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Research paper

Assessing the Green Plantings' Condition of Coastal and Island Territories of the Left Bank Area of Volga River (In the Context of the City of Engels)

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Abstract

At present, in many regions of the Russian Federation, in particular in the Saratov Region, coastal and insular recreation areas are in poor condition, both in the populated locality and in the suburban area. Today, they are inexpressive, compact, dispersed, or monotonous long-linear spaces with damaged green plantings and vegetation cover. The present study analyzes the coastal and insular recreation areas located in the city of Engels and its suburbs. The article identifies the main types of coastal and insular recreation areas, their compositional systems, areas (in ha), recreational load, average distances from the city districts to the analyzed recreation zones. The authors carried out monitoring of recreation coasts in order to determine the predominant types of green plantings. In the end of the article, the major conclusions are formulated.

Keywords: *recreation areas, coastal and insular territories, recreational load, compositional system, types, landscaping, landscape, types of green plantings.*

1. Introduction

In many regions of the Russian Federation coastal and insular recreation areas are in poor condition, both in the populated locality and suburban area. In particular, in the Saratov Region, such an environment was formed in the last century. Coastal and insular areas have significant opportunities, and many of them are carriers of historical types of landscapes, and therefore, are considered as a basis for the identification of the environment around the populated locality. In the Saratov Region there are rivers, which are the main connecting axes of landscape-architectural complexes, united in a single entity. For example, Volga, Khoper, Medveditsa, and Large Irgiz rivers became the axis of a number of entities. Most of these spaces are characterized by high degree of regression due to various impacts.

In recent decades, there has been an increase in territorial expansion of recreational activities on coastal and insular landscapes, accompanied by the irrational use of the coastline, a decrease in the area suitable for recreation, as well as the degradation of green plantings.

In our country, various aspects of the coastal areas were investigated: 1) landscape and architectural space formation [3, 4, 6]; 2) ecological optimization of the recreational environment, approaches to landscape design and landscaping systems' formation principles [3, 4]; 3) study of the landscape from the viewpoint of the organization of recreational activities [7]; 4) functional organization of recreational territories, the definition of recreational potential and types of recreational activities; 5) geomorphological analysis of the coastal zones of large city landscapes, environmental and aesthetic issues of coastal landscapes of the Saratov Region and landscaping in general; 6) methods and means of landscape design, landscaping elements and improvement of coastal zones. Among foreign works, urban and coastal spaces were studied by C. Waldheim, J. Corner, M. Mostafavi [9].

A definition reflecting the essence of the "coastal zone" concept was proposed by the European Commission: "The coastal zone is a space where human interaction with the environment is carried out with particular intensity". "The coastal zone of sea is a zone of interface between the land and sea, including natural complexes – both the coast and the adjacent offshore zone within the boundaries that allow for the environmentally balanced development of coastal areas, the preservation of coastal and marine landscapes and ecosystems from pollution and destruction, – it is a territory with limited and regulated economic and other activities" [10].

Despite the significant theoretical basis, the subject under consideration needs developing a systematic, integrated approach aimed at environmental and aesthetic optimization of the environment, landscape reconstruction, and the inclusion of the territory in the natural and recreational core of recreational formations. The relevance of the study also lies in the fact that the main problem of coastal and insular areas consists in a small range of green plantings' types. This requires monitoring of the declared territories.

2. Research purpose

The main purpose of the research was to monitor the coastal and insular areas of the city of Engels and the corresponding species of trees and shrubs in order to improve the aesthetic quality of the forest stand and the functioning of concerned objects in the complex.

3. Materials and methods

The research objects were the coastal and insular areas of the city of Engels of the Saratov Region. The material for the study was the existing recreational facilities (recreation camps, riverwalks, etc.) and their green plantings. The authors used an integrated approach, system analysis, and theoretical synthesis. The research method was based on the following principles: the study of archival and local history materials based on the methods of O.B. Sokolskaya [4,5,6]; the principle of on-site investigation, i.e. overview and measurement of the investigated site and vegetation forms, small architectural forms, as well as panoramic perspectives based on one of the techniques of Sokolskaya [4, 5, 6]; and the assessment of the vital state of plants based on the most common measuring scales of V.A. Alekseev [1, 2]; large-scale biometric study of planting of the riverwalks was carried out by the detailed inventory of plantings [11,12]; the analysis of the planning and spatial structure was conducted by the method of V.P. Stauskas [7], while the study of green plantings was carried out using the three-dimensional projection method, as well as the level and nature of the object perception according to Sokolskaya [4, 5, 6]. Recreational load on the shores and islands was determined by the method of N.V. Krasnokutskaya [8] using the formula:

$$R = Ni/Si,$$

where R was the recreational load, Ni was the number of people visiting recreational facilities, Si was the area of recreational territory.

