Asymmetry drives the cumulative impacts of multiple stressors on freshwater ecosystems under a warming climate

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Abstract

Climate warming is an important stressor in freshwater ecosystems, yet its interactive effects with other environmental changes are poorly understood. We address this challenge by testing the ability of three contrasting null models to predict the joint impacts of warming and a second stressor using a new database of 296 experimental combinations. Despite concerns that stressors will interact to cause synergisms, we found that net impacts were best explained by the effect of the worst stressor (the dominance null model). When this stressor's impact was at least 50% greater than that of the second, the dominance model was most accurate in 62% of responses. Prediction accuracy depended on the identity of the stressors and declined at higher levels of biological organisation. Together these findings suggest we can often effectively forecast impacts of multiple stressors by focusing on the degree of asymmetry that exists among their independent impacts.

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