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Stability and Risk in Recreational Development of the Coast of the Cheboksary and Kuibyshev Reservoirs

Anna Gumenyuk*, Inna Nikonorova and Marina Vishnevskaya
Chuvash State University, Cheboksary, Russia

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Short Communication

The study area is located in the northern part of the Chuvash Republic, on the right and left banks of the Cheboksary and Kuibyshev reservoirs (The Volga river), which caused the division into the right-bank and left-bank parts. The right-bank part includes the modern borders of the cities of Cheboksary and Novocheboksarsk, the left-bank part –is the Trans-Volga region. Chuvash Trans-Volga region is a favorite place for recreation for urban residents [1].

According to Bredikhin [2] the relief stability is associated with two circumstances. First, the stability of the relief depends on the natural properties of the relief, which determine its dynamics and evolution. These include morphometry (nature of erosional dismemberment, slope steepness, relative heights, remoteness from denudation basis, etc.), morphology (river valleys shape, longitudinal profile of slopes, shore shape, etc.), modern geomorphological processes, their type and intensity. The natural properties that determine the natural stability should also include the properties of the substrate (granulometry of loose sediments, degree of permeability, form of occurrence, etc.).

Secondly, sustainability is determined by the type of recreational development. The territory undergoes changes already at the preparatory stages, during the period of technogenic development and, finally, during recreational operation.

Sustainability is one of the most important factors determining the development path (changes and sometimes destruction) of natural complexes. Only when it is taken into account can one make a reasonable forecast of the development of a recreational territory, and, consequently, save it as a recreational resource for a more or less long time.

The relief of the right-bank part is subject to intensive gully-ravine erosion, landslides are actively developing. The slopes undergo repeated motions that form landslides-alloys. These dangerous relief-forming processes adversely affect the existing recreational areas located within the Cheboksary reservoir. Debris covers the Moscow Embankment, where pedestrian and cycle paths are laid. Currently, this coastal part of the Cheboksary reservoir is under reconstruction.

Problem Statement

The growth of urbanization in the territory of the Chuvash Republic, the development of the service sector are putting forward increasing demands on the organization of recreation and health improvement of the population. At the same time, in the Chuvash Republic, when organizing recreation, a special role belongs to the relief of the coastal area of the Cheboksary and Kuibyshev reservoirs. The possibilities of turning this zone into a "regional recreational center" for the inhabitants of the region are great and many-sided.

Analysis of Recent Research

The study analyzed the stability and risks for the development of recreation on the coast of Cheboksary and Kuibyshev reservoirs. The methodical approaches developed by Preobrazhensky V.S. (1975), were used for scoring natural territorial complexes for recreational purposes. In accordance with the classification of Bredikhin A.V. [1,2] considers the stability of the relief depending on the natural, natural properties of the relief, which determine its dynamics and evolution, and the stability is determined by the type of recreational development. In the works of Nazarov and Frolova and previous studies [3-15] were examined the geological and geomorphologicalbasis of the recreational potential of the coastal zone of reservoirs.

The purpose of this articleis to analyze the existing dangerous relief-forming processes that negatively affect existing recreation areas located within the Cheboksary and Kuibyshev reservoirs. The clastic material of the erosional right-bank slopes goes to Moskovsky Embankment, where pedestrian and bicycle paths are laid and recreational infrastructure is created. The problem of assessing the sustainability of the slopes of the Cheboksary and Kuibyshev reservoirs, including landslide hazardous ones, for recreational development of the coast is analyzed in this article.

The Presentation of the Main Material

The study area is located on the right and left banks of the Cheboksary Reservoir, which led to the division of the territory into the right-bank and left-bank recreational zones. The right-bank recreational zone is located on the Chuvash Plateau, which is part of the Volga Upland. The Volga part of the slope of the plateau 10–15 km wide is carved with transverse potholes, gullies, ravines and beams, which made it possible to identify erosion types of shores [16-19], which abruptly terminate in the north to the Volga. Absolute elevations range from 64 m (at the edge of the Volga River) to 160-200 m (at the watersheds). The steepness of the slopes is from 5° to 10-30° and more, which positively affects the existence of ski slopes for educational and tourist purposes. The density of the ravine network is 1-2 km/km^2 (40-60%). One of the most important features of the relief of the Volga Upland as a whole and its modern part, which lies within Chuvashia, is the layering associated with the development of two main uneven-age (upper Oligocene-Miocene and lower Late Pliocene) and uneven

***Corresponding author:** Anna Gumenyuk, Chuvash State University, Cheboksary, Russia, Tel: +7 835 245-26-97; E-mail: annagumenuk@yandex.ru

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erosion-denudation alignment surfaces [14,19]. Watershed arrays are the main orographic areas. Cheboksary agglomeration belongs to the Sura-Tsivil watershed area, which is characterized by strong erosion dissection (more than 2 km/km^2), numerous river valleys, beams and ravines give the watersheds fancy shapes.

