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Morphometric parameters PINUS SYLVESTRIS L. into condition of guardian and urban lands.

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ABSTRACT

Anthropogenic impact covers urban ecosystems, and specially protect natural areas, including national park. In this regard, required to develop approaches for assessing the impact of different environments to natural components. In most cases, Scots pine (*Pinus sylvestris* L.) is hadused as a biological indicator on technogenic disturbed areas. In his study, we evaluated the morphometric parameters of *Pinus sylvestris* L., growing in a modified urban ecosystems, and national park. It has allowed revealing regularities in the development of plants in different conditions, to evaluate the prospects of using *Pinus sylvestris* L. as bio indicator for protected areas.

Keywords: Scots pine (*Pinus sylvestris* L.); urban ecosystems, national park, anthropogenic load, bioindication, morphometric parameters.

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INTRODUCTION

In the process of the development of science, originally thought that the protected areas are the standards natural state of nature. However, they had not be fully described as "intact." On the protected areas, influence external (transboundary transport of pollutants) and internal factors, relating to the placement within residential areas, the development of tourist and recreational activities, grazing, firewood, etc. All this leads to need for environmental monitoring in the public areas. [4]. Organisms, components of biogeocenosis protected and recreational areas, in lesser extent adapted to influence on the ecosystem of external factors, and therefore more accurately react to the slightest changes in the environment. As a result, even a minor anthropogenic impacts cause enough to recognize the reaction of biota. For this reason, the state of the ecosystem as a whole and its individual components, it is desirable to evaluate using bioindication methods, which give an idea about the general state of the totality living organisms [2, 3, 8].

Currently, very often at the "standard biodiagnostics" industrial sites taken Scots pine. This is because the anatomical and morphological changes of needles, as well as the duration of her life are informative signs of trouble surrounding environment. Initially, lesions appear on the biochemical level. Afterward are going to destruction of internal functions, further leads to the development of any symptoms - chlorosis, necrosis, dieback, changing its biometrics [5, 6, 7].

In this context, the aim of our work was approbation the use of Scots pine as an indicator of the state of the protected area - reserve, and comparative analysis of the results obtained under the conditions of the urban ecosystem.

MATERIALS AND METHODS

To conduct research in the June-July 2015 were selected plots on the territory of Stavropol Taman forests and estates Teberdinsky State Biosphere Reserve (TSBR). Selected to compare areas are similar by physiographic and climatic characteristics that determines the similarity of ecosystems. The main difference is simply that TSBR is a protected natural reserve where the ecosystem is in a state as close to natural, and in urbo ecosystem of the city of Stavropol is present anthropogenic pressure, associated with high vehicular and industrial load. The definition of the environment we had conducted by complex of traits *Pinus sylvestris* L.

Initially at the height from 1.5 – 2 m from the side adjacent to areas with polluted air, are had cut the branches of the conditional even-aged pines. By viewing the shoots was determined by the age of needles. Similarity needles are had calculated by counting the needles per 10 cm shoot of last year. With the help of a ruler and caliper measured the length and width of needles [1, 3, 9]. Afterword, the needle was carefully inspect in order to identify them chlorosis, necrosis of the tips and entire surface, their percent and character (point, mottling, spotting, mosaic). In all cases, used the statistical measurement method for deriving an average value.

Based on the data obtained theoretical (the study of the biology and ecology of Scots pine) and a practical way, was carried out a comparative analysis.

RESULTS AND DISCUSSION

According to the biological characteristics of *Pinus sylvestris* L., as a result deterioration of growing shoot into contaminated area, the bundles of needles tend to converge. Our studies have confirmed this hypothesis. By calculating the mean values, we determined that the reserve number of needles per 10 cm of the shoot last year is 197 units, and in Stavropol - 224.

The need to determine number of needles different ages, predetermined by the fact that not contaminated territory of their life expectancy is much higher. When counting number needles of different ages, revealed that in contrast to the guarded, in the urbanized areas no needles IV-th and V-th age (Fig. 1). This fact indicates the presence of a more aggressive anthropogenic pressure on the territory of the Taman forest ecosystem than homesteads Teberda Reserve. In the study, we found that the presence pollutants affects the size of the needles. In the area more vulnerable to anthropogenic pressure, noted thickening and shortening of the needles compared to homesteads Teberda Reserve (Table. 1).

