Working Papers in Southwestern
Ponderosa Pine Forest Restoration

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Fuels Treatments and Forest Restoration: An Analysis of Benefits

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Ecological Restoration Institute
Northern Arizona University
P.O. Box 15017
Flagstaff, AZ 86011-5017
www.eri.nau.edu

Working Papers in Southwestern Ponderosa Pine Forest Restoration

The Ecological Restoration Institute at Northern Arizona University is a pioneer in researching, implementing, and monitoring ecological restoration of southwestern ponderosa pine forests. These forests have been significantly altered through more than a century of fire suppression, livestock grazing, logging, and other ecosystem changes. As a result, ecological and recreational values of these forests have decreased, while the threat of large-scale fires has increased dramatically. The ERI is helping to restore these forests in collaboration with numerous public agencies. By allowing natural processes such as fire to resume self-sustaining patterns, we hope to reestablish healthy forests that provide ecosystem services, wildlife habitat, and recreational opportunities.

Every restoration project needs to be site-specific, but the detailed experience of field practitioners may help guide practitioners elsewhere. The Working Papers series presents findings and management recommendations from research and observations by the ERI and its partner organizations.

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1: ***Restoring the Uinkaret Mountains: Operational Lessons and Adaptive Management Practices***

2: ***Understory Plant Community Restoration in the Uinkaret Mountains, Arizona***

3: ***Protecting Old Trees from Prescribed Fire***

Introduction

In contemporary ponderosa pine forests throughout the Southwest the need to thin dense stands in order to reduce the risk of catastrophic fires has become evident. Numerous thinning prescriptions have been implemented. While many prescriptions focus solely on lowering fire risk by removing ladder fuels and reducing crown connectivity, others explicitly aim to alter both forest structure and functioning. This publication examines the benefits of restoration treatments that can lower fire danger—while also increasing the overall biological diversity and long-term health of treatment areas.

Restoration Treatments versus Fuels Treatments: What's the Difference?

Mechanical fuels treatments remove ladder fuels in order to reduce the likelihood that a surface fire will become a crown fire. They also reduce the connectivity of tree crowns in order to make it more difficult for a crown fire to spread throughout the canopy. This is usually accomplished by using mechanical devices, such as chainsaws, to remove lower branches or entire trees. The cut wood is either harvested for fuel or other uses, or burned on site.

Restoration treatments also remove ladder fuels and reduce crown connectivity; indeed, fuels treatments can be an important step toward restoration. But rather than focusing only on altering forest *structure*, restoration treatments also aim to alter forest *functioning*. For that reason, they have the potential to provide a long-term solution to the current wildfire problem, which is really only a symptom of a larger problem—namely, an unhealthy ecosystem (Covington 2003).

It is well documented that frequent surface fires played a primary role in maintaining the structure of southwestern ponderosa pine forests before fire regimes were interrupted by Euro-American livestock grazing and fire suppression (Weaver 1951; Swetnam and Baisan 1996). Forest restoration focuses on reintroducing frequent, low-intensity fires, which provide a number of benefits:

- Promoting the growth of herbaceous understory vegetation
- Cycling nutrients from needle litter into the soil, where it can be used by plants
- Maintaining forest structure by removing most pine seedlings or saplings
- Reducing long-term crown fire danger
- Enhancing the health of remaining trees by reducing competitive pressures

Restoration treatments, in other words, provide fire protection and additional benefits. Fuels treatments do reduce fire danger, but only temporarily (see box), and they do not emphasize these other benefits. In the long term, restoration treatments are likely to be a far more cost-effective and ecologically sustainable solution to the current wildfire problem than fuels treatments alone.

What Is a Restoration Treatment?

Like fuels treatments, restoration thinning treatments remove ladder fuels from the forest and reduce the connectivity of crowns. But restoration treatments are focused on long-term rather than short-term ecosystem health. Restoration treatments vary with location, funding, and management goals, but they generally share these qualities:

They are informed by reference conditions. “Reference conditions” are those that existed before forest structure and function were altered by Euro-American settlers. They were not unchanging, but they sustained themselves. Southwestern ponderosa pine ecosystems were subject to frequent surface fires, some no doubt ignited by indigenous peoples and some by lightning. Both types of fires had the same effect: they sustained forest structure by removing tree seedlings and cycling nutrients to plants. These conditions apparently were stable for a long time: soil analyses have shown that some grassy openings have existed in the same places for centuries, and perhaps much longer, while areas with clumps of pines were wooded for equally long periods (Kerns et al. 2001).

After Euro-American settlement, that sustainable cycle was broken by livestock grazing, lumbering, and active fire suppression (Allen et al. 2002; Covington 2003). Grazing removed the fine fuels that carry fire, while timber harvesting removed larger trees and made way for dense stands of younger trees. Fire suppression created fuel accumulations and increases in fire intensity. Forests have grown much denser, and understory productivity has declined. Today ecosystem conditions in many places are unsustainable.

Reference conditions are useful tools because they show what a site’s potential can be under self-sustaining conditions (Egan and Howell 2001). They can be determined by locating trees or tree remains that were present before Euro-American settlement, which generally include living pines or snags with yellowed bark, as well as large downed logs, stumps, and stump holes. Tree-ring records can help document past forest structure and fire history, as can historic photographs, Forest Service records, and other written records. Relatively undisturbed sites nearby can also aid in understanding what reference conditions may have existed on a site to be treated, though the great differences in stand density and structure that can exist on even adjacent sites must be taken into account.

