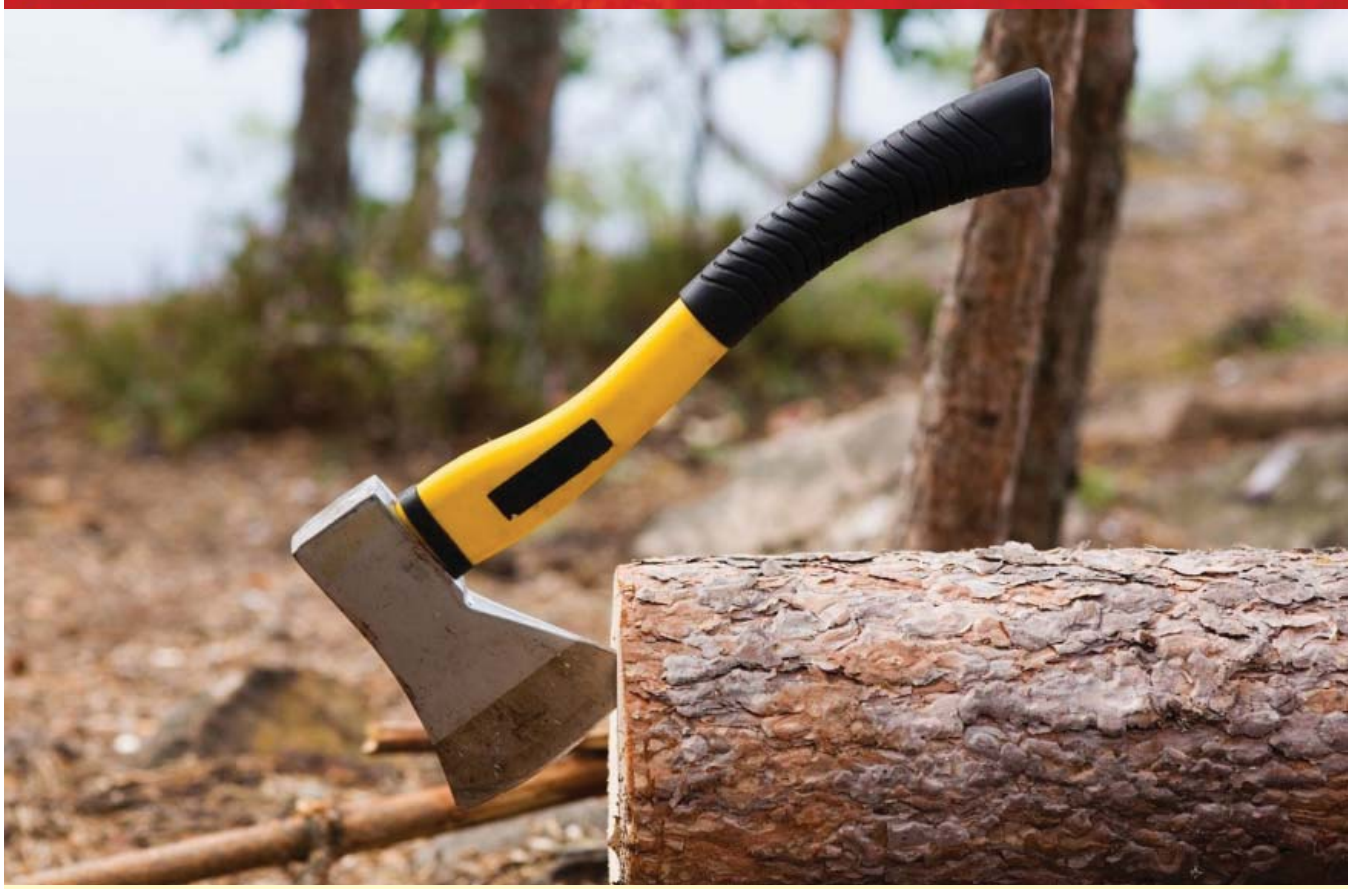
Joint Fire Science Program
Fire Science Brief
RESEARCH SUPPORTING SOUND DECISIONS



How about some clear, simple guidance on what to do with the hazardous fuels on the back forty? *Webofire* offers the sophistication of computer fuels planning models without the anxiety.