A comparative method was used to identify the general development patterns of coastal areas.

4. Results and discussion

We have established a typology of recreation areas in the structure of coastal and insular territories and divided the territories into five types: *riverwalks*; *short-term recreation areas on the banks of the Volga River; short-term recreation areas near lakes; beach areas;* and *long-term recreation areas on islands and lakes*. The total area of the areas under study is 228.4 hectares. In the course of analysis we identified the types of compositional systems and their features, taking into account the data on the areas of recreation zones and the length of their shorelines. From this it follows that among the compositional systems, the *linear-central type with an external orientation* (44%) prevails, *ring dispersed* type (22%) is in the second place. Besides, there is one *dispersed system with a linear inclusion*; as well as one *compact-central system with an external orientation*; and one *compact double-fan-shaped system*. We have noted a negative trend leading to reducing the operation of a number of recreation areas. In terms of percentage, about 32% of the analyzed territory belongs to the zones with the maximum attendance. Areas with the average attendance amount to 26%, hard-to-reach areas and part of the insular spaces with minimum attendance have significant advantage – more than 34%. Despite the effect of a uniform distribution of the percentage, the maximum attendance falls on the central recreation areas. The insular territories, almost completely, belong to the zones characterized by the minimum attendance. The reason for the uneven distribution of holiday-makers is also explained by the location of the most visited centers in the central parts of the cities and the lack of improved recreation areas within walking distance of peripheral areas (see Table 1).

Table 1: Average distance from the various districts of Engels city to the analyzed recreation areas, m

Districts / Recreation areas	Timber mill	River side	Central	Reclamation	Construction	Agricultural
	Distance from district to recreational area, m					
Green area at the Mostotryad	800	1,920	2,340	4,340	4,780	6,870
Rudchenko riverwalk	2,980	3,410	680	1,850	3,460	3,720
Forestland near lake Sazanka	965	1,490	3,740	5,310	4,840	7,390
Shores of lake Bannoe	1,120	2,150	1,420	3,720	3,230	7,940
Shore at the 1st Geological passway	6,850	7,110	4,830	2,910	4,780	760

Table 1 shows that remote districts are located at certain distances from the city center (for example, Reclamation and Construction districts). They are located further than walking distance (more than 1,500 m) from the recreation zones near water bodies. It is important to note that the complex of coastal areas of the Engels city is a group of recreation areas located on the same line running parallel to the river. The main axis can be determined as a Volga Bank street running along the bulk dam line passing through Rudchenko riverwalk. We have determined the indicators of recreational loads falling on the recreation zones, taking into account the number of visitors of not only areas located within walking distance (10% of the population), but also taking into account the nearby districts, from where residents visit these objects (assumed to be 2.5% of the population). To calculate the recreational load on the insular territories, we have taken the average number of inhabitants who visit the islands equal to 10% of the city population. Also, the level of popularity of the territories at the time of analytical studies was taken into account. Thus, the ratios of recreation loads in the territories of recreation zones under consideration, expressed in persons/ha (the authors' studies of 2014-2017) were as follows: greened land near Mostotryad – 551, Rudchenko riverwalk – 684; Forest land near lake Sazanka – 103; lake Bath shore – 449; the shore at the 1st Geological passway – 262; and the Ponomarevsky island – 172.

Recreational load in some recreation zones is much higher than normal (300 people/ha). Rudchenko riverwalk with the city park are the most popular areas of the central recreation site in the structure of coastal and insular territories of Engels city. They bear large recreational load. We have also revealed that recreational load is affected by the season and the climate conditions. In winter, there are almost no people visiting the insular territories. Sharp changes in climatic conditions do not reduce the recreational load on the popular sites, suffering from its impact, such as the Rudchenko riverwalk. First of all, less popular recreation facilities, such as the shores of the lake Bannoe, the recreation area at the Mostotryad, and the shore at the 1st Geological passway lose their relevance. Insignificant popularity of these objects during the periods of reduced activity of citizens leads to the desolation of these sites.

We have established the prevailing types of green plantings in the study areas. For example, in the territories of recreation near the lakes more popular is Populus *alba* L. (15.75%) planted mainly near the lake Sazanka. Next comes *Populus nígra L.* (12.71%), next – *Salix alba* L. (11.35%) perfectly growing in wet areas. *Ulmus pumila* L. (8.85%) is widespread as well. Due to *Populus alba* L. and *Salix babylonica* L. tree species, highly decorative for most time of the year, the landscape in the recreation areas near the lakes is quite attractive, but the lack of contrasting bright accents discolors the overall picture. The Volga river territories are dominated mainly by *Acer negundo* L. (29.35%) and *Ulmus pumila* L. (15.74%) tree species.