Informative sign of a certain level of air pollution is the state of needles: discoloration (chlorosis, yellowing), premature wilting and defoliation of needles, the presence of necrotic spots. Data obtained by examining the damage of pine needles Teberda Reserve and Taman forest city of Stavropol, are had presented in Table 2.

Table 1: Results of quantitative surveys of needles of Pinussylvestris L.

Place selection of needle samples	Age, needles	The length of needles, mm	The width of needles, mm	Weight of 1000 pcs.,g
Teberdinsky State Biosphere Reserve	1	64,6	0,8	-
	2	68,2	0,9	12
	3	63,2	1,0	-
	4	63,0	0,9	-
	5	60,1	0,9	-
	Average	63,8	0,9	12
Taman Land Forest Stavropol (crossroads ave. and Kulakov Str. Vasiliev)	1	54,6	1,0	-
	2	46,1	1,2	10,5
	3	43,9	1,1	-
	Average	48,2	1,1	10,5

Table 2: Qualitative characteristics of pine needles collected from guardian and urban areas

Qualitative indicator of the needles	The number of needles of each age of life, pieces.									
	I-th year		II-th year		III-th year		IV-th year		V-th year	
	O	Y	O	Y	O	Y	O	Y	O	Y
The total number of needles	555	1202	1626	2326	976	383	698	-	316	-
The number of needles with white spots	4	172	318	778	244	79	144	-	58	-
The number of needles with brown spots	3	53	-	229	13	21	67	-	42	-
The number of needles with dark spots	-	109	60	387	60	77	161	-	56	-
The number of needles with a dark tip	-	231	54	166	177	8	121	-	16	-
The number of needles from drying	-	177	86	464	68	196	97	-	118	-
The number of needles with scale	17	2	23	5	49	-	-	-	-	-
The number of needles with rot	-	4	-	7	-	-	-	-	-	-
The number of "healthy" needles	531	454	1085	290	356	2	138	-	26	-

Note: O – a specially protected natural territory of Teberda state biosphere reserve; Y – urban areas – Taman forest Stavropol city.

