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Science FINDINGS

INSIDE

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

PAYING OUR WAY: THINKING STRATEGICALLY TO OFFSET THE COST OF REDUCING FIRE HAZARD IN WESTERN FORESTS

Chad Davis

Strategically placed fuel-reduction treatments may produce merchantable and nonmerchantable timber. Finding ways to use nonmerchantable timber in some areas may help offset the costs of fuel treatments for other areas.

IN SUMMARY

The fire hazard in many western forests is unacceptably high, posing risks to human health and property, wildlife habitat, and air and water quality. Cost is an inhibiting factor for reducing hazardous fuel, given the amount of acreage needing treatment. Thinning overly dense forests is one way to reduce fuel loads. Much of the product removed during these treatments has traditionally been considered unmerchantable, but this is changing with the growing interest in biofuel and bioelectricity. Wood can be used to produce both. Potential may exist in some areas to sell the biomass removed during thinning as a way to offset the cost of treatment and subsidize treatment in other areas.

Scientists have developed the Fuel Treatment Evaluator (FTE) 3.0. This Web-based tool allows users to simulate treatments for reducing forest fire hazard to levels specified by land managers, and it identifies the volume of biomass removed, harvesting costs, and estimated biomass value. The FTE 3.0 was used in an initial assessment of 12 Western States to identify where thinning treatments had the greatest potential to reduce fire hazard and where revenues from the saw logs and woodchips removed would offset the cost of treatment. The Oregon Forest Resource Institute and Western Governors' Association have both used FTE 3.0 in separate analyses of potential bioenergy markets.

"Where such forest lands have been protected from fire, as they are very largely through the progress of settlement, young trees have usually sprung up in great numbers under or between the scattered veterans which had survived the fires…"

—Gifford Pinchot

If there were easy profits to be made by thinning dense forests of small trees to reduce fire hazard, chances are we would have done it already. But, as it is, millions of acres of national forest across the West remain untreated. And, every summer, wildfires consume many trees, large or small, on hundreds of thousands of acres.

Fire is a natural part of the ecosystem. But when fuel levels are unnaturally high, say after a century of aggressive fire suppression, recent droughts, and insect outbreaks that have weakened or killed countless trees, a spark can lead to a fire much more severe than might have burned through the area historically.

Thinning to reduce stand density is one way to make forests more resilient to fire, drought, and insects. Thinning treatments can be designed to reduce hazardous fuel so that when a fire does ignite, it remains a lower intensity surface fire rather than becoming a more severe crown fire, moving through the tree tops. In dense stands, thinning not only lowers the amount of flammable material, it also reduces competition for water and nutrients among the remaining trees so they can better withstand a surface fire.

Historically, this type of forest management was paid for with revenues from timber sales. But as timber harvests on national forests have declined, so has the available funding for many management activities.

Today's challenge is to find a way to make these hazardous fuel treatments pay for themselves. Ken Skog, project leader at the Forest Products Laboratory in Madison, Wisconsin, and Jamie Barbour, program manager at the Pacific Northwest Research Station in Portland, Oregon, and their cooperators used the Fuel Treatment Evaluator (FTE) 3.0 to identify areas where this may be possible.

The "FTE 3.0 provides a comprehensive evaluation of potential biomass supply from fuel treatments," says Skog. "It can identify stands with high fire hazard and can apply several kinds of treatment simulations to get an estimated cost of those treatments. It's a tool to help us think strategically about managing forests and mitigating fire hazard across the West," he explains.

KEY FINDINGS

- The Fuel Treatment Evaluator 3.0 identified 23.9 million acres of timberland across 12 Western States where the cost of treatments to reduce fire hazard may be offset by the sale of products removed during treatment.
- The greatest opportunities for reducing fire hazard and offsetting cost of the treatment exist in California, Montana, and Idaho. Smaller offset opportunities exist in some areas of the nine other Western States.
- Uneven-age treatments (harvesting trees from all size classes) were found to offset costs on more acres than even-age treatments (harvesting the smallest trees first followed by progressively larger ones).

"As an agency, we want to find ways to stretch the budget," says Barbour. Fuel treatments can be expensive, labor-intensive operations. The small trees that are removed traditionally have not had much value to the wood processing industry. The current interest in bioenergy, however, is changing the equation.

