EVALUATION OF THREATS TO PHYTODIVERSITY USING GEOINFORMATION CARTOGRAPHY

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ABSTRACT
Ecological and phytogeographical maps are of paramount applied significance and are used to evaluate the quality of the environment and perspective economic use of the territories. They are made using of common scientific methods, in accordance with the problems to be solved; they are included in a set of ecological geographical maps created to demonstrate a range of features and peculiarities of the spread of vegetation cover.

Modern ecological phytogeographical cartography, in its conceptual and methodological aspects, is based on theoretical and practical knowledge of vegetation, accumulated in Russia and foreign countries. There is a number of summarizing publications which thoroughly describe the peculiarities of mapped vegetation [1-10]. Considerable quantities of general and specific geobotanical maps have been created to solve various scientific and applied problems.

Ecologization (environmentalization) has broadened the informative and methodological basis for geobotanical mapping using scientific and geographical approaches [11]. Ecological phytogeographical maps are different from the traditional geobotanical and phytoecological ones in terms of the applied scientific approach: they demonstrate distinctive geographical features; represent vegetation as a component of geosystem (landscapes), show changes in vegetation caused by anthropogenic influence; and are created to solve ecological geographical problems of the environment quality maintenance. As a rule, the creation of ecological phytogeographical maps is based on a twofold approach: traditional ecological (bioecological) and ecological-geographical [12-16].

The geosystem approach, based on V.B. Sochava's works and developed to study the way the vegetative component is organized, provides thorough and various ecological information. They have data on ecologically important geographical factors, which determine the structure and development of vegetation on various strata; on dynamic and ecological potential of the territory covered with specific plant taxa, and many others [17].

The basic units of studying and mapping the landscape are considered to be a group of adjacent territories or a natural complex which is structurally more complicated in comparison with a natural boundary, but which is taxonomically lower than a landscape, as a typological unit of physical and geographical territory differentiation [18].

Phytodiversity is considered to be a species diversity of vegetation related to a definite territory unit (in ecological geographical research it is related to the landscape) [19]. The threat to phytodiversity is a danger of vegetation transformation and conditions under which the evolution and functioning of species can aggravate or stop [20].

To create the map of threats to phytodiversity a landscape map of 1:1000000 scale, which shows taxa of territories, was taken as a base (IWEP SB RAS, 1995, not published). It features 111 types of natural complexes. The map was created in accordance with morphogenetic approach; and the following structural features were taken to mark landscape areas: geomorphological structure, vegetation and soils.

The main threat to vegetation in the area is caused by land use, mainly agricultural and occasionally forest lands. In the map creating the areal factors of anthropogenic influence were taken into account, as they allow seeing clearly the extent of vegetation degradation on the studied territory [21]. The quantitative data is related to the territories according to the basic ways of land use: arable lands, haylands, grasslands, forest utilization. To analyze vegetation degradation, the following factors were taken into consideration: complete destruction of natural vegetation as a result of ploughing; the extent of damage caused by timber harvesting and grassland digression. The evaluation was made according to the area of arable lands, grasslands and forests in each district. If more than 50% of the area was arable, the threat to phytodiversity was not assessed as almost none of the natural types of phytocenosis were left.

The threat to phytodiversity was assessed by means of quantitative-qualitative method and categorized according to a 3-level scale, leading criteria and analysis of economic use (grasslands, forest use) (table). To assess the threat to phytodiversity, the area of haylands was not taken into account as they cover comparatively small territories and are capable of fast revegetation.

Table. Assessment criteria of threats to phytodiversity

Degree of threat	Landscape use (grassland, forest use) %
Low	less than 40
Medium	41-69
High	70 and more

The following criteria were used to create the map of vegetation degradation and the degree of threat to phytodiversity on the territory of the Altai Region.

The Altai Krai is situated within steppe and forest steppe zones. The territory is densely built-up and intensively developed; its landscapes are under a great economic load and are considerably damaged in many areas. The main features of vegetation cover are determined by its geographical position, complicated geological history, and diversity of climatic conditions of both plain and mountainous areas. Being surrounded by steppe and forest steppe areas of western Siberia and Kazakhstan in the north and the west, woodlands of the Salair in the east, the northern dip slope of the Altai in the south, the vegetation cover comprises various elements of floras of the neighboring territories [22].

Ribbon-like and island-like pine forests, the pine forests of Kulunda (as well as the area adjoining the right bank of the Ob, the northern foothills of the Altai) span the territory of steppe and forest steppe areas of the Krai. A considerable part of woodland is comprised by unique relict pine forests. They stretch in four ribbons from the north-east to the south-west into the interfluve of the Ob and Irtysh. The sand terrain of ridges and hills, where ribbon-like pine forests are quite common, has determined the diversity of vegetation here. On the slopes of the ridges there is a combination of pines and birches, aspens, ferns and forbs. The plain at the foothills, with its hilly terrain, is mainly covered with small-leaved birch forests, sometimes combined with aspen trees. The territory of birch forests has sharply shrunk recently due to deforestation, stubbing and ploughing. As for the plain areas, there are occasional small-leaved groves on flat watershed lowering.

