Wildfire in Montana: Potential hazard reduction and economic effects of a strategic treatment program

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Abstract

About 80 percent of Montana's 9 million acres of fire-adapted forests rate high/moderate for fire hazard. A strategic hazard reduction scenario was evaluated based on treating 1 percent of these stands annually for 30 years. The proposed comprehensive treatment regime moved 90 percent of potentially treatable acres to a low hazard rating and yielded an average return of $624 per acre treated. Further analysis of this "1 percent scenario" showed that it would generate nearly 100 million ft.^{3} of timber annually, along with 3,000 private sector jobs, and $40 million in revenue to Montana landowners.

Unlike the Southwest and Pacific Northwest, Montana emerged relatively unscathed by the 2002 wildfire season. Not so long ago, though, we were feeling the effects of tinder-dry conditions, smoke-filled skies, and forest closures.

The major wildfires that burned over half a million acres in Montana during the summer of 2000 point to the hazardous conditions that exist across much of the state's forested landscape. Several questions arise when contemplating the aftermath of those fires. What is the relative fire hazard associated with existing forest conditions in Montana? How effective are fuel-reduction treatments at reducing the wildfire hazard? How much do these treatments cost, and what other benefits might accrue from the work?

These questions have been on the minds of the public, politicians, and forest managers alike. Reports from recent western wildfires provide evidence that forest thinning can indeed reduce fire intensity, either by diverting flames around treated areas or by bringing fire in the forest canopy down to the ground (Pollet and Omi 2002).

However, the costs of implementing such treatments have generally been thought to be expensive, perhaps prohibitively so. For example, a news report from the Klamath Basin in southwestern Oregon suggests that the cost of thinning forests to reduce fire hazard will be "staggeringly expensive with little economic return – $2.7 billion for 1.6 million acres, or an average of more than $1,685 per acre" (Barnard 2002).

A statewide analysis conducted by researchers at the University of Montana's School of Forestry and Bureau of Business and Economic Research reached a markedly different conclusion for Montana. A comprehensive forest restoration/fuel-reduction program will reduce fire hazard, improve ecological conditions of forests, and bring numerous economic benefits that exceed hazard-reduction costs, according to the study.

Results of the fire-hazard analysis showed that about 80 percent of Montana's 9.3 million acres of lower elevation, historically fire-adapted forests rate high/moderate for fire hazard (**Fig. 1**). These fire-adapted forests are

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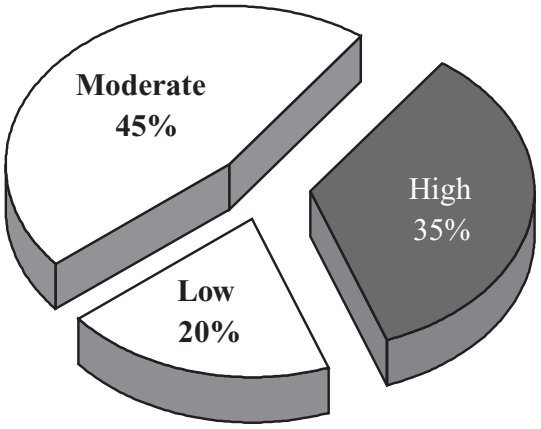

Total acres = 9.3 million

Figure 1. — Proportion of Montana's short-interval fire-adapted forests (PP, DF, DLMC) by fire hazard rating.

primarily comprised of ponderosa pine (PP), Douglas-fir (DF), and dry mixed-conifer (DLMC) forest types.

Forests adapted to frequent, low-intensity fires were identified as the highest priority for treatment in "Protecting People and Sustaining Resources in Fire-Adapted Ecosystems - A Cohesive Strategy" (USFS 2000, DOI 2001). These forests have undergone the greatest changes in terms of increased tree densities, more complex (storied) structures, and increased composition of Douglas-fir/true firs. These are also the forests where people most often live, travel, and recreate.

Fire hazard reduction treatments

Fiedler et al. (1999) and Fiedler (2000) have designed a comprehensive treatment approach to initiate restoration of sustainable ecological conditions in Montana's fire-adapted forest types while substantially reducing wildfire hazard. This approach of focusing on the future ecological condition of the forest fundamentally differs from proposals that call for removal of only small trees. The comprehensive prescription is comprised of treatments aimed at creating stand conditions similar to those that were common in fire-adapted forests prior to fire exclusion and high-grade logging. These treatments also substantially reduce fire hazard.

