Landscape approach in assessing the bioresource potential of specially protected natural areas

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Abstract. There are many different approaches to studying the structure and organization of natural ecosystems. Among those are: geomorphological, landscape and ecosystem. It is generally accepted that a landscape approach has the greatest resolution, completeness and hierarchical depth. Landscape consideration of natural-territorial complexes is a key to understanding the regularities occurring in typological and biogeocenotic structure of natural ecosystems of any rank. A landscape approach to forest areas involves considering a specific forest community along with other spatially adjacent areas that form a system of a higher rank in a specific geographic environment. Any forest area within the facies should be considered taking into account other biogeocenoses existing next to it, not only forest, but also others (bog, meadow, etc.). Landscape properties are determined in many respects by the type of forest and their biogeocenotic composition, configuration of stands, their size and spatial relationship. Typological structure of forests determines many aspects of forest management strategy. The resource potential of the territory, economic value and economic accessibility are directly related to it. Landscape characteristics of forest lands often determine the degree of their development and general level of forestry activities. Forest cover, swampiness, basis of erosion, slope, length, steepness and exposure of slopes, type of geochemical circulation are main interesting characteristics of forest landscapes. The listed number of characteristics is included in the forestry-biogeocenotic attributes in the study of natural-territorial complex.

Assessment of resource potential of forests at landscape level allows to give a clear and objective idea of the amount and variety of resources available to this or that territory.

If researcher is faced with the task of a comprehensive assessment of natural resources, then it is necessary to rely on the landscape basis. “The foregoing gives reason to consider landscape as a basic natural resource area ...” [1]. Or even more clearly: “... The landscape is, in essence, an independent natural resource region, characterized by a specific "set"of resources and at the same time a kind of local conditions for their development” [2]. A G Isachenko also argued that hierarchical approach allows to choose the optimal level (or rank) of a specific research in the territory, which will best meet the solution of the problem.

Research by V F Tsvetkova [3,4], T A Braslavskaya [5] showed that contours of forest ecosystems do not coincide with geographical landscapes identified on a geographical basis. The researchers were convinced that the landscape-geographical parameters of forests should be considered on the so-called "landscapes of wildlife". This approach presupposes among landscape characteristics of forest habitats, first of all, to put climatic conditions, relief, vegetation, and soil.
Such correction of the concept of landscape in relation to habitats of vegetation ecosystems seems to be quite appropriate.

Modern forest management and forest inventory is based on the characteristics of the canonical forest inventory indicators. For a number of reasons, it does not fully reflect the resource potential of natural landscapes, since it operates with specific silvicultural parameters of forest stands on an approved forest typological basis, regardless of landscape features of the territory as a whole [6].

According to D M Kireev [7], "... the main advantage of landscape framework is that within the natural-territorial complexes there are resource complexes that are subject to assessment." Scientist also emphasizes the expediency of using landscape base in inventory of forest fund by statistical methods.

Landscape-geographical vision most fully characterizes forest resources. The structure of landscapes, climatic characteristics create differences in the conditions for the formation of forest resource potential of the European North. N A Solntsev [8], N A Moiseev and V S Chuenkov [9], D M Kireev [7] believe that formation of forest classification should begin with a landscape basis, which determines their purpose, taking into account all the factors.

Landscape level of ecosystem organization can significantly expand topographic accuracy of taxation units [10, 3]. The choice of assessment methods depends on the nature of environmental conditions, economic situation, socio-cultural characteristics of specific territories. The expediency of enriching forest plantations with parameters of landscape organization is also due to the variety of climatic and forest conditions on the territory of the country, and biosphere functions of forests.

Landscape approach is leading in characterization of systems of especially valuable natural objects, including those on forest lands.

