CALIFORNIA FIRE SCIENCE CONSORTIUM

Research Brief for Resource Managers

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Treating Forests more strategically to Reduce Fire Severity and Carbon Loss

Krofcheck DJ, Hurteau MD, Scheller RM, and Loudermilk EL. 2018. Prioritizing forest fuels treatments based on the probability of high-severity fire restores adaptive capacity in Sierran forests. Glob Change Biol 24: 729–37. *https://onlinelibrary.wiley.com/doi/full/10.1111/gcb.13913*

Management Implications

- Prioritizing forest treatments based on high severity wildfire risk can be just as effective as treating much larger areas indiscriminately
- Regardless of treatment strategy, treatment was found to stabilize carbon, and reduce burn severity and hence wildfire carbon emissions compared to not treating

Locating forest treatments in the right places can make them as or more effective than treating everywhere, shows new research out by Krofcheck et al. 2018. The authors found that restoring less acres strategically can have the same impacts as treating more area indiscriminately in terms of reducing high severity wildfire risk and carbon instability.

Due to higher fuel loading in forests from fire suppression in concert with more extreme fire weather, fires are larger and more intense than they were historically resulting in more trees killed and higher carbon emissions. In an effort to minimize this, land managers treat forests through thinning and prescribed burning to reduce fuel-loading. However given declining budgets and other complex issues, managers have only been able to treat a small portion of California's forested landscapes to date. Krofcheck et al. (2018) examined if treating less acres in a spatially strategic way can be as effective at maintaining carbon stores as treating larger areas.

The authors modeled three different scenarios over 100 years in the Dinkey landscape (216,000 acres) on the Sierra National Forest in California. They analyzed what would happen (1) if forest managers did nothing (no management); (2) if managers treated everywhere possible barring wilderness areas, riparian areas, steep slopes, etc. (naïve treatment); and (3) only treating possible areas where there is also a high risk of high severity wildfire (optimized treatment).

Both treatment scenarios (naïve and optimized) used combinations of forest thinning and burning. The optimized treatment incorporated much less thinning (1,800 acres a year in mixed-conifer forests) compared to the naïve treatment (2,875 acres) whereas prescribed burning treatments between two scenarios were the same (1,540 acres a year in mixed conifer). Forest thinning treatments employed the 'thin from below' technique in which about 1/3 of the forest biomass was removed in the first decade of each simulation, and removed only once in the 100-year simulation. Prescribed burning treatments were timed to follow how frequently fires would have burned historically in any given location for each forest type.

To estimate how much above ground carbon (AGC) remained on the landscape after 100 years given each management strategy, 200 replicate models were performed for each scenario. Krofcheck et al. (2018) used landscape-scale models that incorporated vegetation growth and mortality of trees and shrubs. In each grid cell across the Dinkey landscape, the models allowed trees to become established from parent trees, then grow and die from age or disturbance dependent on their species and age. From this vegetation model, Krofcheck et al. (2018) estimated fuel characteristics. To model fire starts, they randomly selected cells to have ignitions over time (that matched what is documented for the region) and then combined fuel estimates in those cells along with fire weather (modeled using five different climate projections). To estimate fire size, they used fuel characteristics in adjacent grid cells, topography and fire weather.

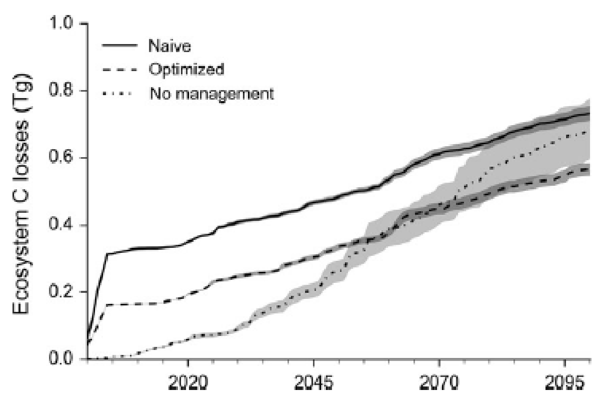

Figure 1. Total losses of C from the landscape represented as means of the 200 replicate simulations for the no management (dotted), naive placement (solid), and optimized (dashed) simulations. Shaded regions represent the 95% confidence interval about the mean. Figures reproduced from Krofcheck et al. (2018).

Model outputs showed that treating forests reduced mean fire severity much more than doing nothing (see Figure 2). Even when less of the landscape was treated strategically (optimized treatment), it was just as effective at reducing fire severity as treating more of the landscape in a broad-brush manner.

Similarly, wildfire carbon emissions were reduced in both the naïve and optimized treatment strategies. For both treatment scenarios there was an initial carbon 'cost' due to removal of biomass through thinning and burning, but thereafter above ground carbon steadily rose as reductions in high-severity fire maintained more carbon across the landscape. Even with early stage losses, the treatment scenarios paid off by the end of the 100 year timespan and had surpassed above ground carbon amounts resulting from doing nothing. In terms of total carbon lost from the system, the optimization strategy was the winner (Figure 2) because less total carbon was removed in initial treatment and less carbon was lost to high severity wildfire. There was also much more variability in the carbon amounts through time in the no-management scenario relative to the other two, indicating how sensitive the un-treated forests were to any disturbance.

Krofcheck et al. (2018) were able to show that informed placement of forest thinning treatments and the regular use of prescribed fire can result in long-term carbon gains throughout time. Given that there currently is an immense backlog of nearly 2.5 million acres of untreated forests (North et al., 2012; https://www.fs.usda.gov/treesearch/pubs/44972), these findings are particularly relevant. The authors emphasize that given long-term climate projections for the region, it is important to restore forests now, so they will be more resilient to future climates and the corresponding wildfires to come.

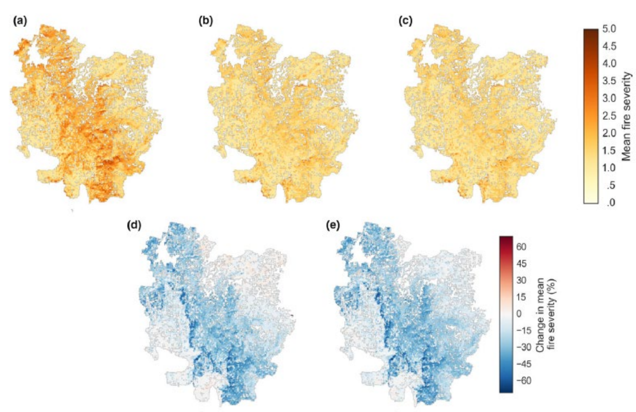

Figure 2. Mean fire severity for the no management (a), naive placement (b), and optimized placement (c) scenarios, and the resulting percent change in fire severity relative to the no-management scenario caused by the naive (d) and optimized (e) treatments.