# Biodiversity benefits of prescribed fire and mechanical thinning in Yosemite Valley

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**Background:** Central Sierra Nevada forests are under mounting pressure from drought, bark beetles, and high severity fire. Low- and mid-elevation forests in this region experienced thousands of years of frequent and low intensity fire until dramatic fire regime changes driven by nineteenth and twentieth century fire suppression policies. In Yosemite Valley specifically, black oak and mixed conifer communities were shaped by more than 3,000 years of Indigenous burning aimed at providing key ecosystem services. Since the removal of Indigenous people and the onset of fire exclusion, fuel has piled up and forest stands have densified, and the 2012 to 2016 drought made things worse, pushing ponderosa pine mortality to 30 to 50% in some parts of the park. That has driven an active restoration program of roadside thinning, prescribed fire, and vista clearing. This study is a post hoc comparison of four treatment histories already on the ground in the valley: prescribed fire only, mechanical thinning only, the combination of both, and no treatment in the past ten years. It looks at how each affects understory plant diversity, and whether terrestrial lidar scanning (TLS) improves on standard field monitoring. At each plot, the researchers took a ground-based laser scan and used the resulting 3D point cloud to measure tree diameters and heights, basal area, canopy openness, and the density and height of vegetation in distinct height layers. They also calculated a greenness index from the scan's color data as a proxy for live, chlorophyll-rich vegetation. These TLS metrics were then modeled alongside field measurements to see which best explained understory diversity.

## MANAGEMENT IMPLICATIONS

- Pair mechanical thinning with prescribed fire when understory diversity is a stated goal, not just fuel reduction. Low severity prescribed fire alone did not raise Shannon diversity here, likely because it is not intense enough to restructure the lower and mid canopy the way thinning does.
- Track canopy openness and tree diameter heterogeneity as concrete, numeric treatment targets. Both had clean, significant, positive relationships with diversity, and unlike treatment category itself, they can be measured directly and set as restoration benchmarks.
- Avoid over-opening the understory in pursuit of diversity gains. Graminoid and seedling cover related to diversity in a hump shaped pattern, so pushing treatment intensity past an intermediate point risks a few species dominating and overall diversity actually declining.
- Where budget allows, pair terrestrial lidar scanning with field-based monitoring. Combining TLS and field measurements explained more of the variation in diversity than any single group of predictors, and the scans captured detail field crews would otherwise miss, such as midstory canopy height and greenness within specific height layers (a chlorophyll index calculated from color imagery the scanner records alongside the laser points).

**Effects of Treatments on Fuels:** Researchers sampled 148 plots and recorded 288 unique understory taxa (80 graminoid, 171 forb, 24 shrub) plus 9 tree species. All three active treatments significantly reduced litter depth, duff depth, total fuel cover, and coarse woody debris compared to untreated areas, and the combined treatment was the most effective of the three at cutting fuel loads.

**Effects of Treatments on Understory Diversity:** Fuel reduction and diversity moved together here, not against each other, but not every treatment got there the same way. Species richness rose significantly in all

three treatment types relative to untreated. Shannon diversity (H'), which is more sensitive to rare species, only rose significantly for the combined burn plus mechanical treatment. Burning alone or thinning alone did not significantly raise H' on its own, even though burn only plots actually had higher plant cover than the other treatments.

**What Explains the Diversity Patterns:** The authors built a set of thematic models to isolate which forest characteristics were driving H', then combined the significant predictors into one integrated model. Understory composition alone explained just under half the variation in H', the best of any single thematic model, and overstory structure explained 37.9%. Combining TLS metrics with field measurements beat every individual thematic model, explaining 55.8% of the variation. Two relationships were clean and linear: canopy openness (p=0.03) and tree diameter inequality (p=0.01) both tracked positively with diversity. Two others were hump shaped: graminoid cover (p=0.000007) and seedling cover (p=0.002) each showed diversity peaking at intermediate levels of cover and dropping off once a handful of species started to dominate.

**Key Conclusions:** The authors did not find a tradeoff between reducing fuels and protecting understory diversity. Every active treatment outperformed no treatment, and the combination of prescribed fire and mechanical thinning did best on both fronts at once, likely by opening the canopy, diversifying tree diameters, and shifting understory composition and cover. That gives managers real flexibility to choose a treatment based on operational constraints without giving up biodiversity outcomes, and the results make a solid case for adding TLS to the standard field monitoring toolkit.

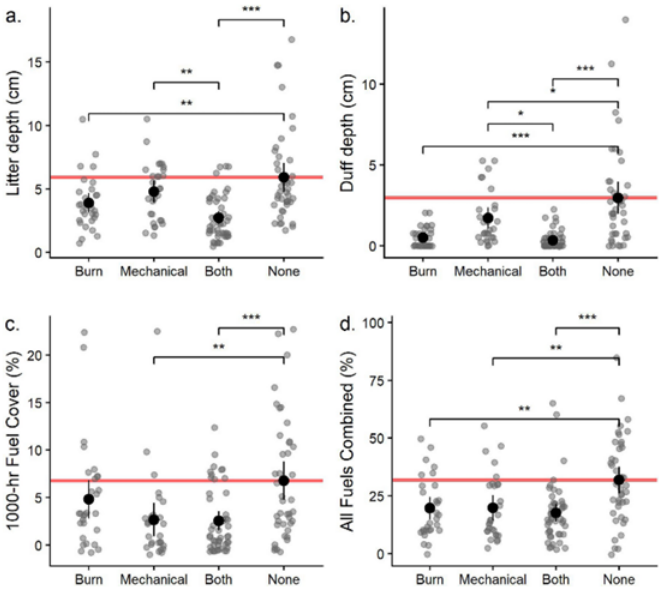



*Figure 1: Litter depth, duff depth, 1000-hr fuel cover, and total fuel cover across the four treatments. Large black dots are treatment means with 95% confidence intervals, gray dots are individual plots, and the horizontal red line marks the mean for untreated plots. Asterisks indicate significant differences between treatments (Tukey's HSD; * p ≤ 0.05, ** p ≤ 0.01, *** p ≤ 0.001). All three active treatments differ significantly from no treatment on most measures.*

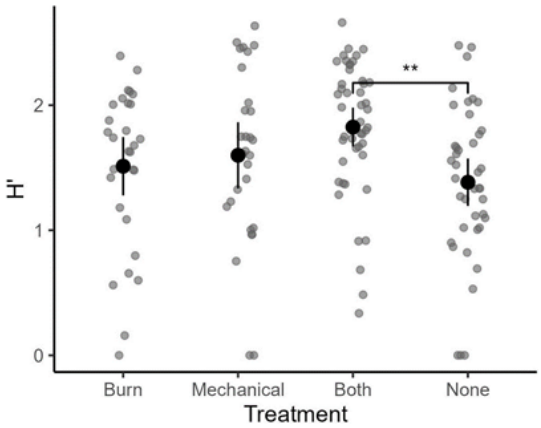



*Figure 2: Mean Shannon diversity index (H') across the four treatments, with 95% confidence intervals. The combined burn and mechanical treatment is the only one that differs significantly from no treatment.*

## Additional Information

This brief is based on the following article:
*Crumrine, S.A., Anderson, C.T. & Hankin, L.E. Biodiversity benefits of prescribed fire and mechanical thinning in Yosemite Valley. Fire Ecol 22, 76 (2026). https://doi.org/10.1186/s42408-026-00501-8*

This brief was written by Helene Le Gall, reviewed by Hugh Safford and Katanja Waldner, and produced by the CFSC Sierra Nevada subregion.
For additional information, contact: cafirescience@gmail.com