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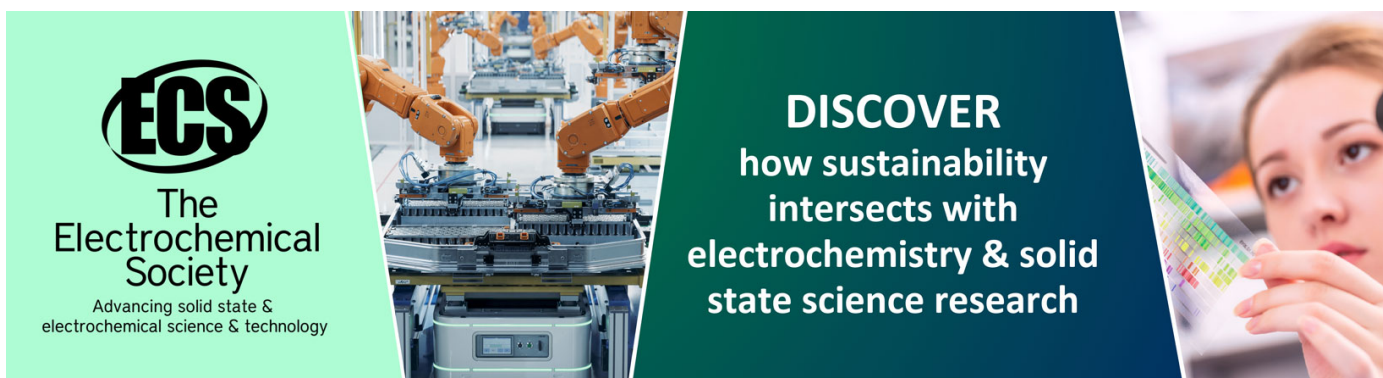
Ecological and aesthetic significance of an autotrophic component of artificial ecosystems in ensuring of the environmental comfort and the public health protection

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Ecological and aesthetic significance of an autotrophic component of artificial ecosystems in ensuring of the environmental comfort and the public health protection

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Abstract. Aim: to assess the aesthetic appeal of tree and shrub plantations of urban ecosystems (for example, the settlements of Central Russia). The research is implemented on the example of common, special and limited use plantations. Environmental diagnostics aesthetic qualities of the plantings carried out on the basic biological and ecological signs. The paper considers one of the key indicators of the environmental comfort, taking into account anthropogenic impacts. It is the decorative effect of tree and shrub plantations. These plants make the basis of an autotrophic component of the urban systems of Central Russia and form the functional core of their ecological frameworks. A high level of decorative plantings of woody plants and shrubs in the research areas was established. The highest points of decorative plantings were found in the town of Novokhopersk and in the urban village of Gribanovsky. In the region under consideration reliable differences in esthetic qualities of tree and shrub plantations are revealed. Planting of trees and shrubs have a high aesthetic appeal. It characterizes the degree of culture of urban landscapes and technogenic pressure upon them. The results obtained can be used in the system of environmental monitoring of the urban environment in Central Russia.

1. Introduction

The technogenic landscapes in the European part of Russia occupy vast territories now [1, 2]. Their economic development is constantly growing. It mainly occurs at the expense of urbanization, agglomeration and the accompanying phenomena of technogenic and degradational character. In technogenically transformed landscapes ecosystems are created for different purposes. Special ecosystems are created in urban and suburban areas. They are necessary to ensure ecological balance in the environment and to create conditions of ecological comfort for local residents [3]. Moreover, it is recognized abroad and in Russia [4, 5].

The most densely populated territories of European Russia are regions of its central part. In essence, the technogenic environment covers them almost completely. The created technosphical



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complex represents an extensive logistic network. Its centers are settlements, first of all, of a town type. Towns, suburban areas and large rural settlements were the most formed in economic terms. In these settlements objects of industrial, building, power, transport, commercial, agricultural and other industries of social production are localized. The said above is true about the Moscow, Saratov and Voronezh regions [6, 7]. These areas have developed transport, industrial and agricultural potential with a complex of adjacent clusters of national economy. The technogenic environment with the remained and in different degrees transformed natural and territorial complexes make the basis of a habitat for the population.

