

# Opportunities to leverage beneficial areas of even undesirable wildfires



Research Brief • July, 2025

## Introduction

Successive catastrophic wildfire seasons in western North America have escalated the urgency around reducing fire risk to communities and ecosystems. In historically frequent-fire forests, government agencies are committing significant resources to fuel reduction treatments that can reduce the probability of high severity wildfire. However, even catastrophic fires with large areas of high severity can still have substantial area of lower severity fire that may be improving forest conditions locally, acting as “treatments.” Understanding how these areas of beneficial fire compare and interact with active management can help inform treatment priorities and opportunities. As a test case, we explored trends in the yellow pine and mixed conifer forests (YPMC) in the Sierra Nevada of California over a 22-year period (2001-2022).

## Comparing active management with beneficial wildfire

### Active management

We grouped treatments into two coarse classes: mechanical treatments (thinning by hand or with heavy equipment, mastication, etc.) and fire-related treatments (broadcast or pile burning). Area treated fluctuated and we did not detect a linear increase in the area treated through time (Figure 1). However, we suspect that there may be clearer increases after 2022 as additional funding became available.

Mechanical treatments declined after 2008, potentially due to decreases in commercial thinning after the financial downturn. Large fires have also likely increased the focus on postfire salvage, which can reduce the capacity to thin in green forests. Fire-related treatment fluctuations are likely attributable to variability in burn windows and staffing, as well as competing needs for fire personnel to fight later-season wildfires. Reductions in 2012-2016 likely correspond to reductions in federal fuels funding.

When considering trends by landowner, mechanical treatments were the dominant treatment on private land as well as US Forest Service (USFS) land, but the latter had a much larger complement of fire-related treatments. The National Park Service (NPS) primarily used fire-related treatments, with greater area treated in the first half of the study period.

### Wildfire

Both wildfire area burned and severity increased substantially over this time period (Figure 1). A total of 475,137 ha of YPMC forests burned, 46% of which burned at high severity. The remaining area burned with potentially beneficial wildfire (low to moderate severity). The two largest fire years in the YPMC, 2020 and 2021, still had substantial proportions of beneficial wildfire, 56% and 53%

## MANAGEMENT IMPLICATIONS

- Beneficial wildfire (low-moderate severity) impacted 4x more area than fire-related treatments
- 47% of the region currently has no resistance to high severity fire.
- Wildfires and treatments together have interacted to create some level of resistance over ~33% of the region, most of which was created by wildfires.
- Leveraging the work done by these wildfires could amplify the impact of individual management treatments.

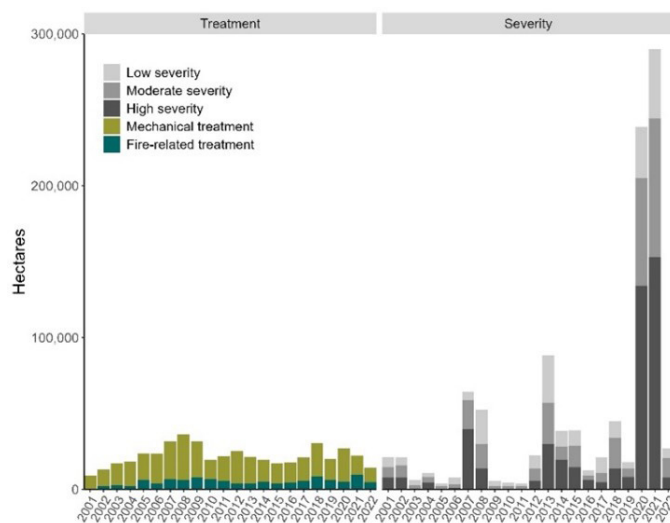


Figure 1. Area impacted by coarse treatment types and wildfire area burned.

respectively.

When compared with active management, beneficial wildfire treated ~17% more area than all treatments combined, and roughly four times more area than fire-related treatments alone.

