Conservation of relict species of Siberian flora in the floral complex "Chernevaya taiga" (Novosibirsk)

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Abstract. The paper deals with the species composition of the floral complex 'Chernevaya taiga' established in the territory of the Central Siberian Botanical Garden in 1967. Of 60 revealed species, 23 were introduced during the establishment of the complex. All the species represent the populations self-maintained by seed or vegetative propagation.

Plant introduction is one of the primary measures of plant biodiversity conservation. Species collections at introduction centres are the way of survival of endangered populations. Besides, they serve as the material to study their biological characteristics and additional living source for natural populations recovery. It is commonly recognized that populations are best recovered within the relevant plant community. The species can be introduced in the appropriate 'artificial phytocoenoses' that are arranged in disturbed landscapes with suitable conditions. A favourable state of phytocoenosis edificators is the essential requirement for that. The long-term monitoring experiments and estimation of sustained functioning of such communities without controlled human interference are of significant interest.

In 1958–1959, the Central Siberian Botanical Garden (CSBG) team, headed by Nadezhda Lubyagina, initiated the work on conservation of relic species (nemoral and Tertial) by introducing them into the artificially established formations. The work aimed at the creation of a floristic complex of Kuznetsk Alatau nemoral relics under the canopy of *Abies sibirica* Ledeb. and *Tilia sibirica* Fischer ex Bayer. The results of the 20-year-old experiment were summarized in several publications [1–4]. The arrangement of the complex resembling both linden tree communities and "Chernevaya taiga" came from the dual composition of Kuznetsk Alatau forest vegetation [1]. A long preparatory period preceded the complex establishment. It involved the study of the composition of natural communities and the biological characteristics of certain relic species. The Zyryanka river floodplain was selected as an experimental plot. Its gentle terrain provided winter snow accumulation and better soil moisture conditions. From all the habitat types observed in the CSBG territory, it featured the closest similarity to the environmental conditions of Gornaya Shoria's natural populations (the original material was collected in the vicinities of

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Kuzedeyevo settlement). In 1967–1968, they planted the dominating tree species of *Abies sibirica, Tilia sibirica, Pinus sibirica* Du Tour, and *Picea obovata* Ledeb. across the 4.8 ha of the selected plot. The 3–5-year-old trees were taken from natural populations. In the spring of 1969, they started introducing the herbaceous young plants grown from the seeds collected from natural populations. The sod fragments with living plants were used as well. The primary introduction was conducted for some herbaceous dominants. Ten years later, the community totaled 59 species, with 17 of them 17 were relic [1].

The aim of the current research is: 1) to study the species composition of the relic floristic complex after 50 years of its existence and with the 30-year-long absence of the controlled conservation activity; 2) to reveal the sustaining introduced species.

The 50-year-old floristic complex was represented by several fragments: the "Chernevaya taiga" plot under teh canopy of linden trees with the participation of fir; the plot with nemoral relics growing under the canopy of linden trees along the slope of the Zyryanka's right bank; small fragments of pure stands of *Pinus sibirica* and *Abies sibirica* growing both along the slopes and in the floodplain. In this paper, we present only the "Chernevaya taiga" plot's data. It should be mentioned that the name of the plot does not comply with the community of "chernevaya taiga". It is conditional and is used here following the earlier publications. All those fragments were founded in the floodplain covered with hydrophilous herbaceous birch forests in combination with shrubberies and along the slopes with birch and bracken pine-birch forests [5].

We studied the archival data, described the vegetation plots in 2019-2020, compiled and analysed the higher vascular plants list, and recorded the phenorythms of herbaceous plants. Population self-maintenance ability was estimated following G.P. Semenova's approach [6] and the published data [7].

