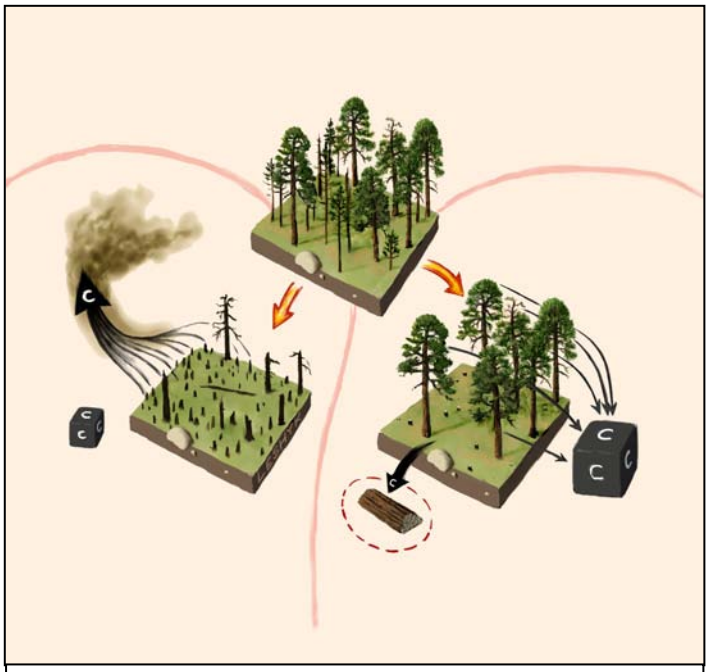
Ecological Restoration Institute

Fact Sheet: Carbon Costs of Mitigating High-severity Wildfires December 2010

Ecological Restoration Improves Carbon Stability While Reducing Risk of High-severity Wildfire

The increasing frequency of large, severe wildfires in western United States forests presents a challenge in terms of maintaining forest health, especially in the face of climate change. In addition to losses of forest cover, species diversity and increased soil erosion, severe wildfires release carbon stored in forest trees and soils, and reduce the number of trees that can remove carbon from the atmosphere. Altering the forest structure by thinning smaller trees and reducing surface fuels through prescribed burning has proven effective in reducing fire severity. However, thinning and prescribed burning comes with its own costs because these activities remove trees and downed wood that store carbon.



The carbon accounting consequences of two possible options for a given forest stand—untreated (left) and treated (right)—and the results following a wildfire event. The C-cubes represent the amount of carbon remaining in the ecosystem after wildfire. Originally published in Frontiers in Ecology and the Environment *6(9):493-498. See Hurteau et al. 2008.*

Recent research in a ponderosa pine forest (Hurteau et al. in press) determined the differences in aboveground carbon storage between 1) the historic forest that experienced frequent, low-severity surface fires (reconstructed forest structure in 1876); 2) a forest where fires of all types have been excluded for more than a century and where no thinning has taken place (typical of today's frequent-fire forests in the western United States); and 3) a forest that has been treated using low, medium, and high levels of thinning of young trees to emulate the historical pattern, followed by one prescribed burn.

Research Findings

- Live tree carbon stocks in today's fire-suppressed forests are 2.3 times greater than historic forest carbon stocks.
- Post-treatment carbon stocks fall within the range of historic forest carbon stocks, but higher levels of thinning are more similar to the historical forest and more sustainable in the face of climate change.
- A relatively small reduction in the live tree carbon stock, within the limits of the low and high thinning levels of our experiment, will produce a forest structure that is less susceptible to torching and crown fire.

