Impact of mine dumps on transport the invasive plant species to Upper Silesia

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Abstract. Human activities significantly change the species composition in the area. The main factor of change was the mining industry, which changed the natural conditions on Upper Silesia. The anthropogenic relief of mine dumps are the main centre of alien plant in an industrial landscape. The poster deals with the state of the invasive plant species by the phytosociological surveys on Upper Silesia.

1. Introduction

The investigated areas used in this research are those of Upper Silesia. Upper Silesia is located in the temperate belt of Central Europe. This highly urbanized landscape has been marked by ongoing mining extraction since the 18th century to the present. There are still preserved remains of mine dumps which are the subject of our research. These are mining depots consisting of tailing which have a specific microclimate. Uncovered tailing offers specific conditions for primary succession of species. This situation is used by species in our conditions considered as non-original.

Figure 1. Map of mine dumps-subject of our research (google.cz/maps, edited by authors).
Intensive coal mining has been involved in the relief formation resulting in both concave and convex shapes. The mine dumps belong to the most significant and the most numerous ones. An indirectly caused anthropogenic shapes are declining areas, often flooded with water [1]. These lands have become valuable habitats providing optimal conditions for many plant and animal species. The monitored area is situated in the river basin of Odra, which originates in the mountain range of Oderské vrchy and together with rivers Olše, Ostravice, Opava and Moravice they form a network, converging towards the Ostrava basin [2]. Rivers are an important transport medium for plant seeds.

This way, the seeds of the invasive species *Reynoutria Šp.* and *Impatiens glandulifera* easily root in riverbeds. Soils in the Ostrava region are significantly affected by the contamination of ecotoxic elements and compounds mainly from the mining and chemical industry not only from Ostrava but also from the whole of Upper Silesia.

According to the Regional Phytogeographical Division of the Czechoslovak Republic [3]. The Ostrava Basin is included in the phytogeographical district No. 83 known as Carpathian mesophysic. These areas are slightly warm with typical Central European flora. The climatic conditions of the Ostrava Basin are the factors influencing species composition. The Ostrava Basin is influenced from the north by the Polon province and from the south by semi-thermo-thermophilic to thermophilic plants from the Pannonian thermophilic [2]. The Polon province is represented mainly by Eurasian species [4]. Forest is the most important connecting element. Together with the territory It forms a compact factor that is harmonious and makes the main protective factor of other environmental components [5].

We included in the areas of our research following mine dumps: Urx, Ema, František, Barbora, Lazy, Heřmanice, the Darkov sea and the reference area was the forest near Šenov.

2. Invasive species

The Ostrava Basin is taken as an area with a relatively monotonous vegetation and the landscape is mostly anthropogenic in nature [6]. Due to anthropogenic burdens and urbanization the biotopes are degraded. The species with a wide ecological valency assert there and the landscape is being fragmented and ruderalized [7]. Into such modified communities invasive species are introduced more easily and expansive species are spread.

Non-native species are those transported outside its original area. Invasive plant species are those that endanger the biodiversity of the original ecosystem [8]. These species come to us deliberately (botanical gardens, seed transport, etc.) or unintentionally (with cargo, animals, etc.). Our research areas include: *Reynoutria Šp.*, *Impatiens glandulifera*, *Robinia pseudoacacia*, *Solidago canadensis*. Among the potentially dangerous invasive species include *Quercus rubra* and *Larix decidua*. Well-known invasive species *Reynoutria Šp.* were imported from Southeast Asia. They reached our continent in the first half of the 19th century. Nowadays mostly northern and central Europe is swamped with it. Here it was introduced as a decorative plant [9]. It was used in this way, but it quickly spread from the gardens into the open country. It is now a highly invasive species. It grows mainly along roads, streams and rubble and it is one of the most popular plants in the waste dumps of Upper Silesia.

*Impatiens glandulifera* was introduced here from the Western Himalayas region. It spread in the first half of the 19th century as an ornamental plant. It has adapted to wetlands, river banks and wetter places. It forms continuous vegetation particularly along river banks, where it is very successful. We can also find it in anthropogenically disrupted habitats [9].

