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RESEARCH ARTICLE

Phytocenotic biodiversity of lime-tree forests in the Altai Region

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The article presents the results of geobotanical examination of lime-tree forests in the Zarinsky district of the Altai Region. There were identified 4 groups of associations based on the completed geobotanical descriptions and compiled the phytocenotic characterization of lime-tree forests and mixed forests with the participation of *Tilia sibirica* Bayer.
Keywords: *Tilia sibirica*; Tiliaceae; lime-tree forests; vegetation; Altai Region

Introduction

Lime-tree forests in the Altai Region, as well as throughout Siberia, are among the rare plant communities (Maleev, 1949; Gudoshnikov, 1986; Krapivkina, 1996). Currently the lime-tree forests of the Kuznetsk Alatau in the state natural monument «Kuzedeevsky lime-tree island» are the most fully studied (Khlonov, 1990; Egorov, 2009; Krapivkina, 2006; Kupriyanov, 2015; Kupriyanov et al., 2015). There is almost no information about this kind of forests of the Altai Region (Khlonov, 1965; Ermakov, 1995; Silantieva, 2013; Terekhina & Kopytina, 2016). *Tilia sibirica* Bayer is the only broadleaf forest-forming species, a tertiary relict, preserved from ancient times on Salair in the territory of the natural complex preserve of regional importance «Togulsky» (Votinov et al., 2002).

In August 2017, the geobotanical survey of the vegetation cover with the participation of *Tilia sibirica* of the preserve was carried out. There were identified species composition, rare and endangered plant species, as well as were represented phytocenotic characteristic of lime-tree forests.

Materials and methods

Various types of botanical and geographical field research were used in the work: route-reconnaissance and route-detailed on key areas. Geobotanical descriptions were performed by the classical method. The plant nomenclature adopted in the «Flora of Siberia» (1986–2003) was used in this work.

Results and discussion

Floristic examination of forests with the participation of *Tilia sibirica* revealed 56 species of plants belonging to 51 genera and 31 families. There has been established the location of 5 species of vascular plants listed in the Red Book of Russia (2008) and in the Red Book of Altai Region (2016). There were identified 6 species of herbaceous tertiary relicts: *Asarum europaeum* L., *Asperula odorata* L., *Festuca altissima* All., *Myosotis krylovii* Serg., *Paepnia anomala* L., *Stachys sylvatica* L. and one woody species *Tilia sibirica* (Polozhiy, Krapivkina, 1985).

As a result of the research, 4 groups of forest associations with the participation of *Tilia sibirica* were identified: tall-grass lime-tree forests, fern lime-tree forests, short-grass lime-tree forests, fir-limes-aspen-mixed forests.

Tall-grass lime-tree forests

Herbs-*Aconitum-Aegopodium* lime-tree forest

This plant community has 80% canopy cover, the forest is thick and wet. It has two-layer stand, the first layer is 20 m high and the second layer of 16 m is formed by *Tilia sibirica*. The average age of the trees is 50 years old, the average diameter of the stems is 18 cm and the maximum is 30–32 cm. In the undergrowth occurs *Padus avium* Mill. of 3 m high. The shrub layer has 10% projective cover; it is formed by *Caragana frutex* (L.) C. Koch. of 1 m high. Common projective cover of the herbaceous layer is 50-60%; dominant plants include *Aegopodium podograria* L. and *Aconitum septentrionale* Koelle. The first sublayer is 150 cm high and formed by *Aconitum septentrionale, Urtica dioica* L., *Pleurospermum uralense* Hoffm. The second sublayer

is 80 cm high and formed by *Stachys sylvatica* L., *Polemonium caeruleum* L., *Impatiens parviflora* DC. The third sublayer is 15-20 cm high and formed by *Asarum europaeum*, *Asperula odorata*, *Myosotis krylovii*, *Cerastium pauciflorum* Stev. ex Ser. et al. *Poaceae* family is presented by *Festuca altissima, Legumes* are represented by *Lathyrus gmelinii* Fritsch., miscellaneous herbs include *Impatiens parviflora* DC., *Crepis sibirica* L., *Polemonium caeruleum* L., *Cirsium helenioides* (L.) Hill., *Lamium album* L. et al. Ferns is presented by *Athyrium monomachii* (Kom.) Kom. and *Dryopteris carthusiana* (Vill.) H.P. Fuchs. Number of species is 21 per 100 m^2.