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The Ecological Restoration Institute is dedicated to reversing declines in the condition of forested communities throughout the Intermountain West, particularly those affected by severe wildfires and insect outbreaks. Our efforts focus on science-based research of ecological and socio-economic matters related to restoration as well as support for on-the-ground treatments, outreach, and education.
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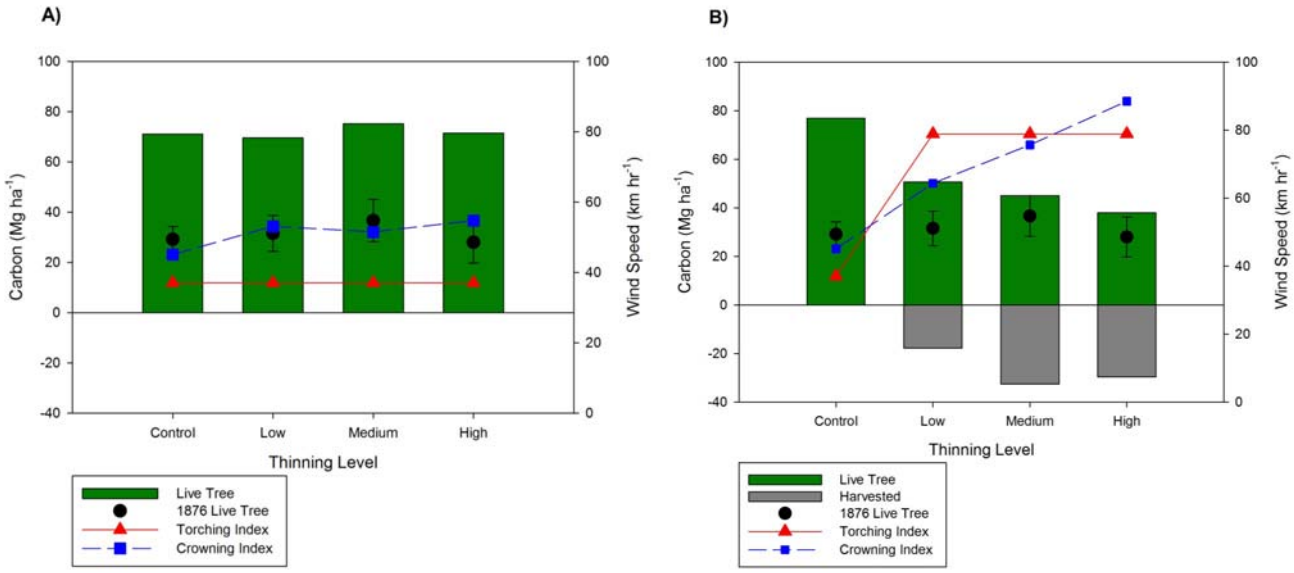
Management Implications

- Managers of frequent-fire forests in the western United States face trade-offs with regard to carbon storage.
- Choosing to maximize the forest carbon stock comes at a cost of reduced stability because of wildfire risk.
- Stabilizing the carbon stock requires a reduction below the fire-excluded forest carbon stock, but comes with increased resistance to high-severity fire.
- Consolidating the carbon stock into fewer trees of larger average size reduces the risk of carbon loss from catastrophic wildfire. Furthermore, these trees continue to grow and sequester carbon.
- This research suggests that the forest management goals of reducing the risk of high-severity wildfire and long-term carbon stability can be achieved simultaneously.



The green bars are the pre-treatment (a) and post-treatment (b) carbon stocks in live trees in the control, low, medium, and high thinning levels. The gray bars in B represent the live tree carbon removed during thinning. Green dots are the mean reconstructed 1876 live tree carbon stocks with standard errors. The pre- and post-treatment torching indices and crowning indices from Fule´ et al. (2001) are represented by red triangles and blue squares, respectively. Note that the three treatment levels are well below the torching and crowning indices indicating that these treatments will likely prevent high-severity wildfire, although they do represent a decrease in carbon storage. Adapted from Hurteau et al. (2010).

References

Hurteau, M.D., G.W. Koch, and B.A. Hungate. 2008. Carbon protection and fire risk reduction: toward a full accounting of forest carbon offsets. *Frontiers in Ecology and the Environment* 6:493-498.

Hurteau, M.D., M.T. Stoddard, and P.Z. Fulé. 2010. The carbon cost of mitigating high-severity wildfire in southwestern ponderosa pine. *Global Change Biology*, 17:1516-1521.

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