ECOLOGICAL AND GEOGRAPHICAL MAPPING OF ALTAI KRAI LAND COVER: APPROACHES AND EXPERIENCE

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ABSTRACT
Mapping is one of the major methods in ecological and geographical studies, particularly in biodiversity assessment and vegetation analysis. Ecological and geographical mapping of land cover or eco-phytogeographic mapping is developing as one of the current trends on the basis of geobotanical, biogeographical, phyto-ecological mapping. In order to develop geoinformation eco-geographical mapping of vegetation was performed an analysis of 50 geobotanical cartographic works, were justified classification features of the main types of maps of the subjects of research, and considered the prospects for the development of this area of mapping of Altai krai land cover in modern conditions.

The vegetation cover is the most dynamic component of geosystems, a vulnerable indicator of growing conditions, i.e., the ecological condition of the territory. Ecological and geographical maps of vegetation (ecological and phytogeographic maps) are distinct from classical geobotanical and phyto-ecological maps, primarily in scientific approaches to their creation: they reflect characteristics of the geographical environment, consider vegetation as one of the components of geosystems (landscapes), reflect vegetation changes associated with anthropogenic impacts, are aimed at solving ecological and geographical problems of environmental quality management. Typically, creating eco-maps is based on the two-pronged approach: the classical environmental (bioecological) and eco-geographical [2].

Geobotanical maps occupy an important place among human environment maps, showing not only vegetation in its modern structurally coenotic manifestations, but also ecological and geographical factors, their determinants, as well as basic spontaneous and anthropogenic dynamic processes taking place in it. They are, by definition of V.B. Sochava, universal or inventory vegetation maps [2]. The ideas of V.B. Sochava in environmental-geobotanical mapping were further developed in the works of A.V. Belov, I.P. Zarutsky, G.I. Ogureeva, A.G. Isachenko.

A.G. Isachenko identified the main types of ecological and geographical maps of vegetation. He subdivided them into the following maps: types (kinds) of

communities, degradation of the vegetation cover, biological contamination (introduction of weeds and poisonous plants), changes in resource and environment protective (security) functions of vegetation, disturbances (destruction) of vegetation, flora habitats, etc. [4]. Following A.G. Isachenko, during private scientific analysis of an array of geobotanical maps, ecological and geographical maps of vegetation and other similar maps in content or subject, was performed a division into groups of maps:

- Plant community types;
- Vegetation degradation;
- Plant community dynamics;
- Disturbances (destruction) of plant communities [15].

For maps of each group were identified differences and peculiarities of the thematic content.

Maps of plant community types. Maps of this group unite the two-pronged approach. Mapping is performed by vegetable cenoses but within classification units of physiographic division of the territory. The vegetation is characterized by a complex hierarchical spatial structure. This group includes: the vegetation map of the Tibetan Plateau [20], the vegetation map of the Republic of Bashkortostan [7], the vegetation map of Volgograd Oblast [12], the forest cover map of Primorye [6], the coastal vegetation map of the Gulf of Finland [3], and others. Displaying the vegetation structure is also the subject of this group of maps. An example is the forest cover map of Altai Krai [10] and the steppe vegetation map of Russia [8]. These maps contain information on plant associations prevailing in the study area.

Maps of vegetation degradation. The maps display changes associated with worsening of growing conditions, such as simplification of plant cenoses caused by anthropogenic activity. There are very strong, strong, medium, weak and very weak degrees of vegetation degradation. Besides, vegetation degradation is expressed as a percentage. An example of this type of maps can serve the vegetation degradation map of the Aral Sea region [5], the forest degradation map of Irkutsk Oblast [19], and others.

Maps of plant community dynamics. The maps contain information about the stages of revegetation, the nature of variability and speed of changes in phytocenoses. They can be used for forecasting and scenario planning of the environmental situation. The examples are: the map of stages of revegetation in the Angara river neighborhoods [21], a schematic map of revegetation of Nizhny Novgorod Oblast [13], the map of forest change during the 1949-1988 period of CIS countries [9], the map of forest dynamics of Lake Baikal basin [19], the map of revegetation of Western Siberia after disturbances [9], and others.

Maps of plant community disturbances (destruction). The maps display disturbances of plant cenoses caused by natural conditions or human activity. Natural factors causing vegetation disturbances include various pests, droughts, wildfires; anthropogenic factors include deforestation, plowing, fires started by human activities, and others. The maps are used for making recommendations for restoration

work. The examples are: the map of assessment of vegetation damage from burning fire in Perm Krai [13], the map of forest logging in the water protection zone of Lake Baikal [19], the map of forest disturbance by fire in the water protection zone of Lake Baikal [19], the map of vegetation disturbance in Southern Kamchatka [9] .

As part of the geoinformation, ecological and phytogeographical mapping of Altai Krai was applied an integrated approach based on the combination of classical ecological (bioecological) and eco-geographical (ecological and landscape) research methods of vegetation. Were analyzed: Atlas of the Altai Territory [1], a number of large-scale landscape maps of 1:500 000 - 1: 1 500 000 and ecological landscape map (1: 1 000 000) created by Institute for Water and Environmental Problems of RAS [14, 16 17], as well as the schematic map of the vegetation of the Altai district, made in 1899 [18]. As a cartographic basis for geoinformation, ecological and phytogeographical mapping was adopted a landscape scale map at 1:500,000, comprising 193 types of areas [14]. Characteristics of landscape sites include geomorphological, vegetation and soil components. The landscape structure is given in conjunction with physical and geographical zoning.