### The State of the Sierra Nevada: Patterns of resistance to high severity fire in the YPMC

To assess current conditions and the potential resistance to high severity fire, we classified the YPMC range by 2001-2022 wildfire and treatment history as follows:

- No resistance: no disturbance
- Low resistance: Mechanical thinning only
- Moderate resistance: one fire-related treatment or beneficial wildfire
- High resistance:  $\geq 2$  treatments/beneficial wildfires ( $\geq 1$  must include fire)
- Mature forest loss:  $\geq 1$  high severity wildfire

We found that 47% of the range has no resistance to high severity wildfire (Figure 2, orange areas). An additional 20% experienced mature forest loss (Figure 2, red areas), with extensive areas dominating the northern Sierra Nevada. In the southern region, forest losses are raising concerns about critical species such as the endangered Pacific fisher and ancient giant sequoia forests.

In contrast, roughly 33% of the range has some level of resistance. Specifically, Moderate or High resistance comprised 25% of the range, primarily as a result of beneficial wildfire. The largest concentration of resistance is in the central Sierra Nevada (Figure 2, teal areas), much of which is due to the prescribed fires and wildfires managed for resource benefit that Yosemite National Park has been implementing since 1972.

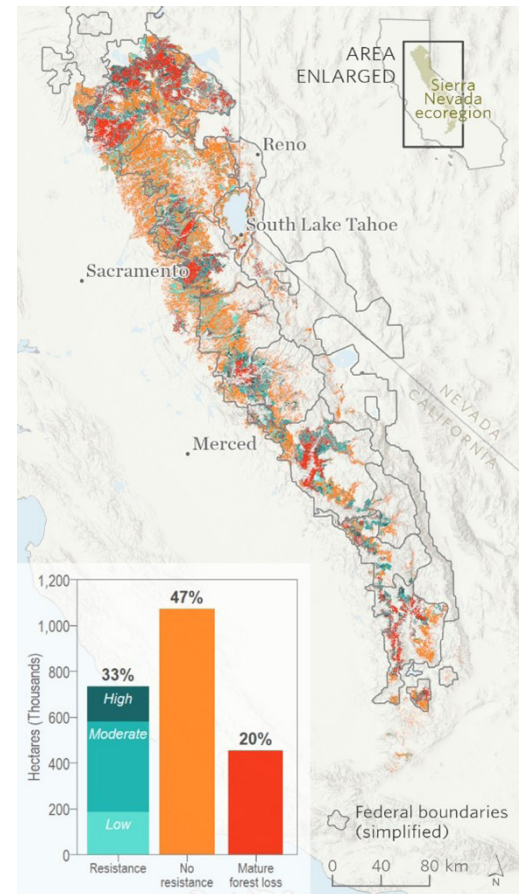


Figure 2. The status of resistance across the yellow pine and mixed conifer forests of the Sierra Nevada.

### Future treatment needs and opportunities

Our resistance classification highlights the variation in opportunities to initiate, enhance and maintain resistance. In areas of No resistance, a first-entry treatment would initiate the process of creating resistance, but in areas that already have Low or Moderate resistance, follow-up treatments can move them closer to target conditions (e.g., High resistance) than the first-entry treatment in No resistance areas. Critically, High resistance areas will also need another treatment to maintain resistance, although on a lengthier time frame.

Forecasting into the future, at current annual treatment rates we would not be able to maintain the current resistance areas in half of the next 22 years, nor any year if we consider fire-related treatments alone, let alone moving into additional No resistance areas. This is also highly conservative, since our treatment longevity window is likely an overestimate (a recent study suggests treatments last ~10 years). Given limited resources for implementing active management and the likelihood of a more fiery future, incorporating beneficial wildfire into landscape-level treatment planning has the potential to amplify the impact of active management treatments.

## Additional Information

This brief is based on the following article:

Shive, Kristen L., Clarke A. Knight, Zachary L. Steel, Charlotte K. Stanley, and Kristen N. Wilson. 2025. "Leveraging wildfire to augment forest management and amplify forest resilience." *Ecosphere* 16 (6): e70306. <https://doi.org/10.1002/ecs2.70306>.

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