WEBOFIRE:
Easy Fuels Treatment Planning for the Model-Averse

Summary

Webofire is a model for people who tend to break out in hives at the mention of the words "modeling" or "algorithm." It provides a simple method for objectively evaluating existing wildfire hazard, prioritizing treatment needs, and estimating the potential effectiveness and costs of proposed treatments before they are carried out. *Webofire* is designed for people who plan, conduct, or oversee hazardous fuels reduction activities but who may lack training in model use or be model averse. *Webofire* allows users to take advantage of the sophisticated modeling tools that serve as workhorses for fuels reduction specialists—without the complexity. *Webofire* seamlessly integrates and simplifies fire hazard models, computer visualizations, fuel classifications, treatment algorithms, harvest/treatment cost models and product value databases into an easy to use, online tool for evaluating treatment effectiveness and cost at the project level.

Key Findings

- *Webofire* can evaluate three key elements of a fuel reduction treatment—effectiveness, cost, and appearance—in a single point-and-click model run.
- *Webofire* is most appropriately used to provide relative comparisons of treatment effectiveness, rather than precise (absolute) estimates of various fuel and fire hazard parameters.
- Resulting cost estimates have been shown to be reasonable and reliable over a broad range of conditions and partial cutting prescriptions.

Got hazard?

Over the past century, fire exclusion, logging, and successional changes in tree species dominance have resulted in high fire hazard over large areas of the western landscape. Nowhere have these changes been more significant than in ponderosa pine and dry mixed conifer forests. Drier forests over much of their range were historically maintained in relatively open conditions by frequent, low intensity fire. Effective removal of this natural process has resulted in dense, overstocked conditions, and sometimes a change in species composition from pine dominance to more shade-tolerant fir. These conditions are common in Montana and New Mexico, which have millions of acres of ponderosa pine and pine/fir forests. Wildfires of unprecedented size and intensity have raised public concern and interest in well-designed treatments to reduce hazard in areas where humans, property, or ecosystem services are at risk.

Webofire was developed for application in two western states: Montana in the Inland Northwest and New Mexico in the Southwest. Credit: http://webofire.cfc.umt.edu/webofire.

Managers and forest landowners need the capability to assess forest conditions for wildfire hazard—both to identify high-hazard areas and to prioritize stands for treatment. They also need ways to evaluate treatment effectiveness and costs, and be able to accomplish this for a range of stand conditions and treatment scenarios. As wildfires have become larger and more frequent, more and more people with varying levels of experience have undertaken these increasingly important projects. It's not just federal fire and fuels managers anymore. Private landowners, community groups, conservation organizations and extension agents are all getting involved—yet many don't have experience or training with the sophisticated tools their federal brethren rely on to evaluate existing hazard and potential treatment effectiveness.

University of Montana (UM) research professor Carl Fiedler recognized this significant gap between the hazard fuel reduction planning resources available for federal fire and fuels managers and the expanding group of people who are undertaking these projects on non-federal lands. Many federal managers receive training in the use of sophisticated computer models that can help them in planning and decision-making. Most others don't. Fiedler used his own experience with computer models as inspiration for the development of a simpler, interactive, web-based system for assessing fire hazard and evaluating treatment effectiveness. The program—called *Webofire*—harnesses the power of the sophisticated models while hiding their complexity. Fiedler holds a Ph.D. in Silviculture and Forest Ecology, yet admits being challenged trying to keep up with the complex and ever-changing models employed in fire hazard assessment and treatment planning. "I don't find them very user friendly," he says, "they're highly technical because of course they have to be technically based. But many who develop models just have a different way of thinking. It's all very easy for them."

"A lot of people out there have no background with models or lack access to them. The reality is that this is the majority of people doing the work," he continues. "They have no tools. They're just out there doing it. Some of them are doing a pretty darn good job because they have a seat-of-the-pants feel for it or they have a lot of trial-and-error experience. But there are a lot of the others who are just getting started, or have a back forty and are just now realizing that they need to deal with it."

Fiedler cites his home state of Montana as a prime example of an area where these stewards need help. He points out that over the last five years approximately 80 percent of the forest management/harvest activity in the state took place on non-federal lands. The work is performed by consultants, community groups, non-governmental organizations, private and industrial landowners, tribal folks, and state service people. "You name it. There are all kinds out there," he says.

But generally they're not comfortable with models and many aren't using them. However, they certainly care about doing a good job in every aspect of it and they could benefit from some of the existing technical tools. They go out and do the best job they can regardless of whether or not they have all the information they need to design effective treatments."

