



Research Brief for Resource Managers

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Forest Restoration and Fuels Reduction: Convergent or Divergent?

Stephens, S.L., Battaglia, M.A., Churchill, D.J., Collins, B.M., Coppoletta, M., Hoffman, C.M., Lydersen, J.M., North, M.P., Parsons, R.A., Ritter, S.M. and Stevens, J.T. 2021. Forest restoration and fuels reduction: Convergent or divergent? BioScience 71(1): 85-101.

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In the wake of the past two fire seasons, managers have been tasked with a monumental challenge - to increase the pace and scale of treatments that reduce the risk of large, severe wildfires. However, as the momentum for these types of treatments increases, an important question emerges: Do fuel reduction treatments result in restored conditions that align with those found in historically frequent-fire forests of the west? A recent paper sets out to answer that question by examining the principles behind fuel reduction and forest restoration projects and identifying situations where the two approaches align and where they may diverge.

The primary goal of fuel reduction in historically frequent-fire forests is to reduce the likelihood of large stand-replacing fires. This is typically achieved by manipulating a few key elements within the stand: the amount, arrangement, and continuity of fuel, and the retention of large, fire-resistant trees. Conventional fuel reduction techniques often focus on the removal of small to mid-size trees (i.e. ladder fuels) and reduction of surface fuels. These treatments are commonly developed using nonspatial fire behavior models (e.g. FVS-FFE) and have well-known outcomes for moderating fire behavior and effects.

Management Implications

- Consider the trade-offs between forest restoration and fuel reduction when designing and evaluating treatments.
- Variability in forest structure and composition is often an explicit goal in forest restoration but may be viewed as a liability in fuel reduction.
- The two approaches can align when treatments focus on creating variability and leaving structures and fuels in a condition that when burned, will promote low to moderate-severity fire effects with some small patches of high-severity fire.

Forest restoration projects tend to take a much broader approach by considering the need to increase resilience to a wide range of disturbance processes (e.g. fire, but also insects and disease, drought, etc.). One unifying principle guiding many forest restoration projects is the reintroduction of variability, in both forest structure and fuels, to more closely align with the range of conditions found in historical frequent-fire forests. Treatments are often guided by landscape features like topography, moisture gradients, and natural disturbance patterns, resulting in spatially diverse residual forests. Restoration projects also often include the reintroduction of fire as a long-term objective, to both maintain and create spatial heterogeneity over time.

Divergence

Reintroducing complexity and variability are common goals in forest restoration. Thinning through a range of diameter classes is often used to promote an uneven-age forest structure, resulting in a residual stand containing individual trees and tree clumps that vary in age, size, and composition, and are interspersed among treeless openings. In contrast, fuel reduction often relies on space-based thinning prescriptions to increase crown separation and canopy base height. In some cases, this can result in homogenous forest conditions, characterized by evenly spaced trees of relatively similar sizes.

The variability that restoration treatments produce can result in fine-scale variation in fire effects when fire is eventually reintroduced into a stand. Heterogeneity in structure and surface fuels can result in small areas of torching created by moderate or high-intensity fire, as well as unburned or lightly burned areas that provide refugia for mature trees, saplings, and understory plants. While this variability in fire effects may be desirable from a restoration standpoint, it may not fully meet the objectives of a traditional fuel treatment. This is particularly true in areas like the wildland urban interface (WUI), where the desired outcome is consistent low severity fire effects, which increase a stand's resistance to fire and the effectiveness of fire suppression.

Forest restoration and fuel reduction treatments also differ based on the ecological elements that they leave behind. For example, restoration treatments may retain moderate levels of coarse wood or snags for wildlife or create larger

openings to enhance tree regeneration. These attributes may be a liability in areas important for fire containment, where the primary objectives are to increase firefighter safety and effectiveness and to moderate fire behavior.

Convergence

Fuel reduction and forest restoration treatments both play an important role in forest management and can be considered endpoints along a spectrum of possible treatments that vary across a landscape. For example, in areas that are within or adjacent to the WUI, strict fuel reduction will often need to be prioritized. However, outside of these areas, managers can incorporate a broader set of objectives, including a focus on increasing variability in stand structure. In many cases, merging these two principles can result in treatments that effectively reduce fire intensity under most weather conditions relative to an untreated forest.

A key element in the convergence between fuel reduction and restoration treatments is that both promote the important characteristics that frequent fire historically produced: variability in vegetation structure and composition across a given landscape and inability to support large patches of high-severity fire. If both fuels reduction and restoration treatments focus on leaving structures and fuels in a condition that, when burned, will produce low to moderate-severity fire effects with some small patches of high-severity fire, desired forest and fire conditions can become self-reinforcing. At that point, fuels reduction and restoration treatments become convergent in creating and maintaining a resilient landscape.

Characteristics of fuel reduction and forest restoration treatments.

	Intention	Contextual considerations		
		Temporal	Spatial	Heterogeneity
Fuel reduction	Reduce risk of large stand- replacing fire.	Shorter term: the next fire is the focus.	Focus on stand; location of treatments typically driven by operational or safety concerns.	Not a priority, possibly considered a liability.
Forest restoration	Restore stand structure and composition to resemble historical range of variation and facilitate reintroduction of fire.	Longer term: the next fire is one of many that together represent a regime.	View stands within a landscape context. Concern for landscape composition and variability; treatment location driven by past disturbance regimes, topography, or ecological values.	Often explicit goal is to increase or restore heterogeneity in structure and composition, with the understanding that this leads to variability in fire behavior and associated effects.