



Formation of Forests under Contrast Environmental Conditions in South-Western Pre-Baikal, South-Western Trans-Baikal and North-East Pre-Baikal (Some Aspects of Structure and Dynamics)

Alexander P. Sizykh

Siberian Institute of Plant Physiology and Biochemistry RAS SB, Irkutsk, Russia

Email: alexander.sizykh@gmail.com

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Abstract

Zonal and height belts differentiation of environmental parameters determine forms and types of changes during formation of systems of any natural hierarchy. Under climatic conditions, when shifts of environmental (geographic) zones or height belts as definite environments is possible, there are processes able to result in structural differentiation of the whole biosphere. The problem of forests and steppes interaction is up to nowadays a subject of essential studies of the peculiarities of cenoses formation under transitional environmental conditions in different areas and territories.

Subject Areas

Forestry, Biogeography

Keywords

Forests of Contrast Environmental Conditions, Key Sites, South-West Pre-Baikal, North-East Pre-Baikal, South-West Trans-Baikal

1. Introduction

The papers [1]-[9] present a wide range of opinions on the character of forests and steppes interaction, on the reason of forests absence in the steppes and on the appearing of steppe inclusions, as well as characteristics of zonal (mountain) steppe and forest-steppe. The opinions on this matter differ. Some researchers

state that forests invade steppes, other ones have an opposite opinion. Characteristics of this or that processes are often based on a temporal interval of studies. There are as well opinions on predominance of anthropogenic factors or of their series and of climate in formation of concrete environmental systems.

The aim of our studies is to reveal the structure and the peculiarities of forests communities formation at the boundary of taiga and extrazonal steppe in South-West Pre-Baikal and North-East Pre-Baikal, as well as under the conditions of zonal forest-steppe in South-West Trans-Baikal. There are just very different areas by physical-geographical conditions for formation and development forests on the environment contact sites. In the Barguzin and Tunka depressions are contact of the extrazonal steppe communities and forests in the zonal dark-light coniferous taiga different areas of Pre-Baikal territories. The main task was to establish a factor determining trends in the development of contacting forest communities on the background of climate dynamics and change in the Baikal Region.

2. Methods

Our research methods are geobotanical survey with establishment of model sites within key sites and field deciphering of large-scale spatial photographs (Landsat 7ETM+, Landsat 2MSS, Landsat 5TM; print scale is 1:100,000) of different survey years. Research areas were key sites of South-West Pre-Baikal (middle part of Tunka Depression), South-West Trans-Baikal (middle part of the Selenga River basin) and North-East Pre-Baikal (middle part of Barguzin Depression) (**Figure 1**).

3. Results

According to botanic-geographic zoning of Central-Asian (Dauria-Mongolia) sub-area of Eurasian steppe area [10] [11], the steppes of Tunka and Barguzin Depressions (the key sites) are not related to any sub-area or sub-province of forest-steppes and steppes. The steppe territories of the key site in the middle part of the Selenga River basin (South-West Trans-Baikal) form a part of mountain-forest-steppe Orkhon-Lower Selenga province of Central Asia sub-area of Eurasian mountain steppes [10].

Due to the studies performed, we have determined basic structural-dynamic characteristics of forests actual state on the above mentioned key sites. This is current dates about structural-dynamics organization of forest communities for different environment contact sites.

Key site—middle part of Tunka Depression (South-West Pre-Baikal). Basic modern vegetation of this case consists of pine (*Pinus sylvestris* L.) steppified forests combined with steppe communities including practically everywhere abundant undergrowth of pine (*Pinus sylvestris* L.) 10 - 15 y.o. It is to notice that here a considerable part of the depression territory was being used for a long period as pasture (burning-out was performed often), or the earth was

