Life at the Edge: Trait Variability at the Thermal Limits Can Drive Diatom Community Dynamics

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Organismal distributions are largely mediated by temperature, suggesting thermal trait variability plays a key role in defining species' niches. We employed a trait–based approach to better understand how interspecific thermal trait variability could explain and characterize diatom community dynamics. A culture library was generated consisting of 23 strains from 5 diatom species in the genus *Skeletonema*, isolated from Narragansett Bay (NB), RI, USA, where this genus can comprise up to 99 percent of microplankton. Growth rates were determined at temperatures ranging from -2 to 36°C to construct strain-specific thermal reaction norms. Comparison of performance curves revealed interspecific overlap at the thermal optima and significant divergence at the thermal limits. Cellular elemental composition was then examined in two thermally differentiated species and the most variation was again exhibited at the thermal limits.

To determine the potential impact of interspecific trait variation on community composition, a species succession model was formulated utilizing parameters from each species' empirically-determined reaction norm and historical temperature data from NB. Seasonal succession patterns in our modeled diatom community paralleled those observed in the field, indicating that thermal limits of growth are important determinants of diatom community dynamics and, ultimately, carbon flux and nutrient cycling through marine ecosystems. Here, characterization of thermal limits rather than thermal optima were the best predictors of community composition patterns, suggesting that thermal limit analysis be incorporated into both empirical and modeling efforts in the future.