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Financial Analysis of Fuel Treatments on National Forests in the Western United States

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Abstract

The purpose of this note is to provide a starting point for discussion of fire hazard reduction treatments that meet the full range of management objectives, including budget priorities. Thoughtful design requires an understanding not only of the physical and biological outcomes, but also the costs and potential revenues of applying variations of fire hazard reduction treatments in a wide range of stand conditions. This analysis was done with My Fuel Treatment Planner software and provides estimates of cost and net revenue from fire hazard reduction treatments on 18 dry forest stands from 9 national forests in the Western United States. The data and software tools used in this analysis are all available, so these analyses can be easily modified to address a wider range of treatments and conditions.

Keywords: Financial analysis, silviculture, fire, prescriptions, economics, fuel treatments, national forests.

Introduction

The fuels synthesis project (Graham and McCaffrey 2005) set out to provide integrated information and a set of tools to help fuel treatment planners access the available scientific information that would be useful for doing National Environmental Policy Act planning for fuel treatment projects. This note provides a financial analysis of fuel reduction treatments on nine forests in the Western United States. We describe a range of treatment intensities that illustrate the financial impacts associated with removing increasing numbers and larger trees. Where merchantable trees are cut, the potential exists for offsetting at least a part of the

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cost of fuel hazard reduction.[2] These stands represent conditions that commonly exist on the respective forests, but they are not a representative sample of conditions. We therefore do not make any comparisons between forests or regions and only report averages for the treatments that were applied.

Analysis Assumptions

The following tabulation provides a list of the forests, regions, and number of stands that were included in this financial analysis.

Region	National forest	Number of stands
Northern	Bitterroot	2
Northern	Gallatin	1
Northern	Lewis and Clark	2
Intermountain	Payette	3
Pacific Southwest	Plumas	3
Pacific Southwest	Sierra	1
Pacific Northwest	Deschutes	3
Pacific Northwest	Malheur	1
Pacific Northwest	Okanogan	2

There are four levels of thinning from below: leaving 50, 100, 200, or 300 trees per acre. There is a size limit of 18 in diameter at breast height (d.b.h.) that in some cases prevents thinning to 50 trees per acre. In some cases there are not enough trees available to apply a thinning and leave 300 trees per acre. Each level of thinning has two postthinning treatments: broadcast burning and machine piling and burning. This combination results in a maximum of eight treatments for each stand.

Markets for logs and chips vary widely in the Western United States. These analyses were done with delivered log prices for the area where the stands exist. This provides an overview of the financial cost (or return where revenue minus treatment costs and hauling costs are positive) of doing fuel reduction treatments. Those who want to use this analysis as a starting point for estimating financial cost for their circumstances need to use stands and markets that are similar to their situation. One strategy is to pick one of the example stands that is similar and customize the market information. The Web site from which My Fuel Treatment

[2] The stands and prescriptions used in this analysis were selected and provided by Morris C. Johnson, USDA Forest Service, Pacific Northwest Research Station, Pacific Wildland Fire Sciences Laboratory, 400 N 34th Street, Suite 201, Seattle, WA 98103. The effects of these treatments on forest structure and fire hazard are addressed in *Guide to Fuel Treatments in Dry Forests of the Western United States: Assessing Stand Structure and Fire Hazard* by Morris C. Johnson, David L. Peterson, and Crystal L. Raymond. Unpublished manuscript. On file with: Jamie Barbour, Forestry Sciences Laboratory, P.O. Box 3890, Portland, OR 97208.

Planner (MyFTP) software (Biesecker and Fight 2006) and documentation can be downloaded (http://www.fs.fed.us/pnw/data/myftp/myftp_home.htm) also has one saved MyFTP scenario for each of the national forests that is included in this analysis. When an example scenario is opened in MyFTP, the market information and the management assumptions will be available for modification. All of the stand input files are also available from the Web site, so the modified market and management assumptions can be applied to any of the scenarios by running the stand files in MyFTP with those assumptions.