Matteuccia-Aconitum-Aegopodium lime-tree forest

This plant community has also 80% canopy cover; the forest is thick and wet. It also has two-layer stand, the first layer is 20 m high and formed by *Tilia sibirica* and *Populus tremula* L., the second layer of 17-18 m high is formed by *Tilia sibirica*. The average age of *Tilia sibirica* trees is 60 years, the average diameter of the stems is 23 cm and the maximum is 30 cm. The average age of *Populus tremula* trees is 40-50 years, the average diameter of the stems is 20 cm and the maximum is 40 cm. There are trees of *Abies sibirica* Ledeb. of 5 m high and 30-35 years old, and specients of *Padus avium* Mill. in the undergrowth. The shrub layer is not expressed. Common projective cover of the herbaceous layer is 50%; dominant plants include *Matteuccia strutiopteris* (L.) Tod., *Aegopodium podograria* and *Aconitum septentrionale*. The first sublayer is 170 cm high and formed by mesophilic miscellaneous herbs of *Aconitum septentrionale* and *Urtica dioica.* The second sublayer is 80 cm high; dominant species are *Matteuccia strutiopteris* and *Aegopodium podograria.* The third sublayer is 15-20 cm high and formed by *Asarum europaeum*, *Asperula odorata* et al. *Poaceae* family is presented by *Festuca altissima, Legumes* are not represented, miscellaneous herbs include *Pulmonaria mollis* Wulf. Ex Hornem, *Impatiens parviflora* DC., *Crepis sibirica* L., *Bupleurum aureum* Fisch. ex Hoffm. et al. Ferns is presented by *Matteuccia strutiopteris* and *Athyrium monomachii*. Number of species is 15 per 100 m^2.

Fern lime-tree forests

Oxalis- Aegopodium Matteuccia lime-tree forest

This plant community has also 80% canopy cover. It also has two-layer stand, the first layer is 20 m high formed by *Tilia sibirica*, *Abies sibirica* Ledeb., *Betula pendula* Roth. and *Populus tremula* L., the second layer of 18 m high is formed by *Tilia sibirica*. The average age of *Tilia sibirica* trees is 50 years, the average diameter of the stems is 20 cm and the maximum is 26 cm. There are trees of *Abies sibirica* of 3 m high and 35 years old, and trees of *Tilia sibirica* of 2.5 m high in the undergrowth. Common projective cover of the shrub layer is 10%; the first sublayer is 2.0 m high and includes *Sorbus sibirica* Hedl., *Caragana frutex* (L.) K. Koch, *Lonicera xylosteum* L. and *Sambucus sibirica* Nakai. The second sublayer is 1.0 m high and is formed by *Ribes atropurpureum* C.A. Mey. Common projective cover of the herbaceous layer is 50%; dominant plants include *Matteuccia strutiopteris, Aegopodium podograria* and *Oxalis acetosella* L. The first sublayer is 130 cm high and formed by tall-grass species of *Cacalia hastata* L., *Crepis sibirica* and *Aegopodium podograria.* The second sublayer is 100 cm high and formed by dominant species of *Matteuccia strutiopteri* and *Paeonia anomala.* The third sublayer is 15-20 cm high and formed by *Asarum europaeum*, *Glechoma hederacea* L., *Oxalis acetosella* (5 cm high) et al. *Poaceae* family is presented by *Festuca altissima, Cyperaceae* family includes *Carex macroura* Meinsh. There is no *Legumes* in the forest, miscellaneous herbs are represented by *Crepis sibirica*, *Senecio nemorensis* L., *Saussurea latifolia* Ledeb., *Urtica dioica*, *Aconitum septentrionale*, *Cirsium helenioides* et al. Ferns are presented by *Matteuccia strutiopteris*, *Athyrium monomachii* and *Dryopteris carthusiana*. Number of species is 30 per 100 m^2.

