PNW
Pacific Northwest Research Station

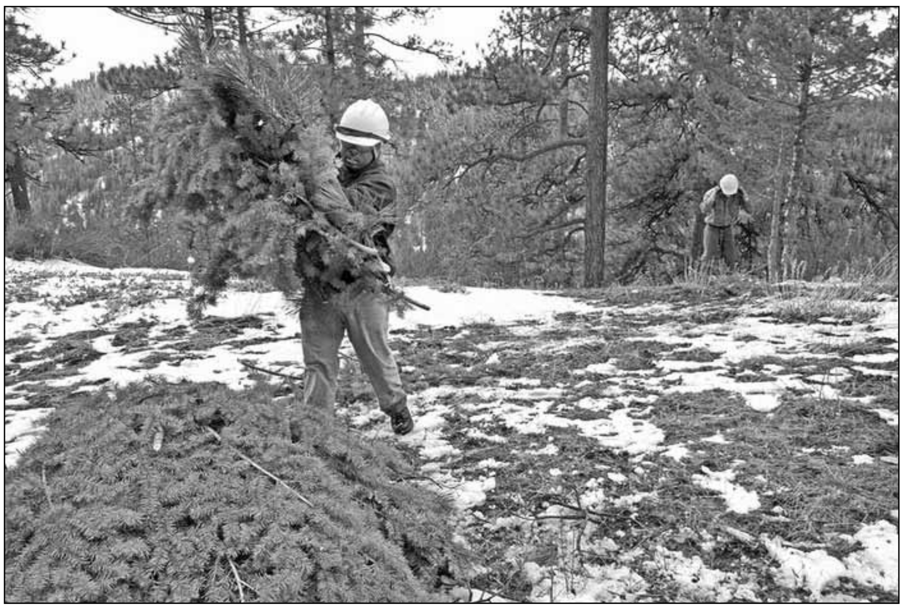
Science FINDINGS

INSIDE

issue one hundred thirty four / july 2011

"Science affects the way we think together."
Lewis Thomas

Seeking Common Ground: Protecting Homes From Wildfires While Making Forests More Resilient to Fire



Amber Mahoney

New wildfire simulations indicate that reducing fuel levels 3 to 6 miles away from the wildland-urban interface lowers fire risk to homes and the expected loss of large, fire-resistant trees. Above, a field crew conducts a thinning treatment on the Umatilla National Forest.

IN SUMMARY

Federal policies direct public land managers to reduce wildfire risks for urban areas close to wildlands, while broader agency goals call for landscape restoration to create fire-resilient forests. Alan Ager and Nicole Vaillant, researchers with the Pacific Northwest Research Station, used simulation modeling to examine trade-offs between investments in fuel management activities in a wildland-urban interface (WUI) in Oregon's Blue Mountains versus treating fuel in the surrounding Wallowa-Whitman National Forest, where fire management objectives are to restore fire resiliency to old-growth forests.

The researchers simulated thousands of wildfires to test different fuel treatment strategies. As expected, fuel treatment in the WUI had the largest reduction in wildfire risk to structures. However, fuel treatment in the WUI also resulted in substantial wildfire-caused mortality of large trees in the surrounding forest, and thus did not contribute to broader forest restoration goals. Treatment strategies to meet forest restoration goals outside the WUI decreased wildfire risk to large trees, and also reduced the incidence of wildfire in the WUI. The results suggested that fuel treatments well outside the WUI can significantly reduce wildfire threats to property and help meet broader forest restoration goals.

"There are no easy solutions to the challenges of wildland fire. But a cohesive wildfire management strategy will provide the best blueprint to ensure community safety and the restoration of ecosystems that will, in the long run, benefit all Americans, especially those who live in rural areas."

—Tom Vilsack,
Secretary of the U.S. Department of Agriculture

Since the mid-1980s, wildfire activity in the Western United States has escalated dramatically. From 1987 to 2003, six times as much forest was scorched as in the previous 16 years. Currently, about 7.5 million acres go up in smoke annually. In tandem, the scope of destruction to property and natural resources has accelerated. From 2002 to 2006, some 10,000 homes were lost to wildfires, and the cost for federal agencies to prepare for and respond to wildfires has more than doubled, averaging more than $2.9 billion annually. And although wildfire is a critical part of ecological cycles, extreme events can cause extensive and long-lasting damage.