For all forests, only trees that are 8 in d.b.h. or more are made into merchantable logs and sold. The minimum merchantable log diameter is 6 in inside bark diameter on the small end (top of tree) in the three Pacific Coast States and 4 in inside bark diameter elsewhere. The 4-in limit is of necessity because of model limitations rather than reflecting a difference in markets. Even where the limit is 4 in, only logs 6 in and larger receive a price.

The following tabulation shows the price ranges for logs delivered to a mill for most of the species found in the scenarios. Prices are in dollars per thousand board feet, Scribner scale. In some cases a single price is used for all logs 6 in and larger. In other cases larger logs have a higher price.

Price	Poderosa pine [1]	Douglas-fir	True firs	Lodgepole pine
Lowest price	275	370	321	265
Highest price	525	465	360	434

[1] See "Species List" for scientific names of species.

Smaller trees can be converted to clean chips (for pulp or board products) or dirty chips (for fuel) where markets exist. The tops of larger trees can be converted to dirty chips. Markets for both clean and dirty chips are widely scattered. The following tabulation shows the number of forests and scenarios for which there were chip markets available and included in the analysis.

Chip type	Number of forests	Number of scenerios
No chips	5	9
Clean chips	2	5
Dirty chips	2	4

Because markets are highly variable across the West, the distances that logs and chips must be hauled to a market are also highly variable. Haul distances for logs ranged from a low of 60 to a high of 130 mi. Haul distances for chips ranged from 15 to 80 mi. The shorter haul distances for chips does not mean that chip markets are more ubiquitous than log markets, but rather that it is not feasible to haul a low-value product like chips longer distances.

The stands included in the analysis had a range of slopes from 10 to 40 percent. The logging system used in all cases was a ground-based mechanical whole-tree system. The tops and limbs were chipped in those cases where there was a market for dirty chips. In other cases, tops and limbs were included in the material that was treated onsite with machine piling and burning or broadcast burning.

Results

The merchantable volume, gross revenue, harvesting cost, and hauling cost do not change with the postthinning treatments (machine pile and burn versus broadcast burn). Figure 1 shows the average merchantable log volume for the four thinning prescriptions applied to the 18 stands. On average, the log volume with 50 leave trees is almost three times the volume with 100 leave trees. With 200 leave trees, there were very few saw logs. None of the stands had any trees large enough to yield merchantable logs with 300 leave trees.

Figure 2 shows the average gross revenue for the four thinning prescriptions. The average gross revenue with 50 leave trees was over three times that for 100 leave trees. The gross revenue is almost proportional to volume because most of the revenue is from saw logs, and the premiums for larger logs are small. The small amount of gross revenue for the prescription with 300 leave trees is solely from chips on the stands that had a chip market.

Figure 3 shows the average harvesting cost for the four thinning prescriptions. Note that the harvesting cost for the prescription with 100 leave trees is about half that for 50 leave trees even though the log volume is only about one-third as much. This is because the trees removed from prescriptions with 100 leave trees are on average smaller and more costly to harvest.

Figure 4 shows the average hauling cost for the four thinning prescriptions. Patterns in hauling costs look similar to patterns in volumes—higher volume removed require higher hauling costs. They differ somewhat because the volume shown in figure 1 is only log volume, whereas haul costs in figure 4 include costs for chip volume. The haul cost per unit volume, however, is generally less for chips because the haul distances are shorter.

Figures 5 and 6 show the mechanical treatment and burning costs, respectively. The following tabulation defines the combinations of prescription and fuel treatment for the remaining figures.

Categories	Prescription	Fuel Treatment
1	50	Mechanical pile and burn
2	100	Mechanical pile and burn
3	200	Mechanical pile and burn
4	300	Mechanical pile and burn
5	50	Broadcast burn
6	100	Broadcast burn
7	200	Broadcast burn
8	300	Broadcast burn

