Ecological Restoration Institute

Fact Sheet: Effects of Tree Cutting and Fire on Understory Vegetation in Mixed Conifer Forests

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Effects of Tree Cutting and Fire on Understory Vegetation in Mixed Conifer Forests

By Scott Abella and Judy Springer

INTRODUCTION

Mixed conifer forests and their understory floras evolved with disturbance such as fire, drought, windthrow, insects, or disease (Heinlein et al. 2005, Reynolds et al. 2013). Historically, fire occurred in some mixed conifer forests as often as every 2-20 years, which is as frequent as in many ponderosa pine forests. Other mixed conifer forests, often on moister sites, likely burned less frequently but with greater severity. Fire, together with the other disturbance types, created patches of tree mortality to form canopy openings. These opening resulted in diverse environments — shaded and sunny — for understory vegetation. Changes to mixed conifer forests since Euro-American settlement beginning in the 1800s have included the introduction of livestock and exotic species, the removal of upper food-web predators, fire exclusion, increased fuel loads, reduced sunlight on the forest floor, and decreased proportional abundance of fire-tolerant trees such as ponderosa pine (Covington et al. 1994, Knapp et al. 2013). Current mixed conifer forests are susceptible to stand-replacing wildfire, even where such regimes were uncommon historically. Additionally, these forests are currently of keen interest for other conservation reasons such as vulnerability to climate change (Barbour et al. 2002, Anderson et al. 2008).

Thinned mixed conifer unit, Klamath Mountains, Oregon. *Photo courtesy of S.R. Abella*

Understanding influences of silvicultural, fuel reduction, and restoration treatments involving tree cutting and fire is fundamental to managing mixed conifer forests, coupled with knowledge of effects of wildfires that are likely eventual outcomes of passive management. To examine influences of tree cutting, prescribed fire, and wildfire on understory vegetation in mixed conifer forests, we conducted a systematic review of published literature. We used a reproducible literature search in research databases such as AGRICOLA, and we created a database of understory data extracted from papers.

RESEARCH FINDINGS

- We identified 41 studies (Figure 1) that met criteria for analysis (e.g., including either pre-treatment data or untreated controls) of effects of tree cutting and fire on understories in mixed conifer forests.
- Time since treatment dominated understory response to treatment. Initial declines in understory plant cover and diversity were common following tree cutting and prescribed fire. Studies that measured response ≥4 years post-treatment, however, usually reported that understories had increased over the longer term.
- For example, a study in Sequoia National Park found that understory plant cover and diversity did not increase above levels in unburned controls until more than 5 years after prescribed fire (Webster and Halpern 2010). Burned understories then remained greater than controls at 20 years post-treatment.
- Heavy slash loadings, or associated treatments for slash (e.g., chipping, pile burning), were suggested by several authors to have tempered understory response. Further research to identify optimal slash treatment procedures is warranted.
- Tree thinning and prescribed fire applied individually increased understory measures at similar rates.
- However, there is apparently a component of fire-dependent native species that are uncommon or absent after tree cutting alone (e.g., Dodson et al. 2007). These species are primarily short-lived forbs, such as *Chamerion angustifolium* (fireweed).
- Applying tree thinning and burning together at the same sites resulted in the greatest abundance of non-native plants, but native species still predominated. It is important to further compare levels of non-native plant invasion in treated areas against a benchmark of post-wildfire communities.
- Depending on site conditions, overstory-understory relationships suggest that to elicit a strong understory response, treatments must reduce overstory canopy cover to <40-50%, and <30% on many sites (Larson and Wolters 1983).

