

Fire, Forests, and Carbon: Reducing Hazardous Fuels to Avoid Catastrophic Fires

There is no doubt that fires will continue to happen in California's forests and rangelands, and in many locations the area burned by wildfires is only predicted to increase as the climate changes. At the same time, there is widespread hope that forests will play a key role in helping meet the statewide, national, and global goals of reducing atmospheric carbon through increased sequestration. However, because fires can emit the carbon stored in forests back to the atmosphere, it is important to better understand how the risk of fires can be reduced so that a greater percentage of forest carbon can stay in the forest or be used in carbon-neutral products.

One of the key tools used for reducing fire risk in forests is to decrease hazardous fuels – small diameter trees and surface vegetation – in places where they are most likely to increase fire severity. Reducing these “ladder” fuels can reduce the negative impacts of severe fires and potentially generate climate benefits by reducing carbon dioxide and methane emissions, as well as generating biomass fuels that can offset some of fossil

fuel burning that is still the mainstay of California's energy supply. Biomass from fuels reduction projects can also be used for other wood products that could help to defray the costs of the expensive treatment projects. Avoiding the upfront costs of fuels reduction projects simply shifts the impacts and recovery costs into the future.

To develop and implement cost-effective fuels reduction projects, it is necessary to determine where to spend scarce resources and to establish the best



Fire center staff researcher Tadashi Moody ignites a “mechanical plus burning unit at UC Berkeley's Blodgett Forest in the Sierra Nevada. Photo by Andy Amacher.

methods for reducing fuels. When funds are limited, it is important to be able to determine the “above average” projects that would be most effective both in terms of reducing real fire risk and in avoiding potential carbon emissions from wildfires. In addition, once project locations are determined, it is then important to understand what combination of mechanical thinning, prescribed fire, and/or no treatment would create the preferred mix of climate, wildlife habitat, and water quality benefits.

Max Moritz, fire center co-director, is leading an effort to map fire probabilities across California – a method that could be applied to other locations as well. These mapped fire probabilities go beyond the backward looking fire history approach and provide predictions to help decision-makers better understand expected fire return intervals using science-based models built from fire-climate relationships. Developing these probabilities will also help decision-makers develop baselines for identifying additional emission reduction credits that might be used as part of a cap-and-trade or other greenhouse gas accounting system.

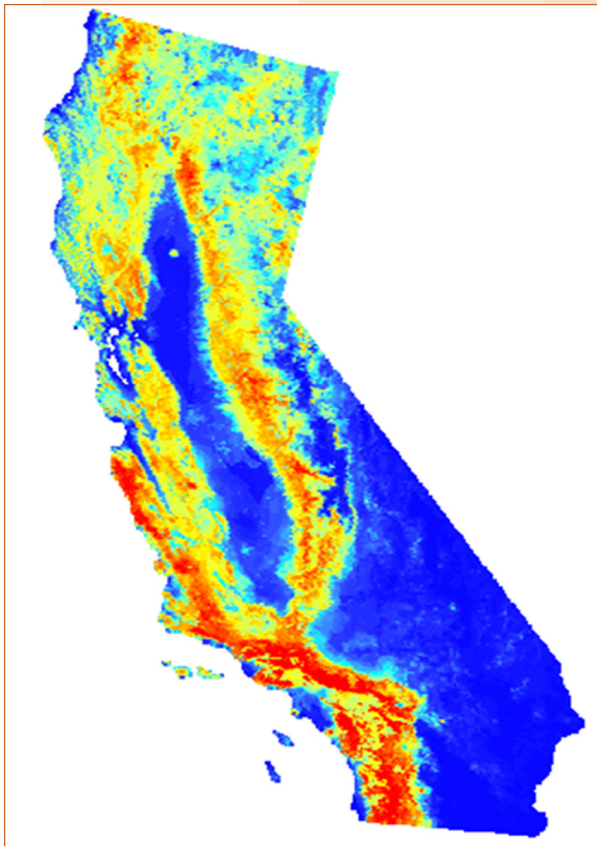
At the same time, center co-director Scott Stephens is leading a related

effort to better understand what methods are most effective in reducing forest fuels from a carbon sequestration perspective. Stephens is working to quantify the carbon fluxes and sequestration that result from the most commonly used fuels treatments – prescribed fire alone, mechanical thinning and mastication followed by prescribed fire, mechanical only, and no treatment – in the Sierra Nevada.

In addition, John Shelly, a UC Cooperative Extension Advisor affiliated with the fire center and the Center for Forestry, has been researching the issue of biomass utilization for many years. After thinning treatments, the biomass that has been cleared can be put to use by creating things like wood chips that can generate electricity, wood pellets for use in wood stoves, or other wood products such as furniture. There is an ongoing debate about whether biomass utilization can provide enough income to local communities to make fuels reduction projects more cost-effective.

While California forests sequester carbon, it is likely that some of those stands will burn and release most of the stored carbon during the coming decades. This is part of the natural cycle of fire and regeneration. However, better understanding where the risk of severe fire is the highest, how to target appropriate fuels treatments methods, and how to efficiently utilize biomass and carbon offset opportunities are key to implementing cost-effective projects that benefit state and local communities.

-- Faith Kearns



Spatially explicit annual burn probabilities that are developed based on environmental variables that control fire can be used to aid decision-makers in optimally placing and implementing the most cost-effective hazardous fuels reduction projects. From M.-A. Parisien and M.A. Moritz, *Ecological Monographs*, 2009.