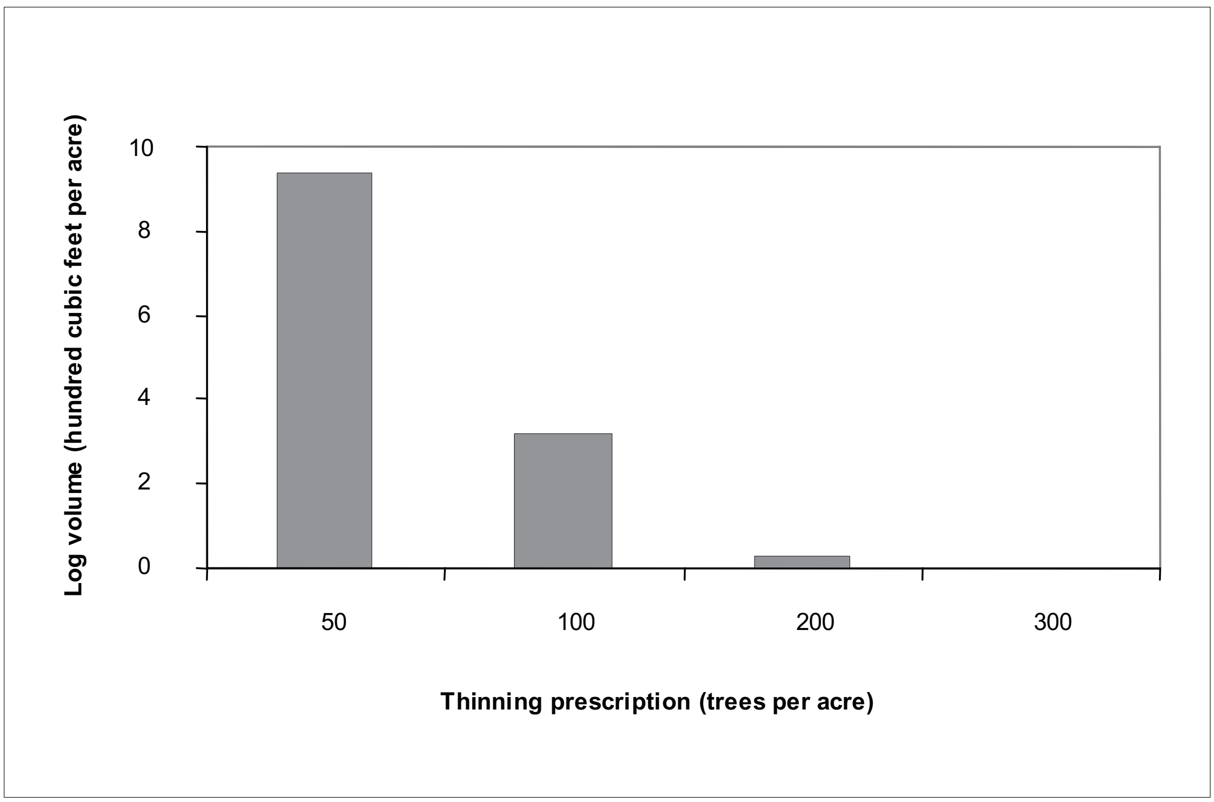

Figure 1—Average merchantable volume from thinning from below to 50, 100, 200, and 300 trees per acre.

