

Assessment of the diversity of vascular plants in phytocenoses with a share of *Quercus mongolica* on the territory of Relic Oaks State Reserve

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In this paper, we assess the diversity of vascular plants in phytocenoses with *Quercus mongolica* (family Fagaceae) on the territory of the Relic Oaks State Reserve (Eastern Siberia, Transbaikal region), where *Q. mongolica* is located at the northwestern boundary of the areal. The descriptions of phytocenoses have been processed in the PAST3 application. The similarity of species composition has been determined using the Jaccard index. The resulting tree diagram shows two groups of descriptions at a similarity level of 0.14–0.15. The first group includes the descriptions of mixed forest quadrats, in which *Q. mongolica* is a co-edificator. The second group of descriptions presents the communities where *Q. mongolica* is the only species in the tree layer. The analysis of the tree diagram shows the dependence of species richness within the phytocenoses on the surface patterns and edaphoclimatic conditions. The phytocenoses located on steep southern slopes show less diversity.

Key words: Eastern Siberia; Transbaikal region; *Quercus mongolica*, phytocenoses; Jaccard index

Introduction

The Relic Oaks State Reserve situated in middle latitudes between 52°57'–52°32' N and 119°58'–120°21' E, in Gazimuro-Zavodskoy district of Transbaikal region has a species composition of the vegetation cover unique to Eastern Siberia (Korsun, 2004; Korsun et al., 2008; Korsun et al., 2012; Bondarevich, Kotsyurzhinskaya, 2014; Chernova et al., 2017). The topography of the study area is dominated by middle altitudes, in some places - by low-mountain relief dissected by river valleys and their tributaries. The climate in the territory is distinctly continental.

In accordance with the biogeographical zoning (Takhtajan, 1978), this area is at the border of two major floristic regions of Holarctic: Circumboreal and East-Asian, and belongs to the region with predominance of the southern taiga. The flora of this region is rich with East-Asian species, some of which are met only here (Korsun et al., 2012; Chernova, 2012; Nobis et al., 2016). There are phytocenoses with a share of *Q. mongolica* Fisch. ex Ledeb. at the northwestern boundary of the areal on the territory of the state reserve (Dobrynin, 2000; Chernova, 2012; Bondarevich et al., 2013). The areal of *Q. mongolica* in Russia predominantly lies within the Amur basin. Its main areal, though, is China (Manchuria floral province), Korean peninsula, islands of Japan, Sakhalin Island, and South Kuril Islands (Dobrynin, 2000; Menickij, 1982, 1984).

The history of flora on the adjacent territories to the state reserve shows that communities with *Q. mongolica* presumably appeared in Eastern Siberia some five-six thousand years ago and represented the populations isolated or semi-isolated from the main areal. Budyumkan oak grove is the only one that survived in the eastern part of Transbaikal region (Korsun et al., 2012; Bazarova, Mohova, 2012).

In the conditions of Eastern Siberia, there are only steppified mountain oak communities occupying the warmest slopes facing southeast and south-west, where *Q. mongolica* is a codominant or forms pure stands (Chernova, 2012).

Research goal: to evaluate the diversity of vascular plants by means of the Jaccard index in phytocenoses with a share of *Quercus mongolica* at the north-western boundary of the areal in the Relic Oaks State Reserve.

Materials and methods

In the course of our research, we compiled 31 geobotanical descriptions in accordance with established procedures in order to study the floral composition of communities with *Q. mongolica* on the territory of the state reserve and evaluate their biodiversity (Andreeva et al., 2002; Kulikova, 2006).

One of the essential indicators of biodiversity is beta diversity (β). This is the diversity, whose value reflects the similarity and dissimilarity among habitats in terms of the abundance of species and their composition. β -diversity can be used to get an insight into the overall diversity of conditions on this territory. The fewer species are common to communities or different gradient endpoints, the higher is β -diversity (Lebedeva et al., 1999; Mehgaran, 1992).

