Pacific Northwest Research Station

Science Update

REDUCING FIRE HAZARD: BALANCING COSTS AND OUTCOMES

IN SUMMARY

Massive wildfires in recent years have given urgency to questions of how to reduce fire hazard in Western forests, how to finance the work, and how to use the wood, especially in forests crowded with small trees.

Scientists have already developed tools that estimate fire hazard in a forest stand. But hazard is more difficult to estimate at a landscape scale, involving concepts from forestry, fire science, economics, ecology, and geography. Forest Inventory and Analysis (FIA) BioSum is a tool that integrates these concepts and connects existing computer models. People use it to analyze the effectiveness of fire hazard reduction and the financial feasibility of fuel treatments—using merchantable wood for solid wood products and low-value wood as biomass to generate power—under a range of product prices and fuel-treatment prescriptions. FIA BioSum helps users find solutions with a reasonable balance between acceptable costs and desired outcomes.

Work that can pay for itself is more likely to get done. If work to reduce fire hazard returned net revenue and low-value wood was used to generate electricity, the solution would appear promising.

Is there a small-wood alchemy that can do all this? Scientists from the Pacific Northwest (PNW) Research Station developed FIA BioSum and related models to answer this question. These tools, described inside, can help people find a balance between the outcomes they want and costs of the fuel reduction.

How can we reduce fire hazard for entire landscapes?

Millions of forested acres in the West could be treated to reduce fuel loads and fire hazard. Treating all acres would be virtually impossible. To set priorities, people need information on the relative reductions in hazard that would be possible with alternative actions, what kinds of forests would result from the fuel treatments, what could be done with the wood removed, and what the financial feasibility would be.

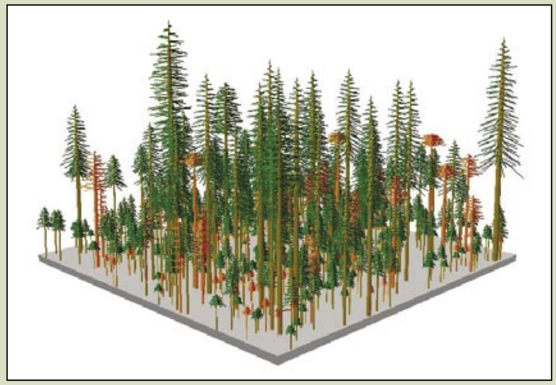
The scientific problem is that these kinds of information belong to different realms. The units of measure are not easily compatible. Forest inventory databases, forest growth-and-yield models, maps of road networks, fire hazard indicators, economic analyses of treatment costs, and so on, all use numbers, yet they come from quite different analytic approaches. For example, road maps are spatial and financial analyses are not.

Also, it's easy to determine how much thinning and fuel treatment would be needed to reduce fire hazard in one stand, but more difficult to determine at a landscape scale. The FIA BioSum analysis tackles landscape-scale questions: How many acres are there across the landscape where treatments would lower fire hazard? What would the costs and revenues be? Is it possible to balance costs and outcomes?

Types of Fuel Treatments

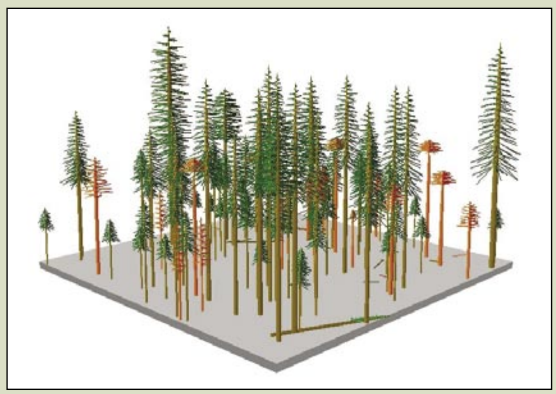
Fuel treatments are classed into two main types: crown-fuel reduction and ladder-fuel reduction. In both categories, hazard is reduced only if ground fuels are treated also. These fuels include existing underbrush and dead wood as well as down wood and slash created by the thinning. Both graphics show a 1-acre plot. Treatment goals typically include a residual basal area target and often a constraint that no trees larger than a specified diameter will be harvested.

"Basal area" is the total cross-section area of all live trees in a given area, usually expressed in square feet per acre. It is calculated by measuring diameters of individual tree trunks, figuring their cross-section area, and then calculating the total per acre. In practice, foresters use established formulas that calculate basal area from sample plots.

