Ecological Restoration Institute

Fact Sheet: *Five-Year Post-Restoration Conditions and Simulated Climate Change Trajectories in a Warm/Dry Mixed-Conifer Forest*

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Five-Year Post-Restoration Conditions and Simulated Climate Change Trajectories in a Warm/Dry Mixed-Conifer Forest, Southwestern Colorado, USA

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Introduction

Wildfire frequency and severity in the western United States has increased as a result of fire suppression, increasing temperature, and prolonged drought. Detrimental ecological impacts from these uncharacteristic disturbances include loss of critical wildlife habitat, increased vulnerability to invasive plant species, ecosystem shifts from forest to non-forest. Warm/dry mixed conifer forests were historically dominated by fire-resistant tree species and low-severity fire regimes. Management in these dry coniferous forests has primarily focused on thinning smaller trees followed by prescribed fire to reduce wildfire severity, restore forest structure and increase resiliency across landscapes. Evaluating treatment effectiveness in terms of reducing wildfire severity and ecological responses is a flourishing topic. However, there is limited information on the longevity of these treatments, specifically with respect to their effectiveness in maintaining ecosystem integrity, such as composition, structure, and function (Tierney et al. 2009), and increasing resilience to disturbances under future climate conditions.

Middle Mountain, San Juan National Forest, five years following thin/burn restoration treatment.

In this study, we field tested alternative treatments (thin plus burn, burn-only, and control) for restoring a warm/dry mixed-conifer forests and then simulated stand dynamics under various future climate scenarios over the next 50 years. Mixed-conifer forests provide unique habitats for rare species, valuable biodiversity, and numerous recreational opportunities. Recent landscape-scale fires (e.g., Rodeo-Chediski Fire [2002], Hayman Fire [2002], Las Conchas fire [2011], and Wallow Fire [2011]) have burned large severe patches, compromising the integrity of these ecosystems.

Key Questions and Findings

1. *How do forest characteristics, such as tree density, mortality, and regeneration, differ among alternative restoration prescriptions five years following treatment (based on empirical evidence)?*

    - Mean basal area and tree density were significantly lower in the thin/burn treatment (49.2 ft2/acre; 47.3 trees/acre) compared to prescribed burn (89.3 ft2/acre; 128.1 trees/acre) and control (116.7 ft2/acre; 218.7 trees/acre). No significant changes occurred in forest structure in the four years following initial treatment.
    - Tree mortality four years following treatment was observed primarily in smaller trees and less fire-tolerant species. Mortality of larger trees (>16 inches) averaged 16% in thin/burn (2.7 trees/ac), 9% in burn (2.1 tree/ac), and 4% in control treatments (1.0 trees/ac).
    - Changes in regeneration were largely due to increases in aspen. Aspen regeneration increased 119% in the thin/burn treatment, and 31% in burn, while decreasing (-22%) in the control.

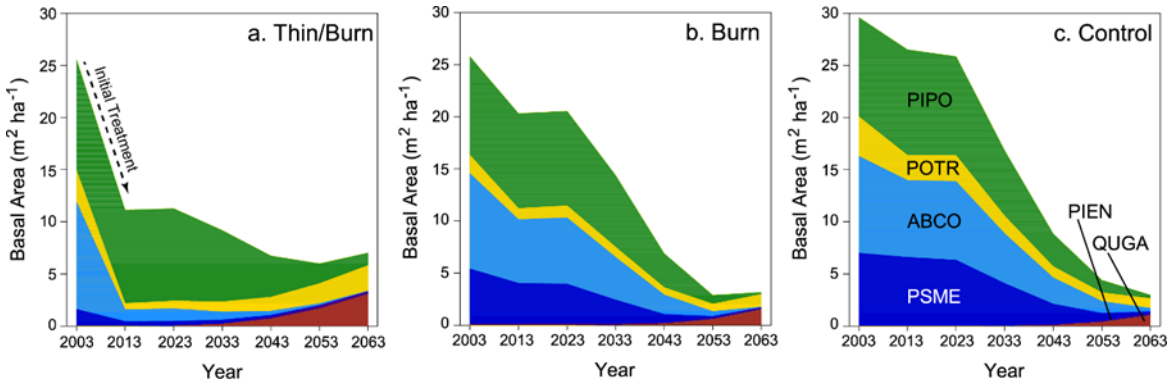

Figure 1. Basal area by species before treatment (2003), five years after treatment (2013) and simulated future changes using the most conservative climate model. ABCO= *Abies concolor*; PIPO =*Pinus ponderosa*; POTR = *Populus tremuloides*; PSME =*Pseudotsuga menziesii* (Representative Concentration pathways 6.0 (IPCC 2013)).

2. *How might forest characteristics following restoration treatments change under differing future climate scenarios (based on modeled simulations)?*

- Simulations showed that the thin/burn treatment was the most resilient to climate change, with average mid-century (2063) basal area decreasing less (-45%) than other treatments (-82% in the burn and -88% in the control).
- Changes following three different climate scenarios indicated that all sites became consistently less suitable for mixed-conifer forest species. One notable exception was observed; models suggested that ponderosa pine in the thin/burn treatment may be retained at higher proportions thereby maintaining a forested structure.

Research Highlights

- ◊ Thin/burn treatment sustained tree densities and basal area within the range of site-specific reference conditions, whereas prescribed burn treatment and control remained outside (higher) those conditions
- ◊ Changes five years following treatments were largely due to increases in sprouting species.
- ◊ Forest structural conditions were predicted to persist in the thin/burn treatment under projected climate change.

Conclusions

Considering global increases in large, high-severity fire occurrence, and increases in tree densities in warm/dry mixed-conifer forests resulting from decades of fire suppression, there is an urgent need for large-scale implementation of ecological restoration treatments in these ecosystems. Compounding this urgency are projections of increased drought, warmer temperatures, and more extreme weather events. Results from previous studies suggest restoration treatments can increase forest resiliency, improve drought tolerance, and improve ecosystem function (Fulé et al. 2012). Our results justify the use of restoration treatments for enhancing long-term ecosystem resilience to future climate.

References

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This fact sheet summarizes information from the following publication:

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