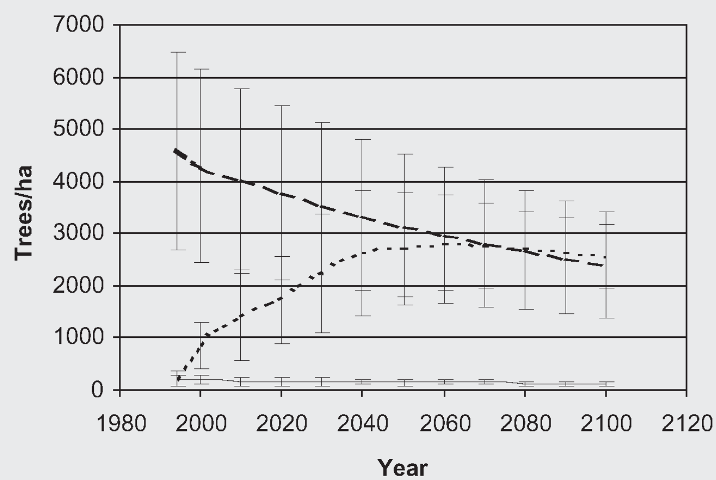
Reference conditions are not necessarily the same as restoration goals (Allen et al. 2002). Social, economic, or other management considerations may make it impossible or undesirable to attempt to recreate reference conditions. But knowing what a site once looked like is an important tool in deciding management goals and strategies.

They retain old trees. Decades of logging in southwestern forests that emphasized cutting of large trees has resulted in a scarcity of old, yellow-barked ponderosa pines. These trees tend to be resistant to fire and often provide valuable wildlife habitat, as well as aesthetic benefits, but many of those that remain are in declining health due to increased competition with younger trees (Mast et al. 1999; Covington 2003). Restoration treatments preserve old, yellow-barked pines by cutting only younger pines, by lowering competitive pressures around old trees, and by protecting these trees from fire (see *Working Paper 3: Protecting Old Trees from Prescribed Fire*).

They emphasize understory restoration. The grasses, forbs, shrubs, and other plants of the herbaceous understory comprise most of the diversity in ponderosa pine forests (Alcoze and Hurteau 2001), and are important for wildlife food and cover, as well as for aesthetics. In addition, the understory provides fuel for the needed frequent low-intensity fires that maintain forest structure. For these reasons, restoration treatments emphasize restoring the diversity and productivity of these plants. In some cases, this may require reseeding with native species or removal of invasive species (Korb and Springer 2003; also see *Working Paper 2: Understory Plant Community Restoration in the Uinkaret Mountains, Arizona*).

Why Just Thinning Is Not Enough

A recent study (Covington et al. 2001) used the FIRESUM model to project forest densities over decades following actual restoration treatments at the Gus Pearson Natural Area near Flagstaff. Treatment areas were thinned in 1994 to a density that mimicked the presettlement forest density. One treatment area has been burned at 4-year intervals following thinning, while another has not been burned. The FIRESUM model projected that the thinned-only area (the middle, dotted line) would rapidly increase in tree density in the absence of fire, increasing fuel loads and decreasing herbaceous production. After 65 years, its tree density would equal that of the control area (the upper, dashed line). The thinned area treated with prescribed fire at 4- to 10-year intervals (the lower, solid line), meanwhile, would continue to have a low tree density and abundant understory vegetation. Figure 4 from Covington et al. 2001. Reprinted by permission of Blackwell Publishing.



They often emphasize clumps and openings. Soils analysis has shown that some grassy openings in southwestern ponderosa pine forests were apparently in place for very long periods before young pines encroached on them in the twentieth century (Kerns et al. 2001). Re-creating such openings provides habitat for many wildlife species, and can also reduce the risk of crown fires.

Ponderosa pines frequently grow in small clumps, often with interlocking crowns, that provide habitat for species that utilize tree trunks and crowns (White 1985). The size, density, number, and location of such clumps profoundly affect both wildlife habitat and the future risk of crown fire. Finding a balance between wildlife habitat considerations, individual tree health, and future fire risk is a vital part of planning restoration treatments.

Because they are based on averages across an area, basal area measurements are often not very useful in quantifying the extent to which forested areas are made up of clumps and openings.

They incorporate fire in the long term. Fire is crucial in cycling nutrients and in maintaining forest structure. Without fire, thinned forests will quickly become dense again (Covington et al. 2001). Future fires, whether prescribed or lightning-ignited, should be part of the restoration planning process. Though initial fires after thinning are often hot and/or smoky, due to the large quantities of needles and woody fuel on the ground, future fires should burn mainly herbaceous vegetation and tree saplings, producing less heat and less smoke (Barkmann 2003).

They incorporate monitoring programs and adaptive management practices. Restoration is a new science, and we have much to learn about it. For that reason, monitoring of treatments and of their effects is urgently needed to improve treatment planning and implementation, modify future treatments, and communicate progress to practitioners and stakeholders (Fulé 2003). The results of monitoring programs should be fed back into the planning of future treatments through a flexible adaptive management process. With careful monitoring, the lessons we learn from current treatments will improve both our restoration practice and our overall management of these forests.

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For More Information

A number of different thinning prescriptions have been proposed for southwestern ponderosa pine forests. Read about some on the ERI website at **www.eri.nau.edu**, or call us at 928-523-7182.

Written by Peter Friederici

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Ecological Restoration Institute
Northern Arizona University
P.O. Box 15017
Flagstaff, AZ 86011-5017
www.eri.nau.edu

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