

## INVENTORY OF RARE ALLOCHTONOUS SPECIES IN DAUGAVPILS CITY

Natalja Romanceviča

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The aforementioned territory is investigated by excursion method. In total 41 rare alien plant species from 14 families are found in Daugavpils after collecting data from literature and inventory during 2007-2008 vegetation periods and at spring 2009. There are conclusions made about distribution of alien species after analysis of maps of findings – alien species are distributed around railways, highways, and gardens. It is known that railways and roads are main routes where alien species enter any state or city inadvertently, while gardens and plantations near housing are main sources from which deliberately introduced alien species can spread to degraded and semi-natural habitats, afterwards – to natural habitats (for example, *Asparagus officinalis*). Six species sometimes emerge in flora in Daugavpils, nevertheless they are fluctuating and quickly disappear. The rare allochtonous flora of Daugavpils consists from anthropophytes 4%, hemerophytes 4%, epikophytes 22%, ergasiophygophytes 19%, ephemerophytes 30%, neoindigenophytes 21%.

Key words: Daugavpils, allochtonous species, distribution, adventive species.

Natalja Romanceviča. Institute of Systematic Biology, Daugavpils University, Vienības 13, Līv5400, Daugavpils, Latvia; nata.kavriga@biology.lv.

### INTRODUCTION

The inventory data about Latvian flora shows that 633 alien species (33% of all plant species) are found in Latvian wild flora nowadays. Nevertheless most of these species are rare and distribution of them in Latvia is uneven. It is necessary to determine the state of these plant species for the evaluation of present distribution of them in Latvia, the estimation of potential probability of following distribution and anticipation of possible changes in ecosystem structure and landscapes.

The alien species traditionally are divided in archaeophytes (species found before the 16<sup>th</sup>

century) and neophytes (after 16<sup>th</sup> century). The archaeophytes are naturalized usually and are considered as autochthonous species. Most of the alien species in Latvia have entered during the 19<sup>th</sup> century. Most of species, entered Latvia at the 20<sup>th</sup> century, especially at the end of the century, are rare and unevenly distributed (Priede 2006).

The last data about the whole Daugavpils allochtonous flora were collected in the time of the Soviet Union (Гаврилова & Табака 1985). However since then there have happened changes in intensity of industrial and agro activity and traffic roads. City has developed new connections with foreign countries, but several old ones are partly or completely stopped. These factors had

influence on weak adventive plant species – they disappeared and new species came in to the city. In 2002 student of Daugavpils University, Oksana Sokolova, developed bachelor paper about flora of railway in Daugavpils city, where non-native plant species were looked partly and did not disclose situation about the whole city. For that reason new research was done, it includes the whole territory of Daugavpils city and allows recognizing new non-native species and their distribution, they temporary are rare.

Daugavpils is the second largest city in Latvia, the area is full of production factories, which operations are fully or partially stopped, such as Chemical Fibre factory, Ditton Driving Chain Factory, Electrical Instrument Works, Locomotive Repair Plant. Besides factories there are also various food manufacturing companies and other industries - large and small enterprises.

Daugavpils origins are linked to the Daugava River trade route - one of the largest East European river traffic trunk over several centuries. Today, when modern road is used for logistics and river transport means in practice are not used, Daugavpils has kept the role of the biggest East Latvian transport hub securing the rail and auto traffic to the Latvian cities, as well as Lithuania, Belarus, Russia, Poland and other countries and cities small towns.

Daugavpils city is also known as the commercial and industrial centre. The railway traffic introduced radical changes in the economic life of the city and marketing communications. It also contributed to the entry of vigorous non-native plant. Railway is one of the primary habitats, which promotes introduction of adventitious seeds into the country and city with materials and goods transported by the railway. In the second half of the 19<sup>th</sup> century in the Daugavpils began to function railway lines Petersburg - Warsaw, Riga - Daugavpils, Riga - Orel. Traffic intensity and economic development promoted more intensive introduction of adventitious plants (Rinkeviča 2000).