Under this approach, trees are retained in the sizes, numbers, species, and arrangement that will go furthest toward restoring ecologically sustainable forest conditions, given existing stand conditions (Fiedler 2000). Specifically, trees that do not contribute to the desired conditions of the future are removed, and the associated slash is removed from the site or burned to reduce the surface fuel hazard. The resulting forest stand is comprised of mostly larger pine trees, although some trees of all diameters are retained, if available.

The comprehensive prescription is designed to deal with the primary ecological problems present in many stands:

- Excessive stand density because fire has been excluded for decades and with it, the associated "thinning" effects on smaller trees.

- A shift in stand structure from relatively open-grown conditions dominated by large trees (most commonly ponderosa pine) to stands that are dense and contain a ladder-like structure of trees. This layering of fuels allows fire to climb from the ground into the crowns of even the largest trees.

- A transition in species composition from dominance by fire-resistant ponderosa pine to more shade-tolerant (and less fire- and disease-resistant) species like Douglas-fir. In Montana, Douglas-fir regenerates readily in dense, shaded conditions, and many typically vulnerable firs have survived due to the extended absence of surface fires. Past harvest practices sometimes accelerated this shift in composition by removing the largest and most valuable ponderosa pine trees.

An effective treatment approach must address all three of these problems to the extent they exist in the stands considered for treatment. Typically this requires dealing with trees across the size range occurring in a given stand. The objectives of treatment are to increase vigor and growth of the remaining trees, and provide the moisture and sunlight needed to regenerate the shade-intolerant species like ponderosa pine that historically dominated these stands. Of the 7.4 million acres of fire-adapted forests in Montana that rate high/moderate for crown fire hazard, more than 6 million acres have stand conditions potentially benefiting from treatment under the proposed comprehensive ecological approach (Fiedler et al. 2001b).

Estimating treatment costs and revenues

Treatment costs and potential timber revenues were not taken into account when developing the treatment prescriptions; instead, prescriptions were developed solely to produce a desired range of forest conditions. However, because cost is a major factor influencing the potential implementation of treatments, costs were analyzed after the prescription was developed and its effects modeled. Net revenues were calculated as the value of the timber (if any) recovered as a byproduct of treatments, minus the costs associated with treatments.

Costs typically include removing trees to reduce fuel loading and piling and burning of trees or parts of trees not removed from the site for product use. Harvest and haul costs were estimated using databases and a recently completed predictive logging cost model applicable to hazard reduction and restoration treatments in Montana (BBER 2001a, Keegan et al. 2002). Treatments were assumed to occur on sites already accessible by road; therefore, no road-building costs were included in the analyses. Also not included were administrative and legal costs associated with project design and implementation. Data gathered from land management agencies and the private sector provided the basis for estimating costs associated with piling and burning.

Tree values were developed from an extensive log price data system maintained by the BBER (2001b) and from a sawmill simulation model (Wagner et al. 1998, 2000). On average, about 70 percent of the volume of trees removed to accomplish the comprehensive prescription would be suitable for lumber or ply-