The planning structure of the city follows a relief area formed by the watersheds of the tributaries of the Volga River: Cheboksarka, Sugutka, Trusikha, Kaibulka, which are fan likely spent in the meridional direction. As a result, the main urban buildings are located on the watersheds and form wedge-shaped territories of administrative districts, converging with the amphitheater at the Volga Bay, and expanding to the south. All major transport highways are laid at the upper elevations of the ridges of the watersheds and form a radial system of streets converging to the bay.

In assessing recreational geomorphological systems, A.V. Bredikhin (2008) applied the positional principle, which consists in the dependence of the properties of objects (systems) on their position in space. Many functional aspects of the relief for recreation can be identified by considering the geomorphological location of recreational objects. The indicated author subdivides the recreational geomorphological systems (RGS) into two types: 1) local and 2) regional [2].

The Nodal-merging RGS are located at the junction of various morphostructures. In the city - this is the contact of the Cheboksary and Kuibyshev reservoirs and its shores. RGS are located for the most part on the territory of the Moscovsky and Kalininsky districts of the city of Cheboksary and the city of Novocheboksarsk.

The Nodal-estuary RGS are confined to small rivers of agglomeration - Cheboksarka, Sugutka, Trusikha, Kukshum. Small rivers flow in all administrative districts of the city.

The Neutral-flat RGS are next types. To them we attributed the left bank terrace of the Cheboksary reservoir, as well as small areas of the watersheds on the right bank, for example, the southern part of the city of Cheboksary.

The macro-slope RGS are large slopes along large rivers (the root slope of the Volga River). Including neutral - macro-slope RGS of Cheboksary and suburbs are represented on the right bank.

Linear (routing) RGS are territorial structures that serve as the basis for extensive excursion routes. They are confined to cars and pedestrian roads and pronounced boundaries of watersheds. Linear (routing) RGS unite all recreational facilities.

Areal (parks) RGS. They are located in all administrative districts of the city: in Moskovsky - the Park of the 500th anniversary of Cheboksary, the Guzovsky grove, the Berendey forest; in Leninsky - the children's park of A. Nikolaev, Lakreevsky Forest, Doriss Park, Botanical Garden, in Kalininsky - a small landscaped forest near the recreation center of tractor manufacturers.

For the Cheboksary agglomeration, for the most part, RGS are characterized as nodal-mergers, i.e. the interaction of water and dissected relief, then neutral-flat, areal (parks), linear (route) and nodal-source-mouth.

The slope steepness in the Cheboksary agglomeration has values from 5° to 10-30° and more, which positively affects the existence of ski slopes for educational and tourist purposes. The density of the ravine network is 1-2 km/km^2 (40-60% of the territory is subject to ravine erosion) and is estimated at 4 points, and has a favorable qualitative assessment (Table 1 and Figure 1). According to a study [16], the degree of favorableness of the slopes for skiing is estimated at 4 highest points.

According to the degree of stability, both stable and unstable slopes are observed in Cheboksary, this is explained by their various steepness and various exogenous processes (landslides, gully erosion, etc.).The increase in recreational load on coastal geomorphic systems has contributed to the activation of landslide, erosion, deflation and other dangerous relief-forming processes, and also affected the quality of water resources.

The difficult terrain of the city attracts young people who are passionate about extreme sports. Winter youth extreme sports include snow jumps, toboggan runs, cross-country ski runs, freestyle snowboard festivals, snowmobile races, etc. In the summer it is mountain biking, climbing and formed for sports recreation, trails on the slopes of ravines, Volga River and small rivers in the city.

On the banks of the Volga, a lot of slopes were laid for skiing from slopes on skis and sleds. Steady snow cover and hilly relief create excellent opportunities for acquiring skiing skills. Every year on the slopes of the "small snowy mountains" a lot of exciting events are held, which involve not only professional athletes, but also amateurs.

The ski season in Cheboksary begins in mid-December and ends in the second half of April. There are two routes in the city: the first in Victory Park and the second in the Park of the 500th anniversary of Cheboksary, where there are lifts and rental equipment.

