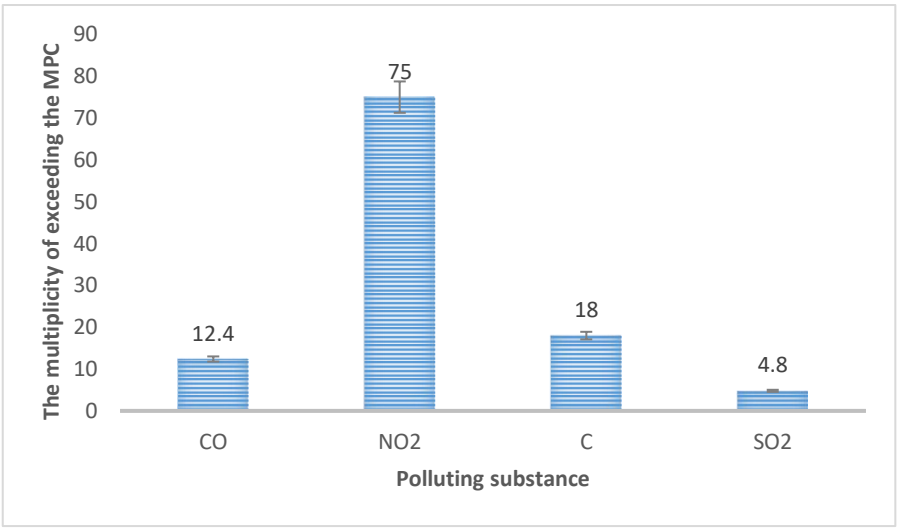

Fig. 2. Multiplicity of exceeding the maximum permissible concentration of pollutants from cars

Source: author's own composition

All these pollutants cause serious damage to public health, causing lung diseases and asthma.

These substances also have a negative effect on plants: nitrogen oxides cause plants to decrease their protective properties against bacterial diseases and have a mutagenic effect, and sulfur oxide slows down natural growth and causes yellowing of leaves [3].

To identify the dependence of the condition of tree plantations on heavy traffic along the adjacent street, the park territory was divided into three sections as we moved away from Rostovskaya Street: the first section is close proximity to a busy road section (up to 100 m), the second section is an average distance (100-200 meters) from the highway and the most remote section is 200-288 meters from the place of the most intense automobile traffic (Figure 3).

Fig. 3. The scheme of the division of the park named after Wool for sections away from the highway.

Source: the author's own composition.

Based on the results of the work carried out, the following data were obtained.

On the site adjacent to the highway (Rostovskaya Street), we identified 88 trees in different categories of condition (Table 3).

Table 3. Plantings of the park named after Sherstyuk on the site adjacent to the highway (Rostovskaya street)

№	Type of woody plant	The number of tree species of plants by category of condition					
		1	**2**	**3**	**4**	**5**	**6**
1	Small-leaved elm	3	9	10	4	0	0
2	Common ash	0	0	0	0	0	0
3	Black poplar	0	0	0	0	0	0
4	Pyramidal poplar	0	4	4	4	0	0
5	Hanging birch	0	2	5	8	0	0
6	Ash-leaved maple	0	0	0	0	0	0
7	Robinia is a fake	0	0	3	0	0	0
8	Small-leaved linden	6	6	5	0	0	0
9	Holly maple	4	3	7	0	0	0
10	Apple tree	0	0	0	0	0	0
11	Common spruce	0	0	1	0	0	0
Total		13	24	35	16	0	0

In the "medium distance" area, we identified 122 trees of various categories of condition (Table 4).

Table 4. Plantings of the park named after him. Sherstyuk at a distance of 100-200 meters from Rostovskaya street

№	Type of woody plant	The number of tree species of plants by category of condition					
		1	2	3	4	5	6
1	Small-leaved elm	23	8	7	0	0	0
2	Common ash	0	0	0	2	0	0
3	Black poplar	0	10	2	2	0	0
4	Pyramidal poplar	0	5	4	0	0	0
5	Hanging birch	0	4	3	0	0	0
6	Ash-leaved maple	9	2	0	0	0	0
7	Robinia is a fake	0	4	1	0	0	0
8	Small-leaved linden	8	1	0	0	0	0
9	Holly maple	18	5	4	0	0	0
10	Apple tree	0	0	0	0	0	0
11	Common spruce	0	0	0	0	0	0
Total		58	39	21	4	0	0

At the site farthest from the highway (200-288 m.), we found 143 trees of various categories of condition (Table 5).

