



# Afforestation of Extrazonal Steppes in the Baikal Region

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## Abstract

The published paper presents the results characterizing structural-dynamical changes and anthropogenic destructions of forests, which form in the zones of contact between taiga and extrazonal steppe of Barguzin and Tunka Depressions (the Baikal Region). We have used perennial (for 22 years) geobotanical descriptions of model sites and made inventory large-scale geobotanical schematic maps on the base of field deciphering of aerophotographs of different years (1974-2002). Soil-geobotanical profiling allowed revealing some links of edaphic conditions with structural-dynamical characteristics of forest cenoses of the above-mentioned areas of Pre-Baikal. The subject of studies is determination of the trends of forest cenoses development in the zones of contact between forest and extrazonal steppe. Such cenoses reflect structurally and dynamically changes occurring in natural zones on the background of climatic fluctuations under anthropogenic impact much more rapidly than zonal vegetation.

## Keywords

Extrazonal Steppe, Afforestation of Extrazonal Steppes, Baikal Region

**Subject Areas:** Biogeography

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## 1. Introduction

The aim of our studies is to investigate forest cenoses forming on the place of extrazonal steppes of the Baikal Region. Their structural-dynamical characteristics reflect spatial and temporal variability and anthropogenic destructions of vegetation at local and regional levels of environmental organization in general. The task of this study is to reveal a structure and trends of forests formation under the conditions of extrazonality of steppes of depressional type on the background of climate dynamics during last decades.

Formation of vegetation under the conditions of environments contact (interzonal, interheight belts, extrazonal) is accompanied by development of very complex by their structural and dynamical parameters phytocenoses,

and their successions reflect processes of environmental systems self-organization at any range. Under the conditions of global environmental changes, integrated studies of vegetation taking into account its previous state on the background of present one are more and more important for future forecast.

## 2. Research Areas, Methods and Materials

We have been investigated the structure and formation of the plant communities at the different areas of Lake Baikal basin under afforestation process of the extrazonal steppes on the 2 key sites—Tynka Depression (South-Western Pre-Baikal) and Barguzin Depression (North-Eastern Trans-Baikal) as well.

In our studies, we have used a principle of systematic study of phytocenoses of extrazonal vegetation organization in a whole. This allowed us to reveal practically all its possible changes on the background of climate dynamics during last decades. Structural and dynamic differences of phytocenoses under different natural conditions are revealed. Geobotanical mapping on the base of aerospace pictures made during different years and combined soil-geobotanical profiling with geobotanical descriptions from different years and seasons concerning at key (model) sites allowed to establish the direction of development of vegetation of Baikal region at all.

## 3. Results

We present some dates of your researches of the extrazonal steppe afforestation for two key sites in Lake Baikal basin. These processes are characteristics for all areas of the region where extrazonal steppes were been observed for long-time investigation.

### 3.1. First Key Site—Tynka Depression (South-Western Pre-Baikal)

The vegetation of middle part of the Tynka Depression (South-Western Pre-Baikal—first key site), according to botanical-geographical demarcation [1] [2], is not included to any area, sub-area or province of steppes or forest-steppes. Is the zone of contact of extrazonal (non-zonal) steppes of depressional type and polydominant dark coniferous-light coniferous taiga. Mountain taiga forests of South Siberia formations from Ural-Siberian formations phratry are characteristic for the Tynka Depression [3]. The right board of the depression is covered with cedar forests with spruce and larch admixture containing as well ledum, cowberry and green mosses as well as with cedar-rhododendron forests containing bilberry, cowberry, green mosses and bergenia; the left board is covered with pine and larch-pine forests containing grasses and undershrubs; the bottom is covered with larch, pine-larch and pine-motley grasses forests together with stepped larch forests (upper part of the valley), pine forests (middle and lower parts of the valley) and steppe sites.

The base of modern vegetation at the key site are pine stepped forests together with steppe cenoses, in which the abundant pine undergrowth, mainly 10 - 15 y.o., is found out everywhere. It is necessary to notice that during long time period, a considerable part of depression territory was used as pasture lands (burning out was often performed) or were ploughed up in the beginning of 1950ies. In turn, it constrained to some extend natural development of vegetation, mainly forests cenoses formation. This is confirmed by the presence of timber stands of the same age consisting everywhere of pines. In the living soil cover, dominant position belongs for a long time to representatives of gramineous plants, such as Krylov mat-grass, *Poa attenuata*, wormwood sage, fleawort, characteristic mosses are из мхов характерны *Abietinella abietina* and *Rhytidium rugosum*. Main factors stipulating modern spatial organization of stepped forests in the studied area is the way of anthropogenic impacts (pasturing, ploughing up, cutting, fires) on the background of climate dynamics (mainly mean annual precipitations by year periods). A comparative analysis of spatial and temporal variability as well as of territories occupied by forest and steppe cenoses revealed trends of forestation of steppe territories during last 25 - 40 years. Gradual afforestation of extrazonal (depressional type) of steppes in the studied area (as was revealed by comparative analysis of spatial photographs of 1974-2002) is a response to changing environmental conditions during last decades. Soil-geobotanical profiling showed as well that there are no direct links of phytocenoses with soil types. Here the steppe cenoses are extrazonal, and soil composition is characteristic for light coniferous zonal forests. According to the last classification [4], the soils of this area are characterized as cryoaridic (non-zonal) ones. It is manifested in formation of stepped forests together with steppe cenoses. For taiga zone (South-Western Pre-Baikal) these processes are to be considered as a climatogenic succession within zonal vegetation.

