

Classification of landscape diversity as a source of the qualitative and quantitative information

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Abstract. Being one of ways of systematisation of scientific data, classification plays especially important role in the landscape science. Classifications help to aggregate objects, to set up their spatial and taxonomic hierarchy. The Belarusian Landscape Classification is developed at scale 1:600.000 in a form of a typological landscape map. It has seven hierarchy levels; four of them are principal and three are intermediate. Each level is based on primary (mostly qualitative) indicators. For example, the classification indicators for the level of class are large morphostructural attributes of the territory and landscape zones that represent the area; the type of landscape should belong to one of the landscape zones; the genus of landscape (rod) is recognized by the genesis and time of landscape origin; specie (vid) assembles the areas with similar topography (forms of mezorelief) and soil/vegetation cover.

The quantitative information in classification may "hide" behind qualitative characteristics and often can be derived from the indirect attributes. For example, genesis of relief in the zone of glacial accumulation usually correlates well with morphological parameters of the relief, podzol content in the soil - with either pH level in the humus horizon and the depth of the horizon. On the other hand, classifications and the maps based on the classifications allow to calculate the areas of each contour, to make the analysis of landscape structure at any classification level and to assess the landscape diversity (LD). The concept of landscape diversity (LD) implies several levels of landscape diversity assessment. Variations in the approaches to the assessment are caused by complexity of landscape as an object of study, its hierarchical structure and system organization. In the view of the system approach, landscape diversity can be considered as variability of complexes of smaller ranks within a larger system. Landscape diversity is expressed by an index, which reflects objective fundamental characteristics of geographical space: the index contains the information on spatial structure; correlates with the levels of entropy and dispersion in the system and represents the metric characteristic of a landscape in general. The two levels can be distinguished in the LD structure with different specifics of landscape diversity on each level: (1) morphological, i.e. variability of elementary associations (faciya) and sites (urochische) within the landscape; (2) taxonomic, i.e. variability of landscape species (vid) within the genus (rod) and types (type) of landscapes. The assessment of landscape diversity is made on the taxonomic level using indexes of various authors.

Key words: natural landscapes, landscape classification, landscape diversity, the assessment of landscape diversity

Introduction

Belarusian geographers started research in landscape in 1960th. At that time the term "landscape" had been defined only as a "natural complexes" missing of all anthropogenic elements. As a result in Belarus the landscape maps of different scale reflecting structure of natural landscapes of the country in whole and administrative regions were developed and published. These maps have been used as an basis for assessment of landscape diversity of Belarus.

The term «landscape diversity» has appeared in connection with alarm of biologists and ecologists concerning decrease in a biological diversity and necessity of its protection. Accepted in 1992 in Rio de Janeiro the

International Convention on a biological diversity has suggested the idea, that biodiversity conservation is impossible without protection of habitats of animals and plants, e.g. landscapes. Therefore in 1995 the Council of Europe has accepted «Pan-European strategy of conservation of a biological and landscape diversity», and in 2000 the European convention on landscapes is opened for signing. Therefore the problem of landscape diversity is one of focused problems of the modern fundamental and applied researches, allowing to receive new scientific and practical results in the field of wildlife management and protection of the environment.

The term “diversity” was widely used in biology and ecology in 50-60th of XX century. Under the title «an ecological diversity» it was used by R. Margalef (1951), J. Hutchinson (1957) and P. Whittaker (1965). The last researcher has developed the concept of an ecological diversity providing three levels of its existence: an alpha diversity or genetic, beta diversity (specie), gamma diversity (ecosystem) (Whittaker 1980). A genetic diversity is the sum of the genetic information containing in genes of individuals of plants, animals and the microorganisms living on the Earth. A specie diversity is measured by quantity of kinds, ecosystem – quantity of habitats, biotic communities and ecological processes.