Table 5. Plantings of the park named after him. Sherstyuk at a distance of 200-288 meters from Rostovskaya Street

№	Type of woody plant	The number of tree species of plants by category of condition					
		1	2	3	4	5	6
1	Small-leaved elm	42	18	2	0	0	0
2	Common ash	0	0	0	6	0	0
3	Black poplar	0	15	21	0	0	0
4	Pyramidal poplar	0	4	2	0	0	0
5	Hanging birch	0	0	2	0	0	0
6	Ash-leaved maple	0	6	0	0	0	0
7	Robinia is a fake	4	0	0	0	0	0
8	Small-leaved linden	10	1	0	0	0	0
9	Holly maple	7	1	0	0	0	0
10	Apple tree	0	0	2	0	0	0
11	Common spruce	0	0	0	0	0	0
Total		63	45	29	6	0	0

Thus, we get a summary table with the number and condition of trees at different sites of removal (Table 6).

Table 6. The number and condition of trees at different sites of removal from the highway

Distance from the highway	Number of trees by status category					
	1	2	3	4	5	6
0-100 meters	13	24	35	16	0	0
100-200 meters	58	39	21	4	0	0
200-288 meters	63	45	29	6	0	0

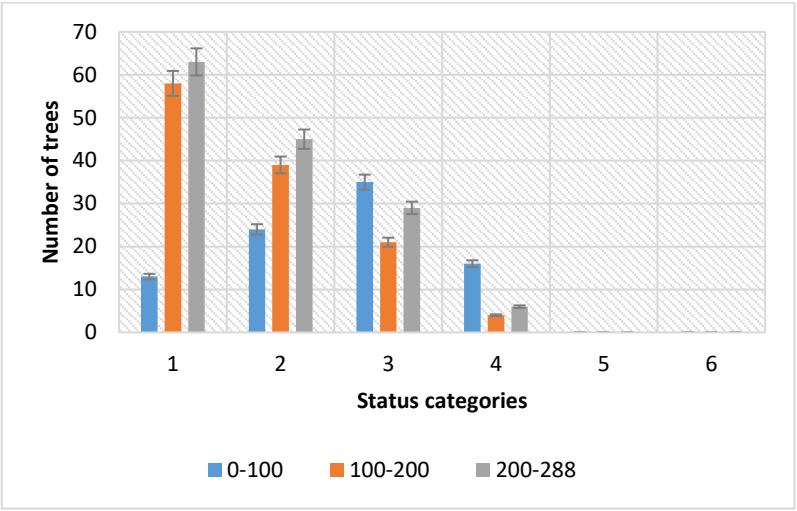

Fig. 4. Categorization of the condition of trees growing in different areas away from the highway.

The figure shows that at the removal site of 0-100 meters, the number of trees without signs of weakening is significantly lower (the first category of condition), but the number of drying trees is significantly higher (the fourth category of condition), which confirms that a significant excess of pollutants from vehicles in the atmospheric air has a detrimental effect on tree plantations.

4 Conclusions

Using the example of the park named after. Sherstyuk and the adjacent territory, we see that the flow of vehicles, increasing with the development of the area and the opening of new production sites on the outskirts of the city, is increasing, and the indicators of pollutants from vehicle emissions already exceed the maximum permissible concentration by 75 times. This negatively affects the condition of scarce tree plantations in the Left Bank region and the park named after. Including Sherstyuk, which is one of the few green islands of vegetation and on which the health of the population living around depends.

The current trend could be changed by the organization of additional green areas, as well as the construction of an additional viaduct from the street. Rostovskaya to st. Heroes of the Stratosphere and st. Volgogradskaya and an additional bridge across the Voronezh Reservoir to reduce the load on the road section along the street. Lebedeva. In addition, it is necessary to establish stable operation of public transport, and when updating it, preference should be given to environmentally friendly models.

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