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Environmental Program Award
Project Report

The Direct and Interactive Effects of Warming and Species Interaction on Plant Functional Traits

Global climate change is a threat that continues to affect nearly every ecosystem on the planet through warmer temperatures, changes in precipitation patterns, and many other manifestations of a warmer world. Climate change directly affects ecosystems as new abiotic conditions shape ecosystem function; climate change also affects ecosystems indirectly as the plant community shifts in response to abiotic changes, with consequences for ecosystem function. Here, we conducted an experiment to determine how the direct and indirect effects of warming interact to impact plant functional traits in an alpine ecosystem. We leveraged an existing warming experiment in the Almont Triangle Colorado, USA. The ongoing 6-year study simulates the direct impact of climate change using open-top warming chambers that raise plot air and soil temperatures and implements the indirect impact of climate change by removing the dominant plant species to cause shifts in the plant community, with some plots receiving both treatments, We sampled leaf tissue from the most common plant species from within the plots to answer a series of interrelated questions: (1) How does warming directly alter plant functional traits? (2) How do plant community shifts affect plant functional traits? (3) Will warming and species removal interact synergistically to alter plant traits? We hypothesized that: Warming will shift the individual and community-wide traits to be more conservative by exacerbating water-stress in a moisture-limited environment. (2) Removing the dominant species will shift the plant community to be more acquisitive as the remaining plants are released from competitive pressure. (3) Warming and species removal will have counteractive effects on plant functional traits, resulting in no net effect of climate change when both treatments occur simultaneously. Our results confirmed that warming and species removal have opposing effects on community shifts, though not in the direction that was expected. Warming resulted in an increase in specific leaf area within a community which indicates that plants are allocating more resources to increasing productivity, a more acquisitive growth strategy. We also saw a significant increase in leaf dry matter content with warming showing that communities display water conservative traits which is likely indicative of growth strategies in an arid ecosystem. By comparing trait values within a species across the warming and removal treatments, we did not see overall shifts in most traits due to climate change. This leads to the conclusion that these traits are less plastic than we believed and that individual plants are physiologically locked into a specific growth strategy. Therefore, shifts in the functional traits at the community scale are driven by shifts in the relative abundance of species in response to climate change, evidenced by shifts in relative abundance of four species in our climate change treatments. Functional traits of plants remain an effective lens through which we can observe the pathways through which climate change drives shifts in ecosystem structure and function. These data will be used in future projects to help determine how the shifting of plant community function may affect the ecosystem’s service as a grazing land.