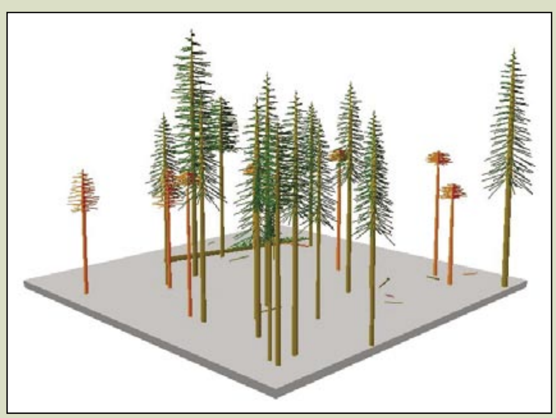


Untreated stand.

Crown-fuel-reduction treatment. Stands are thinned across all tree sizes, small and large, with emphasis on removing small trees (70 percent of the basal area removed is trees less than 14.5 inches diameter at breast height (d.b.h.). Goals are to create canopy gaps, reduce total material in tree crowns, create thrifty vigorous stands, reduce competition-related mortality, and lower fire hazard. This example shows a treatment with 125 square feet per acre residual basal area.



Ladder-fuel-reduction treatment. Stands are thinned from below to remove small-diameter trees and underbrush, breaking fuel "ladders" that allow ground fires to move into the crowns. Goals are to reduce ladder fuels, the risk of torching (fire reaching individual tree crowns), and the density of tree crowns so if fire does reach them, it will be unlikely to carry through the whole stand as a crown fire. This example shows a treatment with 80 square feet per acre residual basal area.



Graphics by Glenn Christensen. Stand Visualization System developed by Robert J. McGaughey, PNW Research Station.

People want some analysis results in dollars and cents, such as thinning costs; some results in fire science terms, such as changes in fire hazard indicators; and some results in geographic terms, such as potential locations for processing the wood removed. Scientists from the PNW Research Station developed tools to bridge these realms and produce scientifically sound answers.

"FIA BioSum is a framework that integrates existing computer models," explains Jeremy Fried, research forester in PNW Research Station's FIA Program. FIA BioSum analyzes the financial feasibility of fuel treatments—using merchantable wood for solid wood products and low-value wood as biomass to generate power—under a range of product prices and fuel-treatment prescriptions (see sidebar on page 5).

Several factors are key in the economics of small-tree harvest and utilization. FIA BioSum can do an integrated analysis of these factors.

Its development involved scientists from three Station programs who brought expertise from their own disciplines. "Jeremy contributed an understanding of the FIA data and how it can be integrated with other data types such as road density, haul distances, and processing sites," explains Jamie Barbour, Program Manager for the Station's Focused Science Delivery Program. "Roger Fight, a research economist, figured out how to calculate the financial returns from thinning, and I focused on what types of material would be produced by thinnings and how the material could be used." Glenn Christensen, research forester, solved the challenges of integrating a forest growth-and-yield program with FIA BioSum.

Purpose of PNW Science Update

The purpose of the *PNW Science Update* is to contribute scientific knowledge for pressing decisions about natural resource and environmental issues.

PNW Science Update is published several times a year by:

Pacific Northwest Research Station
USDA Forest Service
P.O. Box 3890
Portland, Oregon 97208
(503) 808-2592

Our mission is to generate and communicate scientific knowledge that helps people understand and make informed choices about people, natural resources, and the environment.

Valerie Rapp, writer and editor
vrapp@fs.fed.us

Send change of address information to
pnw_pnwpubs@fs.fed.us

Forest management to reduce fire hazard falls into two basic treatment categories (see sidebar on page 2). "More complex approaches are now being explored to achieve both stand vigor and fuel goals in one prescription," comments Barbour. For example, foresters can specify the spacing between trees and add other requirements to the residual basal area target. Ecological restoration approaches are intended to produce stands that are resilient to fire, insects, and diseases and can regenerate themselves with indigenous tree species.

Key Findings

- The economics of proposed fuel-reduction projects differ widely, depending on the assumptions used and treatments specified. Only an integrated analysis of all the factors will give accurate answers to feasibility questions.
- FIA BioSum can simulate treatment options and assess the financial feasibility of fuel treatments—using merchantable wood for solid wood products and low-value wood as biomass to generate power—under a range of product prices and fuel-treatment prescriptions. It can also analyze the financial feasibility of possible locations for biomass or other wood-processing plants. Thus FIA BioSum allows users to find solutions with a reasonable balance between acceptable costs and desired outcomes.
- The decision on harvest of merchantable trees is not just an economic or ecological question. In many landscapes, the decision is also fundamental to how much fire hazard is reduced. Crowded, midsize trees (10 to 21 inches d.b.h.) affect fire hazard by creating a canopy with high crown bulk density. The tops and limbs of midsize trees are much of the total fuel load. In fact, these tops and limbs usually add up to more biomass than the small trees removed from the same stand.
- The small trees, however, are much more expensive to remove than the tops and limbs of midsize trees. Nevertheless, if part of the treatment goal is to reduce the hazard of fire carrying into tree crowns, small trees would have to be removed.
- Forests differ among ecoregions, and effective fire hazard reduction treatments will differ as well. In parts of northeastern Oregon's Blue Mountains, the removal of only small trees would reduce fire hazard significantly. In southwestern Oregon forests, fire hazard would not drop to an acceptable level unless some trees greater than 7 inches d.b.h. are removed along with smaller trees.
- In southwest Oregon, wood utilization can pay the way toward fire-resistant forests in some cases. It is, however, the merchantable trees greater than 7 inches d.b.h. that pay the way, not the low-value biomass.