There are thick larch, birch and larch, cedar forests; dark coniferous taiga forests; spruce paludal forests of river valleys in the mountains. Dark forests of Salair refigium are dark coniferous taiga with the Siberian linden. Birch and aspen forests in various combinations are widely spread here; willow and poplar forests are common in the areas adjoining rivers. Forests cover more than 20% of the Altai territory. About 40% of the wooded area is comprised by pine forests [22].

Steppe vegetation is represented by meadow steppes, steppes and arid steppes. The typical feature of present time is secondary steppes which have developed on former dry meadows, fallows, deforested areas and degraded initial steppes. Forbs and gramineous meadow steppes, frequently combined with halophyte plants, are typical of Northern Kulunda and Priobskoye Plato. The meadow steppes of the forest steppe area, adjoining the right river bank, have a more mesophytic character. They can be found on the Ob terraces and are quite common on the Altai foothills and in the low mountains. On the steep gravelly slopes meadow steppes change into petrophyte meadows; and on the knolls – into shrubby steppes. The edaphogenic variant of steppes is psammophyte steppes, found in slightly deforested sandy areas, on the

edges of pine forests and sandy soils. Dry steppes can be found in the south of the steppe zone. On the foothills and in the low mountains there are real steppes with prevailing bunchgrass steppes and their petrophyte variants.

Grassland vegetation occupies vast territories in the region. Gramineous and mixed herbs steppes as well as mixed herbs and gramineous steppes are common on typical fertile chernozem. On low river terraces and bottomlands there are lush mixed herbs lowland meadows and gramineous and mixed herbs water meadows. Lowland meadows are common on the foothills and in the low mountains of the Altai and the Salair. Alms are typical of the Tigiretskiy and Korgonskiy Ranges. Bottomland meadows are common in big river valley.

Shrub vegetation can be both of primary and secondary origin and in the region it is represented by mesophilous and steppe shrubs; in the valleys – by willow beds, sea buckthorn, prairieweed and Sibiraea altaiensis thickets; in the mountains – by dwarf (Arctic) birches, willow beds, junipers, etc.

In the mountainous part of the region, in the Alpine belt, there are gramineous sedge tundras, which develop on highly moisture soils, as well as shrub and stony tundras (on the Tigiretskiy and Korgonskiy Ranges). The territory covered with moss and lichen tundra is not vast. Cliff vegetation is represented by plant communities and associations on various lithogenuous substrata [22].

Sinanthropus vegetation, represented by subtypes of ruderal, segetal vegetation and the one of settlements, is widely spread in the region.

In the course of anthropogenic transformation of the vegetation cover, there can appear “anthropogenic deserts” of a scarce diversity and low productivity. In this case, revegetation is almost impossible.

The lowest degree of threat to phytodiversity is observed on the territory of the Salairskiy Ridge, the Altai foothills, and in big river valleys (the Ob, the Alay, the Chumysh, the Charysh, etc.). The reason of such a situation is mountainous terrain, which prevents farming and thus destroying natural vegetation. In relict pine forests natural vegetation has been partially preserved, as they are considered to be unique and are protected by the government.

On the territory on the Altai foothills and low mountains woodlands, subalpine tallgrass and short grass Alpine meadows combined with dwarf (Arctic) birches, patches of mountainous tundra, dark coniferous high grass forests, larch spruce grass forests, and second growth birch aspen forests have remained intact; gramineous and mixed herbs forests, gramineous forests with willow, poplar and white willow forests are common in the river valleys.

The average degree of vegetation cover degradation is observed on the territory of Biysk-Chumyshskaya Upland and Predaltayskaya Plain. The former is highly tilled and is considered to be the territory of intensive agriculture. The latter also provides favourable conditions for farming, which is the main factor of destroying natural vegetation [23].

On the territory of Priobskoye Plato and Kulundinskaya Valley natural vegetation has hardly remained. There is an extremely high degree of vegetation cover degradation.

A low degree of threat to phytodiversity is registered on the territory of Predaltayskaya Plain and in big river valleys.

Due to the intense forest use within the Salairskiy Range and the western part of the relic pine forest, the level of danger, phytodiversity is exposed to, is dramatically increasing. In the main part of the ribbon-like pine forest it is said to be of a mean level. A high and mean level of danger in the river valleys is provoked by intense pasturing.

The created map of threats to phytodiversity makes it clear that natural vegetation has been almost completely destroyed on the greatest part of the Altai Krai. An extremely high degree of vegetation cover degradation can be observed on 51% of the Altai Krai, a high degree of degradation is typical of 25%, a medium degree of degradation – of 10% and a low degree – of 13% [24].

Degradation of the vegetation cover is accompanied by numerous negative effects: insufficient species composition, structure simplification, replacement of natural plant associations by second-growth sinanthropous and cultural communities, decrease in genetic diversity of certain species, breaking up and isolation of populations.

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