At the same time, housing and other development have steadily expanded into areas that abut or intermix with forests. In the western states, the amount of territory in wildland-urban interfaces, or WUIs, rose by more than 60 percent from 1970 to 2000. Most of this area lies in or near forests vulnerable to high-severity fires, which are notoriously difficult to control. With climate-change forecasts for the West pointing to continuing trends of elevated spring-summer temperatures, earlier snowmelt, more frequent drought, and increased incidence of extreme weather events, wildfire risks are unlikely to abate.

The growing crisis around wildfire hazard has galvanized a revisioning of federal fire management policy. In 2000, the U.S. National Fire Plan (NFP) emphasized lowering the risks of catastrophic wildfire to communities and restoring forests to conditions of greater fire resilience. Following a mandate for a long-term program to reduce hazardous fuels, over the past decade federal land management agencies have decreased surface and canopy fuels on tens of millions of acres. But increasingly, land managers are facing strained budgets. They also are finding themselves between the proverbial "rock and a hard place" in striving to satisfy numerous and sometimes conflicting regulations, objectives for protecting ecological values (such as old-growth forests), and society's expectations for urban-wildland fire protection and forest restoration.

One particularly pressing policy question is the overall benefit of fuel treatments around WUIs to reduce wildfire risk, compared to treatments in surrounding wildlands. To investigate this issue, Alan Ager, an operations research analyst at the Pacific Northwest Research Station's Western Wildland Environmental Threat Assessment Center (WWETAC), analyzed various treatment scenarios to better understand the tradeoff between the two priorities. Using a fire-simulation model developed by Mark Finney of the Rocky Mountain Research Station, as well as other tools, Ager and Nicole Vaillant (also with WWETAC) demonstrated that optimally designed fuel treatments can serve both aims.

Purpose of PNW Science Findings

To provide scientific information to people who make and influence decisions about managing land.

PNW Science Findings is published monthly by:

Pacific Northwest Research Station
USDA Forest Service
P.O. Box 3890
Portland, Oregon 97208

Send new subscriptions and change of address information to:

pnw_pnwpubs@fs.fed.us

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Science Findings is online at: http://www.fs.fed.us/pnw/publications/scifi.shtml

USDA United States Department of Agriculture

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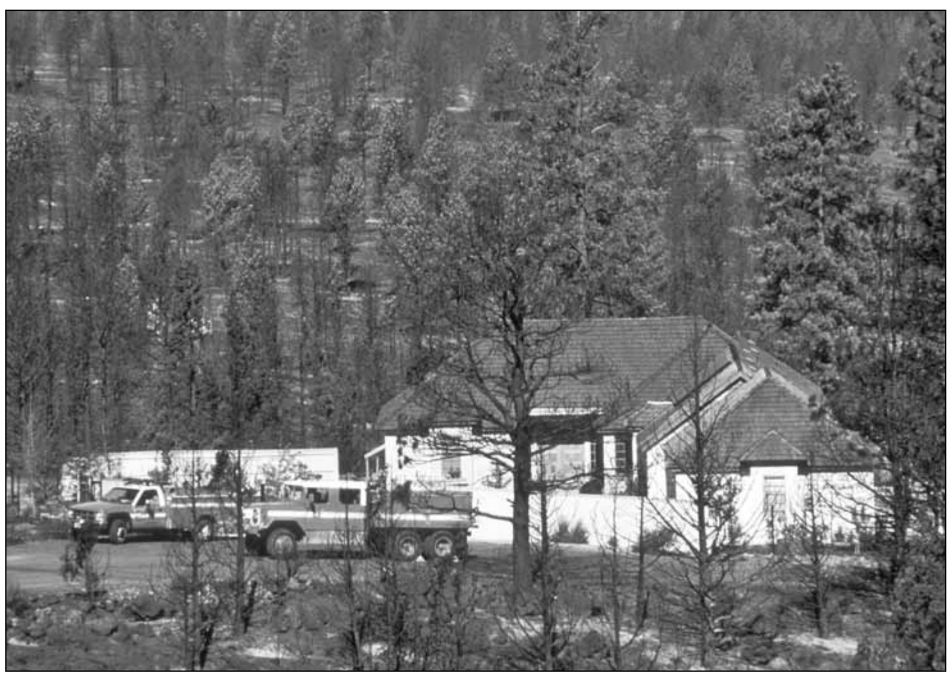
KEY FINDINGS