Modern practice of forest management in the European North, and in particular in the taiga forests of Russia, is traditionally focused on the use of forest inventory materials, organized according to the quarterly or "rectangular-linear" principle of division of forest spaces. Such a system leads to tangible damage, to a decrease in economic efficiency. The quarter network, which is used in planning, rationing and organizing the use of forest resources, purely mechanically differentiates forest ecosystems "cutting like a knife". The permissible rate of use appears as a complex of areas of different nature scattered in space. This approach does not provide true efficiency of resource development, does not eliminate the likelihood of high environmental risks in forest management, that is, the requirements for accounting for inevitable violations of the water balance of lands are ignored, there is a danger of provoking erosion and solid flow [11].

An alternative to the "quarterly" system is a landscape approach, where differentiation and grouping of forest lands is carried out taking into account complex of factors, both forestry and geomorphological, when natural boundaries determined by the relief and hydrological conditions are observed. In the landscape approach, plantations are always considered as elements of natural ecologically and biogeochemically subordinate parts of systems with stable interbiogeocenotic connections. The systemic subordination of forest biogeocenoses is built through differences in relief conditions (absolute elevation above sea level, erosion base, habitat type, position in a geomorphological or topo-typological catena, slope exposure, slope magnitude, etc.). Elements of landscape organization allow expanding the complex of properties and connections of adjacent ecosystems, and significantly increase the efficiency of land use [11].

Our research was carried out on the territory of the Siysk forest park, located in the Kholmogorsky district of the Arkhangelsk region within the boundaries of the state natural biological reserve of regional significance. The forest park was established with the aim of preserving, reproducing and restoring the number of wild animals that are valuable in economic, scientific and cultural terms, as well as protecting their habitat. It has a fairly high recreational potential and is an excellent place for organizing mass recreation and tourism in the Arkhangelsk region.

Due to the fact that the subject of the study is areas of biogeocenoses and ecosystems differentiated by nature, connected in dynamics of relationships, it is more correct to perceive the considered structure of the landscape of the Siysk forest park as an organized system consisting of geographical units: areas, tracts, facies. With organizational and economic activities carried out in the forest park, it is advisable
to divide the territory according to bioresource, physical-geographical (landscape), natural boundaries, taking into account landscape units.

The study of the forest park structure made it possible to identify 12 geographical areas with an area of 1.1-2.5 thousand hectares. Three localities typical for the region are divided into natural boundaries, which quite fully represent the differences in the structure of the forest fund. The total area of area 1 was 1365 hectares, area 2 - 841 hectares, area 3 - 1120 hectares "Figure 1".

Assessment of the structure of each geographic area, as a representative part of landscape lands, taking into account the differences in the complexes of forest areas in terms of the relief, structure of formations of prevailing rocks, swampiness, and lakes, has been carried out. For each set of plots and for tracts, in general, the indicators of landscape component of habitat types and properties of plantations were processed.

With the use of geoinformation technologies, typological and age structure of plantings, structure of categories of genesis (origin) have been analyzed, and a quantitative account of the areas of forest lands has been made.

On the example of territory No. 1, natural boundaries No. 2, the allotments were digitized in order to determine typological structure of plantings Figure 2. On the example of area No. 2, the digitization of allotments was carried out in order to determine the age structure of the stands Figure 3. On the example of area No. 3, the allotments were digitized in order to determine the category of genesis (origin) of the plantings Figure 4.

Figure 1. Location of the studied areas of the Siysk forest park.

Territory No. 1 is characterized as a “low-lying, relatively highly forested, heavily swampy and moderately lakeside plain” in the landscape of the middle left bank of the Northern Dvina, representing estuarine parts of the basins of its inflows: Vaimuga, Sia and Emsy. Forest cover of individual natural
boundaries varies from 15% to 88%, waterloggedness varies from 1% to 85%, and lake area varies from a fraction of a percent to 34%. The total area of forest land in the area as a whole is 872 hectares. Of the 872 hectares of forest land, 471 hectares (54%) are occupied by plantations of pine formation, 280 hectares (32%) are spruce plantations; 103 hectares (12%) are birch, 18 hectares (2%) are aspen.

In a detailed structural analysis of natural boundaries No. 2, territory No. 1, bilberry is the predominant type of forest growing conditions (64%). Further, in the order of decreasing participation, are located: lingonberry - 16%, sphagnum - 10%, oxalis - 7, long moss - 2%, and lichen - 1%. The share of lakes and swamps is 75 hectares.

