Insecticide and climate warming impact stream insect communities

September 16 2021

Lead author: Dr Sam Macaulay. Credit: University of Otago

New research highlights the impact of one of the world's most widely used insecticides on stream macroinvertebrate communities in the context of climate change.

The research is the first to study the combined effects of the neonicotinoid insecticide imidacloprid and raised water temperatures

due to climate-change on experimental stream communities, using the award-winning ExStream System developed by University of Otago researchers.

Lead author Dr. Sam Macaulay, graduate of the Department of Zoology, says the combined effects of the insecticide, increased temperature and a ten-day natural heatwave that occurred during the experiment caused a shift in the stream invertebrate community.

"Relative abundances of pollution-sensitive insect species such as mayflies, stoneflies and caddisflies decreased, and the communities instead became dominated by more tolerant invertebrates such as stream-dwelling worms, crustaceans and snails," Dr. Macaulay says.

The study assessed pesticide and warming effects in fast-flowing and slow-flowing experimental streams, simulating the effects of water abstraction on reduced flow velocity.

"Overall, we found that freshwater invertebrate communities were significantly impacted by environmentally realistic concentrations of the common pesticide imidacloprid, and that communities present in fast-flowing and unheated experimental streams were the most negatively affected as they contained higher numbers of pollution-sensitive species," Dr. Macaulay says.

"Although pesticides are applied onto land, many easily dissolve in water and get washed into streams and rivers where they can kill aquatic insects that are important for the health of streams and the surrounding ecosystems they support."

The study, published recently in the leading science journal *Global Change Biology*, suggests that conservation efforts may therefore be most effective when allocated to protecting healthy, diverse systems

from exposure to pesticides.

"To maintain the biological integrity of streams and the ecosystems they support, streams with fast flows need adequate protection from pesticide contamination, as well as protection from excessive water abstraction."

Pesticide use in New Zealand is high, given the country's economic reliance on agriculture, with estimates from the Food and Agriculture Organization of the United Nations of more than 5,000 tons applied annually.

Many of these pesticides are water-soluble and can end up in groundwater or surface waters. However, as New Zealand has no regular monitoring program for surface water bodies such as streams and lakes, very little is known about pesticide presence or concentrations in these freshwaters.

The research was undertaken at the Kauru River in North Otago using the experimental ExStream System developed by University of Otago researchers Professor Christoph Matthaei and Dr. Jeremy Piggott, both co-authors of the published study.

Over a period of seven weeks, the experiment simulated the impacts of pesticide inputs and raised water temperature on invertebrate communities representative of fast- and slow-flowing microhabitats in streams.

Dr. Macaulay says that while the experimental research simulated increased water temperatures forecast with climate change, it serendipitously also captured the effects of a natural heatwave that occurred at the same time.

"The combination of the simulated climate warming and the natural

heatwave strongly reduced populations of heat-sensitive insect larvae in our experimental communities, highlighting how negative effects can be exacerbated when more than one stressful factor is affecting an ecosystem."

Imidacloprid is one of the most widely used insecticides in the world. In New Zealand, it is the active ingredient in several agricultural insecticides, and is also used in applications such as flea treatment and some household insecticides.

Its highly toxic effects on non-target insects including bees has led to the ban of the majority of neonicotinoid insecticides (including imidacloprid) for outdoor use in the European Union since 2019. In New Zealand however, these pesticides remain in use and there is limited information available of volumes imported, sold or used.

Professor Matthaei says further surveys of streams in catchments where pesticides are used in known quantities are required, as little is known about pesticide concentrations in New Zealand's freshwaters.

"The only regular monitoring of pesticides undertaken in New Zealand is a four-yearly survey of groundwater, and accordingly very little is known regarding in-stream pesticide concentrations," Professor Matthaei says.

"Contamination by pesticides in freshwaters is a global problem, and the prevalence of pesticide use and the impacts they are having on aquatic insects that are crucial for maintaining healthy stream ecosystems require urgent attention."

More information: Samuel J. Macaulay et al, Warming and imidacloprid pulses determine macroinvertebrate community dynamics in experimental streams, *Global Change Biology* (2021). DOI: 10.1111/gcb.15856

PHYS.ORG

Provided by University of Otago

Citation: Insecticide and climate warming impact stream insect communities (2021, September 16) retrieved 27 April 2024 from https://phys.org/news/2021-09-insecticide-climate-impact-stream-insect.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.