Climate change leads to disproportionately high pollutant absorption

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Pesticides and other chemicals harm biodiversity, and climate change is also threatening many habitats. With his study, Eawag researcher Johannes Raths has shown that these two challenges for our society may even worsen. Amphipods absorbed pollutants faster as water temperatures rose. The researcher has received an award from the Society of Environmental Toxicology and Chemistry for his paper on the toxicokinetics of amphipods in combination with increased water temperatures.

Environmental pollution and climate change are two of the greatest threats to ecosystems and biodiversity. We know a great deal about these two factors, but little research has been done into how they interact. Several studies in recent years have concluded that native invertebrates in aquatic environments are more sensitive to pollutants when water temperatures rise. In his study, Eawag researcher Johannes Raths looked into the question of whether this increased sensitivity can be explained by changes in toxicokinetic processes.

Higher temperatures lead to increased pollutant absorption

Together with researchers from the ETH, the Carinthia University of Applied Sciences and the Helmholtz Centre for Environmental Research, Raths studied the biochemical aspects of amphipods at four different temperatures and with twelve polar organic pollutants. These small aquatic animals are a fundamental component of the aquatic food web and are practically native all over the world.

Raths' research revealed a clear connection between toxicokinetic rates and water temperature. Toxicokinetic rates describe how pollutants are processed in the body, i.e. the resorption, distribution,

metabolism and excretion of the pollutants. This means: as water temperatures increase, amphipods absorb, metabolise and excrete more pollutants, not just linearly but also exponentially. Raths was also able to show that the influence of temperature on toxicokinetic rates was on a similar scale to the influence of temperature on physiological rates, for example, the animals' respiration. This connection can simplify the practical application of the results in models of pollutant absorption.

The warmer the water, the faster amphipods absorb pollutants.
(Photo: Johannes Raths, Eawag)

The findings show that dependencies exist between environmental pollution and climate change and that these can become stronger. According to Raths: "High temperatures and peaks of pollutant concentration in the water often occur together, for example following pesticide application in spring and summer. This makes the temperature-related acceleration of toxicokinetic processes especially worrying, as much higher peak concentrations can be achieved in the organisms than previously assumed." However, more studies, including with other substance classes, are necessary to obtain an even better picture of the underlying mechanisms. The results give new insights into how aquatic life absorbs chemicals in different climate scenarios. These results can therefore contribute to improving assessment of environmental risks.

Award for publication

Johannes Raths has just received the SETAC Europe Rifcon Early Career Scientist Award for the paper. The award for early-stage researchers was set up to support members of the Society of Environmental Toxicology and Chemistry (SETAC) in their career development. It is conferred for original scientific research, political or other professional achievements by an early-stage researcher. The Eawag researcher was presented with this prestigious award at the ceremony last Sunday.

Cover picture: Eawag researcher Johannes Raths (right) has won the SETAC Europe Rifcon Early Career Scientist Award for his paper on the toxicokinetics of amphipods at increased water temperatures. Here, receiving the award in Dublin. (Photo: SETAC)

Original publication

Raths, J.; Švara, V.; Lauper, B.; Fu, Q.; Hollender, J. (2023) Speed it up: how temperature drives toxicokinetics of organic contaminants in freshwater amphipods, *Global Change Biology*, 29(5), 1390-1406, doi:10.1111/gcb.16542, Institutional Repository

Related Links

Website SETAC

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