Research Brief for Resource Managers

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Smart Practices and Architecture for Prescribed Fire in California (SPARx-Cal) - https://sites.uci.edu/sparxcal/

Using pyrosilviculture to make forests inclusive of fire at larger scales

North, M. P., R. A. York, B. M. Collins, M. D. Hurteau, G. M. Jones, E. E. Knapp, L. Kobziar, et al. 2021. "Pyrosilviculture Needed for Landscape Resilience of Dry Western United States Forests." Journal of Forestry 119 (5): 520–544. https://doi.org/10.1093/jofore/fvab026.

Dry western forests in the US have accumulated heavy fuel loads and high tree densities over the past century. Coupled with annual droughts, inevitable wildfires often burn at high severity creating large, unforested patches. To realistically reduce burn severity, a substantial increase in the pace and scale of fuels treatment across forested landscapes is needed. Disturbances that are low or moderate in severity and that reduce surface fuels (whether the disturbances are mechanical or fire in origin) inherently increase the chances that the next disturbance will also be low or moderate in severity. This paper suggests pyrosilviculture, a combination of mechanical treatments and prescribed fire and/or managed wildfire, can be used strategically to modify future wildfires at larger spatial scales.

To provide an example of the need for large-scale pyrosilviculture, nine national forests and the Lake Tahoe Basin Management Unit in the Sierra Nevada were evaluated. Within this area, the dominant forest types that experienced historical frequent low to moderate severity fires burned more than 622,000 acres per year on average. Between 2011 and 2020, comparatively, wildfires burned an average of 141,574 acres/year with either low or moderate severity. Within this same time frame, the total area that received fuel treatments averaged 63,000 to 93,000 acres per year.

Management Implications

- Leveraging wildfires as treatments by reducing remaining fuels in low and moderate severity areas can facilitate future prescribed fires.
- Where mechanical treatment will be constrained, identify managed wildfire zones where natural ignitions can be used to reduce fuel loads.
- Use strategic mechanical thinning to create anchors, ecosystem assets, and revenue generating treatments to prepare a landscape for large scale managed fire.
- The spatial arrangement of these treatments can create "boxes" wherein large, prescribed fires or managed wildfires may be managed to maximize fire's use as a beneficial tool on the landscape.

While high severity burn areas are traditionally targeted for post-fire treatments, areas burned with low and moderate severity can be a specific target for pyrosilviculture. Post-fire, prescribed fire treatments can be done in order to facilitate the return to a frequent fire regime. For example, overly dense midstory trees that were killed by a

fire can be mechanically removed, improving the safety of a follow-up prescribed fire. In addition, during this decade, managed wildfire averaged 70 times the size of mechanical and prescribed fire treatments, suggesting that managed wildfire could substantially increase landscape level fuels reduction.

Strategically placed mechanical thinning treatments could be better coordinated and more synergistic to create "boxes" for large scale managed fire. The authors define three types of thinning treatments that can be implemented (Fig. 1 & 2):

1. **Anchor thinning** is strategically locating treatments to serve as fire containment infrastructure where fuels are heavily reduced. Whether these areas are backburned during wildfires or burned out during prescribed fires, these can be advantageous in allowing for larger interior areas to be burned during appropriate weather conditions.
2. **Ecosystem assets** contain important resources that require special consideration when applying treatments. Examples include stands surrounding spotted owl nests and riparian corridors. Mechanically thinning these areas prior to prescribed fires reduces fuel connectivity and can moderate burn intensity during many of the weather and fuel conditions that exist during burn operations. This can provide both protection and treatment for ecological assets under controlled conditions.
3. **Revenue** can be generated from harvesting and selling forest products that come from the removal of larger, fire-sensitive trees that have developed as a result of fire suppression. Revenue treatments can generate funds to support wider use of prescribed and/or managed fire.

The US South widely applies this idea of pyrosilviculture while simultaneously harvesting more timber and treating more acres with prescribed fire than anywhere else in the US. The Florida Prescribed Fire Act acknowledges the benefits of fire and provides land managers with liability protection, which has been an important tool in the wide use of prescribed fire in this region. Similar legislation has recently been signed into California law, but the impact has yet to be evaluated.

Pyrosilviculture – the use of fire at the stand scale to meet silvicultural objectives, can be used to directly improve conditions for the areas that are treated. However, at the landscape level, it is also important to look at the broader effects that fire can have in creating structural diversity and restoring ecosystem functions. Landscape-scale objectives include reducing forest density, creating coarse-scale spatial heterogeneity, and selecting for particular species or phenotypic traits that are fire adaptive.

Major limitations to increasing the rate and effectiveness of fuel reduction treatments include a lack of workforce, resources and funding, and the lengthening of fire season into fall, which narrows or completely excludes the dry season window for applying prescribed burns. As a result, prescribed fire is often implemented at the stand scale in small, fragmented blocks across the landscape. This fragmented approach can work if enough stands are treated cumulatively across the landscape, but for especially large landowners, larger treatments would be more efficient. Creating a Western Center for Prescribed Fire could help train and coordinate crews, increasing burn opportunities when conditions are optimal for fuel drying, weather, and smoke dispersal.

