

# Study of the Structure and Condition of Orel Street Plantings

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Studia struktury  
i kondycji zieleni  
miejskiej w Orle

## Introduction

### Wstęp

Urban plants are an indispensable element of the town landscape. They are connected with the planning structure of the city and have a positive influence on its climate. They revitalize urban environment and help to combat its noise. Moreover they enrich the atmosphere with oxygen and absorb carbon dioxide.

A unique feature of green plants is that they are the only natural component of the urban environment able to protect and improve its quality, while water, air and soil in towns, under the influence of urban conditions are only a pollution buffer, and at a strong pollution may even themselves become sources of environmental hazard. Today, as a result of a high environmental contamination in towns, the urban plants need an efficient care, having in view their important, above mentioned role, along with their decorative properties.

## Research area

### Obiekt badań

Habitats and livelihoods of urban plants are very different from the conditions of natural growth of zonal vegetation types, since the plants in towns are influenced by a variety of environmental factors: climatic, edaphic, anthropogenic etc. The green urban areas are exposed to

chemical, physical, biological and integrated pollution, therefore a co-existence of all specific conditions of urboecosystems is necessary. These conditions determine the influence of environmental pollution on the state of biocoenosis and the importance of town plants from ecological viewpoint along with their functions [Rodoman 1974; Kuperman 1978; Moshkov 1966].

As a result of the above conditions, the special assemblies of plants are formed in towns, i.e. many plant species disappear, while the other, new species are appearing [Aleksandrova 1960]. Therefore in a town the native (*autochthonous*) species are to be found, along with adventitious (*allochthonous*) ones which came from other areas of the Globe (fig. 1).

The number of adventitious species in towns is very large, their contribution in the urban flora can reach up to 40%, especially at dumps and railways. Sometimes they are so aggressive that they throw away the native species. Most of native species disappear from the urban flora during the building of cities; they cannot acclimatize in towns since new habitat conditions are not similar to the natural ones [Kurbatov 2001]. The easier acclimatization was observed at species adapted to the lack of moisture (xerophytes) and adapted to the saline soil (halophytes).

In the town greenery of moderate climate the deciduous trees are the most common while conifers are only very few since they are not resistant

Fig. 1. The main alley in Orel (photo by A. Borcz)

Ryc. 1. Główna aleja w Orle (fot. A. Borcz)



to the polluted urban environment. The dominating deciduous trees are: lime, including tillet (*Tilia cordata*), ash-leaved maple (*Acer platanoides*), balsam poplar (*Populus balsamifera*), black ash (*Fraxinus lanceolata*), elm (*Ulmus laevis*), common birch (*Betula pendula*). The contribution of other species is less than 1%. In the streets are to be found species such as mountain elm (*Ulmus glabra*), English oak (*Quercus robur*), Scotch pine (*Pinus sylvestris*), ash-leaved maple (*Acer negundo*), horse chestnut (*Aesculus hippocastanum*), various poplars

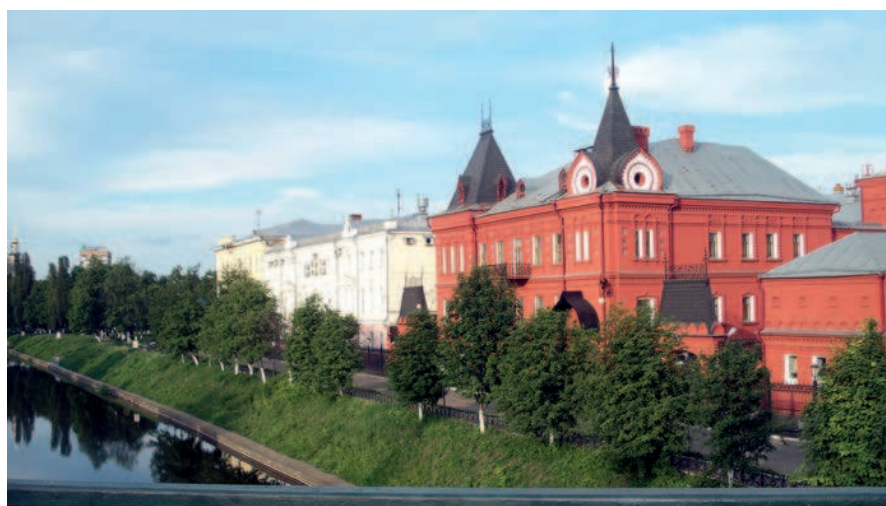


Fig. 2. The riverside boulevard in Orel (photo by A. Borcz)

Ryc. 2. Bulwar nadrzeczny w Orle (fot. A. Borcz)

(Berlin, Canadian, black, Chinese), large-leaved lime (*Tilia platyphyllos*), spruce (*Picea abies*), European larch (*Larix decidua*) etc [Kurbatov 2001].