The term «landscape diversity» (LD) began to be used in 1990th firstly in landscape ecology (Loehle, 1994), and then in the field of fundamental landscape science. One of the first definitions of term LD is given in Pan-European Strategy of conservation of a biological and landscape diversity where it is noticed, that this concept reflects the numerous relations existing between separate components or a society and topographical determinants of territory. These relations are result of actions of natural and human forces.

According to Ukrainian researcher V.T. Grinevetsky (Grinevetsky 2000), the landscape diversity is a real-life set of landscape complexes of any size and a hierarchical level on the surface of Earth – from landscape facia and natural boundaries to landscape sphere of the Earth, created by nature (and to some extent under anthropogenic impact). This definition considers only one dimension of LD concept, namely – hierarchy of landscape sphere, excluding its spatial mosaic.

J.G. Puzachenko, K.N. Djakonov, G.M. Aleshchenko (Puzachenko et al. 2002) provided in their study wider understanding of the term. Authors believe that the concept «landscape diversity» should consider all levels of the system organisation of landscape, and also the hierarchical organisation of landscapes of various territories.

One of the fullest concepts of landscape diversity belongs to M.D. Grodzinsky (Grodzinsky 1999). This known Ukrainian researcher distinguishes four aspects of use of term LD: traditional-landscape (classical), anthropogenic, biocentric, humanitarian. The first of them assumes that natural landscapes, their morphological or taxonomic structure are focuses of LD assessment. The study of influence of hierarchical structure of a landscape on a diversity of vegetation and faunistic communities and ecosystem as a whole is the focus of biocentric aspect of LD. The anthropogenic interpretation of LD is associated with the assessment of natural-anthropogenic and technogenic complexes, humanitarian approach – with the assessment of cultural landscapes. Humanitarian interpretation of landscape diversity is reduced to perception by the person of a landscape as the natural phenomenon including elements of material and spiritual culture of the person. In the situation of existing threat of loss of natural and a cultural heritage, decrease in a biological diversity, conservation, maintenance and increase of a landscape diversity gets special importance.

General characteristics of Belarusian Landscape Classification

The Belarusian Landscape Classification is developed at scale 1: 600 000 in a form of a typological landscape map. It has seven hierarchy levels; four of them are principal and three are intermediate. Each level is based on different key qualitative and quantitative indicators (Martsinkevich G.I., Klicunova N.K. 1989).

The class of landscape is the highest classification level. The classification indicators for the level of class are large morphostructural attributes of the territory and landscape zones that represent the area. These attributes combine both zonal and non zonal approaches and therefore the highest unit of classification has the most generalized character. Landscapes of Belarus belong to class of flat landscapes since the territory of country is located within East-European platform with flat relief and precisely expressed structure of landscape zones.

The zonal principle is used to segregate types and sub-types of landscapes. The following factors as location

of Belarus in one landscape zone with temperal-continental climate, west transfer of air mass and dominant forest vegetation determine the temperal-continental forest type of landscapes. Since the territory of Republic stretches from north to south more than 500 km, some climatic and biotic distinctions between northern and southern areas are found out. Values of total solar radiation (from 3580 to 4100 MJ/m²) and annual radiating balance (from 1530 to 1840 MJ/m²) increase in this direction, defining a trend of some other meteorological indicators. In the result the total photosynthetic active radiation is higher in the south than in the north on 140–170 MJ/m², average temperatures of July – on 1–2o, the sum of temperatures of air above 10o on 300–400o, and the annual sum of precipitation, on the opposite, on 50–100 mm lower. The humidity coefficient defines hydrothermal conditions during warm period. It changes from 1,1 in the north to 0,8 in the south.