Territory No. 2 - Low-lying flat and slightly wavy lakeside plain with a fairly high forest cover and medium swampiness, with a predominance of podzolic and sod-podzolic, sandy loam and sandy soils, with coniferous and small-leaved forests. Forest and forested area - 795 hectares, forest cover 94%. Non-forested area of 46 hectares is represented by lakes and boggy - 6%.

In the age structure of plantings, a reduced participation of young stands - 3% and middle-aged - 8% of stands was revealed. High participation of maturing - 49%, ripe and overripe - 32%.

Territory No. 3 is characterized as a low-lying, slightly hilly plain, with absolute marks of 20-45 m, on the right-bank middle part of the last estuarine space of the basin (catchment) of the river. This is with the system of lakes connected with the river. Forest and forested area is 036 hectares. The forest cover is on average 53%, the waterloggedness is 29%, the lakes are 18%.

To identify the categories of plantation genesis, we took into account the results of the study of issues of genetic and dynamic typologies, used the experience of classification of secondary forests by foresters of the All-Russian Research Institute of Forestry and Mechanization of Forestry and the Leningrad Research Institute of Forestry. The following categories of plantation genesis have been identified:

NP - nominally primary plantations. These are communities with a high age of the predominant main species, which are similar to climax-type stands (“developed” formations);

MG - stands of Mixed Genesis - objects with a significant participation of climax-type elements, but including derivative generations, younger ones.

Figure 2. Typological structure of plantings in natural boundaries No. 2 of territory No. 1.
Figure 3. Age structure of plantings in territory No. 2.

D1 - plantings Type 1 derivatives - at the early stages of formation and maturation (up to the age of 40 - 50 years) developing without an obvious change of species (young pine forests in areas of original pine forests).

D2 - plantings Type 2 derivatives - at different stages of formation of the next generation of the predominant species and formed in place of the original pine forests, larch forests with the change of predominant coniferous species to another coniferous (spruce young stands formed from spruce undergrowth in the place of original pine forests or larch forests);

Figure 4. The structure of the categories of plantations genesis in natural boundaries No. 4 of territory No. 3.

D3 - plantings Derivatives of 3 types - with an intense change of conifers to deciduous at the first (within 40-50 years) stages. Plantations of this type at older ages (more than 50 years) with a clear manifestation of the reversibility of the change (with an increasing participation of conifers, it is
advisable to designate the index D3 - 1, but they form a single dynamic series with plantations of the D3 category).

In the formations of species of nominally primary plantations account for 58%, Mixed Genesis - 35%, Derivatives of type 1 (without changing species) - 7%.

Landscape-based bioresource potential studies are generally fragmented. Most of the studies concern characterization and assessment of only certain types of biological resources, which does not give a general idea of the resource potential of territories. However, the expediency of using a landscape approach to assess bioresource potential of natural areas is substantiated in works of both geographical and biological profiles. Geographers use landscape as a basic territorial unit, but they do not conduct specialized research on various types of resources. On the contrary, biologists and ecologists study biological resources in various aspects, however, this is carried out within the limits of individual biotopes, ecotopes, etc. or administrative units.

Use of the landscape base during the work of resource study plan is justified and effective for three reasons. First, many resources, functions and qualities of taiga ecosystems can be fully identified and assessed only at landscape level (environmental protection and environment-forming functions of forest cover, recreational qualities of the territory, the number and density of population of game animals, etc.). Secondly, necessary territorial differentiation in terms of bioresource parameters is carried out according to physical and geographical (landscape), natural boundaries that remain unchanged for many centuries. In other words, a permanent basis is being laid for the resource and economic characteristics of taiga ecosystems. Thirdly, the presence of maps, quantitative and qualitative characteristics of resources of types of natural systems at different levels of their organization makes it possible to extrapolate with a high degree of reliability the data obtained on a predetermined and limited number of experimental objects to other objects of the same type. The data can be distributed to any part of the territory based on its landscape and sub-landscape structure.

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