

Science for Environment Policy

Evidence for effects of chemical pollution on riverbed invertebrates

To date, it has been difficult to collect data that are robust enough to demonstrate specific effects of chemical pollution in rivers on aquatic wildlife. However, a recent study combining detailed chemical, toxicological and ecological data in three European river basins now provides evidence linking cause and effect by revealing significant differences in the effects of differently polluted sediments on the organisms living in the river basins and the riverbed biodiversity.

As a result of chemical pollution, many European rivers are falling short of the targets set by the EU Water Framework Directive¹, which sets objectives regarding the ecological and chemical quality of water. Improved quantification of the impact of chemical pollution on river-dwelling life can inform water management strategies.

The study, conducted under the EU MODELKEY project², looked at the effect of toxic compounds on invertebrates that live on or in the river floor. Three European river basins were studied that represent different ecological regions of Europe and are exposed to manmade pollutants: the Elbe (Czech Republic and Germany), the Scheldt (France, Belgium and the Netherlands), and the Llobregat (Spain). To date, most studies of this kind have focused on rapid flowing water sources. The authors consider this to be the first study recording, to the species level, the communities living in the soft sediment of rivers and use a combination of detailed chemical, toxicological and ecological data on the sediment for its analysis.

Benthic invertebrates are an important part of the food chain, recycling nutrients from dead organic material and serving as a food source for other creatures. As pollutants build up in the sediment, they can reach levels that are harmful for the invertebrates living there, thus challenging the stability of the ecosystem. However, the risks posed by contaminated sediments to the local communities of organisms are difficult to measure. The study used an advanced 'weight-of-evidence' approach to analyse polluted river sediments from the European river basins and compare them to control sediments.

A wide range of chemicals were measured in the sediments, including insecticides, polyaromatic hydrocarbons (from fuel combustion), hormones, arsenic and heavy metals. In the laboratory, a range of organisms that live at the bottom of the water bodies were exposed to the sediment samples, including bacteria, worms, snails, insects and fish embryos. The number and diversity of species of invertebrates in sediment samples were also examined.

In general, the estimates of toxicity due to organic compounds and metals were higher at the polluted sites than the control sites. Sediments from the more toxic polluted sites affected more species than sediments from the less toxic polluted sites. Test species were affected in different ways by the same sediments..

Measuring the density and diversity of organisms across the sites gave an indication of the effects of pollution levels on invertebrate communities. For example, there was a significant difference in the number of macroinvertebrates (mostly larvae of midges and oligochaetes - i.e. earthworms) and nematode worms between the polluted and unpolluted sites.

The researchers combined the different strands of data in a scoring system. They note that this system can be used to rank sites in terms of their risk to the plants and animals living at them. The researchers suggest that this feature allows sites to be easily compared by non-experts in water management so that restoration priorities can be set in the face of tight budgets. They also point to the relevance of their work to the development of a tool to identify key toxicants.

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1. See: http://ec.europa.eu/environment/water/water-framework/index_en.html

2. MODELKEY (Models for Assessing and Forecasting the Impact of Environmental Key Pollutants on Marine and Freshwater Ecosystems and Biodiversity) was supported by the European Commission under the Sixth Framework Programme. See: www.modelkey.org