CALIFORNIA FIRE SCIENCE CONSORTIUM

Research Brief for Resource Managers

Release:
November 15, 2023

Contact:
Emily Brodie
Tara Ursell

Email:
emily.brodie@fire.ca.gov
tursell@unr.edu

California Fire Science Consortium – Sierra Nevada Region

Wildfire effects on upslope conifer species migration

Brodie, EG, JAE Stewart, S Winsemius, JED Miller, AM Latimer, and HD Safford. 2023 "Wildfire Facilitates Upslope Advance in a Shade-Intolerant but Not a Shade-Tolerant Conifer." Ecological Applications 33 (5): e2888. https://doi.org/10.1002/eap.2888.

Predicting species' responses to climate change involves several factors:

1. Understanding which regions in the future will have climatic patterns similar to those under which the species evolved, and
2. Understanding disturbance patterns and other drivers of migration that will influence whether individuals of the focal species will actually be able to establish within their new or future "climate niche".

While the former can be approximated using downscaled climate models, the latter involves understanding the complexities of species establishment processes and how they interact with ecological disturbances like storms, pests, and wildfires. Indeed, fire is one hypothesized process of reducing competition from established trees and opening up space for regeneration, potentially enabling species range shifts.

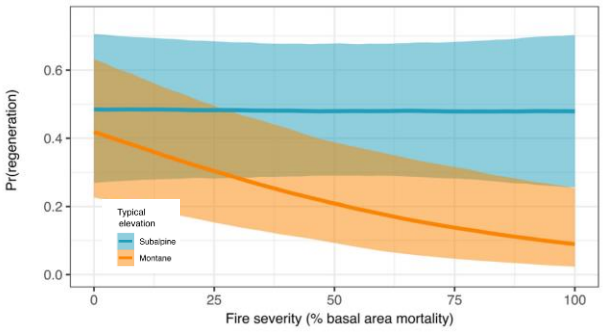
This study investigates whether this process enables the upslope migration of upper montane conifers into the current range of subalpine conifers in the Sierra Nevada, California. With a field study of regeneration surveys in plots that varied by fire severity following wildfires that burned 2-17 years prior to sampling, the researchers characterize general regeneration trends and also identify species-specific patterns for conifers from different elevation belts (i.e. montane and subalpine).

Management Implications

Species migration into recently burned areas depends on the conditions in the post-fire environment. Shade-tolerant species like red fir are less likely to establish where canopy cover is low (e.g., high severity areas), whereas shade-intolerant species like Jeffrey pine and several five-needle pines are more able to establish in high severity patches.

Fires within the natural range of variation therefore may provide opportunities both for resident and migratory species to establish, with outcomes that depend on the characteristics of local species in both upper and lower elevation bands. Wildland fire use may be an important tool for ensuring the establishment of certain conifers within and outside of their climatic niche.

Among all conifers, the probability that a plot would contain at least one seedling ("stocking" level) declined as fire severity increased (see figure below, adapted from *Brodie et al. 2023*).



However, this pattern did not hold for individual species. In general, stocking of resident subalpine species changed little or increased (foxtail pine) with fire severity. Among the montane migrants into subalpine forest, response to fire severity was split: Jeffrey pine had higher regeneration in areas that burned at higher severity and red fir had higher regeneration in lower-severity areas—and four times as much regeneration in unburned compared with burned areas.

The authors suggest that species traits may be an important determinant of which tree species will take advantage of fire to move upslope. As a shade-tolerant species, upper montane red fir may regenerate in subalpine areas only where conditions include a relatively high canopy cover (as in low severity burns or unburned land). Shade-intolerant species like upper montane Jeffrey pine were much more successful in the relatively open environment of a high severity burn in subalpine forest.

Collectively, these findings indicate that fire specifically may not be constraining the ability of certain upper montane conifer species to regenerate and even to migrate to more suitable zones in what is now subalpine forest: many species are able to establish regardless of severity levels, and Jeffrey pine even prefers the high severity conditions common in many contemporary wildfires. Nevertheless, other factors may constrain species migration, including seed availability, post-fire weather patterns, vegetation patterns, and time since the wildfire; each of these explained some variation in regeneration for the species examined. In light of the complexities of these regeneration processes, however, this study provides empirical support for the role of wildfire in enabling the regeneration of shade-intolerant montane conifers into high elevation subalpine forests.

***