These climate conditions influence type of vegetation cover. The main forest types in Belarus are fir-tree and oak. The spatial distribution of these species is well defined and characterized by the following law: (1) the reduction with 16 to 0,5 % of a share of fir from the north to the south; (2) the increase (from 1,6 to 9,9 %) relative density of oak forests, (3) the replacement of elements of boreal florae by West European florae in an underbrush. The southern border of distribution of fir-tree on East-European plain stretches in the northern border of Polesse lowland. This border divides all landscapes into two sub-types: boreal subtaiga and subboreal polesse. Along this border other natural borders as climatic, orographical, tectonic, floristic are determined. An isoline of the sum of monthly average temperatures of air above 10, which equal 24000, southern border of a fir-tree distribution, a sets of the deep faults getting into rocks of a platform and dividing low tectonic structures of the south of Belarus and high structures of its central part are the examples of these borders. A border of sozh (riss-2) glacier passes near the mentioned line of superregional and regional faults. The orographical border separating Polesse lowland from plains of Pre-polesse is detected for the same region along isohypse of 150 m. Thus, series of natural boundaries of a zone and nonzonal origin can be defined in southern Belarus that allows to conclude that the main landscape boundary of the country stretches there.

The level of clarity indicates the sharp and nonsharp type of natural borders. Sharp, distinct edges characterise mostly geological (faults, reverse faults) and geomorphological (types of relief) borders. However, there are predominantly indistinct boundaries such as climatic, geobotanical and soil contours. Landscape boundaries can be both sharp, and nonsharp. If borders of landscapes coincide with distinctly expressed geology-geomorphological border, they have, as a rule, sharp edge. In a case of combination of indistinct natural boundaries with landscape, the last take a nonsharp boundary.

The described natural borders of the southern part of Belarus of a zonal and nonzonal origin are expressed nonsharply. Therefore the landscape boundary which is representing itself as synthesising, also is nonsharp. In reality this border looks like as a transitive strip where a reduction and disappearance of features of landscapes of subtaiga subtype and accumulation of specific features of polesse landscapes occur.

The nonzonal features widespread display in type and subtype of landscapes. These factors are main characteristics of two principal (the genus and specie) and two intermediate level (group of genus and subgenus) of classification units. The genus of landscapes combines the sites of similar on genesis and time of origin. For example, a moraine landscapes with hills and lakes and a moraine landscapes with kame and lakes has been formed in an accumulation zone of Poozersky (vurm) glacier. A moraine landscapes with eroded hills and a moraine landscapes with eroded kame has been developed for the similar sites of a zone of riss glacier.

A moraine landscape with lake is typical within the area of development of basic moraine of vurm glacier; secondary-moraine – of sozh and dnepr glacier. An alluvial terraces prevaile in the area of fluvial accumulation and glacial landscapes with lake - in the area of glacial accumulation with lakes.

The genus of landscapes differs among each other not only by genesis, but also by the degree of drainage (poorly, moderately, intensively drainage), types of soil and vegetation cover. These features were used as additional indicators to define the genuses. The comparison of natural-territorial complexes (NTC), formed in the area of the same genesis, but differed in time of origin, represents obvious distinctions between them. For example, the moraine landscape with hills and lakes is characterized by frequent alternation of drainage and weak drainage sites, complex soil cover and vegetation with prevalence of fir-tree and speckled alder forests on high elements of a relief and lowland meadows – on low elements of relief. Drainage areas, soddy-podzol soil, spruce-broad-leaved forests are inherent attributes for moraine landscapes with eroded hills.

The spatial distribution of genres of landscapes in territory of Belarus is characterized by the certain law: many patterns of this hierarhy level replace each other in latitude direction. For example, the glacial landscapes with lake, moraine landscapes with hills and lakes of the north are replaced by secondary-moraine and secondary fluvial-glacial in the central part and by alluvial landscapes with lakes and alluvial terraces in the south. This distribution can be explained by zonal genetic types of relief and quarternary deposits in the area of glacial accumulation.

At the same time the genres of landscape change each other also from the west to the east. This law especially expressed in the middle part of territory of Belarus. The moraine landscapes with eroded hills has been formed in the west part of Belarus, secondary fluvial-glacial landscapes - in the central, and secondary-moraine and loess landscapes in the east part of Belarus (fig.1).