The STHARVEST program is used to estimate logging costs for small-diameter stands or the small-diameter trees in a mixed-size stand.

In the debates over fire hazard reduction, agreement begins—and ends—with the necessity of removing some small trees. Many small trees, however, are not merchantable (commercially valuable). Merchantable trees are sometimes defined as those at least 7 inches in diameter at breast height (d.b.h.), the smallest size that 2 by 4s can be cut from, or larger. In reality, however, the difference between a profitable tree and a money-losing tree involves more than just tree diameter. The two major costs are the logging cost (from standing tree to landing) and haul cost (from landing to market). The logging cost is determined by several factors, such as the terrain, yarding system, and yarding efficiency; tree size is one of several factors influencing yarding cost. The main factor for haul cost is the distance to market; size of the logs on the truck doesn't make much difference in cost.

The debate over what to do with low-value trees (many of them small) turns on several economic questions.

With all costs calculated, 7-inch d.b.h. trees may pay their own way when cut on gentle slopes with a short haul distance. But in many Western forests, the landscape is anything but gentle, and it's a long way to a mill. In some regions trees must be considerably larger than 7 inches d.b.h. to be merchantable. The debate over what to do with low-value trees (many of them small) turns on several economic questions.

What does it cost to remove small-diameter trees?

Work that can pay for itself is more likely to get done, yet most small trees blamed for fire hazard are not merchantable. The pole-size logs are too small or too knotty for most wood products, and hauling them to mills for chipping is too expensive given the low chip prices in 2004.

Several factors are key in the economics of small-tree harvest and utilization. FIA BioSum can do an integrated analysis of these factors. (See the case study on pages 7 and 8.)

Cost of harvest. The costs of getting small trees cut and to the landing are generally higher than costs for harvesting larger trees. Fight and Bruce Hartsough, professor at the University of California at Davis, developed a program for **S**mall **T**imber **Harvest**, called STHARVEST. Fight, Fried, and Barbour worked together to integrate STHARVEST into the FIA BioSum framework. The Windows-based, public-domain software can be used to estimate costs of small-tree harvest, either in pure small-tree stands or as one part of a mixed-size stand. It can be used by planners with little background in forest engineering to estimate harvest costs in U.S. dollars per 100 cubic feet or per green ton of removed wood, for clearcutting or partial cutting. Costs can be estimated for six harvesting systems over a wide range of stand conditions: two ground-based systems and one cable system with manual felling; and two ground-based systems and one cable system with mechanical felling. Calculations are based on engineering cost studies.

STHARVEST runs with Windows 98 and newer operating systems and is documented in PNW-GTR-582. It can be downloaded for free, along with a users guide, from the Web page http://www.fs.fed.us/pnw/data/stharvest/stharvest_home. The software will be supported, with upgrades under development.

Transportation costs. FIA BioSum calculates haul costs for getting wood from the logging landing to hundreds of existing and potential processing sites. "We used a GIS (geographic information system) road layer to estimate the transportation costs," explains Fried. "FIA BioSum assigns different costs for miles traveled on forest roads and paved roads, based on the speed limits for those road types. Haul costs are added to the onsite harvest costs." FIA BioSum can also be used to identify the most promising locations for constructing new wood-processing facilities, another spatial analysis.

Barry Wynsma

Product values. FIA BioSum calculates wood values by using log sizes and prices for standard wood products such as lumber. Although small trees can be used for some specialty products such as flooring and paneling, markets for these specialties are limited. Wood from tops, limbs, and small trees may have some value for biomass power generation (see sidebar at right).

Subsidies. If the fuel treatments will not pay for themselves but could save major firefighting costs and reduce the loss of resources, subsidies would be one approach for getting the work done. Whether or not subsidies should be used is a policy question. Scientists point out that different types and sources of subsidies are possible, depending on where the cost problem is. If small-tree harvest is uneconomical, a subsidy could be used to treat the woody material onsite, either grinding trees up or burning them onsite to reduce the fire hazard. Tax credits or price supports can be used as incentives to get fuel reduction projects done.

