Proactive fuels management for old growth conservation in the Lake Tahoe Basin

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Warmer, drier summers and human use and management factors have intensified severe wildfire risk in forests across the State of California. Seasonally dry mature and old-growth (MOG) forests are particularly vulnerable to stand-replacing wildfires due to long term increases in stand density, water stress, and fuel loading. Researchers at the University of California Davis and University of Nevada Reno modeled the outcomes of four fuels management scenarios followed by a simulated wildfire at Emerald Point in the Lake Tahoe Basin (LTB), an iconic MOG stand experiencing these vulnerabilities. The study found that TRFX, defined as thinning to within the forest's historical "Natural Range of Variation" (NRV) followed by a fall broadcast burn, was the most effective treatment in reducing projected large-tree mortality, maintaining stand basal area, and retaining post-wildfire live tree carbon. Researchers also discuss potential management co-benefits of treatments, such as reduced competition-driven tree mortality, increased understory biodiversity, raptor habitat conservation, and reduced air quality impacts.

Prior to Euro-American settlement, centuries of Indigenous cultural burning adapted yellow pine and mixed conifer forests in the LTB to low-intensity, frequent fire with a mean Fire Return Interval of 11.7 years. This frequency retained an open forest structure, keeping fuel buildup low and preventing significant mortality from water stress and insect outbreaks. The Emerald Point stand, which includes some of the largest and last-standing old growth Ponderosa Pines spared from logging in the 1800s, has not been subjected to low or medium-intensity fire in at least 120 years. Since 2002, the Southern Lake Tahoe Basin has experienced five major wildfires, with the "Emerald Fire" occurring just 2 km south of the study site in 2018. Given increasing regional vulnerability to drought, the proximity of recent fires, and the demonstrated reduction in fire-driven tree mortality under simulated fuel treatments, researchers strongly recommend prioritizing active fuel removal in order to protect ecologically important MOG forests like the Emerald Point stand.

MANAGEMENT IMPLICATIONS

- Seasonally dry western MOG forests are particularly vulnerable to stand-replacing wildfire due to long term increases in water stress, tree density, and fuel loading, requiring active management to maintain stand resilience despite conventional "hands off" conservation approaches.
- Proactive fuel treatments, including hand thinning followed by pile burning (HTP) and thinning to within the historical "Natural Range of Variation" followed by fall broadcast burn (TRFX) were effective in drastically reducing modeled wildfire-driven tree mortality based on parameters specific to the Lake Tahoe Basin.
- Other management goals, such as increasing stand heterogeneity and understory biodiversity, or conserving habitat for species of concern, may also be met through careful planning and implementation of fuel removal and prescribed burns (for example, conducting treatments in the fall and winter to avoid eagle breeding and nesting season).
- Researchers recommend an implementation schedule that treats 1/3 of a given stand at a time, allowing for the monitoring of treatment effects and real-time adjustments.

The HTP (hand thinning-pile burning) treatment included cutting and piling all trees less than 30.5 cm dbh with the exception of P. lambertiana (sugar pine) as requested by State Parks managers. 80% of all surface fuel in the stand was piled and burned the following year. The TRFX treatment restored stand-level basal area, stem density, and fuel loads to within the adapted natural range of variation (NRV) for the yellow pine-mixed conifer forest type. NRV targets for post-treatment mean basal area, stem density, and fuel loads were 34 m2/ha, 160 trees/ha, and 27 Mg/ha,

respectively, and were derived from a Forest Service Technical Report describing the NRV for this forest type in the Sierra Nevada, Southern Cascades, and Modoc and Inyo National Forests (Safford and Stevens, 2017). A thin-from-below treatment was simulated to remove all trees between 20.3 and 81.3 cm, again with the exception of sugar pine. Smaller trees were retained to promote stand heterogeneity, logistical efficiency, and standing fuel for the fall broadcast burn. TRFX also included biomass removal, particularly under large trees where the deepest duff layers were found. No management and spring prescribed burns unpaired with other fuels reduction measures both resulted in 100% tree mortality, while HTP and TRFX scenarios resulted in only 5-6% tree mortality. Both proactive treatments retained larger, older trees in the stand, but TRFX was more effective than HTP in returning the forest to its NRV conditions, shifting live-tree carbon storage to a larger mean basal area, drastically reducing fuel loads (Fig. 1), and maintaining lower cumulative carbon and PM2.5 emissions.

While the effects of fuel treatments on understory biodiversity and raptor habitat were not quantified in this study, nearby studies show that human management has minimal effects on the productivity of bald eagles at nesting sites if the timing of forest management is limited to fall and winter, and that open forest structures support more nesting sites. Additionally, studies show that species richness increased when plots were subjected to low and moderate-severity burning in the Angora fire. Therefore, treatments that reduce stand tree density, promote the retention of large trees, and remove fine fuels not only have the potential to improve forest health and resilience to wildfire, but may also improve local diversity and conserve habitat for species of concern.

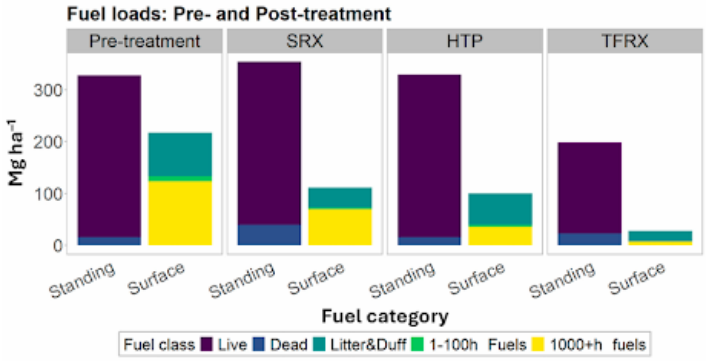

Figure 1. Pre- and post-treatment fuel loads, before simulation of the wildfire. Standing fuels are divided into live and dead standing fuel, and surface fuels are divided into four categories: littler and duff combined; 1-100 h fuels; and ≥ 1000 h fuels (CWD).

Heavy fuel loadings, ongoing density-driven mortality, and the likely devastating impacts of wildfire at Emerald Point urge the integration of fuels management (e.g. thinning and prescribed burns) into plans for old growth conservation in the Lake Tahoe Basin and other seasonally dry western MOG forests. Treatments that restore stand conditions to within or near the NRV, such as the TRFX scenario, are most likely to be successful in significantly reducing fire and drought risk. Researchers recommend that managers treat ⅓of the stand at a time to permit monitoring and social and ecological adjustment to new stand conditions. Proactive, restorative, and iterative management is essential for boosting long term ecological resilience in the ancient and awe-inspiring old growth forests of the Sierra Nevada.

Additional Information

This brief is based on the following article:
Weeks, JonahMaria, Byrant Nagelson, Sarah Bisbing, and Hugh Safford. "Burn to Save, or Save to Burn? Management May Be Key to Conservation of an Iconic Old-Growth Stand in California, USA." Fire 8, no. 2 (2025): 70. https://doi.org/10.3390/fire8020070.

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