Plants species for ecological landscaping in urban territory in Central Siberia

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Abstract. Green spaces such as parks and street trees represent a key component of urban ecosystems. Planting trees and shrubs in cities provides a number of environmental, economic, social and health benefits and also preserves biodiversity in highly urbanized areas. The key problem of the ecological landscaping in Central Siberia is to select plants species resistant both to high level of pollutants and to large variations in temperature. Basing on the comparative study of growth characteristics and physiological state of plants in natural and urban ecosystems we recommend 31 plants species of 16 families for ecological landscaping. Recommended species for ecological landscaping in Central Siberia are Abies sibirica, Acer platanoide, Amorpha fruticosa, Berberis thunbergii, Berberis vulgaris, Cornus alba, Cotoneaster lucidus, Crataegus sanguine, Dasiphora spp., Forsythia spp., Juglans mandshurica, Juniperus Sabina, Larix sibirica, Philadelphus spp., Physocarpus opulifolius, Picea obovata, Picea pungens, Pinus sibirica, Pinus sylvestris, Ribes aureum, Rosa rugosa, Salix alba, Salix ledebouriana, Salix purpurea, Sorbaria sorbifolia, Sorbus aucuparia, Spiraea salicifolia, Syringa josikaea, Tamarix ramosissima, Tilia cordata, Viburnum opulus. Coniferous plants are presented with 7 species of 5 genera. Deciduous plants are presented with 24 species of 21 genera. The list of recommended plants species includes both trees and shrubs.

1. Introduction

Urban ecology is a rapidly developing scientific discipline with great relevance to sustainable city design and management [1]. Green spaces such as parks and street trees represent a key component of any urban ecosystem. Planting trees and shrubs in cities provides a number of environmental, economic, social and health benefits [2], [3], [4]. Planting trees in highly urbanized areas should focus on increasing biodiversity in all aspects of the urban forest, from street trees to urban parks [5].

This paper provides a list of trees and shrub recommended for planting in cities in Central Siberia.

2. Methods and results

Central Siberia is an extensive geographical region located along the Yenisei River. The climate is strongly continental with large temperature variations during the year. According to the 2010 census, urban population is 2.158 million, rural population is 0.670 million. As of January 1, 2018, more than 1 091 600 people live in Krasnoyarsk which is the largest industrial and cultural centre of the region.

The climate is humid continental. The average temperature in January is −19.2 °C, the average temperature in July is +24.8 °C. The record low temperature is − 52.8 °C, the record high temperature is +36.4 °C. Due to its industry, Krasnoyarsk is one of the most polluted cities in Russia.

The key problem of the ecological landscaping in Krasnoyarsk and other cities in the region is to select plants species resistant both to high level of pollutants and to large variations in temperature. In order to solve this problem, we researched growth characteristics and physiological state of different plants species in natural and urban ecosystems in Krasnoyarsk. The list of ecosystems is presented in table 1 and table 2.

Table 1. Natural ecosystems.

Ecosystem	Geographical region	Landscapes	Plant community
Pine-tree forests	Eastern Sayan Mountains	Forested mountains	Pine-tree forest community
Birch-aspen forests	West Siberian Plain	Forested hills, woodlands, grasslands	Birch, aspen, Siberian larch, grassland communities
Stolby Nature Reserve	Eastern Sayan Mountains	Forested mountains, forested hills	Boreal forest community

Table 2. Urban ecosystems.

Ecosystem	Geographical region	Landscapes	Plant community
Gorky Central Park	Yenisei River valley	Plain landscape	Planted trees and shrubs
Yuri Gagarin Park	West Siberian Plain	Plain landscape	Planted trees and shrubs
Builders square	West Siberian Plain	Plain landscape	Planted trees and shrubs
Square Cosmonauts	West Siberian Plain	Plain landscape	Planted trees and shrubs

Basing on the comparative study of growth characteristics and physiological state of plants in natural and urban ecosystems we recommend 31 plants species of 16 families for ecological landscaping in Central Siberia (table 3, 4).

Table 3. List of plants families recommended for ecological landscaping in Central Siberia.

Family	Number of recommended species
Adoxaceae	1
Berberidaceae	2
Cornaceae	1
Cupressaceae	1
Fabaceae	1
Forsythia	1
Grossulariaceae	1
Hydrangeaceae	1
Juglandaceae	1
Oleaceae	1
Pinaceae	6
Rosaceae	8
Salicaceae	3
Sapindaceae	1
Tamaricaceae	1
Tiliaceae	1

Most of the recommended species belong to families Rosaceae (8 species), Pinaceae (6 species) and Salicaceae (3 species). Coniferous plants are presented with 7 species of 5 genera. Deciduous plants are presented with 24 species of 21 genera. The list of recommended species includes both trees and shrubs.

Table 4. Recommended species for ecological landscaping in Central Siberia.

Plants species	Type	Life-forms
Abies sibirica	Coniferous	Tree
Acer platanoides	Deciduous	Shrub or tree
Amorpha fruticosa	Deciduous	Shrub
Berberis thunbergii	Deciduous	Shrub
Berberis vulgaris	Deciduous	Shrub
Cornus alba	Deciduous	Shrub
Cotoneaster lucidus	Deciduous	Shrub
Crataegus sanguinea	Deciduous	Shrub or tree
Dasiphora spp.	Deciduous	Shrub
Forsythia spp.	Deciduous	Shrub
Juglans mandshurica	Deciduous	Shrub or tree
Juniperus sabina	Coniferous	Shrub
Larix sibirica	Coniferous	Tree
Philadelphus spp.	Deciduous	Shrub
Physocarpus opulifolius	Deciduous	Shrub
Picea obovata	Coniferous	Tree
Picea pungens	Coniferous	Tree
Pinus sibirica	Coniferous	Tree
Pinus sylvestris	Coniferous	Tree
Ribes aureum	Deciduous	Shrub
Rosa rugosa	Deciduous	Shrub
Salix alba	Deciduous	Shrub or tree
Salix ledebouriana	Deciduous	Shrub or tree
Salix purpurea	Deciduous	Shrub
Sorbaria sorbifolia	Deciduous	Shrub
Sorbus aucuparia	Deciduous	Shrub or tree
Spiraea salicifolia	Deciduous	Shrub
Syringa josikaea	Deciduous	Shrub
Tamarix ramosissima	Deciduous	Shrub or tree
Tilia cordata	Deciduous	Tree
Viburnum opulus	Deciduous	Shrub or tree

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