In 1985 in Daugavpils city altogether 898 vas-

cular plant species from 98 families were identified, 153 species were adventive. However approximately 50 species, including 37 local and 13 introduced species, were not found (Гаврилова & Табака 1985).

Nowadays also most of adventitious species first appear along the rail and urban industrial areas, as well as in ruderal locations. This is due to the fact that these habitats have low competition of domestic plant (Фукарек et al. 1982).

Given the fact that Daugavpils is located in Southeast part of Latvia, where the climate is moderately continental, medium moist and warm, many southern and Southeast species, that are unable to grow in other Latvian locations, appear and survive in the city. For example, some perennial epekophyte, which are rare in Riga and its surroundings, occur much more frequently in Daugavpils and in some places form extensive stands: *Nonea pulla* (L.) DC., *Cardaria draba* (L.) Desv., *Euphorbia cyparissias* L., *Artemisia austriaca* Jacq., *Sisymbrium wolgensense* M. Bieb. ex E. Fourn., *Salvia verticillata* L., *Veronica prostrata* L. (Шульц 1972).

Core elements of anthropogenic effects on plant cover and flora formation in Daugavpils are:

- introduction and distribution of species along the rail lines and car trunk;
- array of residential and industrial construction, which promotes ruderal habitat creation, which leads to loss of natural, local vegetation;
- recreational use of separate parts of the city (water body shores and forests);
- deforestation for city building requirements;
- grazing and mowing of River Daugava coasts;
- The local road and canal construction;
- Waste water pollution, which affects individual water bodies, as well as the surrounding sites.

In the territory of so big city as Daugavpils anthropogenic effects of various factors usually cover each other or are alongside. They all,

except for the direct introduction of plants and distribution along the railway lines and the car trunks, form peculiar anthropogenic terrain.

Apart from the basic elements local agro phytocenoses - vineyards, orchards and kitchen gardens, play certain role in widening of city flora species.

In the result of anthropogenic influence contents of city flora are intensively supplemented with new, mostly introduced species. Significant part of these plants continue to grow and spread (above the railway line intervention and weed place), sometimes encroaching upon the natural phytocenoses. At the same time many native species, which in the past were not at all uncommon, disappear or have already disappeared from the flora of the city and its surroundings (modern boroughs), (Гаврилова & Табака 1985).

## MATERIALS AND METHODS

The main method that was used for rare non-native vascular plant inventory in Daugavpils city, were the tours - the mapping method. Regular grid (square size 500 x 500 m) was used for mapping of alien species, it included the entire city area. The total number of squares – 307. Maps are bound to Latvian coordinate system LKS-92. Topographic maps at 1:10 000 created by Latvian Geospatial Information Agency were used for the cartographic base.

The rarity of these species were reviewed in „Flora of the Baltic countries”, part 1, 2, and 3 and “List of alien species of Latvia” (<http://biodiv.lv/gma.gov.lv>). For estimation of geographic distribution of species the system of squares where the taxon is found is applied – *very rare* (1-10 squares), *rare* (11-30), *rarely* (31 -100), *not often* (101 -250), *quite often* (251 – 500), *often* (501 -750), *very often* (>751). The estimation of distribution relates to the whole territory of Latvia (Fatara 1992).

Previously known indications of the findings were surveyed and the data, obtained during visits to The University of Latvia, the Faculty

of Biology, Institute of Botany Laboratory were analyzed. The researches done in 2008 from May to September and spring, 2009. Data of researches done in 2007 were used better reflection of distribution of rare plants in the surveyed area.

Classification advised by Pyšek and Richardson (Pyšek et al. 2004) was used for classification of allochthonous species:

- I. **Anthropophytes**- introduced by people regardless time and means;
- II. **Hemerophytes** – introduced intentionally:
  1. **Ergasiophytes** – found only in cultivation;
  2. **Ergasiophygophytes** – found in cultivation and occasionally escaping;
  3. **Ergasiolipophytes** – formerly planted, currently occurring in the territory without need of human intervention;
- III. **Xenophytes** - any unintentionally introduced:
  1. **Archaeophytes** - alien introduced before ca.1500 (approximate date corresponding to the discovery of America (1492), both deliberately and accidentally, regardless of invasion status;
  2. **Neophytes** - alien introduced after ca.1500, both deliberately or accidentally, regardless of invasion status:
    - a. **Ephemerophytes** - occurring temporarily in human-made habitats;
    - b. **Epekophytes** - established in human-made habitats; naturalized or invasive in human-made habitats;
    - c. **Neoindigenophytes** – established in the region, occurring in human-made habitats and penetrating to natural habitats, too.

