

# Multi-stress interplay: Time and duration of ocean acidification modulate the toxicity of mercury and other metals

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## Abstract

The current understanding of multi-stress interplay assumes stresses occur in perfect synchrony, but this assumption is rarely met in the natural marine ecosystem. To understand the interplay between non-perfectly overlapped stresses in the ocean, we manipulated different temporal scenarios of acidification and assessed their effect on mercury toxicity in a marine copepod. We found that the scenario of past acidification aggravated mercury toxicity, but personal and persistent acidification mitigated the toxicity. This is because personal and persistent acidification initiated the energy compensation to enhance growth and mercury efflux. To explore how general temporal scenarios of acidification affected multi-stress interplay, we conducted a meta-analysis on marine animals and found that scenarios significantly changed the toxicity of several other metals. Our study thus demonstrates that time and duration of stresses modulate multi-stress interplay in the marine ecosystem, and suggests that future studies should move beyond the scenario of perfect synchrony.

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