Implications of an Invasive Forest Pathogen for Alpine Treeline Dynamics

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This multidisciplinary project focuses on how an introduced disease, white pine blister rust, can alter ecosystem function through the mortality of whitebark pine, a keystone and foundation species of subalpine and treeline communities of the western United States and Canada. Blister rust is causing whitebark pine to decline across much of its range; this decline has begun to undermine mountain biodiversity and ecosystem services. This research will investigate the combined impacts of whitebark pine mortality and climate change at alpine treelines. It employs a novel approach to attack this problem by synthesizing complex interactions among vegetation, climate and pathogens. The researchers will analyze geographic variation in the role of whitebark pine and blister rust incidence at treelines in the American and Canadian Rocky Mountains by employing spatial analysis to model blister rust incidence and distribution. The researchers will also use natural experiments to reveal how the mortality of whitebark pine may affect ecosystem function. A primary outcome of this project will be a spatially explicit predictive model that integrates theory with empirical observations to determine if and how exotic disease will alter mountain landscapes and confound regional climate change predictions for the treeline ecotone and other mountain ecosystems.

This study is the first systematic investigation of the implications of exotic disease upon alpine treeline dynamics. As such, it is a pioneering contribution to the new field of landscape pathology. The research will shed light on how an exotic and invasive disease, coupled with the impacts of climate warming, can alter the structure and function of a critical global ecosystem through mortality of a keystone and foundation species. By assessing the role of species interactions, such as pathogen-host and nurse species interactions, this study will advance current bioclimatic models that predict geographic range and ecosystem composition in future climates. Project results will guide development of mitigation and management techniques, and will serve as a basis for educating the public in national parks and forests. This project will provide educational opportunities for several graduate and undergraduate students, including those from underrepresented groups, who will participate in field work in Montana and data analysis.