## RESULTS

The placement of all findings detected during the research (Fig. 1.) shows that the alien species are found mainly near railways, roads and surrounding gardens. Railways and highways are among the main unintentional introductions of alien species in any country and city. However gardens and greenery near homes are among the main sources from which deliberately imported

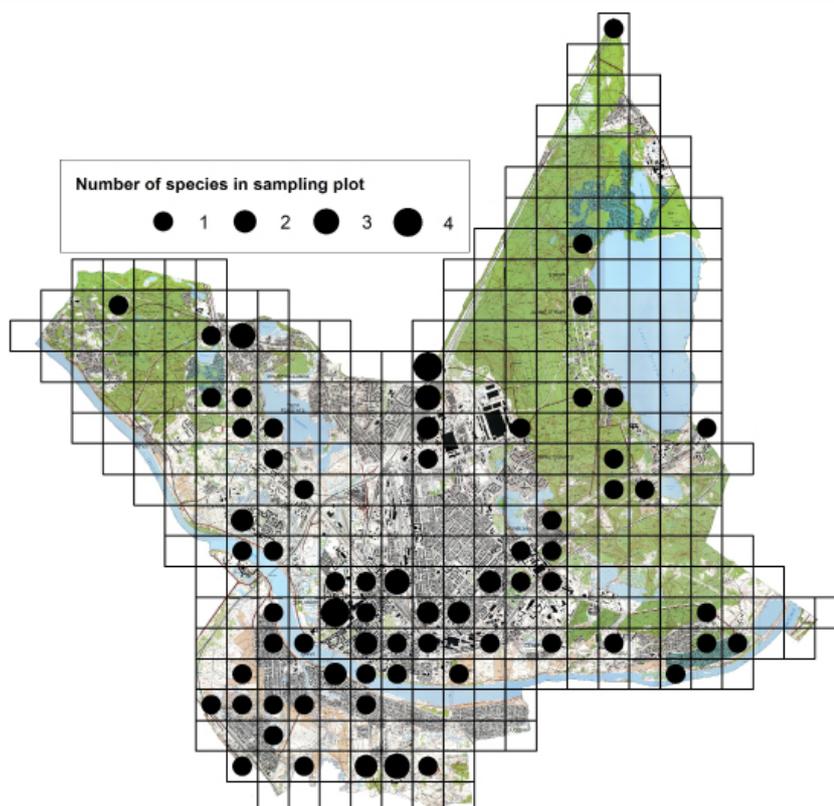


Fig.1. Species found during researches.

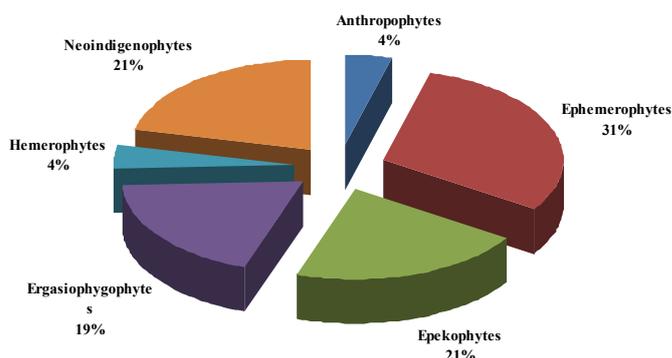


Fig.2. Non-native species, the percentage distribution of floristic status.

non-native species can spread first to degraded, then semi-natural habitats, and later also to natural habitats, for example *Asparagus officinalis* L.

The least percentage have hemerophytes and anthropophytes, each amount to 4% of the species identified during researches.