In fire hazard reduction studies, "woody biomass" is a shorthand term for referring to trees too small for traditional manufacturing processes, as well as the tops and branches of larger merchantable trees. Using proven technologies, woody biomass can be processed to generate electricity. There are several emerging technologies that can use woody biomass to produce biofuels such as ethanol, but these are not currently economically viable.

If the biomass removed during fuel reduction treatments can be sold to offset the cost, more acreage can be treated to reduce fire hazard. And, as an additional benefit, a renewable energy alternative to fossil fuel may be further developed.

The problem has been identifying areas where "fire hazard reduction treatments have the potential to pay for themselves at a scale and over a long enough time to make investment in additional forest products processing infrastructure a realistic option," explains Barbour. "In many places, there isn't enough biomass to interest a sawmill or a powerplant," he says. "Part of our intent is to identify large areas where wood supply could sustain businesses to use biomass from thinning."

Eini Lowell

Unprecedented levels of fuel have accumulated in many dry western forests, thus increasing their fire hazard.

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KEEPING IT REAL

"Our ultimate goal in treating fuels is to create healthy, resilient stands in which fire can play its natural role," says Barbour. "We also wanted to present a realistic picture for Forest Service leadership of where it's feasible to carry out treatments and offset the cost," he explains.

To help accomplish this, Skog and Barbour headed up a team of researchers to use FTE 3.0 to evaluate silvicultural treatments and biomass use for reducing fire hazard in the West. They wanted the analysis to offer treatment options that could be realistically implemented in areas both land managers and the public identified as needing treatment, and realistically acknowledge market potential and capacity of current wood processing facilities.

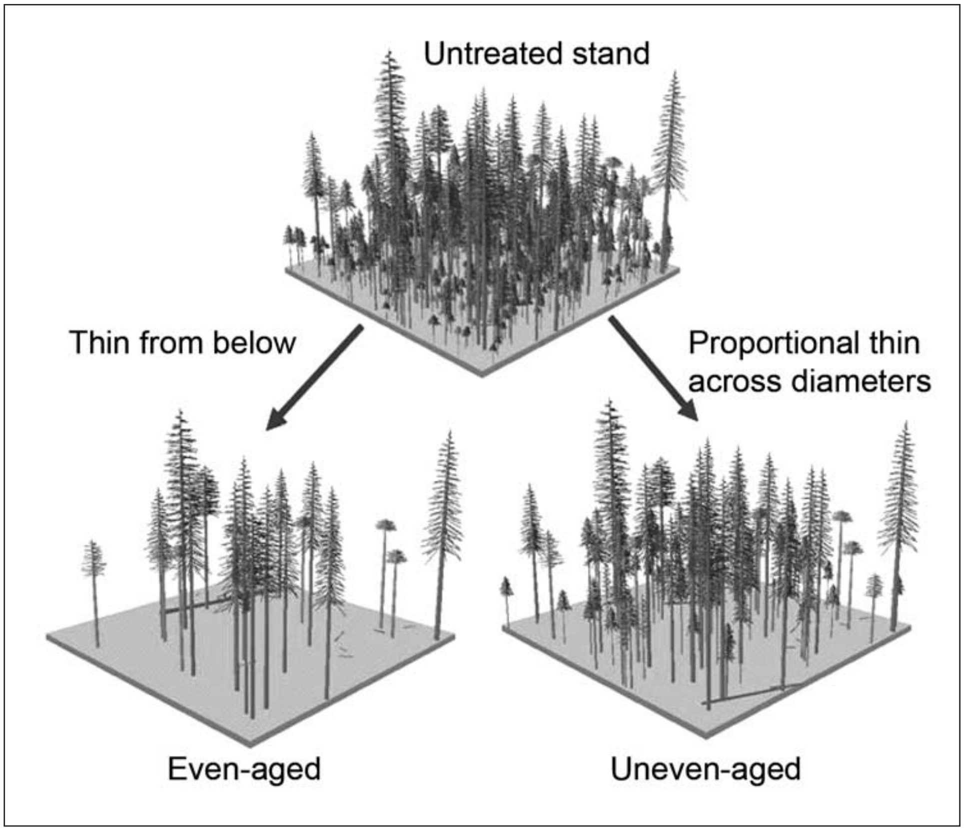
As part of this process, the FTE team met with silviculturists and fuel specialist to develop credible yet generic treatments that could be applied across the West. "This helped us simplify the process," says Skog. For example, "From the silviculturists, we learned that lodgepole pine is prone to windthrow damage, and thinning a stand of lodgepole pine could increase the windthrow hazard. Also, the natural fire cycle in that forest type is stand replacement fire." Based on this information, the FTE team decided to only include lodgepole pine within the wildland-urban interface forest in their assessment.

