Vegetation features of the Olkha tableland

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Abstract. The vegetation of the Olkha tableland is located on the border of the Central Siberian subtaiga light-coniferous and South Siberian mountain-taiga dark-coniferous plant forms. The interpenetration of elements of these two large plant coenotypes leads to an increase in the flora-cenotic diversity and is of particular scientific interest. Currently, the entire territory of the tableland is included in the zone of active forestry use, which leads to serious disturbances and complete destruction of plant communities. Using the method of geobotanical mapping, a detailed study of the structure and dynamics of extension, an assessment of the disturbance was carried out, and the flora-cenotic diversity was revealed. Thanks to cartographic visualization, it can be seen that the distribution of plant communities in the territory is 50% subordinate to the altitudinal-belt subordinates. Microclimatic conditions play a great role in the change in the structure of indigenous vegetation, reflecting the features of the topography. Potentially, the territory is characterized by a predominance of dark coniferous and mixed dark coniferous-light coniferous forest communities. Approximately 15% of the territory is occupied by bog plant communities. There are also stone runs, stony placers, and rocky outliers uncovered by closed plant communities. Almost 76% of the vegetation of the plateau is represented by secondary (disturbed) small-leaved and coniferous-small-leaved forests, which are the result of active forest industrial use.

1. Introduction
The area of the Olkha tableland is located within the Shelekhovsky and Slyudyansky Districts of the Irkutsk Region. The stream canals of such large rivers as the Bolshaya Olkha, the Malaya Olkha, the Irkut, and the Podkamennaya cross through the tableland. Low plateau peaks and watersheds 600-800 meters above sea level form the area. The highest point is the mountain with the rocky outcropping of the same name "Moigota Stone" (1222 m above sea level). The landscape structure of the tableland is represented by various natural complexes and belongs to the South Siberian mountainous region characterized by the predominance of the South Siberian pine mountain taiga low-mountain, slope and foothill landscapes [1].

The Olkha tableland is located in the center of the Asian continent, which explains the sharply continental climate. The circulation of the atmosphere here is seasonal. In winter, the Asian anticyclone, in which very cold air is formed, dominates the area, and dry clear weather prevails [2]. Atmospheric pressure ranges from 718 to 735 mm Hg. Southeasterly and northwesterly winds prevail in the area throughout the year. The average annual temperature ranges from − + 6.9°C to + 5.8°C. On average, approximately 466 mm of precipitation falls per year [3].
The soils of the Olkha tableland are developed on acidic igneous and metamorphic rocks. The study area belongs to a medium and low mountain soil district with podzolic, podburs, soddy podzolic, and soddy forest soils [4].

Based on the geobotanical zoning scheme, the Olkha tableland is located in the zone of the border between the Central Siberian subtaiga light coniferous and the South Siberian mountain taiga dark coniferous vegetation formations, which explains the interpenetration of elements of two large plant cenoses and leads to an increase in the flora-cenotic diversity, which is of great interest from scientists [5].

2. Materials and methods

From 2016 to 2017, expeditionary and office studies were carried out on one of the model sites of the area. They aimed to study the features of the structure and dynamics of the vegetation of the Olkha tableland, assess its disturbance, and reveal the flora-cenotic diversity.

During the expedition, 49 geobotanical sites and 2 geobotanical profiles were described as well as 64 intermediate vegetation descriptions were made. A total of 423 herbarium specimens were collected and identified. To determine the secular dynamics, we analyzed 12 dendrological cores of larch and cedar. Geobotanical descriptions were carried out using the methods of establishing geobotanical areas and profiles. In forest communities, we laid areas of 25×25 meters. In the meadows, areas of 10×10 meters were laid. Geobotanical profiles were laid with a length of up to 5 km, depending on the frequency of vegetation change.

The study of vegetation, taking into account its spatial features, was carried out by the method of geobotanical mapping. This method makes it possible to visually and quickly evaluate and compare the main characteristics of vegetation in different ecological and geographical conditions within a vast area of its distribution [6, 7].

3. Results and discussion

One of the main patterns of the distribution of plant communities over the area is the altitudinal-belt distribution. Additionally, microclimatic conditions reflecting the features of the topography exert a great influence on the change in the structure of native vegetation: the presence of wide depressions and valleys, vast surfaces of gentle and gently sloping watersheds, close occurrence or outcrops of bedrock in the form of rocks, and stone runs.

