Extreme temperature events alter stream ecosystem functioning

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Abstract
Extreme temperature events have increased in intensity, duration and frequency in the last century, with potential consequences on organisms and ecosystems. In many streams, leaf litter of terrestrial origin is a key resource for microorganisms and some detritivores, and its decomposition has a main role on ecosystem functioning and is often used as an indicator of ecological integrity. As litter is often exposed to atmospheric conditions before entering the stream, extreme warming and freezing events may alter its physicochemical structure and affect decomposition and associated detritivores. We tested this prediction in a microcosm experiment by exposing litter of three tree species (in single-species treatments and the 3-species mixture) to different temperature pre-treatments: heating (40 °C), freezing (−20 °C) and both (heating followed by freezing). We then examined changes in litter traits due to leaching (72 h), litter decomposition in the absence and presence of detritivores, and detritivore growth (28 d), with focus on mass and nutrient (nitrogen and phosphorus) changes. Nutrient leaching was promoted mostly by the heating pre-treatment, which apparently produced lower-quality litter. However, microbial activity mostly resulted in litter mass and nutrient gain, which were reinforced by the heating pre-treatment, while freezing had the opposite effect. When detritivores were present, decomposition showed high variation among litter types but, again, the heating and freezing pre-treatments tended to reduce and enhance nutrient loss, respectively. The greatest and more consistent effects occurred for detritivore growth, which was reduced by temperature pre-treatments, particularly in the highest-quality litter type. In general, the sequential application of heating and freezing pre-treatments showed no synergistic effect, and the litter mixture showed similar responses to single-species treatments. Our results demonstrate that short-term extreme temperatures can modify litter quality in riparian soils and have subsequent effects on its decomposition within the stream and associated fauna, potentially altering stream food webs, ecosystem functioning and biogeochemical cycles. © 2020 Elsevier Ltd

Author keywords
Climate change; Conservation/biodiversity; Decomposition; Functional indicator; Invertebrates; Nutrient cycling; Running waters/rivers/streams