THE UNIVERSITY of NEW MEXICO

**Earth Systems Ecology Lab**

**Research Brief**

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# Projected Climate-Wildfire Effects on Sierra Nevada Forests

The interaction of climate change and wildfire has the potential to alter forests in the Sierra Nevada. While mature trees can tolerate a range of climatic conditions, regeneration is more responsive to environmental change because tree seedlings tolerate a much narrower range of abiotic conditions. Understanding how projected changes in climate and increasing area burned will influence tree species distribution is central to understanding how these factors will alter forest communities across the Sierra Nevada.

We used a landscape simulation model to quantify how projected changes in climate and area burned would alter forest communities and carbon dynamics across the landscape. We simulated future climate (2010-2100) and wildfire scenarios using climate projections and corresponding large wildfire projections from three climate models, and a baseline scenario using baseline climate (1980-2010) and wildfire for comparison. By late century, we found modest changes in the spatial distribution of mature trees relative to baseline, but extensive changes in the distribution of regeneration (Figure 1).

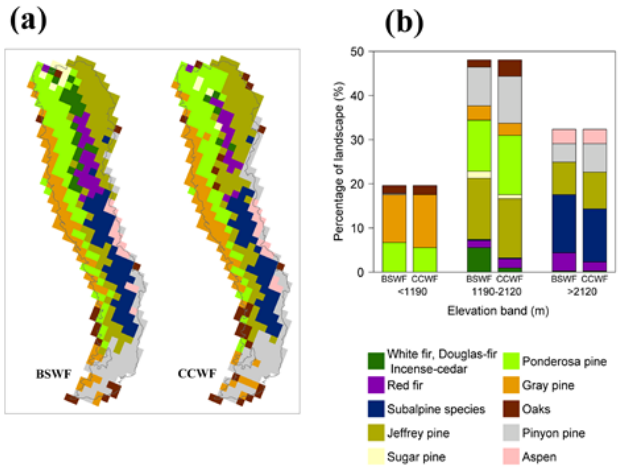


Figure 1: Spatial distribution of dominant tree species by number of regeneration events (a) and by elevation band (b) under baseline (BSWF) and projected (CCWF) climate and wildfire scenarios.

Species that require more moisture (e.g. white fir) had sharp declines in the number of regeneration events and the amount of regeneration was disproportionately less than their contribution to overstory abundance. Species that are more drought tolerant (e.g. ponderosa pine) accounted for more of the regeneration. These species-specific shifts in recruitment were largest at mid-elevations (3900-6900 feet).

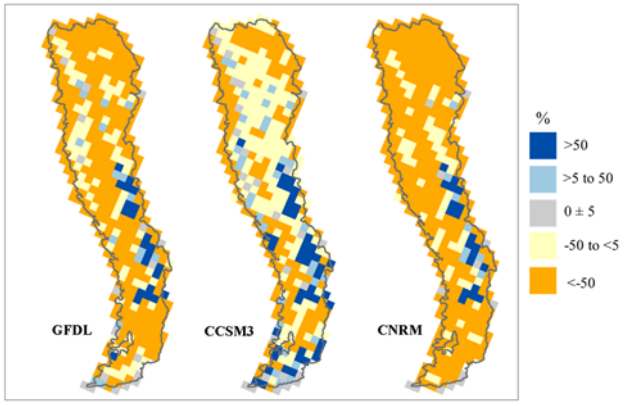


Figure 2: Percent change in the number of regeneration events under climate change and wildfire as compared to baseline climate and wildfire.

Across much of the Sierra Nevada we also found a substantial decline in the number of regeneration events over the simulation period relative to baseline (Figure 2). The majority of the mountain range had 50% fewer regeneration events with future climate and wildfire than in the baseline scenario.

The large decline in regeneration under projected climate and wildfire caused tree species richness to decrease across a large proportion of the landscape. Increasing area burned and reduced regeneration transitioned more area to a C source by late-century, which reduced landscape-level forest carbon uptake.

Our results demonstrate that individual tree species respond differently to future climate and wildfire, suggesting that forest communities are unlikely to diminish as intact units. Increasing high severity fire patch size may require post-fire planting to overcome dispersal limitations. Our results suggest that the influence of future climate should be considered when selecting species for post-fire planting in the Sierra Nevada.

## Management Implications:

- **Projected climate and wildfire favor the recruitment of more drought-tolerant species over less drought-tolerant species.**
- **Sierra Nevada forests are likely to become less diverse as some tree species are unable to re-establish following wildfire.**
- **Altered recruitment distributions may initiate cascading effects on forest successional trajectories, affecting community composition and tree species abundance in the long-term.**

Liang S, MD Hurteau, AL Westerling. 2016. Response of Sierra Nevada forests to projected climate-wildfire interactions. Global Change Biology, doi: 10.1111/gcb.13544

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