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ABSTRACT: There is increasing evidence that climate change is leading to shifts in plant species’ geographic ranges. It is projected that many species will need to establish viable populations beyond their current ranges or risk extinction in coming decades. Recently observed range shifts offer strong empirical evidence of climate change impacts, but it is impossible to decouple climate effects from those of other environmental changes. Because many factors at both local and regional scales control species’ range-limits, experimentation is essential to test the underlying mechanisms. To this end, the main objective of this project is to determine how climate change will affect the distribution of native plants in Pacific Northwest (PNW) prairies. We embedded a fully factorial manipulation of temperature (+2.5-3.0°C) and wet-season precipitation intensity (+20% above ambient) into a 520-km latitudinal climate gradient in three upland prairies in the PNW, with increasingly severe Mediterranean climate conditions from north to south. Treatments were initiated in 2010, and in the fall of 2010 and 2011, twelve native forbs and grasses that have their northern range limits within the PNW were seeded into each plot. Germination, survivorship, plant size, and seed set were measured in 2011 and 2012.

For species’ planted within their current range, increased temperature negatively impacted recruitment, but this negative heating effect disappeared when the species were moved poleward beyond their current range. Germination presented the most significant hurdle to species’ success. Once species were able to germinate, a species’ current range no longer impacted survivorship, plant growth, or fecundity. Instead, warming negatively impacted survivorship regardless of current range, but if individuals were able to survive, they grew bigger and produced more seeds in the heated treatments. Decreased survivorship in warmed plots was in part mediated by an increase in competition in these plots (determined by a competition removal experiment), and increased plant growth in the heated treatments could be explained by an indirect effect of increased nutrient availability. We found minimal effects of added precipitation on any life-history stages, but when significant, increased precipitation decreased germination and survivorship. Our two years of results are consistent with predictions that many species will need to expand their ranges poleward or higher in elevation to successfully maintain viable populations. However, multiple years of data will be necessary to understand if, once established, these species’ will be able to maintain positive population growth. Our results demonstrate the importance of using regional-scale climate manipulations and the need for longer term experimental studies on the demographic responses that control species’ distributions.