Food-web dynamics under climate change

Climate change affects ecological communities through its impact on the physiological performance of individuals. However, the population dynamic of species well inside their thermal niche is also determined by competitors, prey and predators, in addition to being influenced by temperature changes. We use a trait-based food-web model to examine how the interplay between the direct physiological effects from temperature and the indirect effects due to changing interactions between populations shapes the ecological consequences of climate change for populations and for entire communities. Our simulations illustrate how isolated communities deteriorate as populations go extinct when the environment moves outside the species' thermal niches. High-trophic-level species are most vulnerable, while the ecosystem function of lower trophic levels is less impacted. Open communities can compensate for the loss of ecosystem function by invasions of new species. Individual populations show complex responses largely uncorrelated with the direct impact of temperature change on physiology. Such complex responses are particularly evident during extinction and invasion events of other species, where climatically well-adapted species may be brought to extinction by the changed food-web topology. Our results highlight that the impact of climate change on specific populations is largely unpredictable, and apparently well-adapted species may be severely impacted.

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