- Results from wildfire simulation modeling suggest that fuel treatments on 10 to 15 percent of the forest landscape outside the wildland-urban interface (WUI) could dramatically reduce the expected wildfire loss of large, fire-resilient trees.
- Treating stands near residences in the WUI resulted in lower burn probability around structures, but higher expected losses of large trees in the adjacent forest.
- Fuel treatments simulated at distances of 3 to 6 miles from the WUI substantially reduced burn probabilities around structures.
- Objectives for fire protection of WUIs and forest restoration can be compatible if fuel-treatment designs consider landscape features and other factors significant to wildfire behavior in relation to the spatial arrangement of human property and ecologically valuable resources.

FOCUSING ON SEVERE FIRES

In a sense, wildfire suppression has long been a highly successful endeavor. Firefighters extinguish the vast majority of blazes before they can spread and do much damage. Less than 5 percent of all wildfires account for more than 95 percent of the overall area burned. But a small proportion of these blazes grow to uncontrollable dimensions, overwhelming human capacities to quench them—regardless of the funds spent. Thus, better understanding the risks posed by these major conflagrations is critical to optimal allocation of monies for preemptive fuel treatments.

Forest managers routinely file postfire event reports that include assessments of the effectiveness of prior fuel treatment in burned areas. "In many cases, the records show that fuel-reduction projects have achieved little if anything, while in other instances they have succeeded in slowing down a fire's progress," Ager notes. Modeling studies have shed some light on what works and what doesn't. "The current consensus is that there's little or no impact on fire behavior if treatments are random and small relative to the scope of the fire-vulnerable landscape, or if management considerations restrict treatment locations," Ager says. "On the other hand, treatments designed to take into account local landscape properties, historical weather patterns, and other factors that influence fire behavior do have the potential to slow fires."



Tom Iraci

Strained budgets and increasing fire risk in many Western forests necessitate understanding the comparative benefits of treating fuels around communities versus fuel treatments in the surrounding wildlands.

Different perspectives on fire hazard lie at the heart of fire-management policy that seemingly pits forest restoration—re-creating the ecosystem that was historically present in terms of physical structure and biodiversity—against fire protection for WUIs. "The objective for WUIs, conservation areas, and other restricted zones is to completely exclude fire," Ager explains. "But for forests with a long history of fire suppression and other disturbance, moving toward greater fire resilience requires first minimizing fire intensity, to retain large trees essential to ecological integrity, and then reintroducing low-hazard fire as a tool for restoration." Thus, risk assessments for fire-restricted areas primarily are concerned with the chances of a fire arriving onsite (and requiring costly suppression efforts to protect life and property), while the prime risk concern for forests is fire intensity, should a burn occur.

SIMULATING FIRE RISK AND TREATMENT EFFECTS

To examine the WUI-restoration tradeoff, Ager chose a 40,000-acre study site in the Wallowa-Whitman National Forest in northeastern Oregon. The area encompasses the lushly forested slopes around Mount Emily, transitioning to agricultural lands in the Grande Ronde Valley, north of La Grande. The National Fire Plan had identified this section of the Blue Mountains as "high risk," because of the number of rural homes situated there and the potential for severe fires in the surrounding forest. Local fire history revealed that nearly half the national forest lands had burned since 1890. Most of these blazes—including one that nearly took out the town of La Grande—occurred over the last few decades.

