Recreational potential of the pine forests in the Vologda region drawing on the example of Kradikhino forest

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Abstract. The aim of the research is to identify the recreational potential of green plantings in the vicinity of the village of Kradikhino, Kichmengsko-Gorodetsky district of the Vologda Region. The research has been carried out according to the methods of a comprehensive assessment of the recreational potential of S.L. Rysin. The research results indicate that the most recreationally valuable plantings are concentrated in commercial forests. Recreational value plantings of Class III predominate in protective forests (60%), and of Class II – in commercial ones (54%). The expediency of recreational use of these plantings by the local population has been noted. The negative impact on the recreation of clear cuttings in commercial forests has been revealed. Some measures have been recommended to optimize the multifunctional use of the forests. Taking into account the high recreational value of commercial forests, it is advisable to create a landscape reserve in the 1st and 11th compartments of the Karyugsky forestry, where scientific works should also be organized to study the effect of recreation on the forest environment.

1. Introduction

The significance of the forest is great and multifaceted. In the current conditions of the development of the forest sector, the task of multi-purpose economically viable, environmentally responsible and socially beneficial forest management comes to the fore [1-3]. Under the conditions of current ecological situation, the expediency of recreating the socio-cultural foundations of the joint harmonious society and environment development is evident [4]. Nowadays, it is important to reveal forest areas that have environment oriented and habitat forming significance to create optimal conditions for recreation of the local population and attraction of visitors from other regions. Maintaining and increasing long-term socio-economic benefits in order to meet social needs (production and consumption, recreation and tourism, investments in the forest sector, social and spiritual values, employment and needs of population) are a criterion and an indicator for the conservation and sustainable management of temperate and boreal forests approved in the ‘Santiago Declaration’.

The organization of the use of forests adjacent to human settlements should be comprehensive and take into account the traditional interests of the local population. Forests rich in their non-timber resources, located near human settlements, simultaneously serve as a place of rest for the population, performing recreational functions. Such rest is a part of a healthy lifestyle. The use of these forests for
timber harvesting should not interfere with their recreational use due to the risk of deteriorating health of the local population. In this regard, it is important to identify areas of forests of high recreational value for their preservation and to develop compromise solutions for the use of plantings near human settlements. Plants, as part of public space, have significant social, cultural, educational, and historical significance [5].

The purpose of this work is to study the recreational potential of green plantings in the vicinity of the village of Kradikhino situated in the Kichmengsko-Gorodetsky district of the Vologda Region.

The question of the expediency of organizing the recreational use of forests, as a part of the multifunctional use of forest resources, directly depends on the degree of their suitability for recreation, which is determined not only by the resistance of biogeocenoses to recreational loads, but also by the conditions for the comfort of the object for recreation.

Recreational potential is an integrated indicator of the quality of forests, reflecting the ability of the forest (suitability) to comprehensively meet the needs of vacationers. It should be considered as a measure of the ability of the forest to perform recreational functions, characterized by its natural properties. When formulating the concept, the role of recreational capacity is sometimes extra emphasized [6]. Such discrepancies in the interpretation of the term predetermined the fact that the methodology for determining the recreational potential is often of the author's nature, takes into account various factors and is assessed according to different indicators.

It should be noted that not all authors use the concept of ‘recreational potential’ or its synonym ‘recreational value’. So, V Ya Kuramshin uses the concept of ‘optimal recreational forest’. Under this term he understands a forest in which two main qualities are maximized: the capacity of a unit of an area and the beneficial effect on an individual provided that this state is preserved indefinitely. At the same time, he takes into account the attractiveness of the forest (the ability to attract people from an aesthetic and utilitarian point of view), including an assessment of the relative distance, functional characteristics, aesthetic value, and emotional impact. Thus, the author actually identified three components for assessing the optimality of a recreational forest: the attractiveness, the comfort for vacationers, and the resistance to recreational loads. We should note that the concept of ‘recreational value’ is not always synonymous with ‘recreational potential’, but only an integral part of the latter [7].

A specialized scale for the comprehensive assessment of the recreational potential was developed by S L Rysin [7] in relation to homogenous stands. However, later this method was modified for universal use and has recently received the wider application for assessing the recreational potential of natural and homogenous forests in Russia [7-8]. The author proposed to assess the recreational potential according to three main groups of indicators: the attractiveness, the comfort for vacationers, and the resistance to recreational influences. All indicators within each of the group are evaluated on a five-point scale (from 0 to 4). For each group of indicators, the amount of points is determined. The ratio of this sum of points to the maximum possible one is a coefficient for the subsequent integral assessment by classes of recreational value. In total, four classes of recreational value are accepted according to the scale of such an assessment.