The issue of non-native species also applies to *Robinia pseudoacacia*. It is located on steep slopes and unpaved spruces, where its roots strengthen the soil. In the countryside, it benefits as a honey tree (melliferous), but its wood is not suitable for economic use. On the whole, its presence is disturbing because it depauperates the soil of nutrients [5].

The original home of *Solidago canadiensis* is the USA and southern Canada. It introduces to ruderal habitats and anthropogenic affected areas, which include plants, railways and roads. It
reproduces vegetatively using a large number of achenes. It is highly competitive to other plants and displaces native species. However, this highly invasive plant is melliferous and it also has healing properties [9].

*Quercus rubra* is a non-native tree that was introduced here from North America in the 17th century. Now it is widely introduced into the country. It is widely used in parks, urban greenery and sometimes also forests. On our continent, it penetrates into the oak, oak-hornbeam, pine-oak, fir and beech forests. It is very resistant to dirty environment. They also survive in bigger shade than our original oak species. Its fruits are not edible for our birds because of the size, and therefore the seeds remain on the sites and root [9].

3. Methodology

As a basis for this research the methodology by Moravec et al. [10] was chosen. A retrospective field survey was conducted in the spring months. This way an approximate inventory of species composition was obtained. For selection of habitats, a subjective method was chosen [10]. There have been chosen appropriate areas with homogeneity of vegetation throughout their area.

The size and shape of the study area is determined by the methodology. Forest communities were mapped on 225 m² in the square shape. On selected sites, we conducted research based on the species composition (floristic composition of the vegetation cover), stratification (vertical structure), numerosity and coverage of individual species. The Braun-Blanquet 1951 scale was used to evaluate stratification and coverage of vegetation [11].

Table 1. An example of a phytosociological reléve.

| Serial number of reléve | 34 | 35 | 36 | 37 | 38 |
|-------------------------|----|----|----|----|----|
| Job number of reléve    |    |    |    |    |    |
| Plot size (m²)          | 225|    |    |    |    |
| The number of species in a reléve | 16 | 20 | 15 | 19 | 26 |
| Cover of E3 (%)         | -  | 50 | 60 | 60 | 70 |
| *Robinia pseudoacacia*  |    |    |    | 1  | 2  |
| *Acer pseudoplatanus*   |    | 3  | 1  | +  | r  |
| *Fagus sylvatica*       |    |    |    | 1  |    |
| *Quercus rubra*         |    |    |    |    | +  |
| Cover of E1 (%)         | 60 | 70 | 60 | 30 | 90 |
| *Reynoutria japonica*   | 2  |    |    |    |    |
| *Galeobdolon luteum*    | 1  |    |    | +  | 1  |
| *Impatiens parviflora*  | 2  | 1  | +  | 1  | 1  |
| *Impatiens noli-tangere*|    | r  | 1  |    |    |
| *Urtica urens*          | 4  | 2  | 3  | +  |    |
| *Acer campestre juv.*   |    |    |    | +  |    |

4. Result and discussion

In our research we focused on the mapping of invasive species on mine dumps in Upper Silesia. It is clear from the results that mine dumps of Upper Silesia are a great place to begin the expansion of invasive non-native species. Invasive species naturalize here, which means-repeated successful introduction of the reproductive population (Assessment and management of alien species that threaten ecosystems, habitats and species, 2001).

We included in the areas of our research following mine dumps: Urx, Ema, František, Barbora, Lazy, Heřmanice, the Darkov sea and the reference area was the forest near Šenov. Selected dumps were either left to natural succession, or reclaimed in the past. The results show that the most widespread invasive species is: Reynoutria Sp. Poster also contains a graph including the percentage of invasive species on mine dumps. From these results, it is clear that the most affected area is the Urx mine. In conclusion, it can be said that invasive species have a dangerous effect on our original
biocenose. However, their overall impact cannot be predicted in advance. Research on dumps will continue in the coming years.

![Graph showing invasive species on mine dumps](image)

**Figure 2.** Invasive species on mine dumps - subject of our research.

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