The schematic map of the vegetation of the Altai District (Fig. 1), transformed into the computer version, the original scope of which (35 miles to one inch) in modern units can be equated to the scale of 1:1 700 000 (or approximately 1:1 500 000), is used as the initial (basic) geobotanical characteristic of the territory. Thus, on this map are charted relic pine forest belts, with the habitats having significantly decreased within a hundred years. Some forest areas have almost disappeared, which were mapped as "thick birch and aspen forests" in 1899 [18].

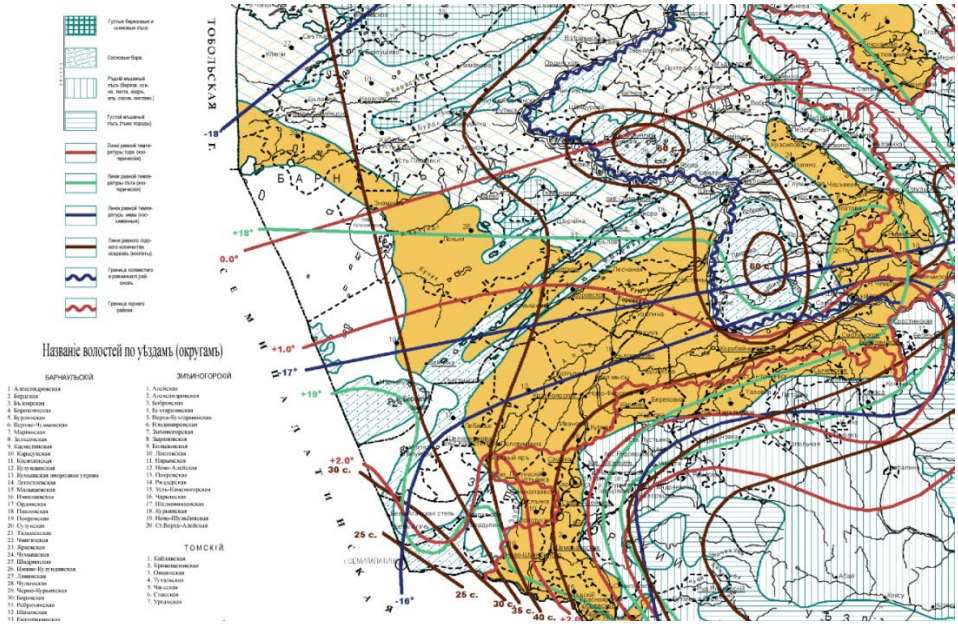

Figure 1. Schematic map of the vegetation of the Altai Mining District (fragment) [18].

Created in the 1990s the ecological and landscape map of Altai Krai (scale 1:1 000 000) contains in its table legend a diverse and detailed information about the types and levels of human impact on natural systems (Fig. 2).

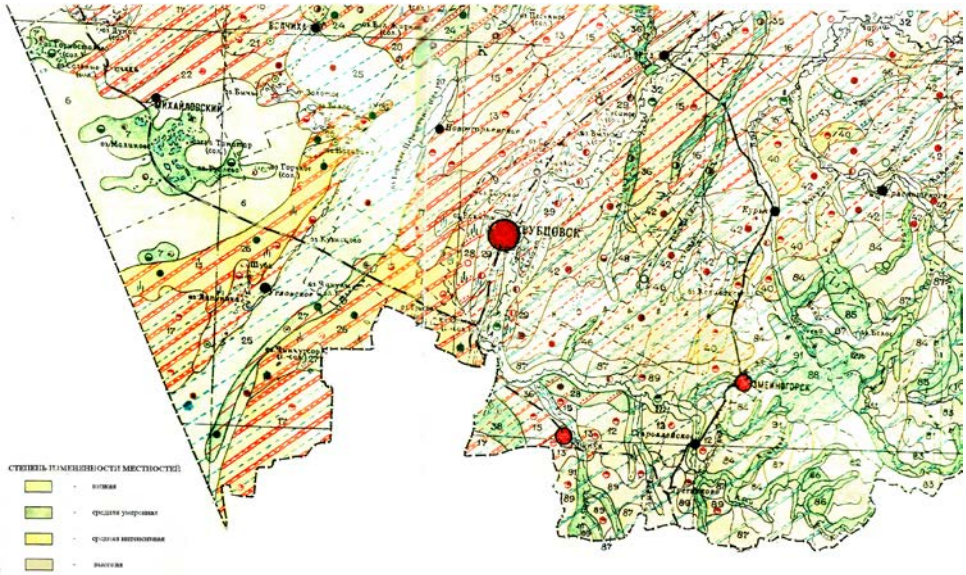

Figure 2. Ecological and landscape map of the Altai Territory (fragment, author I.N. Rotanova, unpublished, work materials of IWEP SB RAS).

The types of impact are differentiated according to the territorial basis into areal, linear and localized; levels of impact are reflected in the multiplying factor, varying from 1 to 4. According to the ratio of the ecological potential of landscapes and the level of impact was evaluated the degree of change in the area according to the four-stage grading: high, medium intense, moderate and low. The high degree of change is typical for landscapes undergoing the impact of agriculture, in particular, plowing. Thus, these landscapes have a high degree of vegetation degradation, almost complete replacement of natural vegetation by cultural phytocenoses.

Attribute data of the analyzed maps forms the basis of the structure and database records for geoinformation, ecological and phytogeographical mapping of Altai Krai. The dependencies and algorithms for the application of quantitative methods to create maps have been built.

In practical terms, a mapping study of the stabilizing function of vegetation is important for identification of the limits of the stability of biotic communities to anthropogenic factors. Demand for mapping support increases with the development of the tourism industry in Altai Krai, in particular, on the specially protected natural territories, currently operating and planned to organize. Assessment of the potential sustainability of vegetation allows normalizing anthropogenic impact with the aim of prevention of irreversible destructive processes that is necessary for forecasting and recommendation development within the ecological and geographical works.

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