A characteristic feature differentiating the town flora from the natural one is the higher dynamism and variety of the former; the composition and the total number of species can change in cities over a short period of time. It is noteworthy that the urban environment in most towns is nearly the same, therefore also the town plants are very similar [Kuzmina 1970].

Urban trees are very feeble, therefore they create convenient places for the development of various pests and illnesses, causing their brokening, and sometimes resulting in their premature death [Kurbatov 2001].

## Research methods

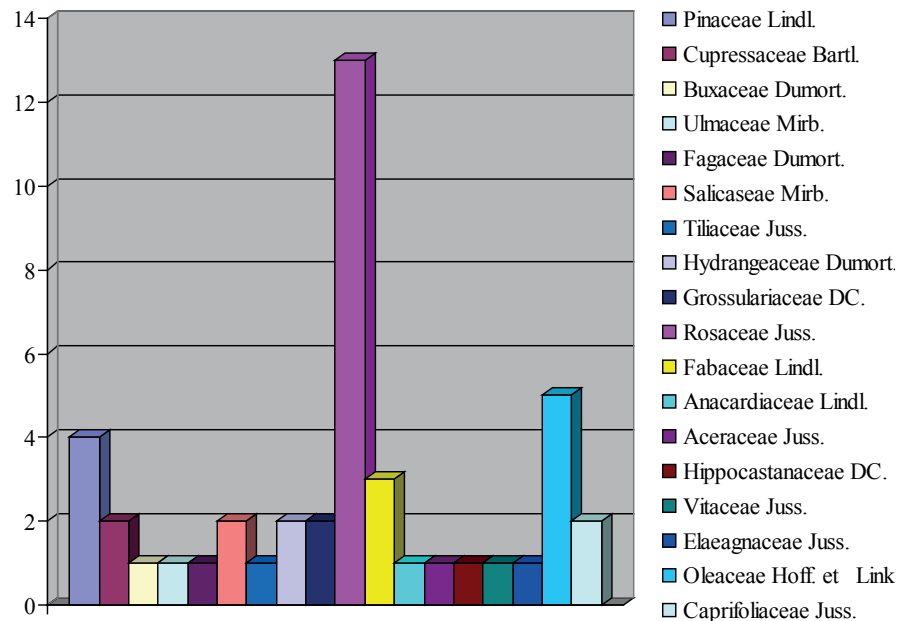
### Metody badań

Orel Region is situated in the central part of the Central Russian Upland in the area of the steppe and forest steppe zones. Orel has 331 thousand inhabitants. The climate is temperate continental with cold winters and moderately warm summers. Annual rainfall varies from 490 mm in the south to 620 mm in the north [Atlas 2000].

The surface relief is hilly flat, podsols and leached chernozem are the soil. Vegetation of this area is the forest-steppe zone. Forests form

Fig. 3. Representative introduced species in Orel urban plantings

Ryc. 3. Reprezentatywne rodzaje roślin wprowadzanych do zieleni miejskiej w Orle



mainly small tracts, while large forest tracts are to be found in the western and north-western part of the region.

In Orel strong anthropogenic influence exists since in its territory the enterprises almost of all industries are built. Pollutant emissions in Orel are determinal factors for this region (fig. 2).

The high degree of anthropogenic influence resulted in the environmental degradation. The territory along the highways is the most degraded, in some streets there are

not enough greenery and therefore no noise and emissions barriers exist.