The aim of the research is to identify the recreational potential of green plantings in the vicinity of the village of Kradikhino, which is situated in the Kichmengsko-Gorodetsky district of the Vologda Region. The research was carried out according to the method of complex assessment of the recreational potential developed by S L Rysin [7].

2. Materials and methods
Before the organization of work in practice, a reconnaissance survey of the forest fund territory was carried out to establish its actual location, the boundaries of forest areas and adjacent territories, as well as their condition. At the same time, places of mass short-term recreation were outlined for detailed surveys in order to obtain a complete description of the plantings under study.

In the course of the research, we carried out an on-site survey of 747 hectares of forest areas in two compartments (Compartment 1 and Compartment 11), including 76 blocks (as well as 13 sub-blocks),
in each of which 29 indicators were determined, 10 of them were indicators of attractiveness (age, species composition, species mixture, height of the main stand, storeyed structure, patchiness, decorativeness, recreational disturbance, littering, and sanitary condition), 8 indicators of comfort (relief, humidity of habitat, condition of the pathway network, accessibility, distance to a water reservoir, presence of blood-sucking and disturbing insects, noise, and air pollution), 11 indicators of sustainability (age, resistance of ground to trampling, presence of underbrush, stability of understorey, granulometric composition of soil, thickness of litter, thickness of sod, thickness of humus horizon, water regime, and slope). The total survey route was 24 km.

When processing the results obtained, first the sum of points for each group of indicators was found separately, then the coefficients were calculated to assess the attractiveness of the studied area. These coefficients were obtained by dividing the score by the maximum possible score. In an integral assessment of the recreational potential, the plantations were subdivided into four classes of recreational value categories (RVC), guided by the following provisions:

– if the value of each of the three coefficients is more than 0.81 – the estimated planting belongs to RVC I and is the most promising for recreational use;
– if the value of at least one of the calculated coefficients is in the range from 0.61 to 0.80, and the value of the rest exceeds 0.60 – the planting belongs to RVC II and its recreational use is possible without significant restrictions;
– if the value of at least one of the calculated coefficients is in the range from 0.41 to 0.60, and the value of the rest exceeds 0.40 – the planting belongs to RVC III and its recreational use is possible only with certain restrictions;
– if the value of at least one of the calculated coefficients does not exceed 0.40 – the planting belongs to RVC IV and its recreational use is undesirable until a set of measures to improve the quality is carried out.

The investigated site adjoins the exploited forests of the Kichmengsko-Gorodetsky forestry, and on the western side it borders on the village of Kradikhino. The length of the site from north to south is 3.2 km, and from west to east – 1.8 km. The total area is 747 hectares (figure 1). Scots pine with an admixture of downy birch and aspen grows in the studied forest. In the undergrowth there are present rowans (*Sorbus aucuparia* L.), bird cherry (*Prunus padus* L.), common juniper (*Juniperus communis* L.). In the ground cover blueberries (*Vaccinium myrtillus* L.) predominate.

### 3. Results

The attractiveness of a planting site is determined by its age, composition, species mixture, stand height, storeyed structure, patchiness, decorativeness, recreational disturbance, littering and sanitary condition. The assessment of these signs for the studied planting varies on average from 1.7 to 4.0 points (figure 2).

The highest scores for assessing attractiveness were obtained according to the criteria: species mixture, recreational disturbance, littering and sanitary condition.

In general, for two compartments, the attractiveness score is 0.79, i.e. the quality of the plantings is high on average. This is due to optimal species composition, recreational disturbance, littering and sanitary conditions. The decrease in the recreational attractiveness in the considered plantings is caused by clear felling. Increasing the attractiveness of plantings is possible by improving their vertical and horizontal structure (storeyed structure and patchiness), as well as contrast, what can be achieved by landscape felling.
Figure 1. The layout of the Kradikhino Forest in the satellite image (59°82”, 46°67” Kichmensko-Gorodetsky district, Vologda Region, Russia).

Figure 2. Average assessment of indicators of greenplanting attractiveness: age of stand (1); species composition (2); species mixture (3); stand height (4); storeyed structure (5); patchiness (6); contrast range (7); recreational disturbance (8); littering (9); sanitary condition (10).