He also points out that because they lack technical information, people may not be meeting their objectives and not even be aware of it. "They might only take a few trees to be sure it looks good, but they haven't moved the dial back on the fire hazard at all," he says. "*Webofire* provides some options for looking at different scenarios, even providing illustrations of them, so folks can get a better feel for the effects of various treatments before they apply them, make more informed decisions, and be more successful."

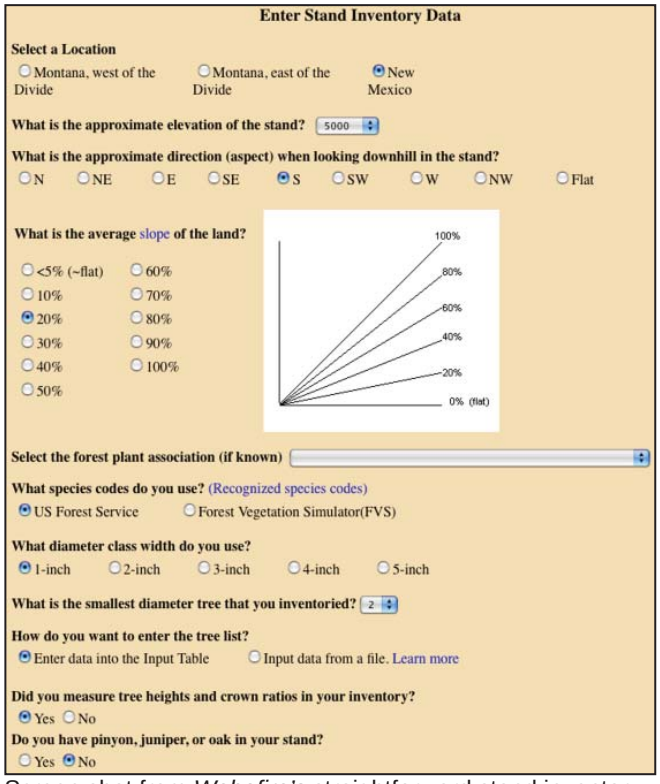
A look inside

Webofire was specifically developed for three locations: western Montana, eastern Montana, and New Mexico, but it can be cautiously extrapolated for use elsewhere. The western Montana variant can be used in the ponderosa pine and dry mixed conifer forest types in Idaho, the eastern Montana variant is applicable to ponderosa pine in South Dakota, and the New Mexico variant to ponderosa pine and dry mixed conifer types in Arizona and southern Colorado. *Webofire* captures the computing power of several workhorse fire and fuels models by seamlessly linking stand inventory data with the Fire and Fuels Extension (FFE) and the Fuel Characteristic Classification System (FCCS) to estimate fire and fuel potentials. It also taps the Forest Vegetation Simulator (FVS), the National Volume Estimator Library and the Stand Visualization System (SVS), which generates illustrations depicting stand density, structure, and species composition before and after treatment based on tree data input by the user. The images produced by SVS, while abstract, provide an easily understood representation of stand conditions and help users evaluate alternative management treatments. *Webofire* does not require that users provide data on surface fuels. Instead users are directed to photos representing high, medium, and low surface fuel loadings for ponderosa pine and dry mixed conifer forest types, allowing the user to interpret which fuel loading best represents their conditions of interest. The models embedded in *Webofire* are automatically upgraded as new versions are released.

Pay no attention to the algorithms behind the curtain

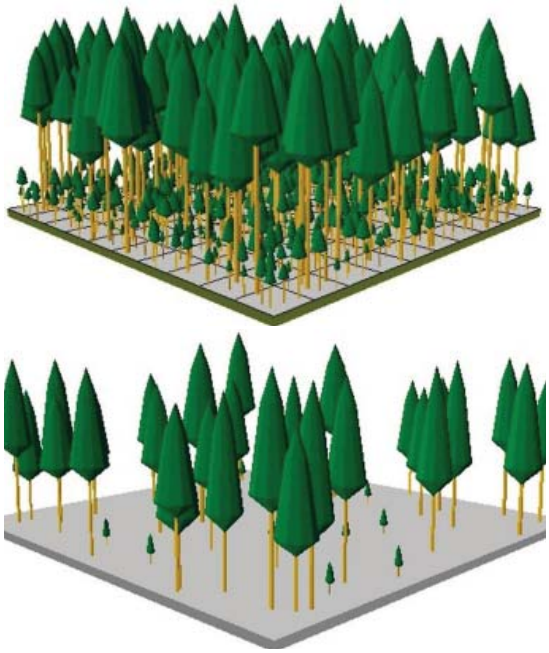
Webofire provides the following three outputs:

- Estimates of fire hazard associated with existing forest conditions in terms of fire behavior potential, crown fire potential, and available fuel potential.
- Estimates of the effectiveness of the selected treatment alternative in reducing hazard.
- Estimates of net revenue associated with the selected treatment alternative.