Fire is inevitable in most dry, western, coniferous forests. Pyrosilviculture is focused on making forest management more proactive and increases the ecological and social benefits of the burning that does occur.

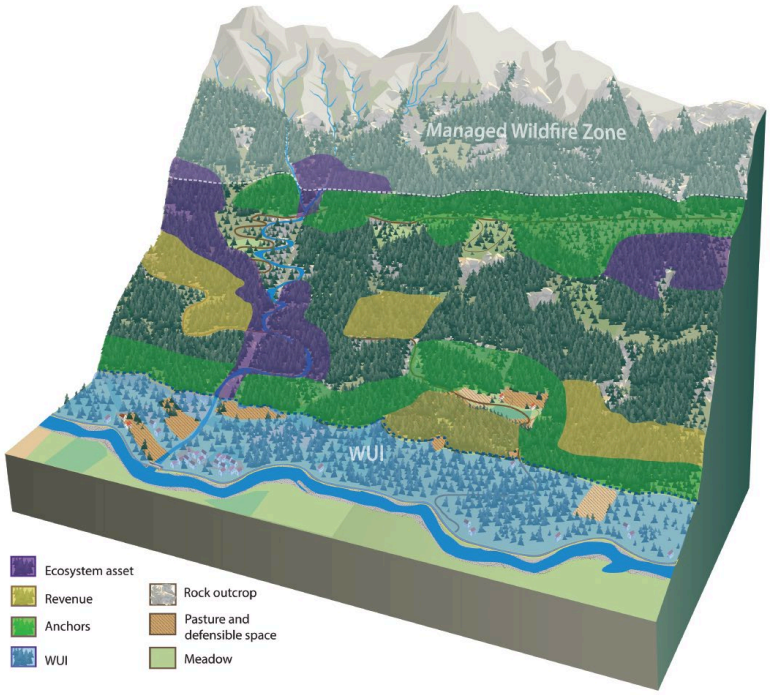

Figure 1. Schematic of how anchors, ecosystem assets, and revenue thinnings might be placed in a landscape. Providing a boundary 'box', anchors back to roads or the WUI and are ignition locations for expanding prescribed fire between anchors. Managers have the option of letting prescribed fire continue up through or managed wildfire burn down through the upper string of anchors under favorable conditions. Ecosystem assets are located where fuel reduction is needed to maintain particular ecological values, and revenue thinnings are in locations where larger shade-tolerant, fire-sensitive species can be removed to restore resilience and provide sawlog revenue.

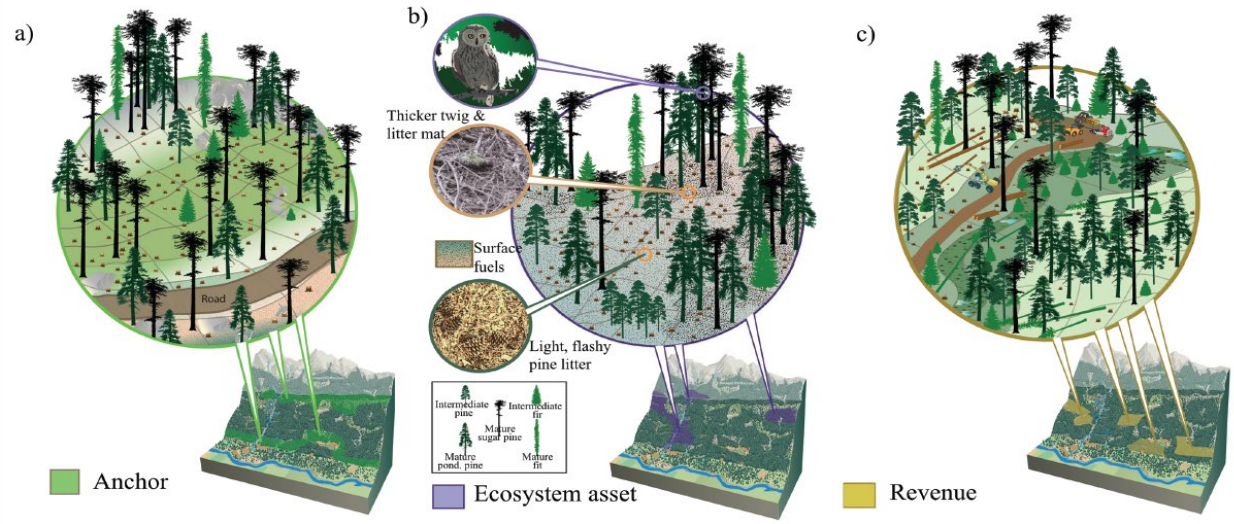

Figure 2. Stand-level schematics of the three thinning treatments: a) an anchor, showing near the road, the backstop (heavy fuels reduction leaving only large spatially separated pines) grading into a more mixed-species forest with a fire resistant spatial pattern (i.e., individual trees, clumps of trees and openings [ICO]) where the fire leaves the anchor; b) an ecosystem asset where most thinned trees are ladder-fuel size, an ICO pattern is created, and pine litter is dispersed in openings to facilitate fire spread; and c) a revenue thinning where intermediate and larger fire-sensitive fir are removed for sawlog processing.