Barry Wynsma

Transportation costs make a big difference in overall costs for harvesting small-diameter trees.

If high transportation costs are the issue, a transportation subsidy could be considered. “If the choice is between burning onsite or hauling to biomass plants where electricity is generated and smoke controlled, a transportation subsidy might be effective,” comments Barbour.

Biomass for power plants is most likely to pay for itself when harvest and transportation costs are low, for example, when the wood is harvested from flat ground near roads. This is not the case, however, for most low-value wood in Western States. Generally, analysis shows that biomass power will be more expensive than power from other sources. “Changes in electricity prices would not change results significantly,” says Barbour, “unless electric rates skyrocketed from what they are now.”

Power companies may have reasons to finance biomass energy. In the Pacific Northwest, Portland General Electric has committed to buy some biomass energy, and the utility might pay more for that component of its power mix, to meet its commitment. In northern California, utilities can charge 1 cent more per kilowatt-hour for green energy, improving its financial viability. In Arizona, power companies are required to have a certain amount of renewable energy in their power mix, so they will take a loss on generating biomass power to comply with regulations.

Barbour points out that FIA BioSum can estimate subsidy levels for different silvicultural prescriptions. The program can estimate the benefits of various types of subsidies or incentives and how much would be needed for particular areas.

Biomass as a Renewable Energy Resource

Biomass is the total weight of organic matter in a given area. In this publication, biomass refers to the total weight of living and dead low-value wood in a stand, including all low-value trees, and the tops and limbs of merchantable trees.

Biomass power is electricity produced from this low-value wood. The most common method of generating biomass power is to burn biomass in a boiler and produce steam, which turns a turbine connected to a generator, producing electricity. Other technologies, some experimental, use gasifiers, fuel cells, and other methods. Under development are biorefineries, which would make many biomass products, including electricity, heat, fuels, and useful chemicals, all at one location.

Like any power generation plant, biomass plants need emissions control to meet air quality standards and must be connected to the power grid. The plants are expensive to build, so a fuel supply should be available in the area for decades to justify the investment. Electricity from biomass plants is more expensive than power from standard sources because the biomass, a mixture of wood chips, bark fragments, and foliage, requires more preparation and handling and has less concentrated energy than fossil fuels. In the right situations, biomass plants are viable. In northern California, a 53-megawatt biomass plant operating since 1988 provides enough electricity for nearly 50,000 homes.

New small, mobile, wood-to-energy technologies are in trial operation. Potentially, these mobile biomass units will produce electricity and heat for small enterprises, rural homes, and schools. One system uses advanced downdraft gasification technology to convert the energy in wood chips to a clean, gaseous fuel that can be used by many engines, including cars. The USDA Forest Service Forest Products Laboratory in Madison, Wisconsin, is working with the federal National Renewable Energy Laboratory to control emissions on mobile units and bring down costs of building and operating the units. The technologies are not yet commercially available.

Jamie Barbour

Overstory trees remain standing after this hazard reduction treatment in southwestern Oregon's Applegate Adaptive Management Area. Slash treatment was incomplete when photo was taken.

The forests crowded with small trees also have bigger trees. One possible way to pay for the unprofitable work of removing smaller trees is the harvest of merchantable trees, the midsize and large trees. Harvest of merchantable logs changes the results on financial feasibility.

In many landscapes, fuel treatments may not reduce fire hazard much unless some merchantable trees are removed also.

Another question needs to be asked. Some people believe that the removal of small trees alone will reduce fire hazard to an acceptable level. But is this true?

Are there any reasons to take big trees?

Whether or not to cut merchantable trees is one of the hottest issues in debates on reducing fire hazard. Some people want policies that prohibit any harvest of trees over a specified diameter. But, scientists point out, such a blanket policy would have significant consequences on both fire hazard reduction and the economics of fuel reduction. "The choice of policy matters," says Barbour.

In many landscapes, fuel treatments may not reduce fire hazard much unless some merchantable trees are removed also. On the economic side, the harvest of merchantable trees does not always pay the full costs of removing small trees. Two landscape-scale studies show some of the differences among forests.

For both studies below, two objective measures of fire hazard were used: the torching index, which is the windspeed that carries fire into tree crowns, and the crowning index, which is the windspeed that sustains a crown fire. The higher the windspeed required to torch or crown, the higher the index number. For both indices, higher numbers mean lower fire hazard—in other words, more wind is needed to produce severe fire behavior. Thinning from below is most likely to improve the torching index. To improve the crowning index, crown bulk density must be reduced.