The genus of landscapes occupies the certain absolute height and forms three altitude-landscape steps. The landscapes of low altitude step have absolute heights of 100-150 m and it is presented by group of six genus of landscapes. The landscapes of middle altitude step have absolute heights of 150–200 m and dominate in Belarus, occupying almost half of its territory. Landscapes which are the most typical for a zone of the mixed woods dominate there. The landscapes of the high step reach heights of 200-346 m and are presented by group of five genus of landscapes. Hence, the nonzonal phenomenon – vertical differentiation of landscapes is classification indicator of group of genus of landscapes.

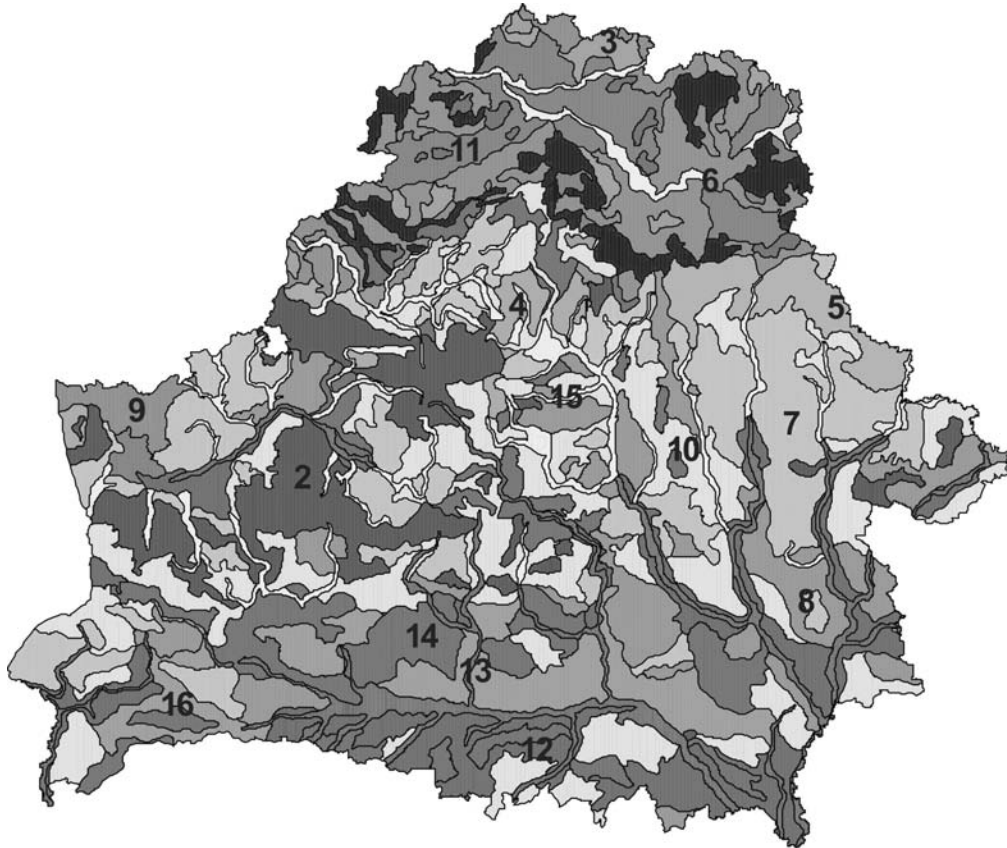


Fig. 1. The landscape map of Belarus (1 – moraine landscape with hills and lakes; 2 – moraine landscape with eroded hills; 3 – moraine landscape with kame and lakes; 4 – moraine landscapes with eroded kame; 5 – loess; 6 – moraine landscape with lakes; 7 – secondary-moraine landscapes; 8 – moraine-sandr landscapes; 9 – fluvial-glacial with lakes; 10 – secondary fluvial-glacial; 11 – alluvial landscapes with lakes; 12 – glacial landscapes with lakes; 13 – alluvial terraces; 14 – landscapes of floodplane; 15 – the landscape of marshes; 16 – the landscapes of river valleys)