In order to compare habitats using two quadrats or to analyze samples in pairs, researchers generally employ similarity or dissimilarity coefficients. In our analysis, we used the Jaccard index as one of the simplest and best understood indicators of floral similarity offered in 1901.

The materials acquired for the phytocenoses were processed by means of the PAST 3 application. Using this statistic package, we determined the similarity of phytocenoses by the Jaccard index.

We conducted the nearest neighbor cluster analysis to compare several areas. This method comprises compiling a similarity matrix for each pair of the objects under comparison and further on combining the said objects based on the levels of their similarity. The resulting tree diagram shows the similarity of areas or samples under comparison on the necessary grounds (Mehgaran, 1988).

Results and discussion

Here is a tree diagram compiled from 31 descriptions of phytocenoses with *Q. mongolica* on the territory of the Relic Oaks State Reserve (Fig. 1).

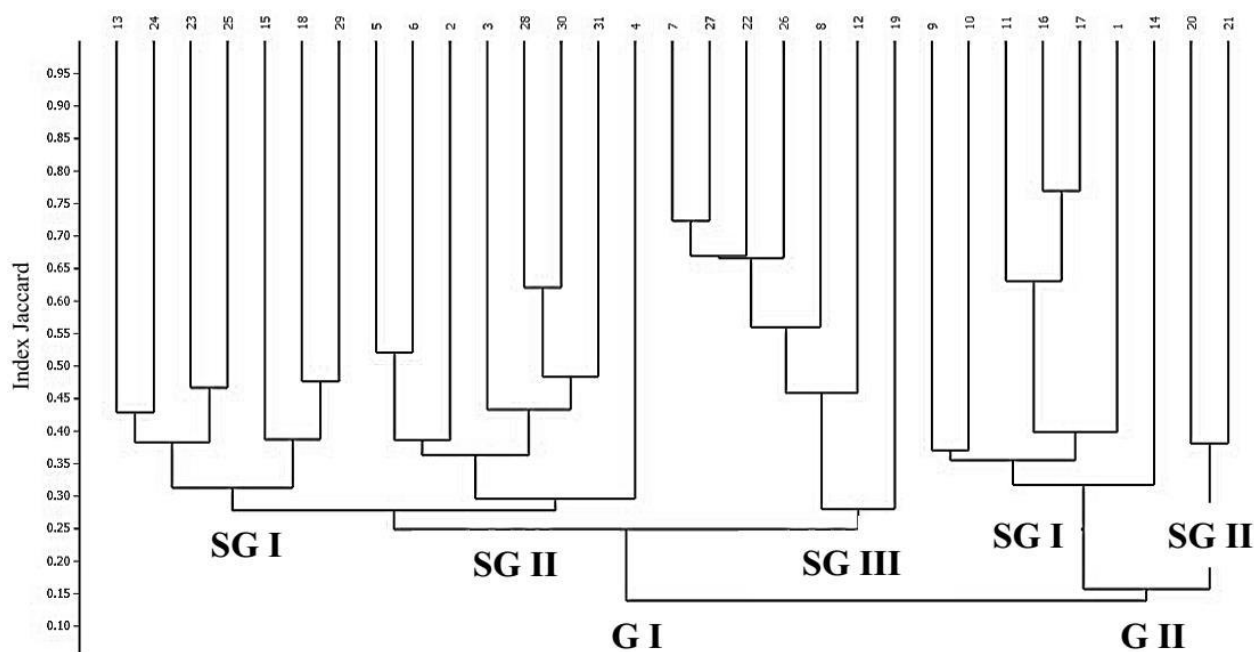


Figure 1. The dendrogram of similarity phytocenoses with *Quercus mongolica* (designations in the text)

The descriptions are divided into two groups at a similarity level of 0.14–0.15.

Group I (G I)

The first group of branches of the cluster tree diagram breaks into three subgroups and it turns out to be more heterogeneous than the second group.