The Blue Mountains Demonstration Project analyzed forests, fire threat, and fuel reduction treatments on a landscape level for the Blue Mountains of northeastern Oregon, by using tools available before FIA BioSum was fully developed. In the Blue Mountains vegetation assessment, commercial potential on federal forest lands was defined as more than 400 cubic feet per acre of trees larger than 7 inches d.b.h. The analysis also assumed that no trees larger than 21 inches d.b.h. would be harvested. Several management alternatives were studied.

In the Blue Mountains study, scientists found that the removal of only small trees would reduce fire hazard substantially. Merchantable trees did not have to be removed to reduce the crown bulk density (and increase the crowning index) to acceptable levels. The harvest of merchantable trees would pay for the treatment costs on only about 40,000 acres, or 3 percent, of the federal forest acres. If restrictions on harvesting trees greater than 21 inches d.b.h. were removed, the acres that could be treated without a subsidy might increase to about 80,000, still only 6 percent of the total acres.

In the FIA BioSum pilot study for the southwestern Oregon subregion, scientists found that the removal of only trees less than 7 inches d.b.h. would not reduce the crown bulk density to an acceptable level. Forests in southwestern Oregon typically had more merchantable trees per acre than the Blue Mountains forests. For the southwestern Oregon forests, removal of some trees greater than 7 inches d.b.h. would be a fuel load and fire hazard issue, not just an economic issue. This analysis is described in the case study (sidebar at right).

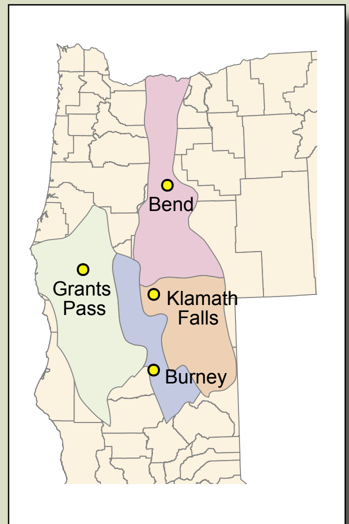
With so many variables, how can people figure out what options are best in their area?

The strength of FIA BioSum is analyzing multiple variables at a landscape or regional level. Fried, Fight, and Barbour did a pilot study of the full FIA BioSum framework as a test. The uses of FIA BioSum are best understood through a detailed examination of the case study.

Case Study: Oregon-California Pilot Study

The Oregon-California pilot study, known as "ORCA4" for the four-ecoregion study area, tested if the forestry, fire science, economics, ecology, and geography concepts integrated into the FIA BioSum framework could indeed yield useful results. Results given below are preliminary.

The ORCA4 study area included about 28 million total acres (see map). About 21 million of those acres are forested; this number includes all forest land ownerships, federal, private, state, and tribal. Field data were available from 6,168 forest inventory plots in the study area. Roadless areas and protected areas such as designated wildernesses were excluded, assuming no fuel reduction work would take place on these acres. All other acres were assumed to be available.



Most of the ORCA4 study area is significantly or moderately altered from its historical fire regime condition class. This means that over the last century in these forests, changes from historical fire patterns have resulted in fuel buildups, increased insects and diseases, and reduced stand vigor and diversity. The risk of losing key ecosystem components to severe fires is considered high.

FIA BioSum was used to evaluate multiple prescriptions. The nine prescriptions were divided between the two basic treatment categories, crown fuel reduction or ladder fuel reduction. All prescriptions were recommended by fire and fuel managers as options that would reduce fire hazard. The treatments differed in the target residual basal area and in the upper diameter limit over which no trees could be cut. Upper limits were 16 inches d.b.h., 21 inches d.b.h., or no limit. Small trees were defined as trees less than 7 inches in diameter. FIA BioSum selected a prescription for each acre that best met the criteria of the scenario being considered.

FIA BioSum used Forest Vegetation Simulator (FVS), a growth-and-yield model used widely in the West, to apply treatments. Glenn Christensen converted FIA data to inputs usable in FVS, analyzed the treatments, and integrated the outputs into FIA BioSum. The fire and fuels extension of FVS was used to assess changes in torching index and crowning index as measures of changes in fire risk.

STHARVEST was incorporated to assess costs of the fuel treatments. For ORCA4, the (*continued on next page*)

Case Study: Oregon-California Pilot Study

Jamie Barbour

The ORCA4 pilot study included the Applegate Adaptive Management Area in southwestern Oregon.