Looking at the fig.2. it can be concluded that in Daugavpils majority of 47 found species are ephemerophytes, which represent 30% of all identified species, 22% are epekophytes, 21% - neoindigenophytes, 19% - ergasiophygytes.

Summarizing the literature data about the flora of Daugavpils and performing re-inventory in 2007, 2008 and 2009 totally 47 rare non-native species were found. Within three seasons 41 rare adventive species from 14 families found. There

Table. 1. Rare non-native species found in Daugavpils city during researches

Species name in latin	Time when species first time recognize in Daugavpils	Floristic status	Invasiveness
<i>Allium angulosum</i>	1981, Stropi	Epekophytes	Non invasive
<i>Alyssum turkestanicum</i>	1972, whole territory of city	Ephemerophytes	Non invasive
<i>Amaranthus paniculatus</i>	2008, Centrs	Ergasiophygophytes	-
<i>Asparagus officinalis</i>	1979, Grīva	Ergasiophygophytes	-
<i>Atriplex hortensis</i>	1972, Grīva	Ergasiophygophytes	-
<i>Atriplex oblongifolia</i>	1981, Grīva	Epekophytes	Non invasive
<i>Atriplex rosea</i>	1893, railway Daugavpils - Rīga	Neoindigenophytes	-
<i>Atriplex sagittata</i>	1972, whole territory of city	Anthropophytes	-
<i>Cardaria draba</i>	1940, coast of river Daugava	Neoindigenophytes	Non invasive
<i>Carduus acanthoides</i>	1979, Stropi	Neoindigenophytes	-
<i>Centaurea diffusa</i>	1974, ?*	Neoindigenophytes	Non invasive
<i>Centaurea rhenana</i>	1975, Forštate	Epekophytes	-
<i>Cerintho minor</i>	1984, Stropi	Neoindigenophytes	-
<i>Chondrilla juncea</i>	?, railway Daugavpils - Rīga	Ephemerophytes	-
<i>Corispermum algidum</i>	1977, railway, Daugavpils - Viļņa	Neoindigenophytes	Non invasive
<i>Corispermum declinatum</i>	1980, railway Daugavpils - Rīga	Ephemerophytes	-
<i>Diplotaxis muralis</i>	1978, railway Daugavpils - Rīga	Epekophytes	Non invasive
<i>Dracocephalum thymiflorum</i>	1939, Grīva	Epekophytes	Non invasive
<i>Elsholtzia ciliata</i>	2008, Liginišķi	Anthropophytes	Non invasive
<i>Erysimum canescens</i>	1976, railway Daugavpils - Rīga - Viļņa	Neoindigenophytes	-
<i>Erysimum hieracifolium</i>	1884, ?	Ephemerophytes	-
<i>Geranium sibiricum</i>	1976, Grīva	Ephemerophytes	Non invasive
<i>Jovibarba globifera</i>	1898, Liginišķi	Ergasiophygophytes	-
<i>Kochia densiflora</i>	1968, ?	Epekophytes	-
<i>Leonurus quinquelobatus</i>	?, whole territory of city	Hemerophytes	-
<i>Lepidium densiflorum</i>	?, whole territory of city	Ephemerophytes	Non invasive
<i>Lepidium ruderales</i>	1870, ?	Ephemerophytes	-
<i>Lobularia maritima</i>	2008, Jaunbūve	Hemerophytes	-
<i>Lunaria annua</i>	2009, Centrs	Epekophytes	-
<i>Myosotis sylvatica</i>	1971, Stropi	Neoindigenophytes	Potentially invasive
<i>Nonea pulla</i>	1969, Stropi, Mežciems	Epekophytes	Non invasive
<i>Oxalis dillenii</i>	2008, Centrs, Esplanāde, Jaunie Stropi	Epekophytes	-
<i>Papaver somniferum</i>	1894, Grīva	Ergasiophygophytes	-
<i>Phalacrologia annuum</i>	2008, Jaunbūve, Centrs	Epekophytes	-
<i>Plantago arenaria</i>	1895, railway	Neoindigenophytes	-
<i>Potentilla bifurca</i>	1969, ?	Ephemerophytes	Non invasive
<i>Potentilla supina</i>	1972, ?	Ephemerophytes	-
<i>Reynoutria japonica</i>	2006, Stropi	Ergasiophygophytes	Potentially invasive
<i>Reynoutria sachalinensis</i>	2008, Centrs	Ergasiophygophytes	Non invasive
<i>Rorippa austriaca</i>	1972, bank of railway	Ephemerophytes	Non invasive
<i>Sedum album</i>	2008, Mežciems	Ephemerophytes	Non invasive
<i>Sedum rupestre</i>	2008, Ķīmija	Ergasiophygophytes	-
<i>Sedum sexangulare</i>	2008, Mežciems	Ephemerophytes	Not invasive
<i>Sedum spurium</i>	2008, Ķīmija	Ergasiophygophytes	-
<i>Stachys recta</i>	1977, railway Daugavpils - Krāslava	Ephemerophytes	Non invasive
<i>Vaccaria hispanica</i>	1892, Liginišķi	Ephemerophytes	Non invasive
<i>Viola odorata</i>	2008, Ruģeļi, Centrs	Neoindigenophytes	Non invasive