Up to the present there was not made an inventory of greenery in Orel in the aspect of its successful growth and the development of introduced species, along with their resistance against unfavorable factors of a big city and the promising use for landscaping. Therefore, since 2003 we are working on an inventory of Orel street plantings; the aims are the identification of species and quantitative composition of introduced

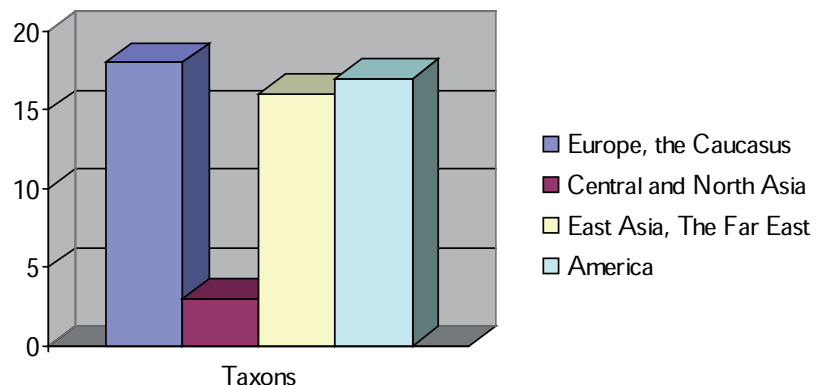


Fig. 4. Distribution of introduced into Orel species by geographical zones

Ryc. 4. Udział wprowadzanych w Orle rodzajów roślin wg stref geograficznych

Table. 1. Representative introduced species in Orel urban plantings

Tab. 1. Reprezentatywne rodzaje roślin wprowadzanych do zieleni miejskiej w Orle

Family	Quantity of taxons	Quantity, %	
		taxons	specimen
<i>Pinaceae</i> Lindl.	4	9.09	1.39
<i>Cupressaceae</i> Bartl.	2	4.55	5.39
<i>Buxaceae</i> Dumort.	1	2.27	0.51
<i>Ulmaceae</i> Mirb.	1	2.27	0.05
<i>Fagaceae</i> Dumort.	1	2.27	0.03
<i>Salicaceae</i> Mirb.	2	4.55	1.73
<i>Tiliaceae</i> Juss.	1	2.27	2.41
<i>Hydrangeaceae</i> Dumort.	2	4.55	4.88
<i>Grossulariaceae</i> DC.	2	4.55	0.04
<i>Rosaceae</i> Juss.	13	29.55	39.25
<i>Fabaceae</i> Lindl.	3	6.82	2.42
<i>Anacardiaceae</i> Lindl.	1	2.27	0.22
<i>Aceraceae</i> Juss.	1	2.27	20.11
<i>Hippocastanaceae</i> DC.	1	2.27	8.83
<i>Vitaceae</i> Juss.	1	2.27	0.03
<i>Elaeagnaceae</i> Juss.	1	2.27	0.13
<i>Oleaceae</i> Hoff. et Link	5	11.36	11.03
<i>Caprifoliaceae</i> Juss.	2	4.55	1.68
Total	44	100	100

plants, assesment of their condition and investigation of practical recommendations for their use in urban environment.

In the study the taxation parameters of plantings are estimated. State groups were defined by the assesment of plants vitality and development in the urban environment [Erokhina et al. 1987].

## Results and discussion

### Dyskusja wyników

In the course of studies, we have found 78 taxons (species and forms) of trees and shrubs (trees – 40, shrubs – 38, including creeper vines 1 species). All the species are represented by 23 families.

Plantings of introduced species are 50.41%, they include 44 species, 18 families (table 1), the local flora – 34 species, 12 families; this fact indicates the prevalence of introduced species.

The most represented are the families: *Rosaceae* Juss. – (13 taxons) 29.55%, *Oleaceae* Hoff. et Link – 11,36%, *Pinaceae* Lindl. – 9,09% and *Fabaceae* Lindl. – 6.82%. The rest of 14 families is represented by 1–2 species (fig.3).

The first place i.e. the largest number of specimen (39.25%) is represented by family *Rosaceae*, this fact being due to wide using of flowering and ornamental shrubs in the hedges. In the second place is the family *Aceraceae* (20.11%), this fact being due to the oversaturation of streets with ash-leaved maple (*Acer negundo*), unpretentious, fast-growing and hard-to-remove species. In the third place is the family *Oleaceae* (11.03%), and in the fourth – family *Hippocastanaceae* (8.83%), horse chestnut being traditionally used for urban plantings in central Russia.

