EnviroMail™ / Europe
No. 8 / September 2023

Hidden Pesticide Threats in Protected Landscape Areas

The extensive application of plant protecion products on cultivated soils often results in environmental contamination, even when following good agricultural practices. Regrettably, despite stringent conservation efforts, pesticides continue to be a concern within protected areas, which are generally considered to be free of pollution.

Protected Landscape Areas (PLAs)

PLAs are invaluable for their pivotal role in protecting biodiversity and maintaining the integrity of natural ecosystems. These designated areas serve as vital sanctuaries for countless plant and animal species, providing a haven where they can thrive and coexist as part of a balanced ecosystem. Nonetheless, the very essence of PLAs, their pristine environments, can be threatened by the unintended consequences of modern agricultural practices, with use of pesticides standing out as a significant concern.

PLAs are often located adjacent to agricultural lands. Pesticides, including herbicides, insecticides, and fungicides, are extensively used in agriculture to control pests and maximize crop yields. These chemical agents, crucial for safeguarding crop yields and food security, pose a dual-edged sword. Rainfall, runoff, and leaching can transport pesticides from fields into adjacent PLAs. As a result, pesticide residues can be detected in water bodies within these protected areas.

When misapplied or excessively used, these chemical agents can severely compromise the quality of both surface and groundwater resources. Surface waters, such as rivers and streams, can become contaminated as pesticide residues are washed away from fields during rainfall or irrigation, infiltrating nearby water bodies. Groundwater, the primary source of drinking water for many communities, is susceptible to pesticide leaching through the soil, potentially resulting in harmful chemical concentrations that exceed safety limits. Long-term impact of pesticide exposure should not be negligted as well. Pesticide residues can persist in the environment for extended time periods, posing a continuous threat to the health of PLAs and their inhabitants. Last but not least it should be noted that pests can develop the resistence to pesticides, leading to a cycle of increasing pesticide use, which exacerbates the aforementioned issues.

Plant protection products used in particular in agriculture, undergo a pre-marketing check thorough evaluation based on the Regulation (EC) No 1107/2009 of the European Parliament and of the Council to minimize negative effects on the environment and non-target organisms. An important part of this evaluation is the exclusion of significant effects on relevant organisms that could be affected by the use of the products.

Analysis of Pesticides

Samples of water and soil were tested for the presence of a wide range of pesticide residues and their metabolites. Almost 400 target pesticides were examined in the water samples, and approximately 200 pesticides were analyzed in the soil samples. The samples were processed in ALS laboratories, which are equipped with modern laboratory equipment and instrumentation specialized in liquid chromatography coupled to tandem mass spectrometry (HPLC-MS/MS). This technique ensures fast, sensitive, and precise determination of even trace amounts of pesticide residues and their metabolites in various environmental matrices. Methods can offer the determination of a wide spectrum of substances in combination with low detection limits in soils, as well as in drinking, surface, groundwater, and wastewater. The applied analytical methods are accredited according to ISO/IEC 17025:2018.

Case study: Pesticides in Moravian Karst

The Moravian Karst is the largest and most karstic area in the Czech Republic. It is considered to be one of the biggest cave systems in central Europe and is located north of Brno. The north part of Moravian Karst is drained by the river Punkva and its headwaters. Each karst represents an extremely fragile ecosystem, susceptible to human activities as it expedites the transport of nutrients and pollutants from the soil to groundwater due to its unique geological and pedological conditions.

The unique nature of the Moravian Karst and the water resources, some of which are used for drinking water production, are endangered by intensive management of karst plateaus. Agricultural activities in this area pose a risk of pesticide substances infiltrating underground spaces, either through leaching through the soil and rock environments (thus forming dripping water) or by leaching topsoil from fields into sinkholes, which tend to be ploughed to the very edge.

In the project, essential data on the contamination of local soils, active surface and groundwater streams, and, most notably, dripping waters, were collected. Concerning dripping water, the Harbes Cave, located just beneath cultivated land, exhibited the highest level of pesticide contamination. Based on the obtained results, it can be concluded that triazine and azole pesticides, along with their polar metabolites, are prevalent and substantial pollutants in the aquatic ecosystem of the Moravian Karst. Concentrations of pesticide substances in this area routinely exceeded the permitted limits for groundwater established by current local legislation (0.1 µg/L for each individual active pesticide substance and its relevant metabolite, and 0.5 µg/L for the total of these substances).