The first subgroup (**SG I**) comprises the pairs of branches No.13 and No.24 as well as No.23 and No.25, which present plots of oak and black birch forest with a high grass layer of mesophilic herbs (*Melica turczaninowiana* Ohwi, *Sanguisorba officinalis* L., *Lathyrus humilis* (Ser.) Spreng., *Fragaria orientalis* Losinsk., *Filipendula palmata* (Pall.) Maxim.) with a field layer projective cover degree of 80-90%. In these plant communities, *Q. mongolica* is a coedificator and it is only here that we can spot large trees 10 to 12 meters high. All the descriptions are performed in southwest-facing midslopes in Polovinnaya Pad. These phytocenoses are located in topographic lows, creek valleys, with enough humus and a favorable water situation due to water flowing down

from the adjacent slopes. The slope angle is 10-25° in these phytocenoses. These landscape features are very likely to be the factor that principally affects the species composition and abundance in the plant communities.

The subgroup also includes descriptions No.15, 18 and 29, with a Jaccard index of 0.40-0.45 (the same as in the previous cluster group).

Description 15 originates from the southwestern slope of Polovinnaya Pad; 18 and 19, from east-facing slopes downstream the river Budyumkan, near Olmovka stream. The communities are variations of sparse oak forest with a significant share of *Lathyrus humilis*, *Carex lanceolata* Boott, *Iris uniflora* Pall. ex Link, *Pulsatilla nuttalliana* (DC.) Bercht. et Presl, *Artemisia sericea* Web. ex Stechm. The herb layer has a total projective cover of 55-70% with a slope angle of 25-30°.

Descriptions 5, 6, 2, 3, 28, 30, 31 and 4 belong to the second subgroup (**SG II**). This subgroup incorporates the communities with a significant share of softwood species, whereas the share of *Q. mongolica* is small. These can be grouped into associations of mixed forests with a share of *Q. mongolica*. They occupy southern or eastern slopes in the central part of round mountains. In terms of the number of species, the quadrats of SG II near the previous group (19 to 39 species).

The third subgroup (**SG III**) consists of the clusters of branches 7, 27, 22, 26, 8, 12 and 19. This is the most interesting subgroup of quadrats including the most diverse plant communities (46 to 86 species). All the communities are united based on similarity of vegetation structure featuring a mixed mesophytic forest with a significant projective cover of the herb layer and high crown density. Overall, all the quadrats are characterized by a mosaic species composition with not only forest species but also a large share of forest-steppe and mountain-steppe ones.

Group II (G II)

The second group consists of two subgroups. In the first subgroup (**SG I**) of the second group of descriptions are quadrats 9, 10, 11, 16, 17, 1 and 14. The most similar descriptions are No.16 and No.17 (with a Jaccard index of 0.77, which is the peak value for the whole tree diagram). All the communities of the subgroup are oak groves with a significant share of steppe species in the herb layer (*Artemisia gmelinii* Web. ex Stechm., *Thymus dahuricus* Serg., *Pulsatilla turczaninowii* Krylov et Serg.). The phytocenoses are significantly steppified and located on steep (25° to 45°) southern or southwestern slopes and in the near-to-summit parts of round mountains.

The second subgroup (**SG II**) of the second group includes quadrats 20 and 21 with a small number of species in their composition (18 and 11 respectively). These plant communities are mostly located on southern, very steep rocky slopes with a large share of mountain-steppe species.

Conclusion

In our research, we compiled 31 geobotanical descriptions in accordance with established procedures in order to study the floral composition of communities with *Q. mongolica* on the territory of the state reserve and evaluate their biodiversity. Has been studied the hierarchy of similarities descriptions in species composition with using Jaccard index.

Thus, the cluster analysis of phytocenoses using the Jaccard index has shown that the heterogeneity of plant communities is largely affected by the terrain features and edaphoclimatic conditions (slope exposition and angle, rocky outcrops, etc.) and to a lesser extent, by the types of edificators at the tree layer.

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