We classified the introduced species in the aspect of their origin and we have found that the number of introduced species from four geographic areas decreases in the order: Europe, the Caucasus > America > East Asia, the Far East > Central and North Asia (fig. 4). The regions with rich dendroflora – Southern Europe, the Caucasus, the Far East and North America are the most promising for

Table 2. Condition of the introduced species in Orel urban plantings

Tab. 2. Stan roślin wprowadzanych do zieleni miejskiej w Orle

Family	Species	Contribution, %	Condition, %		
			good	satisfactory	bad
Pinaceae Lindl.	<i>Picea pungens</i> Engelm.	1.14	81	18	1
	<i>Picea canadensis</i> Britt.	0.05	100	-	-
	<i>Pinus strobus</i> L.	0.15	95	-	5
	<i>Pseudotsuga menziesii</i> (Mirb.) Franco	0.05	100	-	-
Cupressaceae Bartl.	<i>Thuja occidentalis</i> L.	4.72	85	11	4
	<i>Juniperus sabina</i> L.	0.67	58	30	12
Buxaceae Dumort.	<i>Buxus sempervirens</i> L.	0.51	78	22	-
Ulmaceae Mirb.	<i>Ulmus pinnato-ramosa</i> Dieck ex Koehne	0,05	100	-	-
Fagaceae Dumort.	<i>Quercus rubra</i> L.	0.03	100	-	-
Salicaceae Mirb.	<i>Populus balsamifera</i> L.	1.58	55	37	8
	<i>Populus pyramidalis</i> L.	0.15	11	67	22
Tiliaceae Juss.	<i>Tilia platyphyllos</i> Scop.	2.41	80	13	7
Hydrangeaceae Dumort.	<i>Philadelphus coronarius</i> L.	4,86	37	61	2
	<i>Hydrangea cinerea</i> Small	0.02	100	-	-
Grossulariaceae DC.	<i>Ribes nigrum</i> L.	0.03	100	-	-
	<i>Grossularia reclinata</i> (L.) Mill	0.01	-	100	-
Rosaceae Juss.	<i>Cotoneaster lucidus</i> Schltr.	13.05	90	10	-
	<i>Crataegus sanguinea</i> Pall.	0.22	100	-	-
	<i>Amelanchier spicata</i> (Lam.) K. Koch.	2.59	88	11	1
	<i>Physocarpus opulifolius</i> (L.) Maxim	7.93	72	19	9
	<i>Spiraea salicifolia</i> L.	7.19	72	25	3
	<i>Spiraea japonica</i> L.f.	4.41	73	25	2
	<i>Spiraea chamaedryfolia</i> L.	1.13	69	22	9
	<i>Pentaphylloides fruticosa</i> L.	0.01	100	-	-
	<i>Rosa rugosa</i> Thunb.	2.48	74	22	4
	<i>Rubus odoratus</i> L.	0.09	91	-	9
	<i>Cerasus avium</i> L. (Moench)	0.01	100	-	-
	<i>Cerasus tomentosa</i> (Thunb.) Wall.	0.13	94	6	-
	<i>Armeniaca vulgaris</i> Mill.	0.01	-	100	-
	Fabaceae Lindl.	<i>Robinia pseudoacacia</i> L.	1.59	83	14
<i>Amorpha fruticosa</i> L.		0.26	85	15	-
<i>Caragana arborescens</i> Lam.		0.57	73	26	1
Anacardiaceae Lindl.	<i>Rhus typhina</i> L.	0.22	86	14	-
Aceraceae Juss.	<i>Acer negundo</i> L.	20.11	74	21	5
Hippocastanaceae DC.	<i>Aesculus hippocastanum</i> L.	8.83	88	10	2
Vitaceae Juss.	<i>Parthenocissus quinquefolia</i> L.	0.03	100	-	-
Elaeagnaceae Juss.	<i>Hippophae rhamnoides</i> L.	0.13	100	-	-
Oleaceae Hoff. et Link	<i>Fraxinus lanceolata</i> Borkh.	0.73	73	18	9
	<i>Syringa vulgaris</i> L.	9.83	83	13	4
	<i>Syringa josikaea</i> Jacq. f. ex Rchb.	0.06	100	-	-
	<i>Ligustrum vulgare</i> L.	0.23	52	45	3
	<i>Forsythia x intermedia</i> Zabel	0,05	100	-	-
Caprifoliaceae Juss.	<i>Symphoricarpos albus</i> L.	0.82	43	14	43
	<i>Lonicera xylosteum</i> L.	0.86	12	70	18
Total		100.00			



Fig. 5. A monument in the Orel street (photo by A. Borcz)

Ryc. 5. Rzeźba przy ulicy w Orle (fot. A. Borcz)

introduction of plants into urban environments.