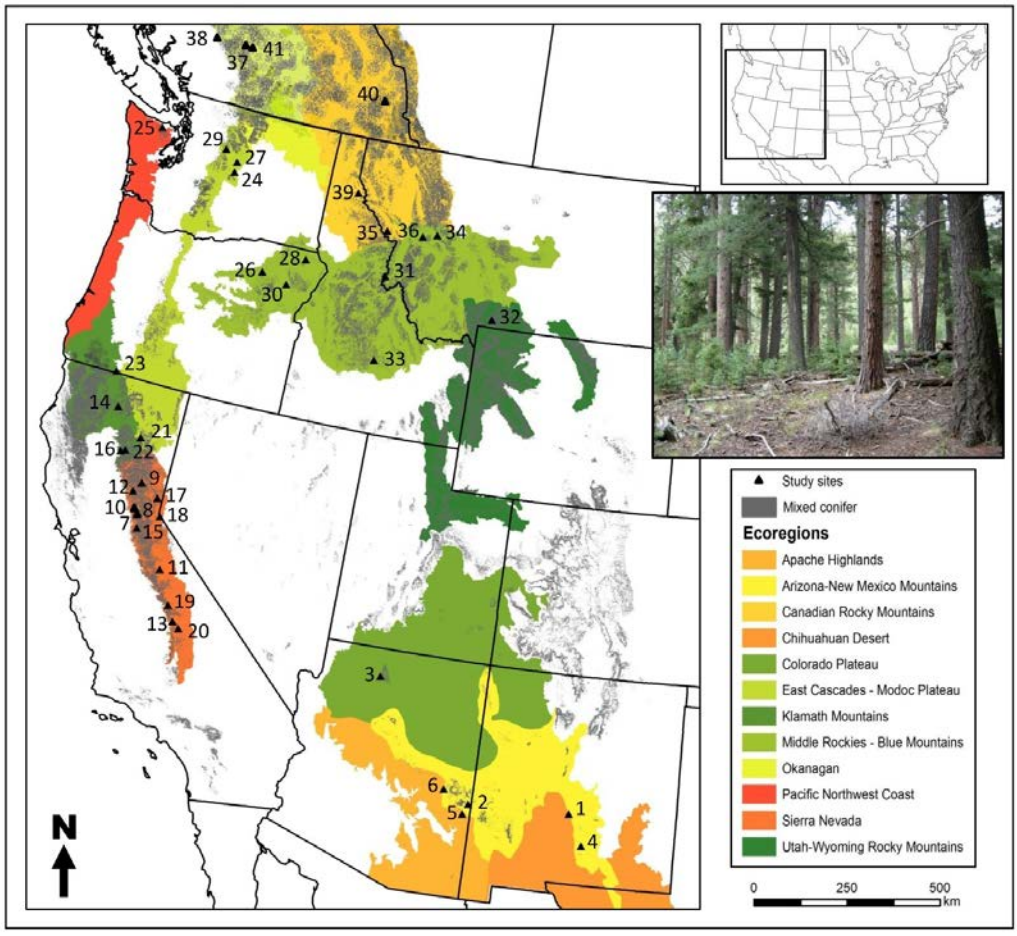

Figure 1. Gray shading signifies mixed conifer forests, with colors designating different ecoregions where studies in the review occurred. Studies are numbered 1-41. Inset photo is mixed conifer forest on Coconino National Forest, Arizona. *Figure courtesy of S.R. Abella*

Management Implications

1) Managers can expect possible temporary reductions in total understory cover or biomass immediately after tree cutting or prescribed fire, but longer term increases often subsequently occur.

2) In contemporary mixed conifer stands where tree canopy closure is nearly complete, tree cutting and prescribed fire must substantially reduce overstory canopies to produce increases in understory vegetation. Tree canopy cover must be reduced to <30% on many sites to elicit vigorous understory responses.

3) Tree thinning alone may produce many fire management and forest health benefits, including promoting understory vegetation. Subsequently reinstating fire after thinning may not only sustainably reduce hazardous fuels, it may also promote fire-dependent native flora.

4) This review suggests that fuel reduction or restoration treatments can be implemented in mixed conifer forests to both a) reduce hazardous fuels, and b) enhance disturbance-associated native species in the short term and total understory abundance in the long term.

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Contact

Scott Abella, abellaNRC@gmail.com

Judy Springer, judith.springer@nau.edu

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