### 3.2. Second Key Site—Barguzin Depression (North-Eastern Trans-Baikal)

The vegetation of the second key site, *i.e.*, of middle part of the Barguzin Depression (North-Eastern Trans-Baikal), according to its botanical-geographical demarcation [1] [2], is not included as well to any area, subarea or province of steppes or forest-steppes. It consists of Baikal-Dzhugdzhur formations of mountain taiga larch-pine forests with underwood of Daurian rhododendron together with South Siberia formations of motley grasses and gramineous steppes [3]. According to the map of zones and types of belts of vegetation in Russia and adjacent countries [5], the phytocenoses on the territory on the key site are related to boreal (taiga) East Barguzin (the Barguzin Depression) goltsy-tundra-elfin wood-light forest-taiga-forest-steppe type. However, the studied area does not belong to the area of steppes and forest-steppes. Here, on graded slopes and aprons on the depression boards, larch-pine forests form. Flatter parts of the depressions were mainly ploughed up or used for a long time for pasture. At present, tillage overgrowth and appearing of pine undergrowth in steppe cenoses used before for pasture are found out everywhere. Modern vegetation of this site consists mainly rare pine forests, stepped, with motley grass and pine undergrowth together with steppe cenoses, among which there are clumps of pine undergrowth and sprouts, especially on the territories, which were not ploughed up. The comparative analysis of spatial and temporal variability, as well as of areas occupied by forest and steppe cenoses showed trends of gradual forestation of steppe areas, especially of lower parts of graded slopes of Argadinsky Ridge forming a board of the middle part of the Barguzin Depression.

Modern trends of formation of vegetation in this area characterize as well the initiation of forestation processes of steppe areas, where main factors stipulating formation of vegetation cover in the studied area is the way of anthropogenic impacts (decrease of anthropogenic impacts in 1980ies). The dominant species in the timber stand is pine with well-expressed undergrowth beyond the canopy and with inclusion of Daurian rhododendron and brier. The living soil cover consists of *Veronica incana*, *Dianthus versicolor*, *Allium subtilissimum*, wormwood sage, *Patrinia rupestris*, Krylov mat-grass, quack-grass. There are small clumps of *Abietinella abietina* and *Rhytidium rugosum*. The soil-geobotanical profiling showed that here there are no direct links of phytocenoses with soils types as well, as the steppes are extrazonal. The soils of the Barguzin depression bottom, according to last classification [4], are named cryoaridic (non-zonal) ones. They determine in many aspects the modern structure of phytocenoses in the studied area.

It is to notice that afforestation processes in the extrazonal steppes with formation of canopy timber stands are revealed earlier both on the western coast of Lake Baikal and in Pre-Ol'khon [6].

## 4. Conclusions

On the background of climate dynamics, the forecasting becomes the main aim of studies of probable changes in the forest cenoses on wide territories. Any forecast requires complete information on the modern state, on past changes in vegetation characteristic for the period of formation of its basic structural and dynamical parameters.

Main part of forecasts is modeling of forests successions on the background of the dynamics of landscape forming factors. The obtaining of basic information for any forecast is possible using method of finding out a network of model territories reflecting real structural and dynamical features of vegetation from definite natural zones within their modern understanding, as well as intra- and interzonal environmental differences. As for the vegetation from model territories, it can represent a succession system reflecting all possible states of forests of modern endo- and exogenesis of the cenoses on a concrete territory.

During Holocene, the climate dynamics caused spatial variations in the structure of the Baikal Region vegetation cover; as well there were different ways of vegetation formation due to the peculiarities and heterogeneity of environmental conditions at different levels of its organization. In our case, the forestation of steppe areas in the Barguzin and Tunka Depressions suggests changing environmental conditions for vegetation formation in this region. Hence, it is possible that in the future it will be necessary to give to non-forest lands the status of forest territories at regional topological level.

It is necessary to notice that processes of afforestation of steppe territories are characteristic as well for some other territories of the Baikal region, *e.g.*, for the “steppoids” (according to V.B. Sochava [7]) on the slopes of the Baikal Ridge and along the boards of the Kurtun, Goloustnaya RR (central part of Lake Baikal western coast), steppoids-uburs of the western macro-slope of the Khamar-Daban Ridge (South-Eastern Pre-Baikal).

Under the conditions of zonal forest-steppe (the Selenga R. basin, South-Western Trans-Baikal) on the background of climate dynamics, re-demarcation of territories occupied by steppe and forest cenoses occurs in the

favour of the latter. At the modern stage of the forests development, such trends are characteristic under existing climatic conditions of the Baikal Region.

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