In the study all species were assembled into the following groups:

- deciduous trees,
- coniferous trees,
- deciduous shrubs,
- coniferous shrubs.

In the group of deciduous trees the most common are: ash-leaved maple (*Acer negundo*) – 20.11% of the total number of plants and horse chestnut (*Aesculus hippocastanum*) – 8.83%. The staghorn sumac (*Rhus typhina*), bird cherry Maackii (*Padus Maackii*), Manchurian walnut (*Juglans mandshurica*), butternut (*Juglans cinerea*) and black walnut (*Juglans nigra*) are found only rarely.

Red oak (*Quercus rubra*) is in the best condition, it has successfully adapted to the climatic and environmental conditions of Orel. The horse chestnut (*Aesculus hippocastanum*) is traditionally used for urban plantings but it does not tolerate big gas

content and high temperature in the streets that destroy its condition and decorativeness; in the midsummer its leaves get burned.

In the group of coniferous trees, 51% are introduced species: Colorado spruce (*Picea pungens*), Mexican white pine (*Pinus strobus*), Oregon pine (*Pseudotsuga menziesii*) and white cedar (*Thuja occidentalis*). Although all these species are suitable for urban environment, in Orel they occur only sporadically. The Mexican white pine (*Pinus strobus*) is in the best condition, it is frost- and gas-resistant, and is soil undemanding. In the group of deciduous shrubs, 63% are introduced species and only 37% are local species.

The cotoneaster lucidus (*Cotoneaster lucidus*) – 13.05% of the total number of plants, and nine-bark (*Physocarpus opulifolius*) – 7.93% are dominating; also Siberian pea shrub (*Caragana arborescens*), ramanas rose (*Rosa rugosa*), meadowsweets (*Spiraea*) and Hungarian lilac (*Syringa josikaea*) are to be found. Condition of these species is good, they are soil undemanding and frost-resistant plants, well tolerated in urban environment. To improve their status we can recommend the timely pruning (including rejuvenescence) and fertilizing (figs 5 and 6).

In the group of coniferous shrubs, the introduced species are represented by creeping juniper (*Juniperus sabina*); its condition is good (table 2).



Fig. 6. A wickerwork sculpture of a bear in the Orel street (photo by E. Zolotareva)

Ryc. 6. Wiklinowa rzeźba niedźwiedzia przy ulicy w Orle (fot. E. Zolotareva)

## Conclusions and suggestions

### Wnioski i sugestie

1. In the Orel plantings of common use there are 44 species of trees and shrubs, introduced species belonging to 18 families.

2. In the group of deciduous trees the maple ash (*Acer negundo*) – 20.11% and horse chestnut (*Aesculus hippocastanum*) – 8.83%. are the most common. In the group of coniferous trees the white cedar (*Thuja occidentalis*) – 4.72%. and Colorado spruce (*Picea pungens*) – 1.14 are the most common.

3. In the group of deciduous shrubs the cotoneaster lucidus (*Cotoneaster lucidus*) – 13.05%, lilac (*Syringa*) – 9.83% and nine-bark (*Physocarpus opulifolius*) – 7.93% are to be found, and among coniferous shrubs – the creeping juniper (*Juniperus sabina*).

4. The most promising origin regions for introduction of plants into urban environments are: Southern Europe, the Caucasus, the Far East and North America.

5. For further use we can recommend horse chestnut (*Aesculus hippocastanum*), black locust (*Robinia pseudoacacia*), white cedar (*Thuja occidentalis*), Colorado spruce (*Picea pungens*), creeping juniper (*Juniperus sabina*), cotoneaster lucidus (*Cotoneaster lucidus*), nine-bark (*Physocarpus opulifolius*) and various

meadowsweets (*Spiraea*); these easy to grow decorative species are suitable for urban environment.

6. Anthropogenic influences must be taken into account in the design of the urban greenery; it is necessary to select plants that are adapted to specific conditions of a given territory.

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