The Voronezh region is a rather inhabited subject of the European part of the Russian Federation. In its large cities critical ecological phenomena connected with technogenesis are noted [8]. They are especially relevant for many urban systems of central Russia at present with its economic crises. This circumstance is aggravated with apparent insufficient funding of ecologically protective measures in production, transport and building spheres, in agrarian sector.

At the periphery, at a distance from the regional center technogenic landscapes are presented by the small towns (examples: Novokhopersk, Borisoglebsk, Povorino) and town-type settlements (Gribanovsky and others).

These settlements represent complex natural and technical systems in their structural and functional terms. The functionality of their ecological frameworks is realized by green plantings. Plantings make the basis of an autotrophic component of the ecosystems of the towns, suburban areas and rural settlements of the Voronezh region. Tree plants and shrubs carry out the environment-forming, protective, environmental and microclimatic, environmental and rehabilitational functions in towns' technogenic landscapes and on suburban areas [9]. First of all, the ecological significance of plantings in the regions of placement of transport infrastructure, the enterprises of agrarian sector, wholesale storage facilities and other engineering systems and constructions is rather obvious. Tree and shrub plantations represent the basis of producers of town and rural natural and technical systems. Therefore, the assessment of the state and properties of tree and shrub plantations is an important task in the structure of the ecological analysis of the urban systems. The assessment of esthetic qualities allows us to reveal the attractiveness of plantations and their ecological opportunities. These bioecological characteristics belong to the leading limiting conditions for providing environmental comfortable habitat for local residents.

The decorative signs of plantations carry out the leading role in the formation of a favorable microclimate and the optimization of sanitary and hygienic factors within towns. The decorative effect of plants reflects esthetic shape of the urbanized environment. Trees and shrubs are the main source of enriching and perfecting the architectural and art image of inhabited territories.

In Novokhopersk, Borisoglebsk, Gribanovsky and Povorino the range of tree vegetation is rich because of a favorable placement in a forest-steppe zone with a temperate climate and historically developed introduction. The decorative qualities of introduced species allow us to use them as material for planting trees and shrubs. When using tree plants and shrubs in town plantings special attention to their decorative appeal is paid.

The purpose of the research is to conduct a complex assessment of the decorative effect of tree plants and shrubs for their further use in making towns green.

2. The methods of the research

Assessing tree plants and shrubs we used a modern methods of scientists from Arkhangelsk [10]. For all the species we made an assessment using 10 signs: crown architectonics, duration of blossoming, blossom degree, coloring and size of flowers, appeal of the appearance of fruits, aroma of flowers, duration of leafing, damageability, autumn coloring of leaves and winter hardiness. The highest point (5) was given to that specimen which had the best properties, further the point decreases to 0. As a result, the points on all signs were summarized and an average assessment was given. Such calculations were carried out for all the settlements included in the areas of the research.

3. The results of the research

During the study of tree plants and shrubs it was investigated and registered: in Novokhopersk – 164 species, in Borisoglebsk – 149 species, in Gribovsky – 103 species, in Povorino – 110 species. Figure shows that the species growing in Novokhopersk (36 points) have the greatest decorative effect. In Borisoglebsk, Gribovsky and Povorino the points were distributed from 35.5 to 34.8.