An Expanded Role for Natural Fire?

Brandon Collins, a graduate student and post-doctoral researcher in Scott Stephens' lab who has recently accepted a position with the U.S. Forest Service Pacific Southwest Research Station, has been researching wildland fire use (WFU) -- a policy adopted by the National Park Service in the late 1960's that calls for the use of both prescribed and natural fire. Although this policy has been in place for decades, it has been difficult to implement natural fire programs due to the uncertainty associated with fire and a tendency to focus on fire suppression. More recently, however, as fire suppression costs continue to rise, WFU is taking on new life.

Brandon's research highlights the similarities between historical fires and more recent WFU fires, both of which resulted in peaks in tree recruitment and growth in his Sierra Nevada study areas. These results led to the conclusion that "fire is the dominant process driving structure" in these forests. While it is not always realistic to implement WFU, there are still large areas where it could be applied to restore ecological integrity to forested areas suffering from decades of fire suppression. WFU could be a cost-effective tool for helping to restore western forests and make them more resilient to climate change.

References:

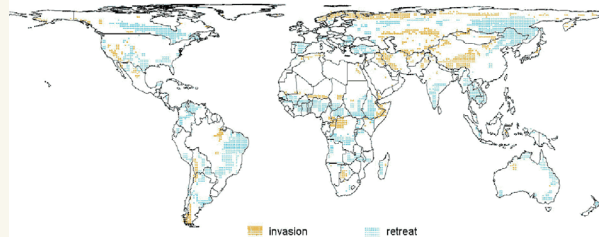
Collins, B.M., J.D. Miller, A.E. Thode, M. Kelly, J.W. van Wagtenonk, and S.L. Stephens. 2009. Interactions among wildland fires in a long-established Sierra Nevada natural fire area. *Ecosystems* 12: 114-128.

Collins, B.M. and S.L. Stephens. 2007. Managing natural wildfires in Sierra Nevada wilderness areas. *Frontiers in Ecology and the Environment* 5(10): 523-527.

Recent Publication Highlights

Global Pyrogeography: the Current and Future Distribution of Wildfire

Fire center post-doctoral researcher Meg Krawchuk -- along with Berkeley co-authors Max Moritz and Marc Parisien, Jeff Van Dorn of the Canadian Forest Service and Katharine Hayhoe of Texas Tech -- recently released a paper in the journal *PLoS One* that examines how fire patterns will change with a changing climate. They found that climate change is likely to alter global "pyrogeography" -- the geographic distribution of wildfire -- with fires increasing in some areas and decreasing in others. The researchers say: "These changes could have important effects on terrestrial ecosystems since alteration in fire activity may occur quite rapidly, generating ever more complex environmental challenges for species dispersing and adjusting to new climate conditions. Our findings highlight the potential for widespread impacts of climate change on wildfire, suggesting severely altered fire regimes and the need for more explicit inclusion of fire in research on global vegetation-climate change dynamics and conservation planning."



Reference: Krawchuk, M.A., M.A. Moritz, M.-A. Parisien, J. Van Dorn, and K. Hayhoe. 2009. Global Pyrogeography: the Current and Future Distribution of Wildfire. *PLoS ONE* 4 (4): e5102.

Visit us on the web at firecenter.berkeley.edu/publications.htm for a link to this paper.

Urban-wildland fires: how California and other regions of the US can learn from Australia

Center co-directors Scott Stephens and Max Moritz, associate director Faith Kearns, and several Australian colleagues -- Mark Adams, John Handmer, Bob Leicester, and Justin Leonard -- recently released a paper on how the Australian "Prepare, stay and defend, or leave early" wildfire policy might be applied in California. With this approach, residents are trained and decide whether they will stay and defend their well-prepared property or leave early, before a fire gets too close. This approach differs greatly from the approach in the U.S., where fire suppression by professional firefighters is often seen as the most important way to deal with the increasing numbers of fires happening in the wildland-urban interface. While in the U.S., there is some attention given to educating homeowners on how to prepare their homes for wildfires, this type of engagement does not receive nearly the funding or attention that it could. By examining the Australian model, it is hoped that we may approach a more sustainable coexistence with fire. "However," the researchers say, "it should be noted that some California communities are so vulnerable that a 'Prepare and leave early' strategy may be the only option."

Reference: Stephens, S.L., M.A. Adams, J. Handmer, F.R. Kearns, B. Leicester, J. Leonard, M.A. Moritz. 2009. Urban-wildland fires: How California and other regions of the U.S. can learn from Australia. *Environmental Research Letters* 4: 014010.

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About the Center

The Center for Fire Research and Outreach was established in late 2005 by the College of Natural Resources at the University of California, Berkeley. The Center is co-directed by Max Moritz and Scott Stephens, both are faculty in the Department of Environmental Science, Policy, and Management. The primary mission of the Center for Fire Research and Outreach is to develop and disseminate science-based solutions to wildfire-related challenges.

Drawing on the expertise of Center faculty and researchers, our goals are to:

- * Facilitate collaboration on innovative solutions to wildfire challenges;
- * Support education and training efforts focused on interdisciplinary approaches to wildfire research and management; and
- * Cooperate with stakeholders to fill their need for information and resources before, during, and after wildfires.

For More Information

For more information about the Center co-directors, affiliated faculty and researchers, staff, collaborators, resources, and projects, please visit us on the web at:

<http://firecenter.berkeley.edu>

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