In the mentioned plot (2 ha) we recorded 60 higher vascular plant species of 34 families with *Tilia sibirica* Fischer ex Bayer as an edificator of the tree layer (up to 80%). This species is regarded in Siberia as a rare nemoral Pliocene relict [8] and is the rarest forest forming species on Salair Ridge [9, 10]. Other tree species in the plot grew as sporadic or even single mature specimens. For *Abies sibirica,* the seedlings were recorded, composing up to 40 % of undergrowth. We also recorded the single young plants of *Populus tremula* L. The herbaceous plants displayed two waves of dominants, the ephemeroids followed by the early summer species. The plant community contained 37 aboriginal species making up 62% of the total species composition. We revealed the following aboriginal species: *Betula pendula* Roth*., B. pubescens* Ehrh., *Populus tremula, Padus avium* Mill., *Viburnum opulus* L., *Equisetum hyemale* L., *E. pratense* Ehrh., *E. sylvaticum* L., *Matteuccia struthiopteris* (L.) Tod., *Lilium pilosiusculum* (Freyn) Miscz., *Maianthemum bifolium* (L.) F.W. Schmidt, *Paris quadrifolia* L., *Geranium sylvaticum* L., *Adoxa moschatellina* L., *Moehringia lateriflora* (L.) Fenzl, *Silene nutans* L., *Stellaria bungeana* Fenzl, A*ctaea erythrocarpa* (Fisch.) Freyn, *Ranunculus monophyllus* Ovsz., *Aconitum septentrionale* Koelle, *Lathyrus gmelinii* Fritsch, *L. vernus* (L.) Bernh., *Vicia sepium* L., *Rubus saxatilis* L., *Veratrum lobelianum* Bernh., *Veronica chamaedris* L., *Aegopodium podagraria* L., *Anthryscus sylvestris (*L.) Hoffm., *Pulmonaria mollis* Wulfen ex Horn, *Glechoma hederaceae* L., *Taraxacum officinale* Wigg., *Crepis sibirica* L., *Orobanche sp., Cardamine impatiens* L., *Carex cespitosa* L., *Urtica galeopsifolia* Wierzb. ex Opiz., *Millium effusum* L. The introduced species: *Tilia sibirica, Abies sibirica, Pinus sibirica, Picea obovata, Erythronium sibiricum* (Fisch. et C.A. Mey.) Krylov*, Allium microdictyon* Prokh., *Primula pallasii* Lehm., *Cruciata glabra ssp. krylovii* (Iljin) E.G. Naumova, *Oxalis acetosella* L*., Geranium robertianum* L*., Asarum europium* L*., Corydalis bracteata* Pers*., Actaea spicata* L., *Anemona altaica* Fisch. et Ledeb*., A. caerulea* DC*., Scrophularia umbrosa* Dumotr., *Viola uniflora* L., *Galium odoratum* (L.) Scop*., Paeonia anomala* L., *Bupleurum longifolium* L*., Sanicula europaea* L., *Brunnera sibirica* Steven, *Myosotis krylovii* Serg.

(the species are listed with their portion decrease in the community). The following introduced species had the highest abundance values: *Myosotis krylovii* (80%), *Galium odoratum* (до 60%), *Oxalis acetosella* (до 25%), *Geranium robertianum* (10%), *Erythronium sibiricum* (3%), *Anemona altaica* и *A. caerulea* (5%), *Corydalis bracteata* (3%), *Asarum europaeum* (2%).

The archival data stated 23 survived introduced species of 43. Four of them, *Campanula trachelium* L., *Stachys sylvatica* L., *Epilobium montanum* L., and *Polistrichium braunii* (Spenn.) Fee, showed a good result of the primary introduction and even diaspore ripening in culture [1]. All these species were not found in the present time.

K.A. Sobolevskaya and N.P. Lubyagina [1] described natural seedings of *Abies sibirica, Erythronium sibiricum, Geranium robertianum, Asarum europium, Actaea spicata, Sanicula europaea,* and *Myosotis krylovii* in the late 1970s. However, we recorded the localized population, i.e. the species had not distributed significantly over the territory of the floristic complex during the following decade. The authors mentioned the prolonged adaptation period for *Oxalis acetosella.* However, the species is still present in the complex. The same authors stated the absence of flowering for *Brunnera sibirica.* On the other hand, vegetative propagation, which is characteristic of the species, allowed the population to survive in a limited area.

The conducted stability analysis of the listed species growing as monocultures in the CSBG expositions stated stability for nearly half of the aboriginal species (18). *Equisetum hyemale* showed moderate stability, while *Actaea erythrocarpa* and *Veratrum lobelianum* were unstable [7]. The rest of the species were not studied in that aspect. Among the introduced species, 15 were stable in monoculture, *Erythronium sibiricum, Actaea spicata, Sanicula europaea* showed moderate stability and the monoculture of *Primula pallasii* was fickle. The stability of *Geranium robertianum, Scrophularia umbrosa,* and *Galium odoratum* was not studied.

After 50 years from the experiment establishment and at a 30-year-long absence of control and interference, the monitoring study of the floristic complex proved the positive experience of relic species conservation approach, which involved introducing to human-disturbed landscapes of edificator species characteristic for natural communities where these relics grow. The preliminary and detailed study of growth, development and reproduction of some introduced herbaceous species provided successful creation of the plant community. The direct introduction experiment proved the ability of most of the relic species to self-maintain beyond their natural distribution area both in monoculture and in a the established community. Some species maintained only in the this complex, while the rest of the species perished even under provided suitable microenvironmental conditions. The work represents the preliminary research as part of a complex study that includes population studies and comparative analysis of the relic species populations of “Chernevaya taiga” and introduced populations in monoculture.

The studies is carried out according to of the state assignment of the Central Siberian Botanical Garden of the Siberian Branch of the Russian Academy of Sciences state registration no. AAAA-A21-121011290025-2 and no. AAAA-A21-121011290025-4 and Biological Center SB RAS, “Collection of living plants in open and closed ground” USU 440534.

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