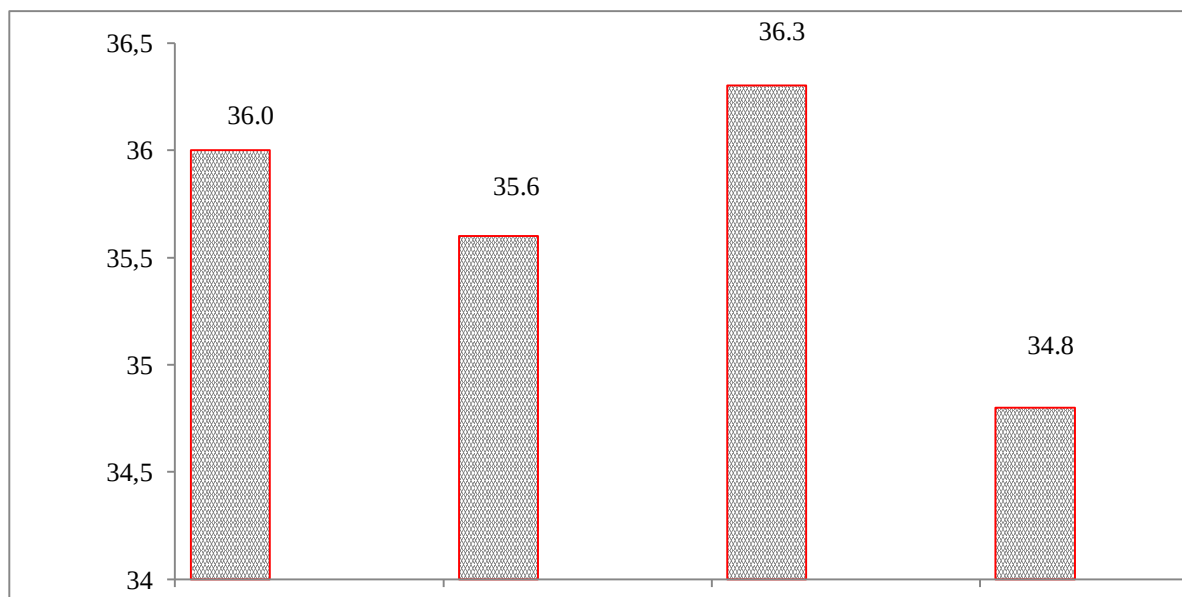


Figure 1. The assessment in points of decorative qualities of tree and shrub plantations (the weighted means on species, routes and years of observations, 2013-2017).

The highest assessment of decorative effect from 40 points and above have the following species: *Picea abies* (L.) Karst, *Picea obovata* Ledeb., *Sambucus nigra* L., *Viburnum opulus* L., *Ribes aureum* Pursh, *Ribes nigrum* L., *Crataegus oxyacantha* L., *Padus avium* Mill., *Physocarpus opulifolius* L. Maxim., *Prunus domestica* L., *Sorbus aucuparia* L., *Malus praecox* (Pall.) Borkh., *Prunus divaricata* Ledeb. The smallest number of points from 31 to 39 have the overwhelming quantity of species among which are *Juniperus communis* L., *Thuja occidentalis* L., *Larix decidua* Mill., *Taxus baccata* L., *Acer saccharinum* L., *Berberis thunbergii* DC, *Catalpa speciosa* Walt., *Lonicera caprifolium* L., *Symphoricarpos albus* L., *Viburnum opulus* Roseum, *Cornus alba* L., *Elaeagnus angustifolia* L., *Robinia pseudoacacia* L., *Hydrangea paniculata* Sieb., *Syringa josikaea* Jacq. fill.

The average assessment of appeal have *Alnus incana* L., *Betula pendula* Roth, *Juglans regia* L., *Fraxinus americana* L., *Fraxinus lanceolata* Borkh., *Forsythia sieboldii*, *Flangula alnus* Mill., *Populus alba* L., *Populus balsamifera* L., *Philadelphus pubescens* L., *Salix acutifolia* Willd., *Tamarix ramosissima* Ledeb.

The species with a low assessment of esthetic appeal are not found. It is an indicator of the relative comfort of town and rural settlements of the Voronezh region.

The arithmetic mean values of the analyzed ecological and diagnostic parameters of tree and shrub planting correspond to high aesthetics. This is an important condition for the ecological well-being of the places of residence for the population. Together with other ecological and diagnostic characteristics, the revealed indicators show the relative ecological comfort of urban ecosystems for local residents. The arithmetic mean values of decorative plantings of trees and shrubs demonstrate variability in different settlements of the Voronezh region.