"The fuel specialists helped us determine that we should use a torching index and crowning index of 25 mph," says Skog. These indices refer to the 20-foot aboveground windspeed at which a crown fire can initiate and spread given a specified set of environmental conditions, like relative humidity and temperature, and surface fuel conditions. "For both indices, lower values indicate more hazardous conditions. In other words, if crown fire activity can occur even under low wind conditions, the stand is more vulnerable," explains Skog.

Barbour continues, "We excluded the moist forest areas in western Oregon and Washington. Forest Service and state foresters told us these areas were not a priority for their fuel treatment programs. We also excluded roadless areas because they're often home to threatened and endangered species and so not likely to be treated."

"We then looked at the wood processing industry to see how much bigger it realistically might get. It's not realistic to assume the industry will grow exponentially," says Barbour. Previous analyses of hazardous fuel in the West simply looked at the amount of biomass out there, explains Barbour. This is useful knowledge to have, he acknowledges, but addressing the economic feasibility and social acceptance of fuel reduction treatments is critical for successful implementation of a policy.

"This type of analysis is intended for use at the science/policy interface," says Barbour. "We have to interact with people who are going to use our information to set policy. To do that, we need to work in partnerships with people who understand the business end of things. We need to be clear about the objective and economically realistic."



The Fuel Treatment Evaluator 3.0 allows users to simulate fuel reduction treatments that will create an even- or uneven-aged stand of remaining trees.

Eini Lowell

The research team evaluated treatment options that could be realistically implemented to reduce fire hazard and produce salable products to offset the cost of treatment in some areas.

EVALUATING CONDITIONS, ESTIMATING COSTS

"Ultimately, we want to identify areas that are large enough to support commercial-scale wood processing facilities based on an objectively defined fire hazard reduction program," explains Skog. "This will allow funding for other types of treatments to be concentrated in areas where the removal and sale of wood is not the most appropriate solution to the threat of fire."

Although millions of acres of timberland are classified as high fire hazard, it appears certain factors need to be present to offset the cost of fuel reduction treatments. "We hypothesize that if you screen for raw materials, processing capacity, and community capacity, there will only be a very few places to make this work," says Barbour. "In addition, environmental considerations might make mechanical fuel treatments unacceptable in some areas where they would otherwise pay for themselves."

The scientists explain that they based their analysis on several assumptions. For example, some forest types and locations are better suited to certain fuel reduction treatments that tend to produce more merchantable timber. Thinning treatments that remove trees large enough to sell as saw logs is one way to provide an internal subsidy to cut smaller trees. The question is, how much of a subsidy is needed to lower the torching index and crowning index to a specified level?

The cost of treatment is influenced by many different factors including the slope of the ground—steeper terrain is often more difficult and hence more costly to treat—and the size and number of trees being removed. Proximity of wood processing facilities is another factor. If the facility doesn't exist, is it realistic to expect one might be built? A reliable supply of material is almost certainly a prerequisite.

REGIONAL RESULTS

In their assessment of 12 Western States, the FTE team found 59.2 million acres of timberland at risk of a stand-replacement fire. After excluding roadless areas, selected counties in western Oregon and Washington, and high-severity fire regimes outside wildland-urban interface areas, they determined 23.9 million acres had the potential to offset the cost of treatment through revenue of removed biomass.

