Temperature modification of per capita interaction strength and dispersal

Temperature has long been known to control species distributions and the timing of seasonal life-cycle events for many organisms. Individuals of most species experience spatial and temporal variation in temperature, which indirectly influences biological and ecological processes without resulting in 'stressful' or lethal effects. Phenotypic plasticity, death or migration, adjusted physiological state and biochemical kinetics (metabolic rate) are mechanisms of ecologically important responses to temperature. There doesn't seem to be a synthetic understanding of the importance of these different mechanisms for local and regional ecological processes.

Metabolic scaling theory predicts constraints on molecular processes that restrict the ability of species to modify their response to temperature. In other words, there is a universal temperature dependence (UTD) of metabolism[1] (Fig 1). The temperature dependence of metabolism is independent of body size and can be explained by kinetics of fundamental biochemical processes such as the temperature dependence of ATP synthesis in respiratory complexes and Rubisco carboxylation in chloroplasts. Further, theoretical work has shown that the rate of respiration is far more sensitive to temperature change than photosynthetic rate[2]. Therefore, environmental temperature should explain geographical patterns of ecological processes related to temperature, such as larval dispersal duration[3], interaction strengths between plants and herbivores[4], perhaps even patterns of abundance and diversity, and could explain variation in time. I propose to investigate the degree to which temperature modifies important ecological patterns and processes, specifically marine larval dispersal and per capita interaction strengths between herbivores and plants.

Ives et al[5] wrote in 1993 that density dependence and species interactions 'may play major roles in determining the magnitude of density changes in response to climate change'. Still, discussions of ecological implications of climate change focus on the direct effects of temperature on a species survival and location[6] but not on the indirect effects of temperature on species interactions. Since to our knowledge no marine species have gone extinct due to modern climate change[6], and some species' ranges are shifting but not many[7], perhaps a focus on the ecological effects of temperature for organisms that don't relocate will provide relevant information for predicting and understanding ecological patterns on scales relevant to management.

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