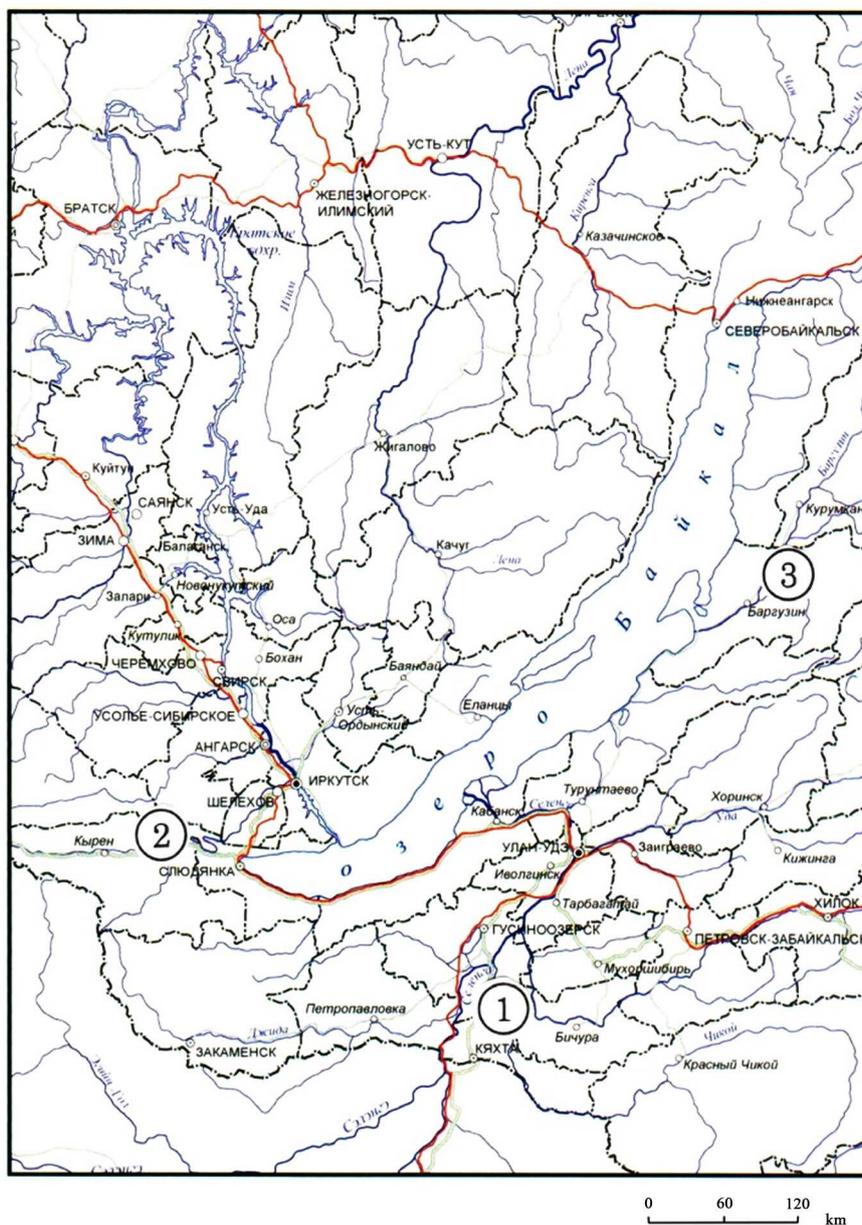


Figure 1. Areas of Study (showing on the topographical schematic map of Lake Baikal region): 1—the middle part of the Selenga River basin (South-West Trans-Baikal); 2—the middle part of Tunka Depression (South-West Pre-Baikal; 3—the middle part of Barguzin Depression (North-East Pre-Baikal).

ploughed in the beginning of 1950ies. There was as well total forests cut-off for needs of local people. These factors constrained the natural vegetation development, mainly formation of forest communities. This is confirmed by the presence of timber stand of the same age consisting of pine (*Pinus sylvestris* L.). The soil cover was dominating during a long period by cereals representatives. The species composition of steppified pine forests is as follows: *Spiraea media* Fr. Schmidt, *Stipa krylovii* Roshev., *Bromopsis enermis* (Leys.) Holub., *Poa attenuate* Trin., *Artemisia frigida* Wild. and *Artemisia scoparia* Waldst. et Kit.,

Galium verum L., *Shizonepeta multifida* (L.) Briq. и *Sanguisorba officinalis* L. There are small clumps of mosses consisting of *Abietinella abietina* (Turn.) Flisch., *Rhytidium rugosum* (Hedw.) Kindb. and *Pleurozium schreberi* (Brid.) Mitt. characteristic for polydominant dark- and light-coniferous taiga in Pre-Baikal.

The comparative analysis of spatial variation in the vegetation structure with time for territories occupied by forest and steppe communities revealed trends of forestation of steppe territories during last 30 - 50 years. This was shown by field deciphering of spatial photographs of different survey years. The studied area represents extrazonal (depression type) steppes, gradual forestation of which is a response to changing environmental conditions in the region. For the taiga zone, where this key site is situated (South-West Pre-Baikal), these processes are to be considered as a climatogenic succession within vegetation zonal type.

