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Warming effects on growth and facilitation in an alpine cushion species

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Climate change is more pronounced in high-elevation habitats than elsewhere, potentially causing important disruptions in plant community composition and dynamics through changes in plant interactions. In alpine systems, facilitation is a main plant-plant interaction mechanism sustaining biodiversity in these stressful environments. We tested the effect of warming and rainfall manipulations on growth and physiological status of Arenaria tetraquetta, a nurse cushion plant species in the Sierra Nevada Mountains in Spain, and assessed the consequences of experimental manipulations on its facilitation effects. We increased temperature using acrylic open-top chambers (OTC) and increased or decreased water availability using PVC pipes. We expected that warming would increase physiological rates and growth whenever water is available, while warming combined with less water availability would decrease physiological rates and growth compared to control conditions. Facilitation effects were measured in terms of species and individuals recorded inside the A. tetraquetta canopy and in open microhabitats. Our rainfall treatments did not have significant effects on plant growth or functional traits, but warming increased daylight temperature, enhancing photosynthetic rate and respiration. By the end of summer, under drier conditions, respiration may be larger than carbon fixation. Warming increased canopy growth and led to larger leaves although it did not change other cushion traits nor its facilitation effects. We conclude that global warming may change the physiology of alpine plant species offsetting carbon storage and, in the long term, allocation patterns. However, for warming to significantly affect interaction intensity between facilitator and beneficiary species, temperature changes should be higher than the differences we reached with our design of open-top chambers.