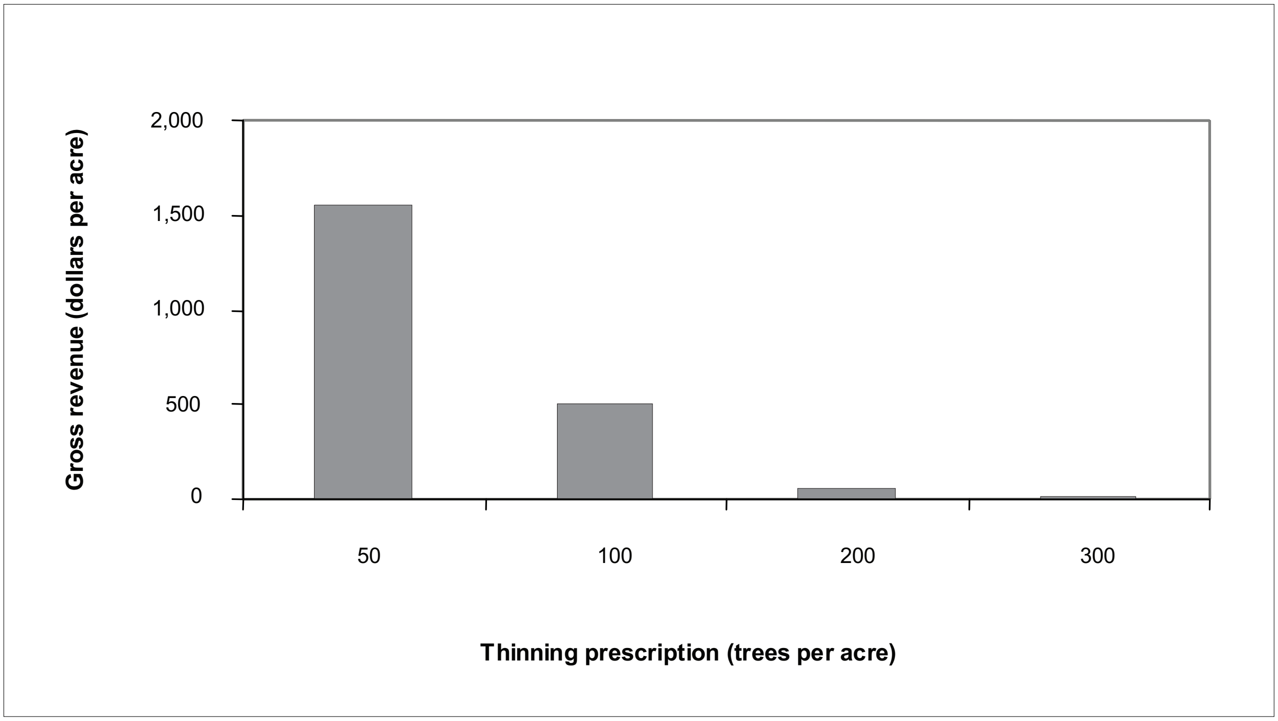

Figure 2—Average gross revenue from thinning from below to 50, 100, 200, and 300 trees per acre.