A comparison can be made with the neighboring Saratov region (according to environmental studies for the same period). Here, the average arithmetic values of the scores of decorative woody

plants are significantly lower. In Balashov they equal 32.5 points, in Rtischevo – 27.4, in Arkadak – 29.6, in Romanovka – 33.1, in Samoylovka – 28.7.

The primary measures for an increase in decorative signs of town plantings are necessary. It can be solved by competent territorial planning of the urban landscapes (taking into account the functionality of ecological frameworks) and competent introducing of tree plants and shrubs from the contents of native and cultural flora.

4. Conclusion

The autotrophic component of urban ecosystems is represented by urban and suburban green spaces. Biological productivity and environmental sustainability of urban and suburban ecosystems depend on their functionality. In terms of actualization of crisis environmental situations, the study of opportunities to ensure environmental comfort of urban ecosystems is an important scientific and practical task. In the structure of environmental comfort is of great importance to assess the aesthetic appeal of plantations in modern settlements. This fully applies to the settlements of Central Russia.

The authentically revealed differing values of the decorative effect of tree plants and shrubs in the considered settlements show a degree of the level of culturalness of urban landscapes. The differences in the decorative effect of tree and shrub plantations are caused by their specific biological peculiarity, the level of the regulating influence of society on town ecosystems, the spatial variability of technogenic factors. The proximity of technospheric objects limits the esthetic and ecological functions of planting trees and shrubs in the towns and in the rural areas.

Thus, the established ecological characteristics of tree and shrub plantations in many respects reflect also an ecological situation differentially to the urbanized territories of the region. In some degree the ecological and among them the esthetic indexes of the plantings determine the indicators of the environmental comfort of the urbanized environment. The established values of the decorative effect of plants demonstrate inequality of the conditions of providing an environmental comfort of the habitat for local residents and their health.

Carrying out the researches on assessment of the esthetic signs of plants allows us to state the following. The types of the cultural dendroflora growing in the considered areas are quite suitable and are recommended for making the towns and settlements of the Voronezh and the neighboring regions green. It concerns the Tambov, Saratov, Volgograd regions and some other regions of central Russia.

Taking into account the modern ecological threats of technogenic character this research is necessary in the fundamental plan. It provides new information on an ecological significance and resource value of green plantings in a regional context. The possession of decorative effect and the ability to keep it throughout a long period of time promotes a general pleasant perception of the urban environment. The last point also is one of the most important factors of a favorable impact on a human body. The preservation and improvement of human health at the population level in Russia is one of the priority reference points of the social development and national economy now. The approved state programs of an ecological and hygienic aspect demonstrate it.

A variety of species, vital forms, ecological groups and the indicators of esthetic appeal of plantings in a complex promotes improvement of a psychophysiological condition of inhabitants of towns and rural areas. Tree and shrub plantations can be in the form of green hedges, avenues, boulevards, various biogroups and other types of plantings. In general, they significantly minimize adverse anthropogenic physical and chemical effects of a town technosphere on soils, other organisms and human health [11, 12].

The results of the conducted research have the essential fundamental value for studying regularities of the tolerance of organisms to the technogenic environment. The obtained results can be put in the system of the assessment of impacts on environment and on its biotic components. It is useful that methods of town-planning practice should be oriented at biological and ecological parameters of tree and shrub plantations. The last ones are the most active, functional and a very dynamic part of the urban environment (the habitat of the modern human populations). Therefore, for an increase in the level of culturalness of technogenic landscapes it is necessary to orient at the esthetic signs of green

plantings and their territorial and time variability. The placement and selection of plants in this case make the basis for strategic territorial planning and reconstructing town and rural quarters. In total, urban plantations play the role of biological recultivation and environmental optimization of urban and suburban land-use at minimal material expenses.

A great importance for ensuring and increasing in ecological sustainability of urban landscapes has a reconstruction and updating of tree and shrub plantations. These works will also contribute to the protection of the health of people both in towns and in rural areas in the Voronezh, Saratov regions and in other regions of central Russia.

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