

# Science for Environment Policy

## Pesticides and pharmaceuticals influence riverbed communities of microbes

**Changes in complex microbial communities** known as 'biofilms' at the bottom of rivers can reveal the effects of pesticide and pharmaceutical pollution of river water, according to a recent study. Painkillers and anti-inflammatory drugs were found to have a significant effect on the structure and functioning of the biofilms.

**Human activities** are contaminating surface [waters](#) with chemicals, including pesticides, which enter water bodies as runoff from agriculture, and pharmaceuticals, which are discharged in industrial and sewage treatment wastewater. These pollutants can harm the structure and function of aquatic ecosystems, including biofilms.

Biofilms are typically composed of algae, bacteria, fungi and protozoa and they coat surfaces, such as those at the bottom of rivers. They are good indicators of the environmental pressures on river systems, as they are part of the food web and natural cycles of river ecosystems and respond quickly to changing conditions.

In this study, partly funded by the EU projects MODELKEY<sup>1</sup> and KEYBIOEFFECTS<sup>2</sup>, the researchers examined the effects on biofilm growth of pesticide and pharmaceutical contaminants in the Llobregat River near Barcelona in north-eastern Spain. The river is a source of drinking water, but is polluted by urban wastewater and agricultural runoff from the surrounding area.

Water was collected at three sites along the river: a pollution hotspot and two less polluted places. It was used to grow biofilms on glass slides in a number of mesocosms (small-scale experimental systems where the conditions can be controlled). After establishing the biofilms for 25 days in mesocosms containing less polluted water, the water was replaced with more polluted water.

Overall, the study detected 57 pharmaceuticals from 14 separate drug groups and 16 chemicals from five separate pesticide groups in the water. At all three sites, analgesics (painkillers) and anti-inflammatory drugs were found in the highest concentrations (more than 100 ng L<sup>-1</sup>) (nanograms per litre of water), with the anti-inflammatory drug ibuprofen the most concentrated chemical identified at all three sites. The most commonly found pharmaceutical was hydrochlorothiazide, a blood pressure regulator. The concentrations of pesticides were generally lower (less than 100 ng L<sup>-1</sup>) than those of pharmaceuticals, with chemicals in the triazine, phenylurea and organophosphate families found in the highest concentrations.

Transferring the biofilms to increasingly polluted water in the laboratory revealed that the most polluted water had the strongest effect on the structure and function of the biofilms. The direction of biofilms' responses could be explained by both direct and indirect effects of environmental factors and chemical pollution on community structure and function. The availability of higher levels of nutrients (especially phosphates and nitrates) from wastewater treatment plant effluents and agricultural inputs in the more polluted waters increased the biomass of the biofilms. Contaminants were found to affect the functioning of the biofilms through changes in photosynthetic capacity and in the activity of enzymes, released by biofilm organisms that degrade organic matter, suspended or dissolved in river water. After 16 days, for example, the release of certain enzymes by biofilms translocated from moderately polluted water to highly polluted water resembled that of biofilms established in the highly polluted water. Three analgesic and anti-inflammatory drugs, diclofenac, paracetamol and ibuprofen, appeared to cause the greatest changes in biofilms relocated to more polluted water.

The researchers suggest this method of translocating biofilms to more highly-polluted water is useful for studying the effects of real mixtures of conventional and emerging pollutants on biological river communities.



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1. 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](http://www.modelkey.org)

2. KEYBIOEFFECTS (Cause-effect relationships of key pollutants on the European rivers biodiversity) was supported by the European Commission under the Sixth Framework Programme. See: [www.udg.cat/keybioeffects](http://www.udg.cat/keybioeffects)