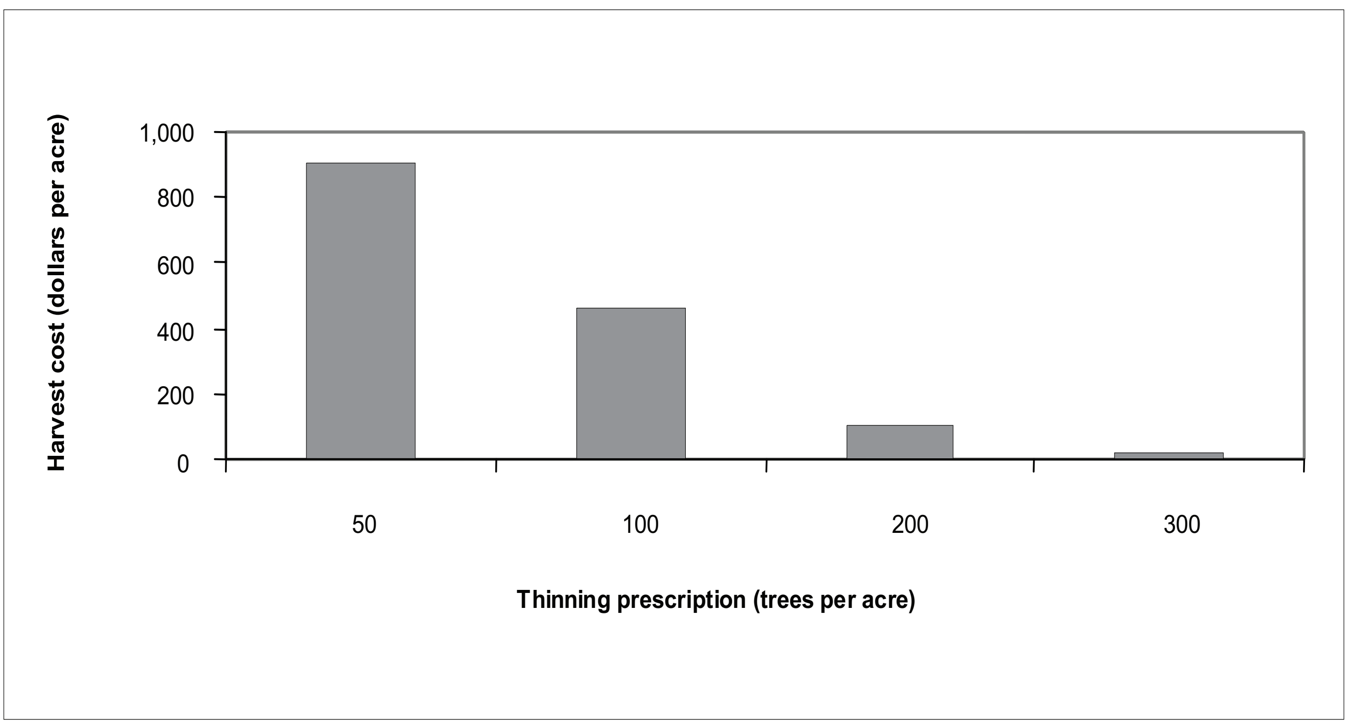

Figure 3—Average harvesting cost for thinning from below to 50, 100, 200, and 300 trees per acre.

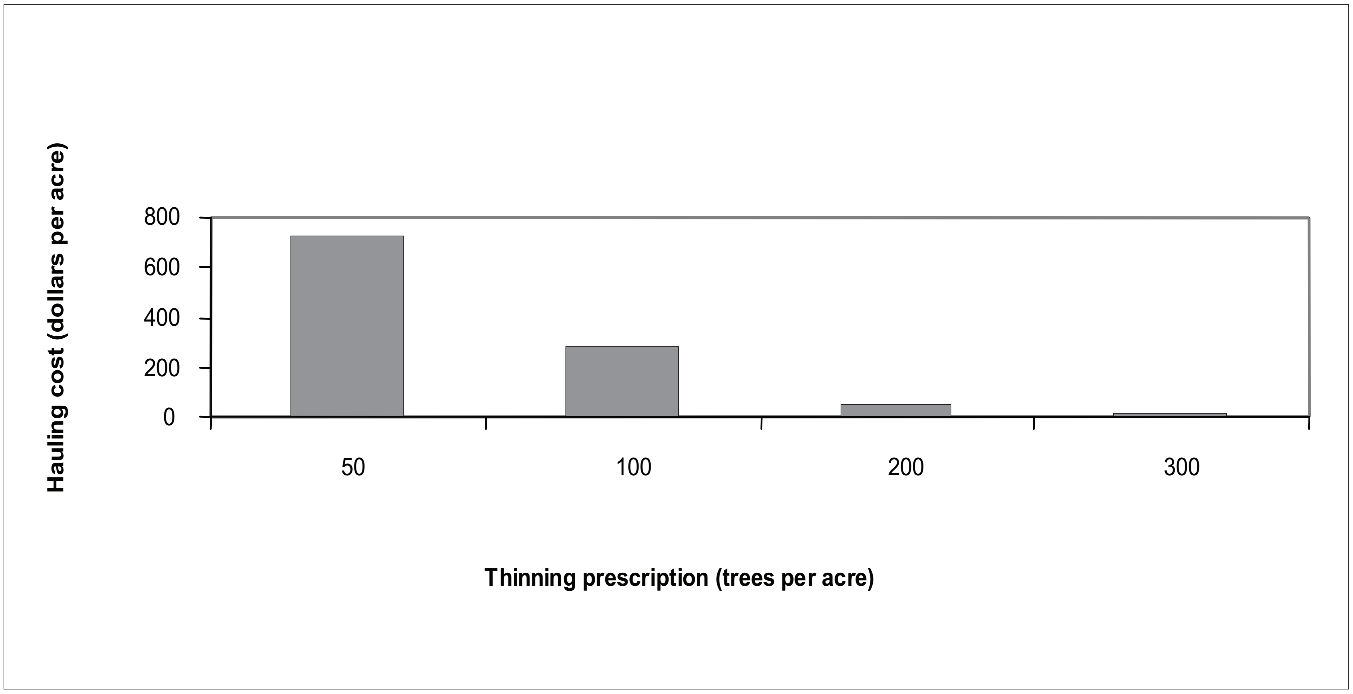

Figure 4—Average hauling cost for thinning from below to 50, 100, 200, and 300 trees per acre.