(*from page 7*) assumption was made that all trees greater than 7 inches d.b.h. were used for solid wood products, until the tree top narrowed to a 5-inch diameter. Biomass was assumed to be all hardwoods greater than 3.5 inches d.b.h., all trees of other species 3.5 to 7 inches d.b.h., and the limbs and tops of all trees. On slopes more than 40 percent, manual felling, limbing and bucking, and cable systems were used, and the only biomass brought to the landing was trees 5 to 7 inches d.b.h. All other material was left onsite.

The final ORCA4 database included logging costs, timber and biomass yields, fire hazard indices for each plot, and haul costs to each of 221 potential processing sites.

Results. Scenarios were run for five policy options. The total acres treated, cost of treatment packages, and acres with effective reduction in torching index greatly differed among the options. Options with financial constraints to increase revenue or reduce total cost resulted in changes in the number of acres treated, with some acres dropped. “Small changes in prescriptions can turn net revenues to losses,” comments Fried. Preliminary results are given below; numbers may change as the analysis is further refined.

One option maximized biomass production. Its cost was over $1,700 per acre. “The more biomass you take, the more money you lose,” says Fried. Another option maximized net revenue; it yielded an average net revenue of about $1,300 per acre, an increase of $3,000 over the maximize-biomass option. This option treated only acres with the highest volume of large trees and lowest harvesting and hauling costs, probably acres on flat ground closest to major highways and mills.

Results from the three other options fell between the two extremes represented by the maximize-biomass and the maximize-revenue options. Of these three, one option would maximize the number of acres treated effectively (fire hazard reduced) yet also balance this by requiring that the package of treatments have no net cost. The balanced hazard reduction with no-net-cost option would treat more than half of the acres that would be treated by the expensive, maximize-biomass option.

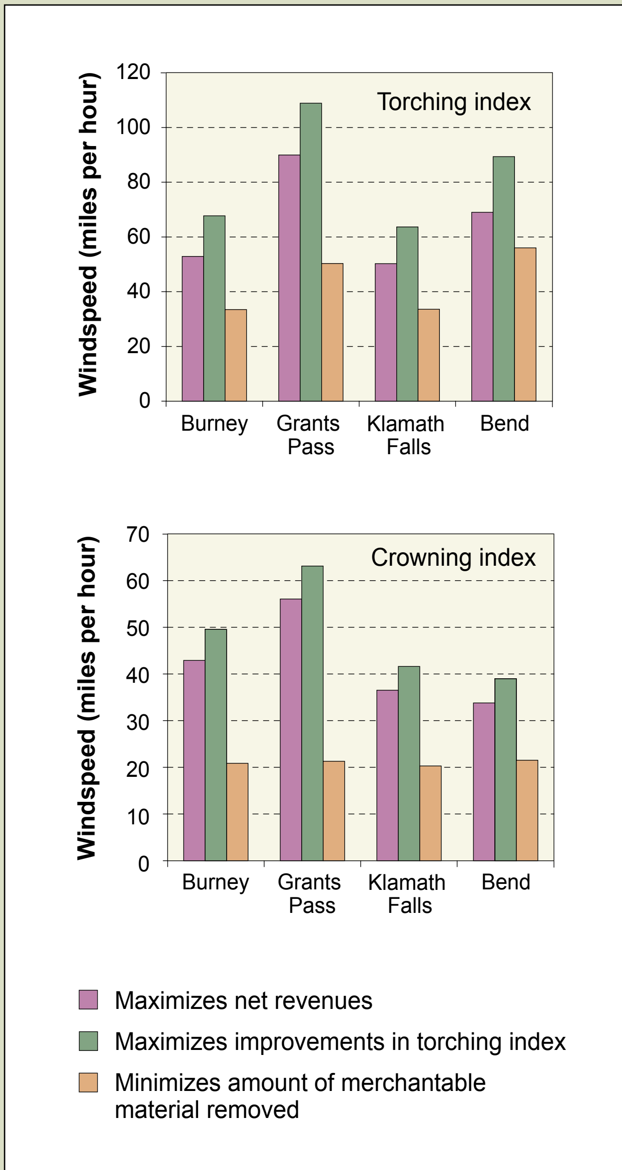
On any given acre, about 80 percent of the low-value biomass would consist of the tops and limbs of the merchantable trees. Small trees would be a small percentage of the total biomass, though they account for much of the total logging cost. So whether or not to cut merchantable trees is a critical question for biomass supply to a power plant. Besides the economic questions, the decision on harvest of merchantable trees is also fundamental to how much reduction in fire hazard is achieved because the tops and limbs of these trees are much of the biomass, whether on standing trees as crowns, on the ground as slash, or loaded on trucks and shipped to power generation plants.

