THE UNIVERSITY of NEW MEXICO

FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

Research Brief for Forest Managers

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Carbon Costs and Benefits of Fuels Treatments

Fire suppression has caused an increase risk of high-severity wildfire in many dry forest types of the Western U.S. Treatments aimed at reducing this risk often employ thinning and/or prescribed burning to reduce both tree density and surface fuel loads. There are several carbon (C) costs to these treatments including increased C emissions from prescribed fire, thinning residue and milling waste, the treatment's consumption of fossil fuels and a reduction in C stocks. However, effective treatments lower the risk of large C loss from high-severity fire and can increase available resources for leave trees, accelerating growth and C sequestration. What are the relative C tradeoffs between different types of fuels treatments?

In an on-going study at the Teakettle Experimental Forest we quantified the carbon consequences of different levels of thinning and burning treatments immediately and 7-years post-treatment. Carbon stocks were reduced and emissions increased with increasing treatment intensity (Figure 1). The understory thin, and understory thin and burn treatments increased the torching index by approximately 15 km h^{-1} and the crowning index by approximately 10 km h^{-1} over the control. The overstory thin, and overstory thin and burn increased the torching index by approximately 30 km h^{-1} and the crowning index by approximately 20 km h^{-1} over the control. While removing larger trees in the overstory thinning treatments increased fire resistance, the carbon cost was substantially higher.

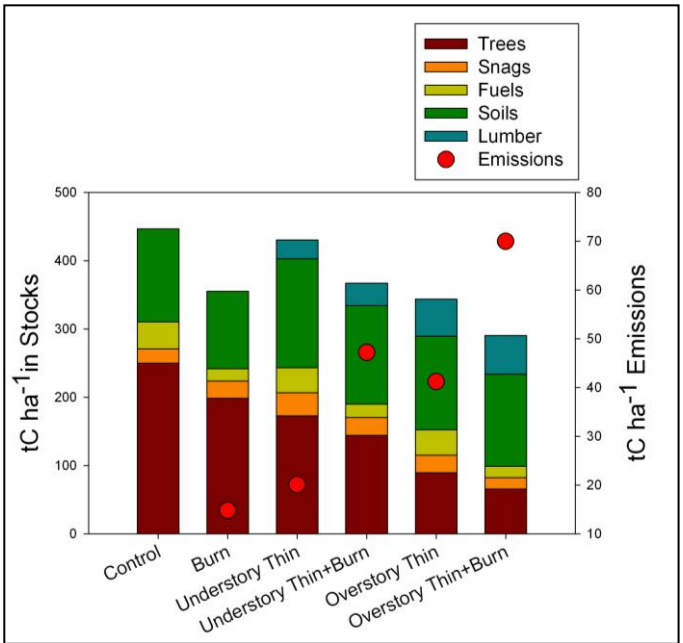

Figure 1: Carbon stocks and treatment emissions by treatment type. Figure adapted from North et al. (2009).

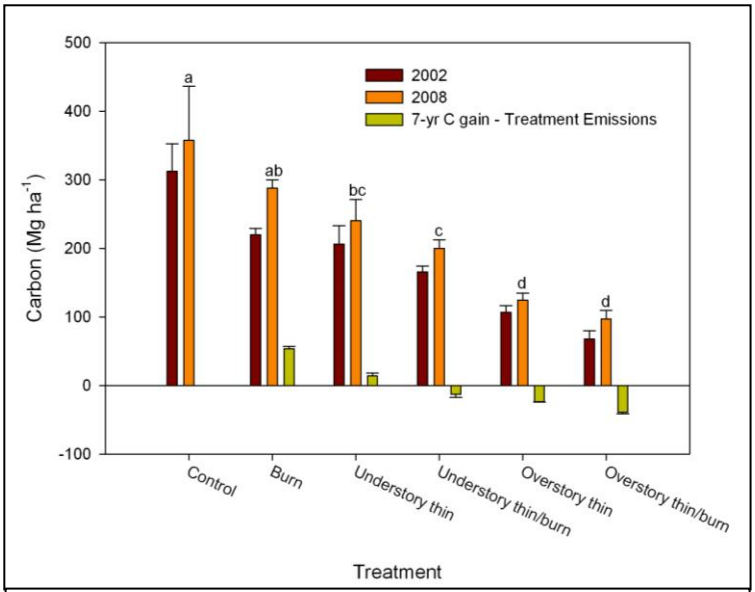

Figure 2: Immediate (red) and 7-year post-treatment carbon stocks (orange) by treatment. The yellow bars represent the carbon accumulated over the 7-year period, minus the total carbon removed and emitted during treatment. Positive values mean the treatment has re-sequestered all of the carbon removed or emitted during treatment. Figure adapted from Hurteau and North (In press).

Seven years following treatment, tree growth in all treatments had re-sequestered some or all of the carbon removed or emitted during treatment implementation. By subtracting total treatment carbon costs from the growth that occurred over the seven-year period, we found that the burn only and understory thin treatments had regained all of the carbon lost during treatment. The results in the burn only treatment indicate that while prescribed fire does release carbon, subsequent tree growth re-sequesters that carbon in a much shorter period than the historic mean fire return interval of 15-30 years for Sierran mixed-conifer forest. Given the measured growth-rates, we estimate that the understory thin and burn treatment will re-sequester all of the carbon removed and emitted during treatment in as few as nine more years of growth. Both overstory thin treatments will continue to have net negative carbon balance for a much longer time period because of the removal of many large trees.

Management Implications:

- Consolidating carbon stocks in fewer, larger trees reduces the risk of carbon loss from fire.
- Fossil fuel emissions from treatment implementation are equal to approximately 3% of the total carbon stock per hectare.
- Understory thinning and prescribed fire reduce carbon stocks and produce emissions, but continued tree growth re-sequesters that carbon in approximately fifteen years.

References:

North, M., Hurteau, M., Innes, J. 2009. Fire suppression and fuels treatment effects on mixed-conifer carbon stocks and emissions. Ecological Applications, 19:1385-1396.

Hurteau, M.D. and M. North. 2010. Carbon recovery rates following different wildfire risk mitigation treatments. Forest Ecology and Management, doi:10.1016/j.foreco.2010.06.015