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Nutrients in streams can mask toxic effects of pesticides on aquatic life

Moderate levels of nitrogen in streams and rivers can make it difficult to assess the effects of pesticides on aquatic wildlife, because nutrients mask the pesticides' impacts, according to recent research. This highlights the importance of considering nutrient levels when developing measures to protect aquatic ecosystems.

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Freshwater organisms are exposed to a number of natural and non-natural stressors, including agricultural pollution. Pesticides, for example, have been found to be highly toxic to aquatic species that are not the target of the applications, and more than one pesticide is typically found in monitored waters.

Although previous research has shown that pesticides and nutrients can affect the structure and function of aquatic communities, the combined effects of these inputs are not well known. This study examined how the presence of added nutrients in streams could modify the effects of a mixture of three insecticides used to protect food crops: chlorpyrifos, dimethoate and imidacloprid. All are toxic to non-target species.

The researchers evaluated the responses of bottom-dwelling macroinvertebrate communities, including e.g. non-biting midges (*Chironomus* species), to exposure from the insecticide mixture in oligotrophic water (containing low nutrient levels) and mesotrophic water (containing moderate amounts of nutrients).

Over 20 days, the creatures, collected from a river in Canada, were exposed to a range of insecticide mixture doses in 80 outdoor artificial streams. The streams mimicked the invertebrates' natural habitats with beds of stone and gravel coated in an algae film and were fed with natural groundwater from the area. Two natural predator species, dragonflies (*Gomphus* species) and stoneflies (*Agnetina* species) were also added to the artificial streams to act as additional stressors for the invertebrates.

The researchers tested the effects of different doses of the insecticides in water enriched with nitrate (representing mesotrophic conditions) and unenriched water (representing oligotrophic conditions).

When the insecticide mixture was absent or at low (sublethal) levels, moderate levels of added nitrate in the artificial streams increased macroinvertebrate numbers compared with those in the unenriched streams. This suggests that the added nutrients promoted algal growth which increased the supply of food at the bottom of the food webs within the macrobenthic communities. This masked the impact of the sublethal doses of the insecticide mixture on species in the macroinvertebrate community.

However, moderate to high doses of the insecticides had a more toxic effect in nutrient-enriched than in oligotrophic waters, reducing the numbers and diversity of macroinvertebrates. Furthermore, the effects on different species varied according to the dose of insecticides. The impact of the dragonfly and stonefly predators was significant only in the oligotrophic waters.

These results suggest that it is difficult to predict the effects on aquatic organisms of complex mixtures of pesticides, commonly used in agriculture, particularly when streams and rivers are moderately enriched with nutrient inputs from the surrounding landscape.