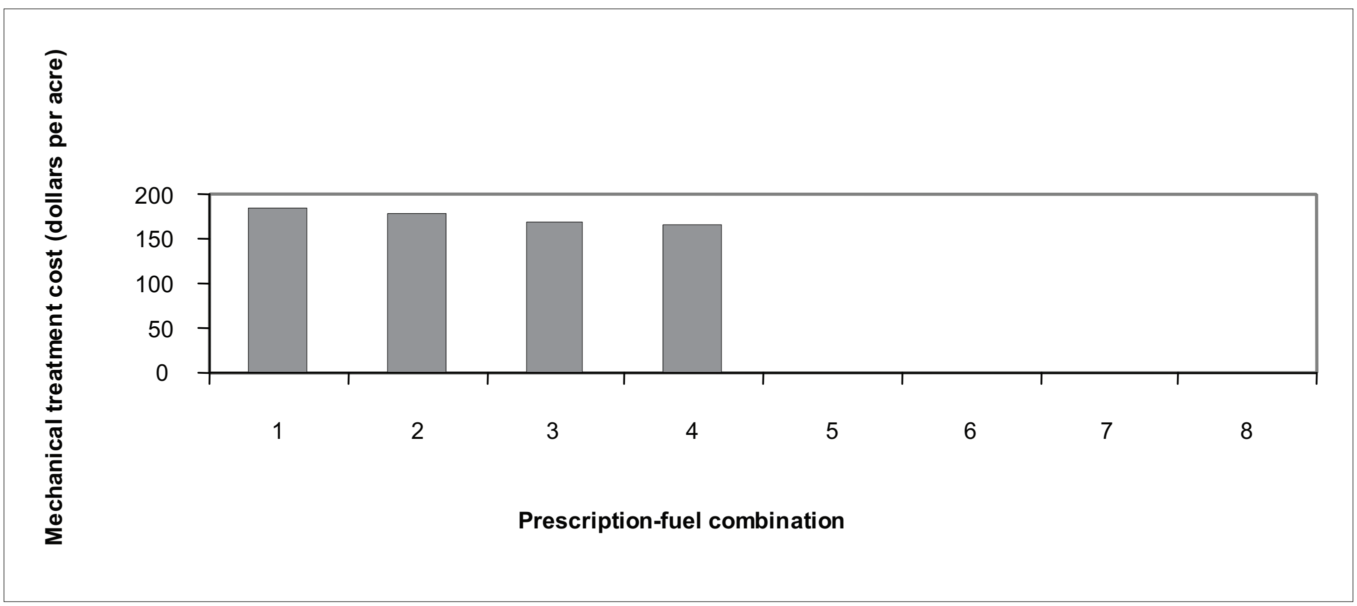

Figure 5—Average mechanical treatment cost for thinning from below to 50, 100, 200, and 300 trees per acre with machine piling and burning (categories 1, 2, 3, and 4, respectively). Mechanical treatment cost is zero for broadcast burning scenarios.