Screen shot from *Webofire's* straightforward stand inventory entry interface.

The program leads you through the steps of data entry or allows you to skip dealing with data altogether by providing an option to select an illustration and description that best depicts your forest conditions. Next you select your location, tree species, stand structure and over/understory tree diameters.


Users can enter detailed data or simply select from a library of illustrations like these to represent stand composition and structure for the forest of concern.

You can then select from three types of treatment prescriptions:

1. Thin-from-below, in which all trees below some user-specified diameter limit are cut.
2. Proportional removal, in which a specified proportion of the stand basal area is cut from the smallest trees on up.
3. Comprehensive treatment, in which a specified level of basal area per acre is reserved and distributed by diameter class and species—all other trees are cut.

Once a treatment option has been selected, the embedded algorithms orchestrate the treatment generating a cut-tree list, a leave-tree list, and before/after illustrations of the stand. The post-treatment stand condition (represented by the leave-tree list) is then classified into the appropriate Fuel Characteristic Class (FCC). The change from the existing (pretreatment) condition to post-treatment condition provides a quantitative estimate of treatment effectiveness in terms of fire behavior, crown fire, and available fuel potential.

Show me the money

Treatment costs and potential revenue from products are an important consideration for many landowners, but are highly variable based on things like stand structure, geographic location, and market conditions. *Webofire* provides users a generalized estimate of net revenues or costs per acre associated with treatment. Projects in New Mexico and areas of eastern Montana that are distant from markets and lack infrastructure will typically be "in the red"—and often quite costly. Conversely, in western Montana, multiple markets and greater availability of skilled woods workers with efficient equipment results in a higher probability that projects will break-even or be "in the black." Trees cut as part of the selected treatment in *Webofire* are converted into the highest value product consistent with tree size, species, geographic location, and distance to processing facility. The net revenue estimate is calculated as revenue (if any) received for timber products, pulpwood, or biomass, minus the actual costs of doing the treatment. Costs are estimated using a harvest cost model tailored to geographic location, forest type, stand conditions, volume and size of trees removed, slope/harvest system, distance to mill/processing facility, and current market conditions. Estimates also include costs of cutting or masticating unmerchantable trees and removing them from the stand or piling-and-burning, broadcast burning, or chipping them on-site. Project layout and road-building costs (if any) are not included.

Costs were collected by Charles Keegan, director of UM's Bureau of Business and Economic Research (BBER), using an expert opinion approach and real-world treatment scenarios. The experts surveyed were logging company operators and managers directly involved in harvesting timber and performing the activities required to accomplish treatment objectives. Costs of treating slash were gathered from land management agencies and the private sector. Resulting estimates have been shown to be reasonable and reliable over a broad range of conditions and partial cutting prescriptions.

Fiedler says, "We do this periodically to update it, but it's still something that we qualify a bunch. The net revenue estimate should be viewed as a ball-park figure. The variability inherent in woods work, rapid changes in market conditions and the costs of fuel make precise estimates difficult. But the cost estimator is still a nice feature to show whether a treatment is going to be really costly, or if product removal might cover some or all of the costs." *Webofire's* product value databases are maintained and updated by UM's BBER and are available for sawn products, veneer logs, pulpwood, house logs, posts and poles, and specialty products such as vigas and latillas.

Treatment:

Proportional removal - remove 30 percent of basal area from the smallest trees on up

Stand Density:

------	Untreated	Treated
Basal area/acre	110.0	77
Trees/acre	609	178

Fire Potential:

------	Untreated	Treated
Crowning index	23	34
Torching index	40	90+

Fuel Characteristic Class (FCC): (For more information click here.)
Click Surface Fuels links (High, Medium, Low) to see photos of different fuel loadings.

Treatment	Surface Fuels	Fire Behavior	Crown Fire	Available Fuel
Untreated	Medium	2 (Low)	6 (High)	4 (Medium)
Treated	Low	1 (Low)	4 (Medium)	2 (Low)

Cost/Revenue Factors:

Project area size: >20 acres
Net Revenue per acre: -$300 to -$800
Net revenue estimates are most appropriately used for relative comparisons between and among treatments (more than or less than), rather than as actual expected costs, and may be negative. Projects in steep or rocky terrain, or that require extra work or care, such as pruning, completely cleaning up the slash, working around sprinkler systems, or removing trees that overhang buildings or power lines, may cost more.