Outcomes of the Project

The information obtained about pesticide contamination in the Moravian Karst has significantly contributed to negotiations regarding new measures aimed at safeguarding the local karst environment, both below and above the surface.

These arrangements have been gradually implemented since 2019 and have included:

- Change in zoning: The first zone has been newly defined above the caves (100 meters on each side) and around the sinkholes (30 meters from the edge of the sinkhole).
- Regrassing of arable land in the Zone I: In the first zone, green islands were established on arable land with the aim of protecting the karst environment from pollution and providing a habitat for various animals and plants.
- Restrictions on the pesticide use in the Zone II: The use of certain pesticides with a long half-life has been prohibited.

Project Related Publications:

- Halešová, T. et al. (2022). Occurrence of pesticides in the Punkva river. VTEI, 2022(2), 29–32.
- Halešová, T. et al. (2022). Grassing of Zone I in the Moravian Karst Protected Landscape Area. Nature Conservation
- Map with certified content: Halešová, T. et al. (2022). Monitoring of pesticides in water resources of the Moravian Karst Protected Landscape Area. Certified interactive map. ISBN: 978-80-7427-373-5.

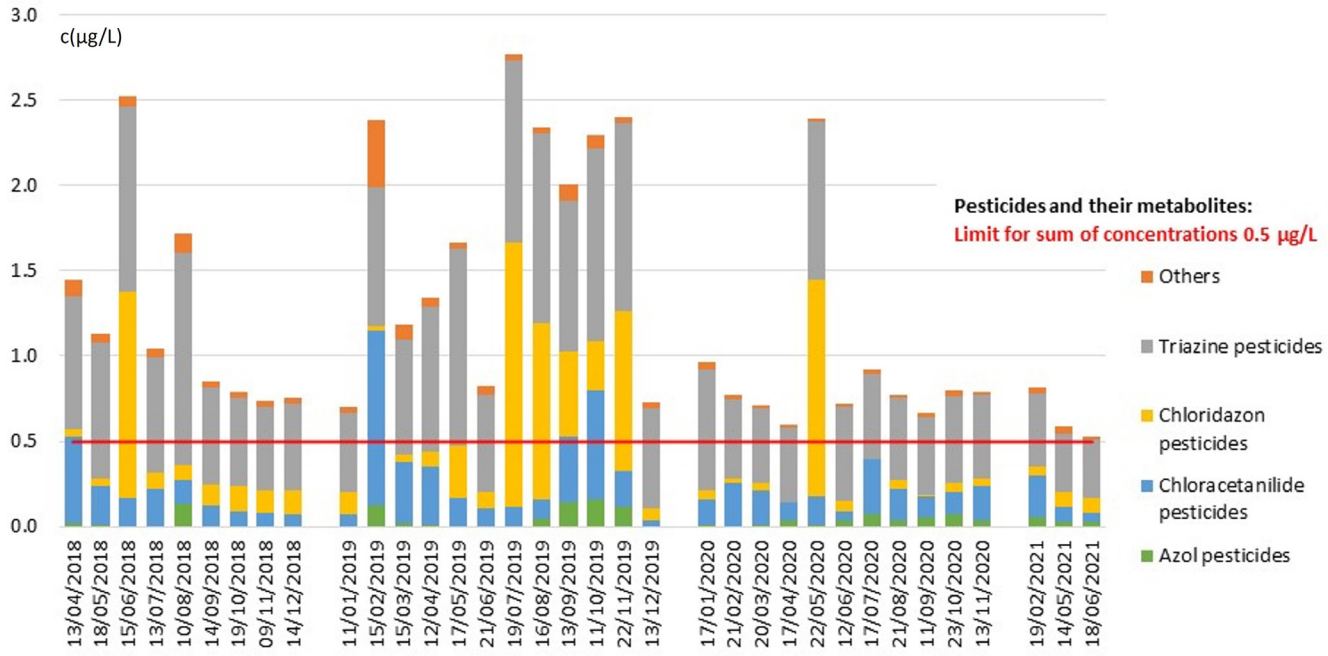

Figure 1: Pesticides in dripping water of the Harbes Cave in the Moravian Karst protected landscape area, years 2018 - 2021. The summary of concentrations (µg/L).