Title: Predicting complex microbial temperature responses across scales

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Project Goals: This project scales up biological responses to warming from the individual level to the ecosystem level by using microbial traits to link complex population, community, and ecosystem processes.

Abstract Text: Microbial communities regulate ecosystem responses to climate change. But predicting these responses is challenging due to complex interactions among processes at multiple levels of organization. Organismal traits that determine individual performance and ecological interactions are essential for scaling up environmental responses from individuals to ecosystems. We combine protist microcosm experiments and mathematical models to show that key traits—cell size, shape, and contents—each explain different aspects of species' demographic responses to changes in temperature. These differences in species' temperature responses have complex, cascading effects across levels of organization—causing nonlinear shifts in total community respiration rates across temperatures via coordinated changes in community composition, equilibrium densities, and community-mean species mass in experimental protist communities that tightly match theoretical predictions. Our results suggest that traits explain variation in population growth and, together, these two factors scale up to influence community- and ecosystem-level processes across temperatures. Connecting the multi-level microbial processes that ultimately influence climate in this way will help refine predictions about complex ecosystem-climate feedbacks and the pace of climate change itself.

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