Title: Does Predation by Protists Mediate the Effects of Temperature and Nutrient Additions on Microbial Food Webs?

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Project Goals: To assess whether predation by protists can mediate the responses of microbial communities to temperature and nutrient increases.

Abstract Text: Rising global temperatures and increases in nutrient deposition through severe air pollution may have catastrophic effects on natural ecosystems. Warmer temperatures increase metabolic rates, leading to increased energetic demands among endotherms. The burning of fossil fuels, emission of ammonia by industrial regions, and the indiscriminate use of fertilizer have contributed to ever-increasing nutrient deposition rates. Worse, anthropogenic nutrient additions interact with warming temperatures in often unpredictable ways. While we have previously shown that the temperature response of microbial communities is mediated by ecological interactions, how these communities may respond to both temperature increase and nutrient additions in the presence of predators is unknown. To test how predation mediates the combined effects of nutrient additions and temperature, we set up microbial microcosms where we manipulated temperature, nutrients, and the presence and absence of protists. Specifically, microbial microcosms were assembled using moss-associated bacteria from the DOE-supported SPRUCE site in the Marcell experimental forest in Minnesota. We manipulated microcosm temperatures (22°C and 25°C), nutrient conditions (standard and half concentration Carolina protist media), and the presence of protist predators on 200mL glass jars over three weeks. To assess the response of the bacterial communities, we quantified total microbial biomass using OD600, total respiration rate using real-time respirometry, and changes in microbial community structure using amplicon sequencing.

Our results show that temperature, nutrient concentration, and the presence of protists interactively influence microbial growth and community structure. Increased temperature and low nutrient conditions negatively affect total microbial biomass, while the presence of protists has a positive effect on biomass independent of temperature and nutrient conditions. The microbiome functional changes are accompanied by distinct shifts in community structure that show a stronger response to protist predation than temperature. These results suggest that while temperature and nutrients may indeed interactively influence the structure and function of microbial communities, their response is ultimately determined by top-down controls exerted by bacterivore organisms that may themselves be responding to increased temperature). Moreover, we show that while protist presence may certainly provide top-down control, it can also fertilize microbial growth by recycling nutrients stored in bacterial biomass. Overall, these results can help improve predictions on how the combined effects of nutrient additions and warming will affect ecological communities and food web structure.

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