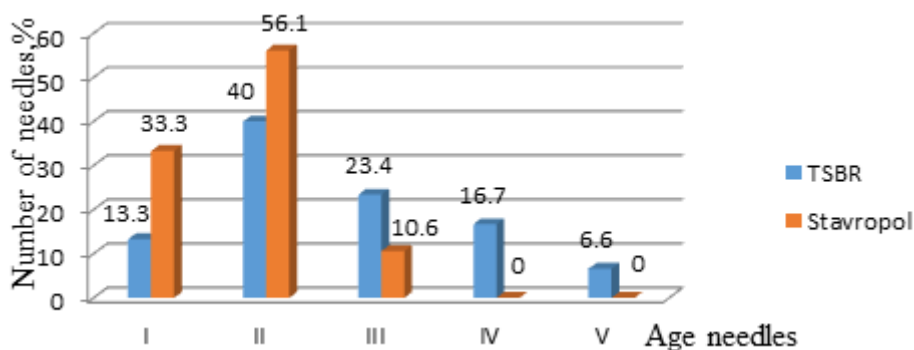


Figure 1: Presence of needles of different ages in the surveyed areas

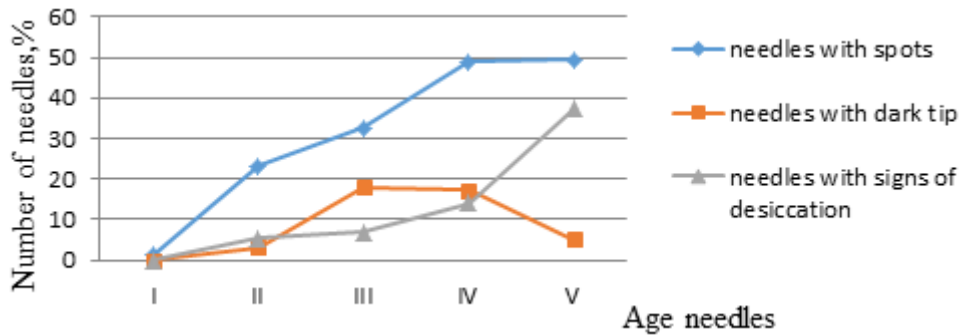


Figure 2: Changes quality characteristics of needles TSBR

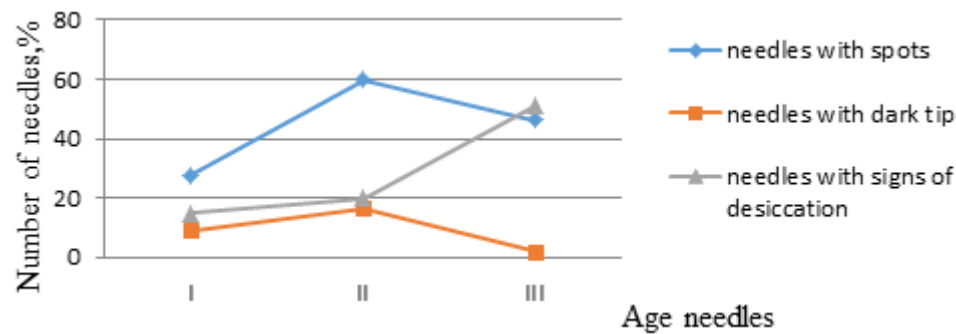


Figure 3: Changes in the qualitative characteristics of the needles in the city

From the table, one can see a gradual stepwise reduction in the number of "healthy" of needles collected from the protected area, which is caused by normal physiological development of Scots pine. In this connection, we can assume a minimal impact on the ecosystem. In urban areas, we see quite a sharp decline in "healthy" of needles (3 and 21 times, respectively), indicating the presence of the city in a sufficiently large number of air pollutants that lead to the emergence synergies.

Analysis of the data also showed that with increasing age in the pine needles appear TSBR white necrotic spots, brown and black color (Fig. 2). This fact indicates the presence of some of the air pollutants, especially nitrogen oxide fluorides. Suffice it to a sharp increase (from 3.3% to 18.1%) the number of needles, that has browning of the tips, are indicates the presence in the air of sulfur dioxide, the main source of which is the highway that runs along the reserve.

The gradual reduction of the same indicators in the "older age" due either to complete browning of needles or their withering away, which is associated with an accumulation of pine needles capacity. Drying up of the needles of pines growing in the reserve Manor, related in our opinion, primarily with the natural process of withering away.

Analysis of changes in indicators of pine needles collected from the pine trees of the city of Stavropol with age revealed quite clearly the dynamics of increasing the proportion of needles with different injuries (necrotic spots, darkening of the tips of the needles, drying) in the second age (Fig. 3). This is due to the presence in the atmosphere of certain pollutants: the increasing proportion of needles with Browning at the tips of the needles in the early stages of development indicates the presence of sulfur atmospheric pollution. The sharp increase in the number of drying needles (between the ages II and III), due to the presence of chlorine in the air, nitrogen oxides, lead, cadmium.

A comparative analysis of the obtained data, we found that the total percentage of damaged needles in the city of Stavropol (83%) more than Teberda state biosphere reserve (48.8 per cent). There is a difference in "age" of the damage the needles. Needles of I age has damage, only 4,32% of the examined needles of the reserve and in Taman forest, the figure is 62,23%. For II and III ages for both territories these figures are respectively 33,27 and 87,53; 62,61 and 99,42%.

CONCLUSION

Morphometric characters of *Pinus sylvestris* L. can be used as indicators of airborne pollution in anthropogenically disturbed areas and protected. This is due to the fact that pine needles have the ability to effectively absorb pollutants in the form of aerosol deposition through diffusion and the latter in the cavities of lamina air passages. Due to the small surface of the needle, thickened cuticle and a small number of stomata, the removal of trace elements absorbed from the surface of the leaf plate on evaporation of moisture and gas exchange with the atmosphere is very small, allowing pollutants to accumulate and affect the morphological structure of plants. In addition, *Pinus sylvestris* L. is evergreen and gives one shoot per year, which greatly facilitates the observation, and therefore makes the plant a convenient and informative bioindicator.

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