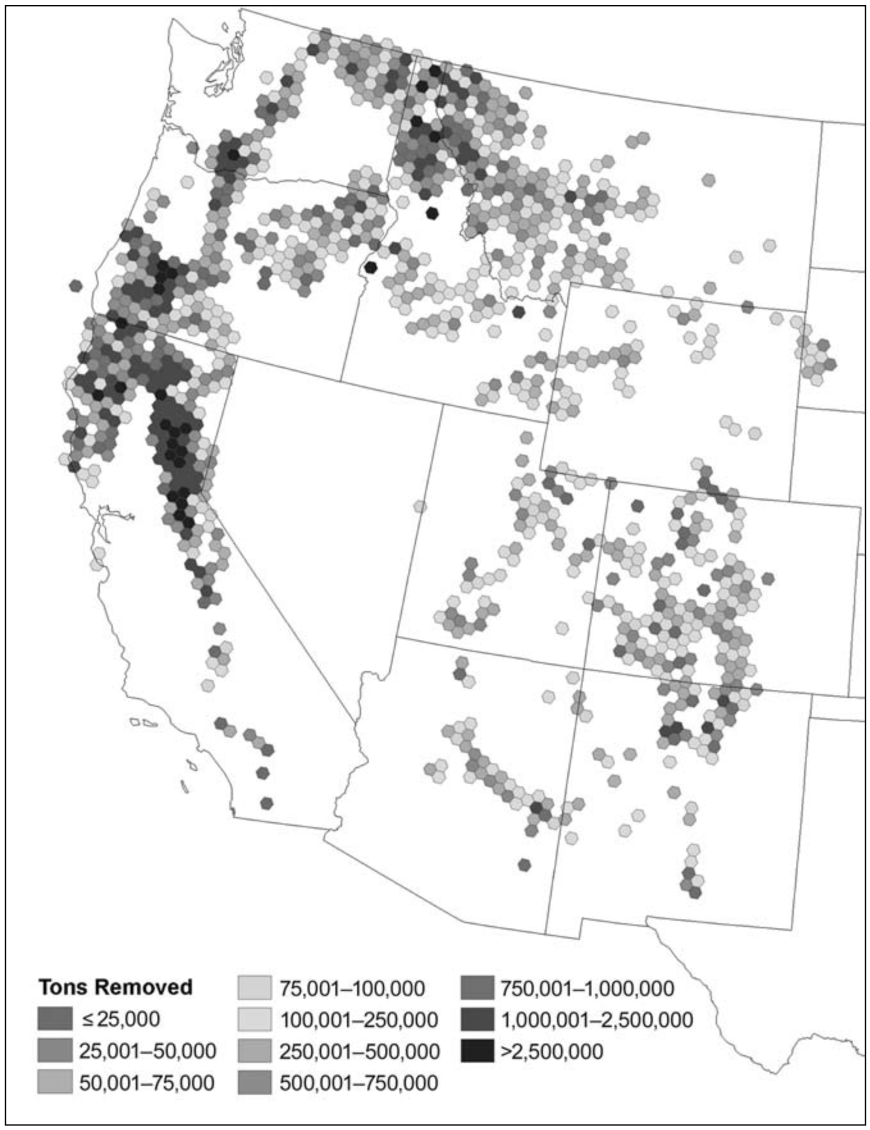
Although the greatest opportunities for offsetting the cost of the treatments exist in northern California, western Montana, northern and central Idaho, central and northern Oregon, and Washington, smaller offset opportunities exist in some areas of the other states. This result isn't too surprising explains, Skog, "because that is the most heavily forested part of the West. It is also where most of the remaining forest products industry is concentrated."

"We found the greatest opportunity for offsetting costs located near existing wood processing facilities," says Barbour. Proximity reduces hauling costs, and if new facilities, such as a biomass powerplant, need to be built to use some of the biomass, existing wood product facilities provide a critical mass of other mill residues and human expertise, explains Barbour.

The type of thinning treatment that was done made a difference in offsetting the cost of treatment. "We found that with uneven-age treatments [harvesting trees from all size classes], it's possible to treat a higher proportion of acres and have positive net revenue than with the even-age treatments [harvesting the smallest trees first]," says Barbour. In the uneven-age treatments, a greater percentage of the biomass volume came from higher value saw logs, rather than woodchips.

"The treatments we modeled resulted in pretty different-looking forest," says Barbour.

With the thinning-from-below or even-aged treatment, smaller trees are taken, which may appeal to people who are concerned about removing large trees. "But in many of the forests we were looking at, crown fires are



This Fuel Treatment Evaluator (3.0) simulation illustrates the volume of biomass that could be removed in an uneven-age treatment where no more than 50 percent of the basal area per acre is removed.

the problem and thinning from below doesn't always solve this," explains Barbour.

"When you compromise a treatment to make it more socially acceptable, you might not get the ecological effect you're looking for," Barbour says. "We need to design treatments that meet the objectives whether those objectives are ecological or social in nature."

Barbour explains that thinning is not the only way to reduce fire hazard. If minimizing the removal of large trees is a priority, supplementary treatments such as pruning and reducing surface fuels through a mechanized mastication process could be done to increase the torching index. But, he points out, "these activities are also likely to increase treatment costs and decrease net revenue per acre, and thus reduce the total area that can be treated with existing budgets."