Short-grass lime-tree forests

Festuca- Aegopodium- Asarum aspen-lime-tree forests

This plant community has 90% canopy cover. It has two-layer stand, the first layer is 16 m high formed by *Populus tremula* and the second layer of 12-14 m high is formed by *Tilia sibirica*. The average age of *Tilia sibirica* trees is 40 years, the average diameter of the stems is 9 cm and the maximum is 20 cm. There are trees of *Tilia sibirica* 6-8 m high in the undergrowth. Common projective cover of the shrub layer is 6%, the first sublayer is 2.0 m high and includes *Padus avium,* and the second sublayer is 0.8 m high and is formed by *Caragana frutex* and *Ribes atropurpureum*. Common projective cover of the herbaceous layer is 25%; dominant species include *Festuca altissima*, *Aegopodium podograria* and *Asarum europaeum*. The first sublayer is 40 cm high and formed by *Aegopodium podograria* and *Festuca altissima.* The second sublayer of 10 cm high is represented by *Asarum europaeum, Asperula odorata* et al. Miscellaneous herbs include *Pulmonaria mollis* Wulf. ex Hornem., *Aconitum septentrionale*, *Euphorbia lutescens* Ledeb., *Paris quadrifolia* L., *Paeonia anomala*, *Urtica dioica* et al. Number of species is 15 per 100 m^2.

Fir-limes-aspen-mixed forests

Herbs- *Urtica- Aconitum* fir-limes-aspen-mixed forest

The forest is wet enough; it has 70-80% canopy cover. It has two-layer stand, the first layer is 22-23 m high formed by *Populus tremula,* and the second layer of 18-20 m high is formed by *Tilia sibirica*, *Populus tremula* and *Abies sibirica.* The average age of *Tilia sibirica* trees is 55 years, the average diameter of the stems is 20 cm and the maximum is 25 cm. The average age of *Populus tremula* trees is 60 years, the average diameter of the stems is 36 cm and the maximum is 45 cm. The average age of *Abies sibirica* trees is 60 years, the average diameter of the stems is 27 cm and the maximum is 42 cm. There is the first shrub sublayer formed by *Padus avium* of 4.5 m high and the second shrub sublayer formed by *Ribes atropurpureum* of 1.2 m high. Common projective cover of the herbaceous layer is 80-85%, dominant species include *Aconitum septentrionale* and *Urtica dioica.* The first sublayer is 160 cm high and formed by *Anthriscus sylvestris, Delphinium elatum* L., *Aconitum septentrionale* and *Crepis sibirica.* The second sublayer is 80-90 cm high and represented by *Lamium album, Paeonia anomala* et al. The

third sublayer is 40 cm high; it consists of vegetative shoots of *Aegopodium podograria* and *Urtica dioica.* Such short-grass species as *Asarum europaeum, Asperula odorata, Glechoma hederacea and Cerastium pauciflorum* are concentrated mainly under the *Abies sibirica* trees. *Poaceae* family is presented by *Festuca altissima, Legumes* include *Lathyrus gmelinii.* Numerous miscellaneous herbs include *Urtica dioica, Aconitum septentrionale, Anthriscus sylvestris, Delphinium elatum, Cacalia hastata, Crepis sibirica, Bupleurum aureum*, *Cirsium helenioides* et al. The tertiary relicts are represented by *Asarum europaeum*, *Asperula odorata*, *Festuca altissima* and *Paepnia anomala*. Number of species is 20 per 100 m^2.