Policy choices would affect the potential for biomass power also. Potential investors in biomass power plants want a long-term, steady fuel supply at a price they can afford, to justify their investment. In the ORCA4 study area, if prescriptions are selected that minimize the harvest of merchantable trees and the work is spread out over multiple years, fuel treatments would yield only enough biomass to run plants less than 3 years. If biomass were removed only from the most profitable areas, yields would fuel plants for 6 to 16 years, differing by location. Under the most aggressive and expensive removal scenario, a projected 76 million tons of biomass could keep four 50-megawatt plants running from 17 to 42 years, again differing by location. This much electricity would power about 160,000 homes over those years.

Out of the 21 million forest acres in the ORCA4 study area, about 1.8 million acres, or 9 percent, can be treated effectively and efficiently, with “efficiently” defined as revenues exceeding costs.

The ORCA4 study does not consider all possible costs, constraints, or benefits. Administrative and planning costs and site cleanup costs are not included. No financial values were assigned for some possible benefits such as improved forest health and reduced firefighting costs.

Changes in fire hazard. The options used in ORCA4 focus on short-term results in fire hazard indices. Removal of only small trees would hardly make a dent in the fire hazard. To get a substantial reduction in fire hazard, particularly to reduce crown bulk density, some trees greater than 7 inches d.b.h. would have to be cut. The reduced fire hazard would not last indefinitely, however. In 10 years, new tree growth would start to change the torching index again.



The graphs show what the torching index and crowning index would be for three options in ORCA4 for the four ecoregions. Higher numbers on the y axis indicate that more wind (measured in miles per hour) would be needed to produce severe fire behavior; thus higher numbers indicate reduced fire hazard.

Can people use FIA BioSum in their regions?

FIA BioSum is a framework that can support analysis for any forest in the United States. The analysis uses FIA data, which are available for the whole country. The Forest Vegetation Simulator (FVS) growth-and-yield model has variants that work for all forest types. "A central Rockies variant works for juniper and pinyon pine types," comments Christensen. He adds, however, that the fire and fuels extension used for ORCA4 is only applicable to the Western United States. Fire and fuels variants are being developed for other parts of the country.

The studies show that there is no one "right" answer on reducing fire hazard. Answers depend on local forests, topography, wood industries, and community choices, among other factors.

FIA BioSum is best suited for strategic analysis at the regional level (areas larger than 10,000 square miles), or to compare alternatives. FIA BioSum is a data-intensive analytic framework that consists of a suite of publicly available software and utility programs that allow the other programs and models to "talk" to each other (the models do not fit seamlessly). It is not yet a stand-alone program that can be downloaded over the Internet, although some of its software components can be downloaded.

The Blue Mountains Demonstration Project and ORCA4 case study show there is no one "right" answer on reducing fire hazard. The answers depend on local forests, topography, wood industries, and community choices, among other factors. Revenue potential is influenced by tree size, overall stand volume, terrain steepness, log yarding system, and haul distance to market, among other factors. Both the Blue Mountains and ORCA4 study areas have viable wood-processing industries, a significant factor. "The costs of getting a wood-processing industry up and running would change the economics considerably, and the tools we used don't analyze these costs," comments Fight.

FIA BioSum offers a way for policymakers, landowners, managers, and the public to discuss the outcomes and tradeoffs of policies, based on an objective, comprehensive, consistent analysis. "FIA BioSum is a useful tool to identify large areas where fire hazard reduction treatments are possible without subsidies—or not," comments Barbour. "Some treatments are financial winners and others are financial losers."

"The economic feasibility of biomass plant proposals can be evaluated under different market conditions," explains Fried. "Managers need ways to sort through all the proposals."

The FIA BioSum analysis produces information about economics and fire hazard, two big pieces of the puzzle but not the whole story. In the ORCA4 analysis, the scientists did not use FIA BioSum to evaluate wildlife habitat, recreation, or

Evelyn L. Bull

Evelyn L. Bull

FIA BioSum could be linked to wildlife habitat models and used to estimate the effects of fuel treatments on habitat. Martens can be sensitive to changes in forest density.

water resources. To do so, scientists would characterize changes in the distribution of forest area by age or structure classes, as a result of fuel treatments; and then they would apply wildlife models to predict changes in habitat quality and quantity.

Computer models, even the most advanced ones, can only provide information. Decisions involve policies and values.

Other risks related to fire are difficult to quantify. For example, FIA BioSum does not evaluate offsite values at risk from fires, such as nearby homes or forested wetlands. It does not place any values on the fact that mechanical fuel treatments can reduce prescribed burning, with its effects on air quality and risk of escaped fire.

Looking toward the future

Since they presented the results of their ORCA4 analysis, the FIA BioSum scientists have been asked to do similar analyses for other regions. Their next large project is an analysis of the forest lands of New Mexico and Arizona, at the request of the Western Forestry Leadership Coalition and the regional forester for the USDA Forest Service Southwest Region.