Key site—middle part of Barguzin Depression (North-East Pre-Baikal). Basic modern vegetation of this key site is pine (*Pinus sylvestris* L.) forests with motley grasses, steppified, thinned with undergrowth of pine (*Pinus sylvestris*) combined with steppe communities. There are among them clumps of undergrowth and young growth of pine (*Pinus sylvestris* L.), especially on the territories, which were not ploughed before. Species composition of these forests consists of *Rhododendron dauricum* L., *Spiraea media* Fr. Schmidt, *Rosa acicularis* Lindley, *Veronica incana* L., *Allium tenuissimum* L., *Stipa krylovi* Roshev., *Galium verum* L., *Patrinia rupestris* (Pall.) Dufr., *Elytrigia repens* (L.) Nevski, *Artemisia subviscosa* Turcz. et Bess., *Artemisia frigida* Willd., etc. There are small mosses clumps of *Rhytidium rugosum* (Hedw.) Kindb. and *Pleurozium schreberi* (Brid.) Mitt.

Comparative analysis of spatial variation of vegetation structure in the areas occupied by forest and steppe communities within any time period, like in the previous case, revealed trends of gradual forestation of steppe space, especially in lower areas of graded slopes of Argadinsky Ridge and of lower areas of the slopes of Barguzin Ridge forming depression boards. This is also suggested by data of field deciphering of spatial photographs of different years survey. The phytocenoses structure on this key site reflects trends of forestation of extrazonal (depression type) steppes of taiga zone in North-West Pre-Baikal.

Key site—middle part of the Selenga River basin (South-West Trans-Baikal, the studied area is a zonal forest-steppe). Modern vegetation of this key site is represented by forests consisting of pine (*Pinus sylvestris* L.), motley grasses, sedge. They are steppified and include larch (*Larix sibirica* Ledeb.) and birch (*Betula platyphyla* Sukacz.) together with steppe communities formed among the forests often passing in motley grasses—cereal steppes of a high riverine terrace of the Selenga R. Basic species composition of such forests are *Spiraea media* Fr. Schmidt, *Cotoneaster melanocarpus* Fischer. et Blytt., *Rosa acicularis* Lindley, *Carex pediformis* C.A. Mey, *Carex macroura* Meinsh., *Vicia cracca* L., *Polygala sibirica* L., *Dracocephalum ruyschiana* L. and *Equisetum sylvaticum* L.

There are very small synusia of forest mosses—*Abietinella abietina* (Turn.) Flisch. and *Rhytidium rugosum* (Hedw.) Kindb., characteristic mainly for the communities of slopes upper areas.

The comparison of spatial variation of vegetation structure within any time period on the sites occupied by forest and steppe communities showed that this case reveals as well trends of forestation of steppe territories among the forests of zonal forest-steppe. Field deciphering of spatial photographs of different years revealed changes in boundaries of zonal forest-steppe in latitudinal way and formation of forests similar by their structure to zonal light-coniferous forests in Pre-Baikal.

4. Conclusions

The performed studies of structural-dynamic organization of forest at the contact of forests and extrazonal steppes in South-West Pre-Baikal, North-West Pre-Baikal and zonal steppe of South-West Trans-Baikal allowed both to reveal modern trends in the development of key sites vegetation and to determine the vector of formation of vegetation on concrete territories of Pre-Baikal in the whole, with time and in space. On the background of climate dynamics and change in the region, mainly of mean annual temperatures increase, of precipitations re-distribution by seasons (for late summer and autumn periods) and of decrease of anthropogenic impact, trends of formation of transitional phytocenoses between forest and steppe increased in the studied area. Processes of steppe areas afforestation are increasing everywhere.

Modern evolution stage of the regional environment reflects increase of areas of forest communities in all the cases cited (on the key sites). While considering the dynamics of such communities as a result of climate-induced successions, it is possible to state activation of paragenese processes [12] for Tunka and Barguzin Depressions (key sites) and shift of forest-steppe zone in latitudinal direction in the Selenga River basin. It is probable that at some scenarios of climate change, steppe territories occupied by extrazonal steppe (at dryness and anthropogenic impact increase) can widen; another scenario is change of zonal steppe boundaries and forestation of extrazonal steppe with formation of light-coniferous forests of zonal types at increase of climate humidity. In the whole, it can impact environments formation in all the regions.

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