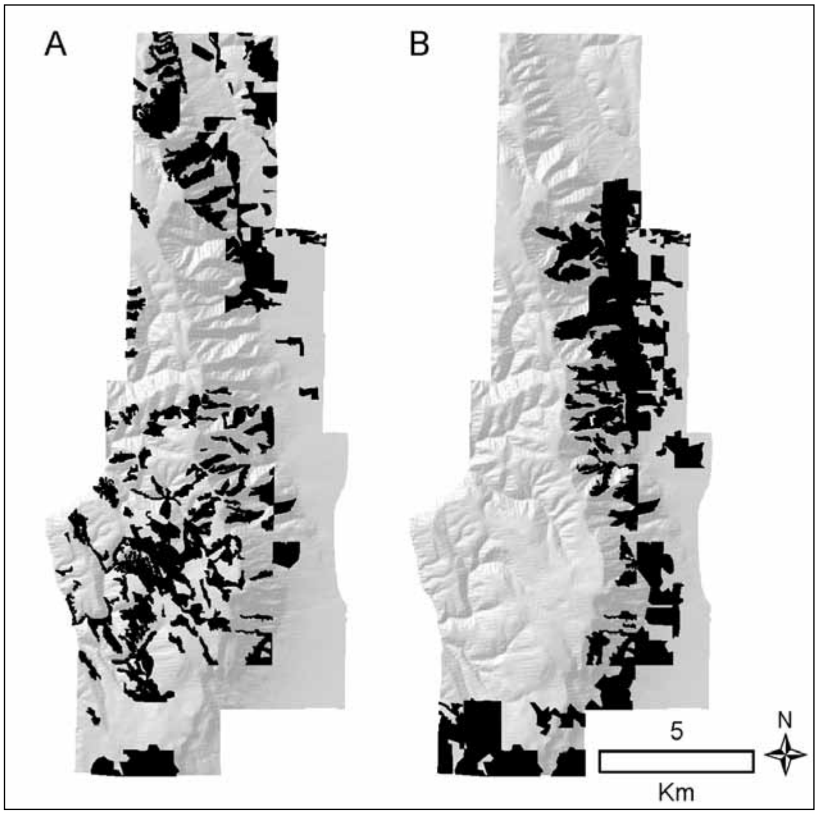
The team used mathematical models to study hypothetical fire events and estimate the resulting losses under two scenarios. "One scenario prioritized treatments in the WUI based on the density of residences, while the other scenario assigned the highest priorities for treatment to overstocked stands on adjacent wildlands containing abundant fuels and prone to crown fire," Ager explains. To set up the simulations, Ager and Vaillant obtained detailed data on the species, densities, sizes, and locations of live trees in the study area, as well as the distribution of ground and canopy fuels.

"Based on historical fire data from the surrounding national forests and input from local fire managers, we developed other simulation assumptions to reflect likely future conditions for severe wildfires, such as low fuel moisture and typical wind speeds and direction," Ager says. Communication with district fire specialists also played an important role. Although prevailing northwesterly winds had driven the spread of two severe fires in recent years, district fire managers told Ager they were more concerned about southwesterly winds that typically blow during the hottest, driest days of summer, fanning the flames of lightning-triggered fires. So, Ager incorporated winds from the southwest into the model. The simulations also included the locations of the 170 houses in the study area, as well as high-resolution topographical information, which critically influences fire behavior.

Amber Mahoney

Without treatment, fuels will continue to accumulate, posing the danger of more severe fire. Above is a site before a fuel-reduction treatment; below is the same site after treatment.

Amber Mahoney



The dark areas of the model output indicate where fuel treatments would most likely be effective, given a specific objective. In figure A, the objective was to protect and preserve large trees. In figure B, the objective was to protect structures.

Tom Iraci

Landscape-scale fuel treatments that account for multiple factors such as topography, fuel distribution, typical fire weather along with risks to human property and other critical forest resources could help promote fire resilient forests while protecting homes in the wildland-urban interface.

Then, as Ager tells it, "We simulated 10,000 random ignitions on the landscape to derive burn probabilities and fire intensities for every 30-meter pixel [100 square-foot plot] of the study area. In other words, for each pixel we estimated the likelihood of a wildfire, given a random ignition location in the study area." The modeling outputs also predicted the distribution of flame lengths for the fires that burned each pixel (an approximation of fire intensity). Using these results, along with modeling outputs that described the mortality of large trees, Ager was able to estimate the expected loss of old-growth trees under different fuel treatment scenarios. "Our work represented the first time quantitative risk analysis was applied to measuring the expected performance of fuel treatments in an ecological context," Ager notes.