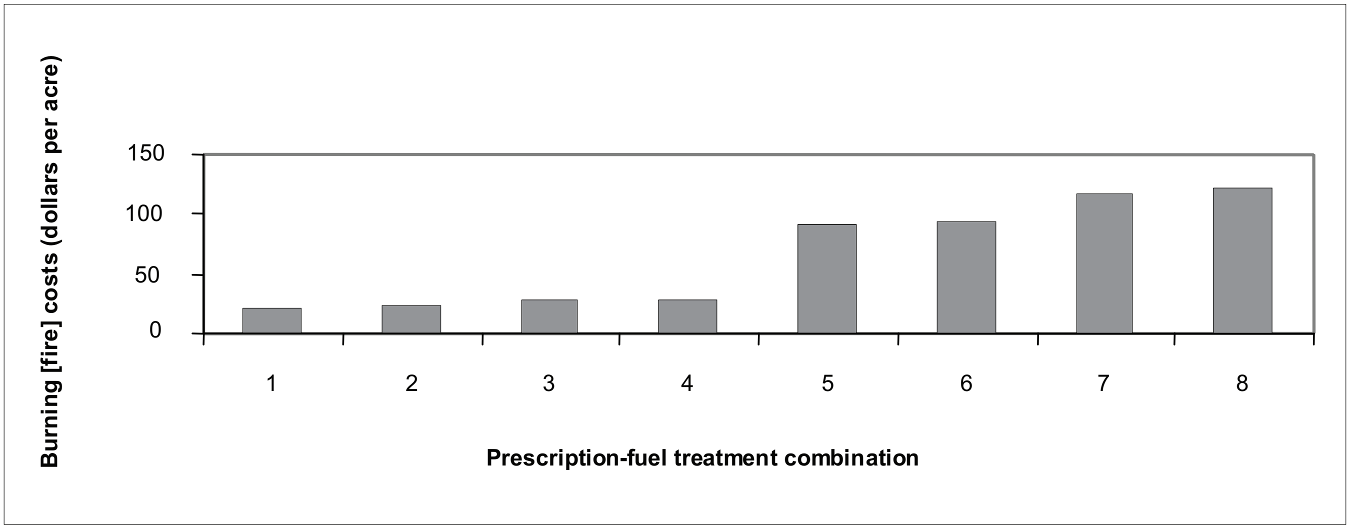

Figure 6—Average prescribed fire cost for thinning from below to 50, 100, 200, and 300 trees per acre with machine piling and burning (categories 1, 2, 3, and 4, respectively) and broadcast burning (categories 5, 6, 7, and 8, respectively).

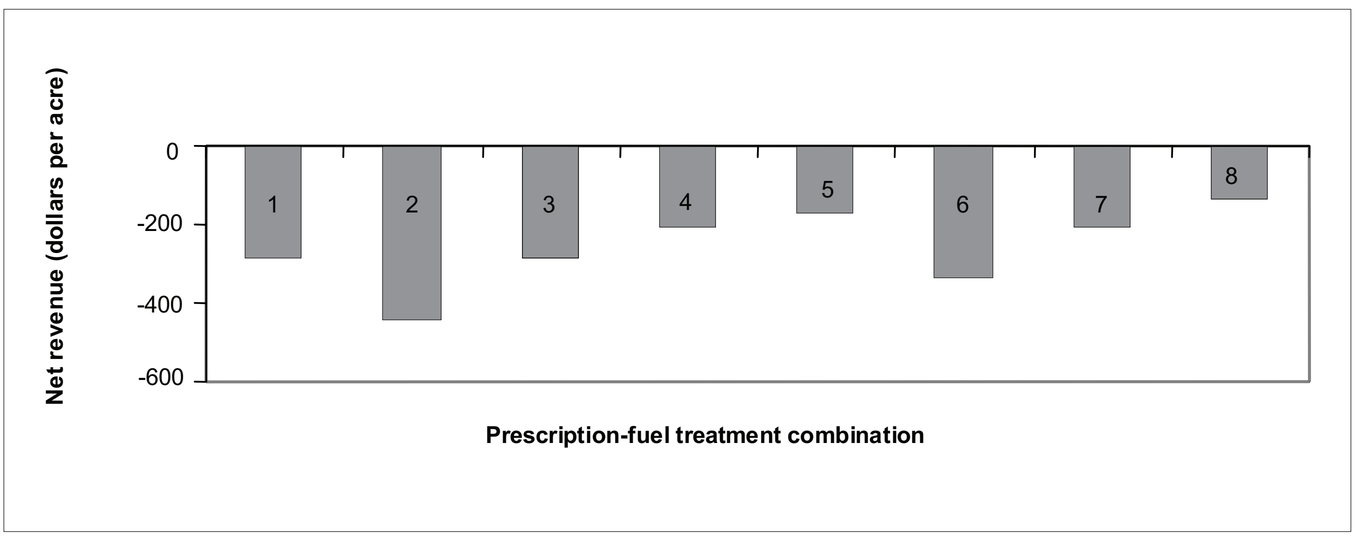

Figure 7—Average net revenue from thinning from below to 50, 100, 200, and 300 trees per acre with machine piling and burning (categories 1, 2, 3, and 4, respectively) and broadcast burning (categories 5, 6, 7, and 8, respectively).

