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Publication Brief

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A Case of Uphill Distribution Shift in Plant Species Shown To Be Unrelated to Climate Warming

Simple models of plant response to warming climates predict vegetation moving to cooler and/or wetter locations (in mountainous regions, "marching upslope"). However, the mechanisms explaining species-specific responses to changes in temperature and water availability are most likely much more complex.

In a *PLoS ONE* study, Texas Tech University ecologist Dylan Schwilk and USGS fire ecologist Jon Keeley re-examined a climate-driven vegetation shift in the Santa Rosa Mountains, California, recently reported in the journal *PNAS*, to determine the mechanisms behind the reported uphill shift of a plant distribution.

Keeley and Schwilk determined that a climate-driven explanation for vegetation patterns is conflated by different fire histories along the elevational transect. A key species in this prior study is the desert ceanothus, *Ceanothus greggii*, an "obligate seeding" shrub that recruits postfire. Keeley and Schwilk focused on this species, and calculated time series of past per-capita mortality rates by counting growth rings on live and dead individuals for the five elevations used in the prior study. The time series would allow researchers to model whether apparent distribution shifts were related to 1) gradual temperature change, 2) instances of past fire disturbance, or 3) instances of past drought.

Models tested showed that any apparent increase in the mean elevation of *C. greggii* was more likely due to past fires than to either temperature changes or drought. Elevational changes in mean cover were driven by patterns of mortality, and mortality changed with time since fire. The lower elevation sites had burned more recently, and due to stand thinning there was much mortality during the period of study in the original investigation. The older upper elevation sites had completed much of their postfire stand thinning prior to the initiation of the original study. These differences in response to postfire thinning gave the appearance of an uphill shift in ceanothus cover. Thus, for *C. greggii* at least, the reported distribution shift uphill appears to be an artifact of disturbance history and stand age and is not evidence for a climate warming effect.

Management Implications

- On fire-prone landscapes, detecting climate change impacts requires carefull analysis of past fire histories and their impact on species with different life history characteristics.
- A major obstacle to detecting climate-warming impacts is that they occur on landscapes subject to other factors contributing to change. Predictions of future changes in ecosystems requires parsing out the relative contribution of all global changes.

THIS BRIEF REFERS TO:
Schwilk, DW, JE Keeley. 2012. A plant distribution shift: temperature, drought, or past disturbance? PLoS ONE 7(2): e31173. doi: 10.1371/journal.pone.0031173

THIS STUDY IS IN RESPONSE TO:
Kelly, AE, ML Goulden. 2008. Rapid shifts in plant distributions with recent climate change. PNAS 105: 11823-11826. doi: 10.1073/pnas.0802891105

http://www.werc.usgs.gov/seki
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Chaparral-dominated slopes studied in the original *PNAS* investigation with dead *Ceanothus greggii* evident in foreground.