Plantings of these species prevail everywhere. Further, according to the percentage ratio goes *Robínia pseudoacacia* L. (8.58%), mainly planted in the territory of the bank of the 1st Geological

passway. The third place with the largest number of trees is represented by species, such as: *Ulmus scabra* Huds (6.36%) and *Salix alba* L. (5.55%). The distribution of *shrubs in recreation areas near the lakes* shows almost equal proportion of *Ulmus parvifolia Jacq.* (15.34%) and *Acer tataricum L.* (15.24%). Not much inferior in prevalence are *Caragana arborescens* Lam. (14.31%) and *Elaeagnus commutata Bernh.* (13.85%). *Crataegus sanguinea Pall* occurs in groups in the forest land near lake Sazanka (8.23%). There are also brushwoods of *Berberis vulgaris L.* (6.15%). Despite a good balance between shrubby species, the lake banks lack bright accents. Conducted survey of the coastal territories has shown the predominance of *Ulmus parvifolia Jacq.* (28.34%), and the next – *Elaeagnus commutata Bernh* (21.45%), which are native species grown independently on the shore at the 1st Geological passway, as well as *Caragana arborescens Lam.* (13.31%). Territory along the Rudchenko riverwalk and Volga Bank street is planted predominantly by *Cotoneaster lucidus SC* (15.34%), and to a lesser degree – by *Ulmus parvifolia Jacq.* (13.25%). We have revealed that among the decorative flowering plants, widespread are *Syringa vulgaris L.* (11.87%) and *Philadelphia coronarius L.* (6.42%), while among the deciduous species of shrubs common are *Berberis thunbergii DC* (8.23%). Thus, the species diversity of shrub plantations on the riverwalk is higher than in other recreation areas. However, this does not contribute to the full uncovering of the aesthetic qualities of the surveyed sites.

Beach territories are mostly dominated by *Populus nígra L.* and *Populus balsamifera L.*, as well as by *Ulmus pumila L.* in small numbers. There are also single species of *Betula pendula Roth.* Banks of the river and ponds in Engels city and its suburbs are covered by trees that do not have pronounced morphological characteristics, such as picturesque colors of the crown, and therefore, for recreants they look quite monotonous.

5. Conclusion

Thus, in consequence of the research we can draw the following conclusions:

1) A typology of recreation areas in the structure of coastal and insular territories was identified and the territories were divided into five types: *riverwalks*; *short-term recreation areas on the banks of the Volga River; short-term recreation areas near lakes; beach areas;* and *long-term recreation areas on islands and lakes*.

2) All considered recreation zones were classified into the following compositional types in terms of their layout: *Compact double-fan-shaped system, Linear-central type with an external compositional orientation, Ring-central type with an external compositional orientation, Compact-central system with an external compositional orientation, Dispersed type with a linear compositional inclusion*; *and Linear with an external and internal compositional orientation* . Among the compositional systems, the linear-central type with an external orientation prevails (44%), while the ring-dispersed type (22%) is in the second place;

3) Features of visiting recreational spaces by city residents were defined in terms of their prioritization, as well as the impact of this distribution on the condition of recreation zones and the system in general was revealed. It was revealed that poorly visited areas were dominated in the total area of recreation zones. It was noted also that despite the optimal conditions, in some areas there were no coastal recreation zones (for example, in the Reclamation and Construction districts). These city districts were located beyond the walking distance from the coastal recreation zones which reduced the attendance of recreation areas by city residents.

4) It was stated that the greatest recreational load fell on the recreational centers of the system situated in the central part of the Engels city.

5) The problem of insufficient landscaping of coastal and insular territories was revealed as well as the monotony of the species range of green plantings. Highly ornamental species with bright morphological features were almost entirely absent. Lawns in the elements of the structure of coastal and insular territories of the city were broken, and by 30% consisted of low-value plants such as the sow-thistle (*Sonchusarvensis* L.), couch grass (*Elytrigiarepens* L.), cleavers (*Galiumaparine* L.), etc.

Therefore, conducted monitoring of the condition of coastal and insular territories of Engels city and their woody-shrub vegetation will provide an opportunity for competent reconstruction of these recreation facilities and improvement of the aesthetic environment by means of landscaping with new decorative types of green plantings.

Conflict of interest

The authors confirm that the presented data do not contain a conflict of interest.

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