Additive impacts of experimental climate change increase risk to an ectotherm at the Arctic's edge.

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Abstract: Globally, Arctic and Subarctic regions have experienced the greatest temperature increases during the last 30 years. These extreme changes have amplified threats to the freshwater ecosystems that dominate the landscape in many areas by altering water budgets. Several studies in temperate environments have examined the adaptive capacity of organisms to enhance our understanding of the potential repercussions of warming and associated accelerated drying for freshwater ecosystems. However, few experiments have examined these impacts in Arctic or Subarctic freshwater ecosystems, where the climate is changing most rapidly. To evaluate the capacity of a widespread ectotherm to anticipated environmental changes, we conducted a mesocosm experiment with wood frogs (Rana sylvatica) in the Canadian Subarctic. Three warming treatments were fully crossed with three drying treatments to simulate a range of predicted changes in wetland environments. We predicted wetland warming and drying would act synergistically, with water temperature partially compensating for some of the negative effects of accelerated drying. Across all drying regimes, a 1?C increase in water temperature increased the odds of survival by 1.79, and tadpoles in 52-day and 64-day hydroperiod mesocosms were 4.1-4.3 times more likely to survive to metamorphosis than tadpoles in 45-day mesocosms. For individuals who survived to metamorphosis, there was only a weak negative effect of temperature on size. As expected, increased temperatures accelerated tadpole growth through day 30 of the experiment. Our results reveal that one of the dominant herbivores in Subarctic wetlands, wood frog tadpoles, are capable of increasing their developmental rates in response to increased temperature and accelerated drying, but only in an additive manner. The strong negative effects of drying on survival, combined with lack of compensation between these two environmental drivers, suggest changes in the aquatic environment that are expected in this ecosystem will reduce mean fitness of populations across the landscape. This article is protected by copyright. All rights reserved.

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