LAND MANAGEMENT IMPLICATIONS

- The Fuel Treatment Evaluator (FTE) 3.0 uses data from 37,000 forest inventory plots in 12 Western States. The Web-based tool enables users to draw a circle on a map, choose either an even-age or uneven-age treatment, and obtain an estimate of the amount of wood that could be produced from the fuel treatments, as well as estimates of harvest costs and biomass revenues.
- FTE 3.0 allows users to choose among several thinning treatments and apply them to plots with the goal of raising both the torching and crowning indexes to more than 25 mph, or increasing the crowning index alone to greater than 40 mph.
- Many features of the analysis can be varied, such as forest type, slope, land ownership, and presence or absence of wildland-urban interface. This allows the user to adjust the tool to match specific conditions. The tool was designed for fuel planners without backgrounds in economics or wood utilization. Minimal training is required.

POCKETS OF OPPORTUNITY

The "FTE was designed for broad-scale analyses, given that it's based on Forest Service Forest Inventory and Analysis permanent sample plots that represent about 6,000 acres each," explains Skog. But it has also proven useful in evaluating what one might call the timbershed scale—the supply area for a wood products mill or group of mills.

The Oregon Institute of Forestry used FTE 3.0 this way to identify opportunities for developing an industry for wood-based bioenergy and biofuel production in the state. Various simulations examined options for potentially restoring forest health, developing an alternative energy industry, and providing job opportunities in rural communities.

Mark Nechodom

The Oregon Department of Forestry and Western Governors' Association have used Fuel Treatment Evaluator (3.0) in separate analyses to identify opportunities for wood-based bioenergy.

The Western Governors' Association used FTE 3.0 and the analysis by the FTE team as part of its Clean and Diversified Energy Initiative to identify opportunities for using wood biomass to generate electricity across the West. "Forest biomass was one part of this more comprehensive study," explains Skog. "We provided county-level supply curves. That is, we estimated the cost of providing biomass supply for electric power production for each county in 12 states."

A second study through the Western Governors' Association is using FTE 3.0 in conjunction with an agricultural component to identify optimal locations for biofuel facilities. "This study is looking at where to place biofuel facilities across the West to provide ethanol or other transportation fuel at various price levels. One goal is to identify areas where it's possible to provide biofuels to fuel transportation terminals for $2.30 per gallon gasoline equivalent," says Skog.

As the cost of oil soars, opportunities for offsetting the costs of fire hazard reduction treatments may substantially increase as well.

"Problems can become opportunities when the right people come together."

—Robert South

WRITER'S PROFILE

Rhonda Mazza is a science writer with the Pacific Northwest Research Station in Portland, Oregon.

FOR FURTHER READING

The FTE 3.0 can be found at: http://ncrs2.fs.fed.us/4801/fiadb/fire_tabler_us/rpa_fuel_reduction_treatment_opp.htm.

Oregon Forest Resources Institute. 2006. *Biomass energy and biofuels from Oregon's forests.* Chapter 2: Assessment of potential. Portland, OR. 417 p. http://www.oregonforests.org/media/pdf/Biomass_Full_Report.pdf.

Skog, K.E.; Barbour, R.J. 2006. *Forest fuel treatment and thinning biomass—timberland.* In: Western Governors Association 2006 biomass taskforce report: supply addendum. Denver, CO. p 11-22ff. http://www.westgov.org/wga/initiatives/cdeac/Biomass-supply.pdf.

Skog, K.E.; Barbour, R.J.; Abt, K.L. [et al.] 2006. *Evaluation of silvicultural treatments and biomass use for reducing fire hazard in Western States.* Res. Pap. FPL-RP-634. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 29 p. http://www.fpl.fs.fed.us/documnts/fplrp/fpl_rp634.pdf.

U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 2006. *Fuel Treatment Evaluator 3.0.* Techline. Madison, WI. 2 p. http://www.fpl.fs.fed.us/documnts/techline/fuel-treatment-evaluator.pdf.

U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 2006. *Paying for hazardous fuel treatments with revenue from removed biomass.* Techline. Madison, WI. 4 p. http://www.fpl.fs.fed.us/documnts/techline/paying-for-hazardous-fuel-treatments-with-revenue-from-removed-biomass.pdf.

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FINDINGS

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