\* unknown year or recognized place.

were found 12 species, which were not included in Daugavpils Flora List published in 1985. Nine of them are not included in the last published list, made by M. Laiviņš and Ģ. Gavrilova in 2009. They are *Amaranthus paniculatus* L., *Lobularia maritima* (L.) Desv., *Lunaria annua* L., *Oxalis dilenii* Jacq., *Phalacrolooma annuum* (L.) Dumort., *Reynoutria sachalinensis* (F. Schmidt) Nakai, *Sedum album* L., *S. rupestre* L., *S. sexangulare* L. Six species occasionally appear in Daugavpils flora, they are fragile and rapidly disappearing. They are *Cerintho minor* L., *Plantago arenaria* Waldst. et Kit., *Potentilla bifurca* L., *P. supine* L., *Stachys recta* L. *Vaccaria hispanica* (Mill.) Rauschert.

In references invasiveness was not indicated for 22 species. 20 species are listed as non-invasive. *Myosotis sylvatica* Ehrh. ex Hoffm. and *Reynoutria japonica* Houtte. are listed as potentially invasive. The author considers the second species, *Reynoutria sachalinensis* (F. Schmidt) Nakai to be included in the list of potentially invasive species.

In 2007, 2008 and 2009 80 rare non-native plant herbarium were collected, herbarium stored in DAU (herbarium of Daugavpils University Institute of Systematic Biology). For 19 species the first herbarium of DAU herbarium were collected.

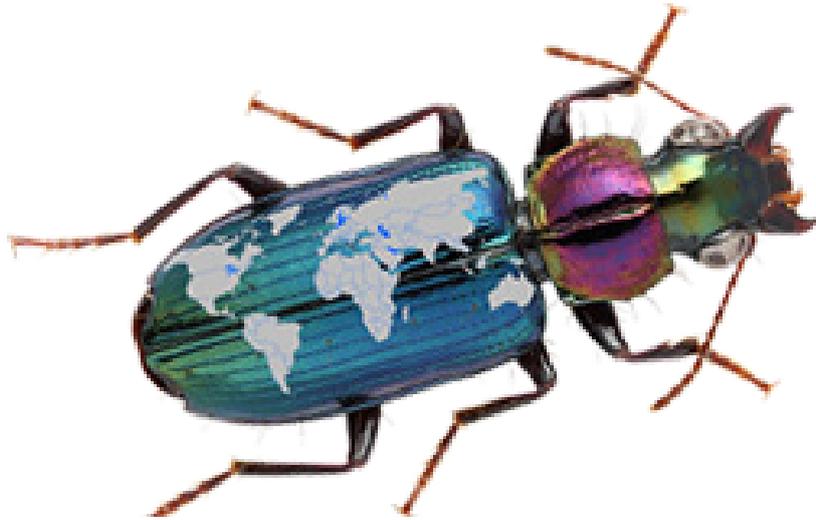
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