People involved with forests and energy issues are eager to get FIA BioSum results for their areas. Information requests have come from the Black Hills National Forest, California Department of Forestry, timber consultants in the Pacific Northwest, and the Rural Technology Initiative at the University of Washington, among others.

Computer models, even the most advanced ones, can only provide information. Decisions on fire hazard involve policies and values. Only people can resolve these issues. If people choose not to manage, their forests may unravel in ways they do not like.

No matter what communities choose, the decisions are not just made once. Trees grow; forests change. Communities will make choices again and again, over the decades, on how their forests will be managed and how they will deal with fire hazard. Forests around the communities will reveal the wisdom of those choices.

FIA BioSum does not calculate the value of homes saved from fire. Firefighters saved this home from burning in the Cache Mountain Fire. The forest around the home had been thinned.

Contacts

Jeremy Fried, jsfried@fs.fed.us, Forest Inventory and Analysis Program, PNW Research Station.

Jamie Barbour, jbarbour01@fs.fed.us, Focused Science Delivery Program, PNW Research Station.

Roger Fight, rfight@fs.fed.us, Human and Natural Resources Interactions Program, PNW Research Station.

The National Fire Plan provided some funding for FIA BioSum development. The USDA Forest Service National Forest System and Riverside Fire Laboratory were partners in the research.

FIA BioSum is a useful tool, but it cannot assign numbers to all values that people have about particular places. Suttle Lake is in the Oregon Cascade Range ecoregion of the ORCA4 pilot study area.

Local forests, topography, community choices, and local timber industry capabilities all affect choices on how to reduce fire hazards.

For Further Reading

Fight, R.D.; Zhang, X.; Hartsough, B.R. 2003. Users guide for STHARVEST: software to estimate the cost of harvesting small timber. Gen. Tech. Rep. PNW-GTR-582. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 12 p.

Fried, J.S.; Christensen, G.A.; Weyermann, D.; Barbour, R.J., Fight, R.D.; Hiserote, B.; Pinjuv, G.L. [In press]. 2004. Modeling opportunities and feasibility of siting wood-fired electrical generating facilities to facilitate landscape-scale fuel treatment with FIA BioSum. In: Bevers, M.; Barrett, T.M., eds. Systems analysis in forest resources: Proceedings of the 2003 symposium. Proc. RMRS-P-000. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Online at FIA BioSum site listed below.

Fried, J.S.; Barbour, R.J.; Fight, R.D.; Christensen, G.A.; Pinjuv, G.L. [In press]. 2004. Small-diameter timber alchemy: Can utilization pay the way towards fire resistant forests? In: Narog, M.G., ed. Proceedings of the 2002 fire conference on managing fire and fuels in the remaining wildlands and open spaces of the Southwestern United States. Gen. Tech. Rep. PSW-GTR-189. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station. Online at FIA BioSum site listed below.

Resources on the Web

U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, FIA BioSum site. http://www.fs.fed.us/pnw/fia/biosum. (1 May 2004).

U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. http://www.fs.fed.us/pnw. (1 May 2004).

Blue Mountains Demonstration Project. http://www.fs.fed.us/bluemountains. (1 May 2004).

Credits:

Communications and applications director — Cynthia L. Miner

Writer and editor — Valerie Rapp

Art director — Frank Vanni

Layout — Keith Routman

Photographs — All photos are by Tom Iraci except where otherwise noted.

PNW Science Update
U.S. Department
of Agriculture
Pacific Northwest
Research Station
333 SW First Avenue
P.O. Box 3890
Portland, OR 97208-3890

Got Science?

New! At last, on the Web, a one-stop site for all USDA Forest Service Research and Development publications. Find the information you need at:

TreeSearch: http://www.treesearch.fs.fed.us

TreeSearch is an indepth catalog of publications written or produced by the Forest Service research branch. Convenient search choices and downloadable publications save you time.

Visit the Pacific Northwest Research Station booth at two conferences coming up this summer and fall. Learn about new research findings… Find out about new tools… Pick up free publications… Talk with leading forest scientists… at these events:

Lessons of Lewis and Clark: Ecological Exploration of Inhabited Landscapes
The Ecological Society of America 89th Annual Meeting

August 1–6, 2004 • Oregon Convention Center • Portland, Oregon

For more information: http://www.esa.org/portland

Monitoring Science and Technology Symposium
Unifying Knowledge for Sustainability in the Western Hemisphere

Organized in partnership with governmental and nongovernmental agencies and institutions in the Americas

September 20–24, 2004 • Adams Mark Hotel • Denver, Colorado

For more information: http://www.monitoringsymposium.com