Potentially, without taking into account the anthropogenic factor, the area shows the predominance of climax light-coniferous, dark-coniferous, and mixed dark-coniferous-light-coniferous forest communities. In more detail, the indigenous communities with similar structural and functional characteristics, according to the requirements for ecological conditions, can be combined into plant associations and groups of plant associations.

Plant communities of the South Siberian plant formation occupy flat watersheds that are more than 750 meters above sea level in the Olkha tableland. They are represented by mountain taiga dark coniferous forests that include Siberian fir (Abies sibirica), Siberian cedar (Pinus sibirica), and common spruce (Picea obovata). Fir-dominated forests occupy tops and slopes. The height of the fir does not exceed 10-12 m. There is a dwarf fir form. Mountain ash grows abundantly in the undergrowth.

On the humid western and northwestern slopes, spruce joins the dark coniferous forests. A wet grassy-moss cover is formed in its canopy. Cedar is widespread on the shady slopes. In cedar forests, the shrub layer is not significant, and in the lower tier, lingonberry (Vaccinium vitis idaea) with a small-grass cover dominate: oxalis acetosella, two-leaved mine (Maianthemum bifolium), European cedar (Trientalis europaea), linnaea (Linnaea borealis), and club-shaped lyre (Lycopodium elavatum). Sphagnum mosses join the green mosses in the depressions. On drier and warmer slopes, cedar forests give way to light coniferous forests.

The Central Siberian formation on the Olkha tableland is represented by subtaiga pine (Pinus sylvestris) and larch-pine (Larix sibirica) forests that are common in the northern part of the area. The
most favorable habitats for these forests are the southern slopes. Pine stands with the participation of larch prevail here. Larch is not found in young pine forests and watersheds.

On the shady slopes below the 700 m altitude, there are spruce-cedar forests with larch lingonberry-blueberry and green moss on the underbath with *Rubus arcticus* and herbaceous (*Allium microdictyon, Equisetum sylvaticum, Diplazium sibiricum, Dryopteris carthusiana*) (figure 1).

Along the illuminated gentle slopes below 700 m altitude, pine and larch forest communities are widespread with forbs (*Vicia cracca, Polygonatum odoratum,* and *Geranium wlassowianum*) and small grass (*Tridentalis europeae, Maianthemum bifolium,* and *Pyrola asarifolia*) soil cover (figure 2).

**Figure 1.** Spruce-cedar forest with larch.

**Figure 2.** Larch-pine forest.

Pine forb forests (*Potentilla tergemina, Geranium eriostemon,* and *Melampyrum nemorosum*) with shrubs: rhododendron (*Rhododendron dauricum*) and meadowsweet (*Spiraea media*) are found on steep illuminated slopes at an altitude of 600–800 m above sea level.

Along the river valleys on the upper parts of gentle slopes, spruce and cedar-spruce with larch forests with wild rosemary (*Ledum palustre*), lingonberries, moss, and forbs (*Carex acuta, C. globularis,* and *Juncus compressus*) are widespread in the lower layer. The undergrowth in them is dense, consisting of meadowsweet (*Spiraea salicifolia*), alder (*Duschekia fruticosa*) and willow (*Salix bebbiana*).

In birch-larch and birch-cedar-larch with spruce and pine forests, there are blueberries (*Vaccinium uliginosum*), wild rosemary (*Calamagrostis langsdorffii*), and sedges (*Carex pamirica, C. loliacea* (*Sphagnum.*)) as well as sedge (*Carex cespitosa*) waterlogged coastal communities. Willow (*Salix viminalis*) grows along the banks.

Bog plant communities occupy approximately 15% of the area. Most often, these are birch bogs (*Betula pendula*) with bushes with sedge (*Carex cespitosa, C. Canescens, C. globularis*). Shrub bogs (*Salix taraikensis*) with Deschampsia cespitosa, *Calamagrostis langsdorffii,* and *Carex globularis* as well as various species of mosses are less common.

There are also areas not covered with plant communities, occupying approximately 2% of the total area. These include stone runs and rocks.

To date, secondary or restored plant communities occupy 76% of the Olkha tableland at the sites of clear cuttings and fires. These are small-leaved birch, aspen or mixed forests, communities of duschekia shrubs (*Duschekia fruticosa*) as well as light coniferous pine and larch-pine forests that are at the stage of restoration to climax forests. The network of logging roads developed in the areas of felling for various purposes is widely spread. Some of them are not used and are overgrown with pioneer vegetation.

Climax cedar and fir forests in the area of the Olkha tableland have survived only in small areas. Due to anthropogenic impact, instead of pine and larch forests, post-fire birch and aspen lingonberry-forb forests grow now.