Conclusion

Phytocenotic characteristics of lime-tree forests of the Altai region

The forests are wet enough and thick, 20–23 m high and have 70-80% canopy cover. The main tree species are *Tilia sibirica*, *Populus tremula*, *Abies sibirica*. The average age of *Tilia sibirica* trees is 60 years, the average diameter of the stems is 23 cm and the maximum is 38 cm. Common projective cover of the shrub layer is 3-10%; dominant species are *Sorbus sibirica, Caragana frutex, Ribes atropurpureum, Padus avium, Lonicera xylosteum* and *Sambucus sibirica*. Sometimes shrub layer is absent. Common projective cover of the herbaceous layer is 65% (maximum is 85%); it has two or three sublayers. The first and the second sublayers (tall-grass) dominant species are *Crepis sibirica*, *Matteuccia strutiopteris*, *Aegopodium podograria*, *Aconitum septentrionale*, *Festuca altissima* and *Urtica dioica*. Short-grass are represented by *Asarum europaeum*, *Oxalis acetosella*, *Cerastium pauciflorum* et al. There are 56 species of higher vascular plants per 400 m^2 in the forests, including 6 species of herbaceous tertiary relics. The total square of *Tilia sibirica* population in the Altai Region is about 2 km^2.

In the Red Book of Russia (2008) and in the Red Book of the Altai Region (2016) are listed *Erythronium sibiricum* Fisch. et Mey., *Asarum europaeum*, *Tilia sibirica*, *Lobaria pulmonaria* (L.) Hoffm., *Phallus impudicus* L.

References

Egorov, V.N. (2009). Assessment of the Ecological State of Lime-Trees in Mountain Shoria. Barnaul: Publishing House of the Siberian Branch of the Russian Academy of Sciences.

Ermakov, N.B. (1995). Classification of the Siberian Mountain Sub-Moral Small-Leaf-Dark Coniferous and Lime-Tree Forests. Botanical studies of Siberia and Kazakhstan, 30–60.

Flora of Siberia. (1987–1997).14 vols. Novosibirsk. Nauka.

Gudoshnikov, S.V. (1986). The Flora of Moss Leaves of the Black Belt of the Southern Mountains of Siberia and the Problem of the Origin of the Black Taiga. Tomsk. Tomsk State University Publishing House.

Khlonov, Y.P. (1965). Tilia Sibirica Bayer. Biological Bases of Protection of Rare and Endangered Species of Siberia: a Collection of Scientific Papers, 58-80.

Kholonov, Y.P. (1990). Lime-Trees and Lime-Tree Forests of Western Siberia. Novosibirsk: Editorial and Publishing Department of the Siberian Branch of the USSR Academy of Sciences.

Krapivkina, E.D. (1996). Shrub-Fern-Broad-Leaved-Grasses Lime-Tree Forest. Green Book of Siberia, 104–107.

Krapivkina, E.D. (2006). The History of the Study of the Kuzedeevsky Lime-Tree Island in the Mountain Shoria. Vestnik of Tomsk State Pedagogical University, 6 (57), 68-73.

Kupriyanov, A.N., Kupriyanov, O.A. & Romanova, N.G. (2015). Occurrences of Siberian Lime-Tree Seedlings in Natural Plantations. Problems of Regional Ecology, 1, 24–26.

Kupriyanov, O.A. (2015). Lime-Tree in Siberia - a Phenomenon or Pattern. Problems of regional ecology, 5, 57–61.

Maleev, V.P. (1949). Tilia Sibirica. Flora of the USSR, 15, 18–20.

Polozhiy, A.V. & Krapivkina, E.D. (1985). Relics of Tertiary Broad-Leaved Forests in the Flora of Siberia. Tomsk: TSU Publishing House.

Red Book of the Russian Federation (Plants and Fungi). (2008). Moscow: Tovarischestvo nauchnyh izdanij KMK.

Red Book of the Altai Region. Rare and Endangered Plant Species. (2006). Barnaul: OAO IPP «Altai».

Silantieva, M.M. (2013). Summary of the Flora of the Altai Region. Barnaul: ASU Publishing House.

Terekhina, T.A. & Kopytina, T.M. (2016). Tilia Sibirica Bayer. In: Shmakov, A.I. & Silantieva, M.M. (Ed.), The Red Book of the Altai Territory. Plants, Barnaul: Publishing House of Alt. University.

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