Screen shot of *Webofire's* treatment summary.

Best for relative comparison of treatments

Fiedler reports that feedback has generally been very positive and that people seem to be using *Webofire* the way he envisioned it—for making informed decisions about the trade offs of different treatments—whether they're doing the work themselves or hiring it out. Fiedler cautions that estimates generated by models in general and *Webofire* in particular—whether of fire behavior, fuel potential, or treatment costs—are most appropriately used for relative comparisons between and among treatments (more than or less than), rather than as actual values or precise estimates. Because the level of input detail and assumptions determine both pre and post-treatment conditions, differences or changes in fire behavior and fuel potential should provide a reasonable estimate of treatment differences and effectiveness.

Fiedler emphasizes that *Webofire* only addresses the fuels and fire hazard considerations of a treatment decision, and many other factors may influence the design or selection of an appropriate stand treatment. While fuel

and fire hazard reduction may be the primary factor, other influences include esthetic considerations, cost of treatment, tree growth and vigor, insect and disease resistance, regeneration of shade-intolerant species, wildlife habitat, and other ecological effects, both positive and negative. *Webofire* is not designed to evaluate treatment effects on—or relationships with—these other factors.

Sophistication simplified

Webofire is complete as envisioned in its current form. Fiedler says, "It was a huge amount of work and after a while it became a labor of love, because until you get all the pieces working together, you have nothing. It's not like we could get it half done and use it half way. It had to be complete for it to work at all. It took a lot of long nights." Users are greeted with easy, engaging instructions, simple steps, thorough, plain language explanations and a glossary. Anyone unfamiliar with technical indexes, cryptic acronyms or file extensions isn't left out in the cold. For example, when results for crowning and torching indexes appear they come with a brief and clear explanation of what it all means rather than expecting someone who may be new to the nuances of fire behavior to understand. For sheer entertainment value, Fiedler's team was not without a sense of humor as they designed the *Webofire* interface.

Users are greeted with easy, engaging instructions, simple steps, thorough, plain language explanations and a glossary.

A spinning yin and yang graphic soothes the impatient while the program generates treatment alternatives and tree lists, and an energetic, animated monkey cranks an odometer while reports are processed. "I think the general approach of trying to wrap sophisticated things in user-friendly packages has a lot of potential," he concludes. "That was our goal, to make the sophisticated available in a simpler way for users. We wanted to further leverage that concept by seamlessly linking several models to allow users to evaluate existing hazard, apply alternative treatments, and evaluate post-treatment conditions in an easy, visual, point-and-click way. I think it's the future. I can see that maybe a modeler might yawn and roll their eyes at that idea—but there are a whole lot of people who would really benefit from what they do—if they weren't intimidated by it. This was an attempt to reach that crowd."

Management Implications

- *Webofire* evaluates stands based on their condition, location, and terrain characteristics. It does not evaluate the larger landscape in which the stand resides.
- The most precise estimates will come from entering or uploading recent stand inventory data from the stand(s) of interest—specifically trees per acre by species and diameter class, and associated average height and average crown ratio for each class.
- Estimates derived using the stand description/computer illustration input option will have more uncertainty associated with them.
- *Webofire* only addresses the fuels and fire hazard considerations of a treatment decision. Many other factors may influence the design or selection of an appropriate stand treatment.
- Stand conditions are evaluated with select model defaults/assumptions that are available on the website.
- Net revenue estimates are most appropriately used for relative comparisons between and among treatments (more than or less than), rather than as actual expected costs.

Further Information: Publications and Web Resources

Webofire Website: http://webofire.cfc.umt.edu/webofire/(ze31dj55tiwoeya1wlkv0sfx)/Default.aspx

Scientist Profiles

Carl Fiedler is a Research Professor of silviculture and forest ecology (retired) with the College of Forestry and Conservation at the University of Montana. His research interests include multi-resource management and operations in second-growth forests, principles and applications of uneven-aged silviculture, forest and ecological restoration, evaluation of the effectiveness and costs of hazard reduction treatments, and old-growth stand dynamics.

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Results presented in JFSP Final Reports may not have been peer-reviewed and should be interpreted as tentative until published in a peer-reviewed source.

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JFSP *Fire Science Brief* is published monthly. Our goal is to help managers find and use the best available fire science information.

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