During evolutionary changes, cedar and fir stands are replaced by larch stands. The reforestation potential depends on the number and condition of tree undergrowth. We observed much Siberian pine and spruce undergrowth in the study area. The destruction of forest vegetation on steep southern
slopes leads to the development of erosion processes and an increase in the area of steppe plant communities dominated by wormwood and mountain-steppe forbs.

The vegetation map compiled for the model area clearly shows the distribution patterns of plant communities (figure 3).

Figure 3. Map of modern vegetation in the model area of the Olkha tableland. 1. Fir-cedar forest with larch; 2. Cedar and larch-cedar forest; 3. Cedar and pine-cedar forest; 4. Spruce-cedar forest with larch; 5. Pine with larch foreshore; 6. Spruce and cedar-spruce forest with larch; 7. Larch-spruce forest with cedar; 8. Larch and cedar-larch forest with spruce; 9. Ledum sedge bogs; 10. Birch bogs with bushes; 11. Stony placers; 12. Anthropogenic vegetation. Numbers “1-12” mark indigenous plant communities. Indices “a, b, c” indicate the stage of restoration of the plant community. The index “0” marks burned-out areas, felling areas.

An analysis of herbarium specimens and literature revealed that 1050 species and subspecies of vascular plants were recorded in the flora of the Olkha tableland. They belong to 471 genera and 116 families, which is 45.8% of the number of flora species in the Irkutsk Region and 44.5% of the flora in Baikal Siberia [8]. Among them, 11 species are included in the Red Book of the Irkutsk Region [9].

One of the plant species included in the Red Data Book, *Listera ovata*, is endangered. Six other species are vulnerable: *Cypripedium calceolus*, *Cypripedium macranthos*, *Epipogium aphyllum*, *Platanthera bifolia*, *Chrysosplenium sedakowii*, and *Orobanche krylowii*. We have identified four rare species close to extinction: *Lilium pumilum*, *Calypso bulbosa*, *Neottianthe cucullata*, and *Paeonia*
Some of these species are outside their ecological optimum. *Lilium pumilum* is located on the western border of its distribution area, and *Paeonia anomala* – in the close limits of the eastern border of its distribution area. Separately, among the plant species from the Red Book, it is necessary to distinguish species with complex developmental biology. These are mainly species of the Orchid family (*Orchidaceae*): *Calypso bulbosa*, *Cypripedium calceolus*, *C. macranthon*, *Neottianthe cucullata*, and *Platanthera bifolia*. Their seeds have an underdeveloped embryo, are devoid of endosperm, and are unable to germinate without the participation of a symbiont fungus [7]. Moreover, they have a long period of underground development, and under unfavorable weather conditions, they may not rise above the ground for the entire season. *Orobanche krylowii* from the family *Scrophulariaceae*, which exists as a parasite on *Thalictrum minus*, also comprises this group with special ecological conditions. The high decorativeness of the plants in this group perniciously collected in bouquets significantly reduces their number.

It should be noted that all the listed representatives of the Orchid family are included in the Red Book of the RSFSR [10], increasing the status of their uniqueness.

The list of rare and endangered plant species noted on the Olkha tableland, which included in the Red Book of the Irkutsk Region [7], is as follows:

- *Lilium pumilum* – Dwarf lily
- *Calypso bulbosa* – Calypso bulbosa
- *Cypripedium calceolus* – Limestone slipper
- *Cypripedium macranthon* – Large-flowered slipper
- *Epipogium aphyllum* – Leafless capillum. Seldom
- *Neottianthe cucullata* – Glomerular nest. Rarely
- *Listera ovata* – Egg-shaped cache. Seldom
- *Platanthera bifolia* – Two-leaved Lyubka
- *Paeonia anomala* – Peony Maryin root
- *Chrysosplenium sedakowii* – Sedakov's spleen
- *Orobanche krylowii* – Krylova broomstick

4. Conclusion
The anthropogenic impact on the area of the Olkha tableland negatively affects the standing of vegetation. The presence of the Trans-Siberian Railway, settlements, and horticultural associations, active economic development of the forest, unlimited collection of wild plants as well as the annual increase in the load from amateur tourism poses a threat to many plant species. Often this is not only the targeted extermination of entire synusias but also a change in their habitats: drainage of reservoirs, deforestation, plowing of meadows, construction of residential buildings, industrial sites, etc. This can destruct individual aboriginal species resulted from the redistribution of the territory and the increase in adventive, sometimes invasive plant species.

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