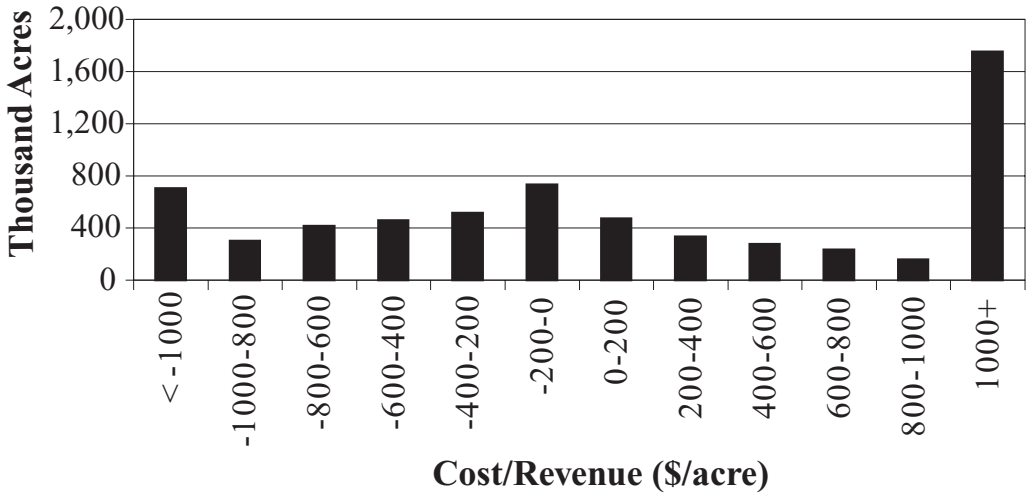

Figure 2. — Distribution of acres by net revenue for the comprehensive hazard reduction treatment for high/moderate hazard conditions in PP, DF, and DLMC forest types (1997 to 1999 market conditions).

wood. Product values for these trees were analyzed based on prices from 1997 to 1999, a period of mixed conditions, with very strong markets in the first half of 1997 and most of 1999 and substantially weaker markets in 1998 due to the Asian financial crisis (Random Lengths 2001). The prices used in this analysis are higher than current prices, which are the lowest in over a decade due primarily to very weak global economic conditions; however, projected prices and timber values are on average higher than those used in our analysis (Adams 2002a, 2002b).

Nearly 30 percent of the volume removed would be from trees less than 9 inches in diameter at breast height. Historically, use of these smaller trees has been as pulpwood, which has a very sporadic market, nonexistent at times. For this reason, the market scenario evaluated did not include a product use for trees under 9 inches in diameter.

Results

Effects of treatments on fire hazard

The comprehensive treatment approach designed to initiate restoration of ecological conditions has been demonstrated to substantially reduce fire hazard, both immediately and long-term (Fiedler et al. 2001b). Under this comprehensive approach, 90 percent of the treated acres moved from high or moderate hazard to low hazard immediately following treatment. Employing widely used growth and fire hazard models (Wykoff et al. 1982, Beukema et al. 1997, Scott and Reinhardt 2001), post-treatment forest conditions were projected or "grown" 30 years into the future, and then reevaluated for fire hazard. Seventy-two percent of the acres receiving the treatments prescribed under the comprehensive approach remained in the low-hazard category for crown fire 30 years later.

Costs/revenues of restoration/hazard reduction treatments

The comprehensive set of treatments needed to address chronic ecological problems in drier, fire-adapted forests often requires removing some trees with product value. For example, the excessive number of shade-tolerant trees in many ponderosa pine stands often calls for removal of numerous Douglas-firs 9 inches and larger – trees that typically have value exceeding the cost of their removal. Reducing high stand density and removing ladder fuels also often results in the removal of trees with commercial value.

Because many of these "byproduct" trees have commercial value, the comprehensive prescription would yield an expected net revenue averaging $624 per acre treated when averaged across all 6.4 million acres with potential for treatment (Fiedler et al. 2001b). The range of revenues was substantial, with some stands costing more than $1,000 per acre to treat and others yielding positive net revenues of more than $2,000 per acre (**Fig. 2**). About half of the acres treated with the comprehensive prescription yielded a value in timber that exceeded all hazard-reduction costs. Although a comprehensive treatment regime will, on average, generate positive revenue flow, over 3 million of the acres rated high/moderate for fire hazard would require an out-of-pocket expenditure to treat.

Economic impacts of statewide treatment implementation

Statewide implementation of a comprehensive fire hazard reduction program would create numerous benefits for Montana. The most obvious and perhaps most important benefits would be reduced wildfire hazard and improved ecological condition of forests altered by disrupted fire regimes and, in some cases, by past high-grade logging. Economic benefits would include:

- Protection of recreation opportunities and property values;
- Reduced firefighting costs;
- A sustainable supply of timber, which could in turn lead to increased employment opportunities and revenues for landowners implementing the treatments.

Determining the specific locations and acreages of high/moderate hazard stands to be treated would require considerable input from scientists, land managers, and the public. It is clear that millions of acres of low-elevation forests should be considered for treatment. However, not all of these acres should be treated, and no single treatment would be appropriate (Fiedler et al. 2001a). The goal should be to leave a mix of forest conditions with a greater proportion of the relatively open, fire-resistant,

large-tree-dominated stands that were historically prominent in the region.

To illustrate potential employment and financial effects, we examined a "1 percent scenario," where 1 percent of the high/moderate hazard fire-adapted forests would be treated each year for 30 years.