Incorporating the risk data into the model set the stage for the final act: comparing the effects of various fuel treatment strategies, based on the residential protection versus forest restoration priorities. As Ager describes it, "For each scenario we tested six levels of treatment—ranging from zero to 66 percent of the landscape. Fuel treatments were modeled using the Forest Vegetation Simulator tool and consisted of thinning vegetation from below, retaining large fire-resilient trees, removing surface fuels, and underburning to further reduce combustible material."

In all, the researchers ran 120,000 simulations to test all the different combinations of variables. "The results for the restoration scenario showed that treating as little as ten to fifteen percent of the study area could diminish the loss of large trees by about 70 percent," Ager says. "Most importantly, those simulations also predicted that treatments 3 to 6 miles away from the WUI could substantially lower the chances of a wildfire reaching houses and other structures. As expected, treating stands in and around the WUI lowered burn probabilities around structures, but this effect was accompanied by higher expected losses of large trees in the adjacent national forest.

Ager says the study suggested that preferentially focusing treatments on WUIs could hamper progress toward forest restoration and other ecological goals. And without appropriate levels of treatment on forests, fuels will continue to accumulate and pose a danger for more severe fires that could sweep through WUIs, treated or not, he warns. "In contrast, designing treatments at a landscape scale—that is, accounting for factors such as topography, the distribution of fuels, and fire-typical weather, in combination with the risks to human property and critical forest resources—could well serve the goals for both restoration and WUI protection," he concludes.

MOVING TOWARD A MORE COHESIVE WILDFIRE MANAGEMENT STRATEGY

In comparing the outcomes between investing in forest restoration to achieve long-term ecological goals versus investing in the direct protection of relatively small areas of highly valued property, the study represents a step toward building optimal fire management strategies. Congress addressed this issue in 2009 with the enactment of the Federal Land Assistance, Management, and Enhancement (FLAME) Act. This law obligates the U.S. Department of Agriculture and U.S. Department of the Interior to produce a cohesive wildfire management strategy for the public lands they manage. A key element is to identify the most cost-effective ways to allocate monies for fire management. This includes assessing risk for communities, funding fuel reduction programs based on priority, and evaluating the efficiency of fuel treatments.

Ager has presented the study findings to the interagency Cohesive Strategy Working Group on fuel treatment strategies. The burn probability analysis published in the study is being expanded to a region-wide wildfire risk assessment. The burn probability analysis was expanded to a national wildfire risk assessment, as well.

"Our hope is that policymakers can use our findings to develop new budget directions that will serve to encourage the designing of fuel treatment programs that consider broad landscape factors and meet multiple objectives, beyond single-issue risk mitigation," Ager says. "The study results should also be useful to planners in justifying the allocation of funds targeted for WUI protection for meeting wider ecological restoration goals with respect to wildfire and biodiversity conservation."

"Wisdom lies neither in fixity nor in change but in the dialect between the two."
—Octavio Paz, 1990 Nobel Laureate in Literature

Amber Mahoney

Findings from this study are helping to inform decisions about cost-effective ways to restore fire resiliency to forests while protecting relatively small areas of highly valued property.

LAND MANAGEMENT IMPLICATIONS

- Fuel treatments well outside of WUIs can significantly reduce wildfire threats to property, a finding that helps inform the debate over the effectiveness of fuel treatment programs in meeting agency management objectives.
- Increasing the focus on forest-restoration activities does not necessarily compromise the protection of private property in WUIs, although management of fuels in both residential ignition zones and the surrounding landscape are important measures for mitigating risk.
- Careful landscape design of fuel treatment projects can achieve multiple management goals, in addition to reducing wildfire risk in the WUI.
- Strictly focusing fuel treatments in WUIs will detract from long-term forest restoration objectives, especially in dry-forest, fire-prone ecosystems.

FOR FURTHER READING

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