The lithological-geomorphological characteristic of the coastal zone of the Cheboksary reservoir acquires a special role in recreational nature management. The presence of low, gentle accumulative shores, the distribution of sandy alluvial sediments in the left-bank zone provides ample opportunities for beach recreation. The combination of high abrasion banks with slope processes on the right bank, flooding and waterlogging and shedding on the left banks, their diverse morphology and dynamics adversely affect the structure of recreational nature management, as many exodynamic processes are dangerous (landslides). A persistent turbid band is formed at a distance of up to 20 m from the coast with significant changes in the indices of the chemical and bacteriological composition of the water. In addition, numerous watercourses that drain out along the native right bank flow through numerous unauthorized landfills in ravines and also violate sanitary indicators of water quality in the Cheboksary reservoir. Due to the reshaping of the coasts and the alongshore movement of sediments from west to east, the coastline becomes shorter and smoother, that

Dismemberment density km/km^2	Quantification	Qualitative assessment
0.3-0.6	1	Unfavorable
0.6-0.9	2	Relatively unfavorable
0.9-1.02	3	Relatively favorable
1.2-1.5	4	Favorable
More then 1.5	5	Most favorable
Depth of dismemberment km/km^2	Quantification	Qualitative assessment
20-40	1	Unfavorable
40-60	2	Relatively unfavorable
60-80	3	Relatively favorable
80-100	4	Favorable
100-110	5	Most favorable

Table 1: Scale of recreational assessment of the relief of the Cheboksary and Kuibyshev reservoirs.

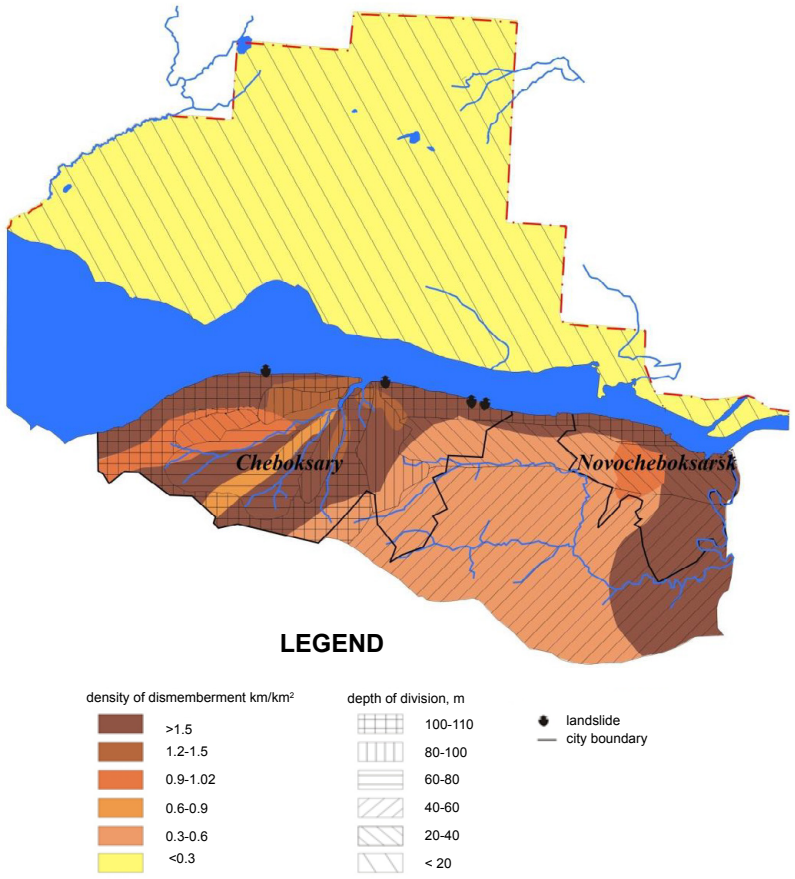

Figure 1: Geomorphological structure of the Cheboksary and Kuibyshev reservoirs coast.

is, less picturesque. This reduces the attractiveness of the coastal zone for holidaymakers. Hydrogeological conditions largely determine the structure of recreational water use. On the flooded areas of the Trans-Volga, the composition of the stand is deteriorating, the waterlogging of the terrain occurs, which makes it necessary to carry out special ameliorative measures like in the Sosnovsky Lowland.

Conclusion

The increase in recreational load on coastal geomorphic systems has contributed to the activation of landslide, erosion, deflation and other dangerous relief-forming processes, and also affected the quality of water resources. So, the geomorphological conditions of the Cheboksary and Kuibyshev reservoirs as a whole are a favorable factor for the development of recreation. The problem of assessing the sustainability of the slopes of the Cheboksary reservoir, including landslide hazardous ones, for recreational development of the coast is analyzed in this article.

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