

## C1. DESCRIPTION FOR THE GENERAL PUBLIC

The study of microevolutionary processes occurring in the environment, in anthropogenically altered habitats is now one of the fundamental issues of ecotoxicology. On these sites, even the creation of new subspecies can be observed, perfectly adapted to extreme conditions as excessive heavy metal pollution, which was recently demonstrated by using genetic methods (Abratowska et al. 2012; Wąsowicz et al. 2014; Wierzbicka 2015). It is also possible to observe many other natural processes of ecological nature, because additional factors released into the environment already within 10-20 years give response from the adaptations of living organisms. It is good to notice the heavily modified habitat and treat them as a “testing ground research”, which will trace the processes taking place there.

In the current study such a “training ground research” will be railroad tracks. They are very good subject for the assessment of effects of herbicides use for many years, as the doses of Roundup were high and regularly supplied for the last 25 years. Thanks to that, it can be now checked whether plants acquire resistance to that herbicide and what are the environmental consequences of its excessive usage. In Poland, railroad tracks are the only places with such large and regular spraying of herbicides. However, in other countries, where genetically modified plants production is conducted, the use of herbicides is applied on a massive scale. The possibility of formation of plant forms resistant to the glyphosate, with simultaneous an enrichment of substrate in nitrogen and phosphorus may be a side effect of these activities, but very significant and unfavorable.

The aim of the research is to verify, whether populations of *Geranium robertianum* L. plants from railway tracks gained resistance to the Roundup herbicide, which contains glyphosate, and whether its prolonged use can lead to an enrichment of substrate in nitrogen and phosphorus. Confirmation of this hypothesis could explain one of the reasons for mass occurrence of *G. robertianum* on railway tracks.

The environmental conditions on railway tracks are totally different from those preferred by *G. robertianum*. This plants prefer mostly shaded and fertile forest habitats with a high content of phosphorus and nitrogen in the soil. Meanwhile, the railroad tracks are exposed to strong sunlight, whereas substrate consists of crushed stone mixed with river sand, which is poor in nutrients. In addition, railway embankments are the places of regular Roundup treatment due to removal of plants. Sprayings are carried out twice a year with use of high doses of herbicide. An interesting question is why the plants colonize this ecological niche, among which are *G. robertianum* plants.

Previous studies performed in our Laboratory (Wierzbicka et al. 2014) showed formation of separate forms of *G. robertianum* on railroad tracks in Walilý-Station. Their adaptation to strong sunlight exposure has been shown, by protecting the photosynthetic apparatus, resulting from increased synthesis of anthocyanins.

In the currently planned studies we want to explain how *G. robertianum* can survive on the railroad tracks despite the strong spraying of the Roundup herbicide. Two hypotheses will be tested: (1) Railway track populations of *G. robertianum* acquired increased resistance to the Roundup herbicide (containing glyphosate), in comparison with forest populations of this species. (2) Decay of glyphosate in soil may increase the fertility rate, as the compound contains the nitrogen and phosphorus in its molecule. Ultimately, this leads to fertilization of the ground, which will promote the growth of plants.

This project concerns microevolutionary processes occurring in plants, with excessive use of herbicides.

### References:

- Abratowska A., Wąsowicz P., Bednarek P., Telka J., Wierzbicka M. 2012. Morphological and genetic distinctiveness of the metallicolous and non-metallicolous populations of *Armeria maritima* s. l. (Plumbaginaceae) in Poland. *Plant Biology* 14(4): 586–595.
- Wąsowicz P., Pielichowska M., Przedpeřska-Wąsowicz E. M., Piotr Bednarek P., Szarek-Lukaszewska G., Abratowska A., Wierzbicka M. 2014. Physiological and genetic differentiation between metallicolous and non-metallicolous diploid populations of Alpine *Biscutella laevigata* (Brassicaceae) in the Tatra Mountains and the Northern Carpathian Foreland. *Annales Botanici Fennici* 51: 227–239.
- Wierzbicka M. 2015. *Ekotoksykologia. Rořliny, gleby, metale*. Wydawnictwo Uniwersytetu Warszawskiego, Warszawa. (in Polish).
- Wierzbicka M., Galera H., Sudnik-Wójcikowska B., Wilkomirski B. 2014. *Geranium robertianum* L., plant form adapted to the specific conditions along railways: “railway-wandering plant”. *Plant Systematics and Evolution* 300: 973–985.