The comfort of plantings for visitors takes into account relief, humidity of the habitat, pathway network, accessibility, and distance to the water reservoir, insects, noise, and air pollution.

The assessment of comfort indicators on average for the compartment varies from 1.5 to 4.0 points (figure 3). The assessment of comfort indicators on average for the compartment varies from 0 to 3.6 points (figure 4).

Resistance to recreational loads takes into account the age of the stand; the stability of the main species; the presence of undergrowth and underbrush; the stability of understorey; the granulometric composition of the soil; the thickness of the litter, sod, humus horizon; and the slope of the surface. The resistance of the forest environment to recreational loads predetermines their recreational capacity and is useful for the rational distribution of rest according to the forms of recreation. An increase in the maximum permissible recreational load on forests inevitably leads to the digression of forest ecosystems. Therefore, in forests with low resistance to recreational loads, places of mass recreation should not be organized.

In general, for the analyzed plantings, the stability coefficient is 0.59, what corresponds to the average quality for the criteria. The age of the stand and the slope of the surface have a positive effect on the assessment of the stability of the studied stands. A decrease in the assessment is noted according to such criteria as the thickness of the sod and the degree of the humus horizon of soils, this is predetermined by the prevalence of podzolic soils characteristic of the study area. It should be noted that the recreational loads that are currently characteristic of the plantings under consideration are not critical, since we have not identified significant signs of recreational digression. Meanwhile, clear cuts contribute to a significant decrease in the resistance of forest areas to recreation.

The recreational potential of plantings largely determines the nature of their further use. For an integral assessment of the recreational potential, plantings were subdivided into four classes of recreational value categories (RVC). At the same time, no plantations of RVC I were identified.
Figure 3. Average assessment of the comfort indicators of green plantings: relief (1); humidity of the habitat (2); condition of the pathway network (3); accessibility (4); distance to the water reservoir (5); presence of blood-sucking and disturbing insects (6); noise (7); air pollution (8).

Figure 4. Average assessment of plantings sustainability indicators: age of stand (1); resistance of the main soil type to trampling (2); presence of a viable undergrowth (3); presence of underbrush (4); stability of understorey (5); granulometric composition of the soil (6); thickness of litter (7); thickness of sod (8); thickness of humus horizon (9); water regime (10); surface slope (11).

On the whole, in both compartments, protective and commercial forests have practically the same recreational value (RVC – II, 6; II, 5, respectively). Nevertheless, protective forests are more comfortable than commercial ones, due to their better accessibility and proximity to the river, but less attractive and stable.

The distribution of forests for various purposes by classes of recreational value is not the similar (table 1).

Table 1. Distribution of forests for different purposes by classes of recreational value.

| Designated purpose of forests | Planting area by classes of recreational value, ha (%) | Total, ha |
|------------------------------|-----------------------------------------------------|-----------|
|                              | II        | III       | IV   |               |
| Protective                   | 83.0(40)  | 125.0(60) | -    | 208.0(100)    |
| Commercial                   | 290.7(54) | 245.1(45) | 3.2 (1)| 539.0(100)    |
| Total                        | 373.7(50) | 370.1(50) | 3.2 (0)| 747.0(100)    |

In general, plantings of RVC III dominate in protective forests (60%) and plantings of RVC II dominate in commercial ones (54%).

4. Conclusion

Thus, the use of forests only for timber harvesting contributes to a decrease in the recreational value of plantings (primarily, their resistance to recreation). At the same time, a significant amount of valuable and used for recreation forests belongs to commercial ones and is a part of a single natural-territorial complex with protective forests. In this regard, it is necessary to organize the multifunctional use of forests, excluding clear cuttings that reduce the stability and recreational value of forests.

The findings of the research allow us to recommend the following:
When exploiting the forests under consideration, the needs of the local population for recreation should be taken into account. At the same time, forests for various purposes represent a single natural system traditionally used by the local population for recreation.

Increasing the attractiveness of plantings is possible by improving their vertical and horizontal structure (layering and patchiness) as well as contrast, what can be achieved by carrying out landscape felling in limited areas in places of mass short-term rest in protective forests (in accordance with functional zoning).

When organizing commercial forests multifunctional use, clear felling reducing their recreational value should be excluded.

Subsequently, due to the high recreational value of commercial forests, in the 1st and 11th compartments of the Karyugsky forestry, it is advisable to create a landscape reserve, in which scientific work should also be organized to study the impact of recreation on the forest environment.

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