Assuming that 1 percent of the 6.4 million acres potentially treatable under the comprehensive prescription was treated for each of 30 years, 64,000 acres of high/moderate hazard ponderosa pine, Douglas-fir, and/or dry mixed-conifer forests would be treated annually in Montana. This translates to roughly one-third (30%) of the treatable acres receiving treatment over the next three decades. Under this scenario, less than 1 percent of the pine/fir/dry mixed-conifer forests in Montana would be treated each year. Over a 30-year period, only about 21 percent of the total acres in these forest types would receive treatment – or less than 9 percent of Montana's total forestland. Given the relatively small percentage of total forest acres treated, it is reasonable to assume that hazard-reduction treatments could occur in addition to acres currently harvested for commercial timber.

Under the 1 percent scenario, the total volume of timber harvested as a byproduct of the hazard reduction/restoration treatments would be slightly less than 97 million ft.[3] (MMCF) per year. From the perspective of recent timber harvest volumes, this increase represents about 45 percent of Montana's total annual harvest (Keegan et al. 2001), and translates to 29 MMCF of pulpwood and 300 million board feet (MMBF; Scribner, log scale) of sawlogs/veneer logs. Again, relative to current harvest levels, these volumes represent about 300 percent of the state's current pulpwood harvest and 37 percent of the annual sawlog/veneer log harvest.

What would implementing this 1 percent scenario mean to Montana's forest products industry? If the treatments were completed as prescribed, the sawlog/veneer log-sized material would likely be utilized. Substantial increases in production levels could be expected in the sawtimber-utilizing portions of the industry that currently have 145 MMBF of unutilized capacity (Keegan et al. 2001) and often struggle to find timber to fill orders. With a reliable long-term increase in timber supply as a byproduct of hazard reduction, numerous mills and companies would be expected to not only utilize more of existing capacity, but also bring more capacity online, especially given the outlook for somewhat higher real prices for lumber in the coming decades (Adams 2002a). In contrast, there would likely be no immediate or long-term increase in capacity to utilize pulpwood unless there were a substantial increase in worldwide demand for pulp and paper products.

In estimating employment impacts, it was assumed that sawtimber would be harvested and processed into lumber or plywood, and pulpwood would be removed to landings and burned in piles (because of the dearth of a reliable pulpwood market). Based on these assumptions, Montana landowners would receive an estimated $40 million annually in net revenue from the sawtimber produced as a byproduct of the hazard-reduction treatments. Harvesting and processing sawtimber generates about 9 full-time jobs per MMBF Scribner log scale, and moving pulpwood to a landing and burning it employs about 12 full-time workers per MMCF (BBER 2001a, CURFOR 2002, FIDACS 2002). Using these employment ratios and assuming an additional full-time worker per MMCF for forest management, administration, and planning, the treatment of 64,000 acres would generate an estimated 3,000 additional workers annually and more than $90 million in labor income.

Conclusions

More than 80 percent of Montana's lower-elevation, historically fire-adapted forests currently rate high/moderate for crown fire hazard. These are the forests where people most frequently live, recreate, and work, and whose sustainability is most threatened by intense wildfires. Comprehensive treatment prescriptions designed to restore sustainable ecological conditions in these forests can move 90 percent of treated acres into a low-hazard condition.

The implementation of a comprehensive restoration/hazard reduction program on just 1 percent (64,000 acres) of high/moderate hazard lower-elevation forests per year would positively impact Montana's forests, its forest products industry, and forest landowners. The 300 MMBF of sawlogs generated each year as a byproduct of hazard reduction could be expected to increase employment by 3,000 workers, boost labor income by $90 million, and provide forest landowners with an additional $40 million in revenue annually. Maintaining the stand conditions (i.e., density, structure, and species composition) necessary for continued fire resistance over time would require that the proposed treatments be repeated at 25- to 40-year intervals. This would in turn lead to a sustainable timber supply.

To return these historically utilized forests to more ecologically and economically sustainable conditions makes good sense for the forests and for the myriad of people and animals that depend on them. Indeed, both public and political support exists for initiatives to address wildfire hazard (Devlin 2001, WGA 2001). The ecological and economic benefits of a comprehensive restoration/hazard reduction program are significant, and certainly deserve the consideration of policymakers.

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