

# Recreation potentials of urban forest parks

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**Abstract.** Recreational stress is a determining factor in the sustainability of forest ecosystems. Objects of research - green spaces of the forest park 51 ° 33'14 "N; 45 ° 55'34" E (green zone of the city of Saratov, "Kumysnaya Polyana"). Purpose: identification and optimization of the recreational potential. The forest park is 4504 hectares. The largest indicators of bulk density (1.35 g / cm<sup>3</sup>) were revealed in the service and recreation areas. For a separate section of the forest park, it is possible to increase the indicators of the recreational potential and capacity by 12.89 and 89.1%. The recreation potential of the forest park is from 65 to 85 percent. Modernization of the zoning of the forest park, accomplishment of improvement works through sanitary and landscape felling, optimization of the road network will lead to an increase in the recreational capacity of leisure to 117.4 thousand people. Landscaping techniques have been developed.

## 1 Introduction

In recent years, great importance has been paid to the analysis of modern approaches to technologies for optimizing the recreation potential of forest parks [1, 2, 3, 8]. A strategy for the formation of recreational and green spaces has been developed and an environmental justification has been made for the effectiveness of renewing the green fund [5, 6, 10].

The recreational potential of the green zone is an integral indicator that takes into account a combination of factors that affect the attractiveness of recreation in a particular territory (OST 56-100-95). The main factor affecting the stability of forest ecosystems is the recreational load [4, 9]. Exceeding the permissible level of visiting the territory of forest parks contributes to the degradation and depletion of phytocenoses, changes in the state and properties of the ground cover [7].

A scientific justification is required for an integrated approach to the study of forest ecosystems for a comparative assessment of compliance with the permissible limits of recreational loads. On its basis, the ecological and technological regulations for the functioning of forest parks are being developed. Realization of the recreational potential of the territories influences the aesthetics, ecology of space, logistics of tourist flows, and

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promotes the creation of optimal conditions for relaxation and decorative durability of plantings.

## 2 Methods

Objects of study - green spaces of the forest park 51°33'14 "N; 45°55'34" E (green zone of the city of Saratov). Forest park - 4504 hectares (Fig.1).



**Fig.1.** Forest Park.

The research program was carried out using current regulatory documents. Accounting for attendance and the level of recreational load at the research objects was carried out according to OST 56-100-95. For research, we adopted - registration and measurement method. The boundaries and areas of landscaping objects were determined using the following programs: Google Earth, CorelDrawX7 Graphic.

The survey sites at the research object were laid according to generally accepted methods. The characteristics of the recreation potential were calculated according to S.L. Rysin, 2003.

## 3 Results

Positive aspects for recreation are: the climate of the territory, features of the relief, diverse flora and fauna, developed transport routes, allowing you to rest almost all year round. Limiting factors include: lack of moisture, a large number of sunny days with a high level of insolation, stressful environmental conditions, paucity and low quality of water bodies.

Assessment of the state of forest areas within the transect showed that all their coefficients fall into the assessment group "High recreational potential" (attractiveness coefficient -  $K_a = 0,708$ ; comfort -  $K_c = 0,759$ ; sustainability -  $K_s = 0,647$ ). The value of the recreational potential of the plantations is 69.92%.

At present, the territory is capable of accommodating about 55 thousand vacationers, or 6.57% of the city's population (Table 1). According to the current norms, this figure should be 15-20%.

**Table 1.** Modern functional zoning and recreational capacity.

Functional zone	Square, ha	Permissible load		Recreational capacity, people	
		Optimal	Maximum	Optimal	Maximum
Recreational	222	50	100	11100	22200
Visitor service area	57	100	200	5700	11400
Agrolandscape	488	1	2	488	976

Tourist area	376	5	10	1880	3760
Conservation area	87	2	5	174	435
Economic zone	3274	2	5	6548	16370
Total	4504			25890	55141

By changing the economic and agrolandscape zones, it is possible to optimize recreation (Table 2).

**Table 2.** Recommendations for optimization of areas for recreation.

Functional zone	Square, ha	Permissible load		Recreational capacity, people	
		Optimal	Maximum	Optimal	Maximum
Recreational	450	50	100	22500	45000
Visitor service area	88	100	200	8800	17600
Agrolandscape	420	5	10	2100	4200
Tourist area	400	20	50	8000	20000
Conservation area	87	0,1	1	8,7	87
Economic zone	3059	5	10	15295	30590
Total	4504			56704	117477

Table 3 shows the mathematical models for the regulation of recreational loads.

**Table 3.** Mathematical models of recreational load.

Functional zone	Mathematical model	R2
Visitor service area	$y = 0.8383x^3 - 22.059x^2 + 159.74x - 177.3$	0.8205
Recreational	$y = 0.4288x^3 - 12.732x^2 + 100.36x - 113.95$	0.8489
Tourist area	$y = 0.0598x^3 - 3.042x^2 + 31.674x - 37.213$	0.9023
Agrolandscape	$y = 0.032x^3 - 1.1084x^2 + 9.5745x - 10.258$	0.9506
Conservation area	$y = 0.0151x^3 - 0.7408x^2 + 7.3359x - 8.1009$	0.9336
Economic zone	$y = 0.1218x^3 - 3.9638x^2 + 33.796x - 37.57$	0.8967

An optimized territory balance has been developed (Table 4).

**Table 4.** The balance of the designed territory.

Name	Current state		According to the project	
	ha	%	ha	%
Green spaces including lawn the trees shrubs flower beds	293.05	90.7	134	60.4
Buildings and constructions	0.15	0.04	3.2	1.4
Ponds	2.8	1.2	2.8	1.2
Roads and paths	25	0.6	38	17
Open spaces	2	7.7	45	20
Total	323	100	323	100

It is recommended to carry out sanitary and landscape felling of the forest stand, develop a network of footpaths, bicycle roads, and increase the level of landscaping (Table 5).

**Table 5.** Optimization of the functional zoning of the territory.

Functional zone	Existing area	Projected area	Change
Recreational	222	450	228
Visitor service area	57	88	31
Agrolandscape	488	420	-68
Tourist area	376	400	24
Conservation area	87	87	0
Economic zone	3274	3059	-215
Total	4504	4504	0

## 4 Discussion

Research on the current state and optimization of the recreational potential was carried out in the forest park 51 ° 33'14 "N; 45 ° 55'34" E (green zone of Saratov, "Kumysnaya Polyana"). The highest indicators of bulk density (1.35 g / cm<sup>3</sup>) were determined in the service and recreation areas.

Assessment of the state of forest areas within the transect showed that all their coefficients fall into the "High recreational potential" assessment group (attractiveness coefficient -  $K_a = 0.708$ ; comfort -  $K_c = 0.759$ ; sustainability -  $K_s = 0.647$ ). The value of the recreational potential of the plantings is 69.92%.

## 5 Conclusion

Currently, the territory is able to accommodate about 55 thousand tourists, or 6.57% of the city's population. According to the current norms, this figure should be 15-20%. By changing the economic and agrolandscape zones, you can optimize your rest. Landscaping techniques have been developed. They are able to increase the indicators of recreational potential and capacity by 12.89 and 89.10%, respectively. Modernization of the zoning of the forest park, accomplishment of improvement works through sanitary and landscape felling, optimization of the road network will lead to an increase in the recreational capacity of leisure to 117.4 thousand people.

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