The model on which these figures are based is relatively better at predicting the average cost for commonly applied thinning treatments than it is at predicting differences in cost for different intensities of thinning. So although these costs do not differ much between the thinning prescriptions, they will likely show greater differences in application.

The right half of figure 6 shows the costs for broadcast burning. The same caveat applies. The model is relatively better at predicting the average cost for commonly applied treatments than it is at predicting differences in cost for different intensities of thinning.

From this full analysis there were 2 cases out of 69 where the cost of machine piling and burning was less than broadcast burning. The broad conclusion is that the cost of broadcast burning is about half that for machine piling and burning. But this conclusion is only valid to the extent that it is feasible to apply either treatment. The detailed fire behavior information (see footnote 2) should provide the data needed to determine if broadcast burning can be applied in the conditions that result from the thinning treatments or if some mechanical treatment may be necessary first to reduce the risk of fires that are undesirably hot or have an unacceptable risk of escape. Furthermore, the risk of escape and subsequent damage from wildfire is likely higher with broadcast burning than with burning piles. The cost of escaped fires has not been included in these estimates of burning costs.

Average net revenue for a category (the average of all cases for a given combination of prescription and fuel treatment) is the best indicator of the revenue that would be generated from doing these treatments or the cost that would have to be expended (see fig. 7). These net revenue figures are underestimates of the full cost because they are only the costs of applying the treatments and do not include agency costs for planning, preparing, or administering these contracts. From the total set of treatments applied to the 18 stands, there are 6 cases out of 138 where the net revenue is positive. As shown in figure 7, the average net revenue ranges from -$139 to -$444 per acre. The machine pile and burn series on the left and the broadcast burn series on the right show similar patterns. The prescription that leaves 100 trees per acre is on average the most expensive. Leaving 50 trees has higher net revenue than leaving 100 trees. This is because the additional 50 cut trees are larger trees that more than pay their way and reduce the total cost. From a purely financial standpoint, the conclusion would be that unless one is prepared to thin heavily enough to remove a significant amount of merchantable logs, it would be less costly to do a minimal treatment that involves no removal. Leaving 200 and 300 trees per acre may not result in a significant reduction in fire risk, however.

Conclusions

We must be cautious about drawing conclusion from a set of mechanistic thinnings applied to a small number of stands. Although these results revealed few opportunities for commercial products to pay for the full treatment cost, they do reveal that in 12 of 18 cases, the removal down to 50 leave trees reduces the cost relative to 100 leave trees. The prescriptions in this analysis are a small part of the set of prescriptions that have been proposed in various venues to respond to the issue of undesirable fire hazard. The greater value of this analysis and the files that are available from this analysis may be in providing a starting point for additional analyses to explore a wider range of options.

Metric Equivalents

When you know:	Multiply by:	To find:
Inches (in)	2.54	Centimeters
Acres (ac)	.405	Hectares
Feet (ft)	.3048	Meters
Miles (mi)	1.609	Kilometers
Cubic feet (ft^2)	.0283	Cubic meters

Literature Cited

Biesecker, R.L.; Fight, R.D. 2006. My fuel treatment planner: a users guide. Gen. Tech. Rep. PNW-GTR-663. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 31 p.

Graham, R.T.; McCraffrey, S.M. 2005. Fact sheet: the fuel synthesis overview. Res. Note RMRS-RN-19-WWW Revised. Fort Collins, CO: U.S. Department of Agruculture, Forest Service, Rocky Mountain Research Station. 2 p.

Species List

Common name	Scientific Name
Douglas-fir	*Pseudostuga menziesii* (Mirb.) Franco
Lodgepole pine	*Pinus contorta* Dougl. ex Loud.
Ponderosa pine	*Pinus ponderosa* P. & C. Lawson
True fir	*Abies* spp.

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