Submitted Abstract

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Abstract

Climate change will alter alpine plant communities both directly and indirectly. Directly through the physiological responses to increased temperature, and indirectly through both changes in interactions within extant plant communities, and novel species interactions by range-expanding species. Such indirect effects have been found to be of overriding impact, to the extent that they can modify or even reverse the direct response of plants to climate changes. For example, alpine species interactions switch from facilitative to competitive as climate becomes more benign. Additionally, climate change is already causing accelerating range-expansions of species into alpine communities. These shifts are happening faster than the alpine species are able to adapt by moving which creates novel species interactions with species which have not coexisted previously. A lot is known of the direct effects of climate change on alpine plants, while the indirect effects have been less studied.

The extent and severity of an alpine species population decline in response to climate change depend on the different underlying vital rates of the population. The specific changes in survival, reproduction, or growth have different implications for e.g., genetic variability in the population. A mechanistic understanding of these changes is therefore important to understand the long-term consequences for alpine plants to different climate change effects.

In this study we present the population dynamics of the alpine species Veronica alpina and Sibbaldia procumbens in a field experiment testing the relative effects of warming, changes in interactions within alpine communities, and colonization by lowland plant species. We followed the fates of all individuals in the experiment over four years and built Integral Project Models (IPM) for every experimental treatment. By combining i) warming experiments with open top chambers, ii) removal experiments with removal of all above ground biomass except the two study species, and iii) transplant experiments of lowland plant individuals, we test the direct and indirect effects of climate change on these two alpine species. To separate the direct effect of warming from the indirect effect of changes in plant interactions we compare the removal experiment to the controls, with and without warming. By comparing the transplant treatments with controls, with and without warming, we test the effect of novel colonizing species in the extant climate and a warmer climate. We expect to see the largest population decline in the combined treatment with warming plus introduction of novel plants.