JFSP Project Number: 06-3-2-24
JFSP Project Title: A feasibility assessment of a methodology to evaluate the costs and benefits of large scale treatment programs under conditions approximating real-world fire, climate, vegetation and economic conditions.

Principal Investigators: Jeffrey P. Prestemon (PI), and Karen L. Abt (Co-PI)

Additional Investigators: Alan Ager, Robert Huggett, Jr., Mark Finney, Eric Twombly

Date: April 6, 2007

Approach Intended and Approach Used

This project was designed as a feasibility study to determine if the data and tools were available to evaluate region-wide and nationwide long-term costs and benefits of fuel treatments. The study design of this scientific analysis of some of the financial and economic benefits and costs of mechanical fuel treatments was proposed as evaluating a base (untreated) and experimental case: (1) simulate, in a Monte Carlo manner, randomly ignite and burn using FARSITE fires occurring on a landscape (the Lincoln National Forest, in our case) in a fire season under a historically accurate sampling of the probability distribution of fire weather conditions, recording fire area and intensities of burn; (2) simulate the growth of vegetation (fuels) on the landscape between seasons; (3) identify the suppression cost differences between the two experimental cases for the simulated fire season, using statistically estimated relationships between these costs and fire area and intensity; (4) repeat the fire season and growth for a large number of future fire seasons; (5) repeat (1)-(4) a large number of times, to identify expected suppression cost differences between treated and untreated conditions in the long-run; and (6) compare the long run discounted total treatment costs with the long-run total suppression cost changes, to come up with an estimate of long-run net benefits of a treatment program. The set-up was to grow stands using a stand growth simulator and to simulate fires using FARSITE.

As of April, 2007, we have concluded that the analysis proposed is not yet feasible, primarily because of what we consider impractically difficult data requirements for treatment design and effectiveness, and because the necessary growth models are not easily linked to the fire simulations. The repeated burn-grow/burn-grow simulations we had hoped to develop are therefore not yet possible. However, in the process of our research, we did identify an approach to evaluating the treatment net benefits of treatments that might yield useful science and economics. The accompanying report of our simulation analysis of the Lincoln National Forest reports this approach.

The procedure we used to estimate the effects of fuel treatments on suppression costs is, under base (untreated) and treated conditions: (1) randomly ignite and burn, using FlamMap, a fire under one of four representative, different fire weather conditions, recording for each fire the intensity and area burned for each fire under uncontrolled (no suppression, escaped-fire) conditions, allowing the fire to grow for five days, recording the sizes and intensities of burn of each fire; (2) repeat (1) a large number of times (in our case, 1,000 times); (3) repeat (1) and (2) for the three other fire weather conditions; (4)

identify the suppression cost differences between the two experimental cases (treated, untreated) under each of the four weather conditions; (5) compare the long run expected discounted total treatment costs with the long-run total suppression cost changes, weighted by the proportion of time that fire weather fell historically into the four weather conditions and accounting for the effects of treatments on non-escaped fires, to come up with an estimate of long-run net benefits of a treatment program.

This simulation aspects of the study took many more months that we had originally planned, so our analysis under all four fire weather conditions is not complete. However, as the accompanying document will describe, we have identified a method for (1) translating simulation results into observed fire activity consistent with historical data for the base case (untreated landscape) simulation, and (2) accounting for the effect that treatments would have on fire activity during program phase-in. For example, this sample landscape treatment project used in our simulations would treat a total of 23 percent of the landscape, but these treatments could not be accomplished in a single year. If the treatments are accomplished over 10 years, and then continued indefinitely after that, the full suppression cost effects will not be reached until after 10 years. We will apply a linear phase-in strategy in our economic analyses, meaning that the fire effects of treatment are linearly related to the proportion of landscape treated.

The simulation and economic evaluation approach that we were able to carry out has at least three obvious shortcomings that need to be overcome or addressed in future work. In particular, we believe that a more complete simulation-based scientific analysis of the net benefits of mechanical fuel treatments needs additional development in the following aspects: (A) Understanding the relationship between the simulation results for escaped fires burning in simulation for a fixed time period under base case (untreated) conditions and actual fire activity observed historically on a (presumably) untreated landscape. (B) Understanding how vegetation on the landscape grows on the simulated landscape, which would capture the growth of fuels without wildfire or treatment, following treatment, following wildfire without treatment, and following wildfire with treatment; a method offered by a recently completed Joint Fire Science Program study ("A National Study of the Economic Impacts of Biomass Removals to Mitigate Wildfire Damages on Federal, State, and Private Lands," Project Number 01-1-2-09) is a prototype of how this could be done. (C) Identifying the treatment design for a given landscape that would maximize net benefits, subject to operational and other administrative constraints to implementation.

To date, we have completed the landscape fire simulations necessary to evaluate a single treatment alternative under a single weather scenario ("High" fire danger). We have also identified a method for accounting for treatment program phase-in and for translating simulation results under the base case into observed historical wildfire activity. And although we recognize the potential shortcomings of our approach in terms of accounting for vegetation re-growth, our remaining task for this funded study is to complete, under base-case and treated conditions, simulations under the other three weather conditions ("Low," "Moderate," and "Extreme" fire danger). In the accompanying document, summarizing our study for the Lincoln National Forest, we present the specific simulation, treatment approaches, simulation results, and a prototype benefit/cost analysis of landscape level fuel treatment projects. The summary and recommendation section discusses the steps necessary to complete our economic analysis to account for all weather scenarios. These steps will be completed prior to submission to a journal of a manuscript, a final product of this study.

Feasibility Assessment Findings

1. Linkages to FVS or other stand or tree level growth models are not yet sophisticated enough to allow burn-and-grow analyses without significant investments by both fire modelers and silviculturists. In particular, the use of FVS for this type of analysis is limited by the lack of regeneration models.
2. The multiple-fire-simulations model used (RandIg/FlamMap) produced the right kind of information for economic analysis, but is currently usable only by researchers with access to high-powered computers. It currently takes multiple days to run a single scenario (1000 fires, a single treatment and a single weather scenario). Improvements in technology (either hardware or software or both) are necessary before this method can be universally applied.
3. The multiple-fire-simulation model, combined with economic and other fire data, provides the data needed to develop benefit/cost analyses for fuel treatment projects within a limited scope. The modeling system will need to incorporate re-growth after treatment, wildfire as a treatment, and fuel treatment project phasing before the system will be readily applicable to economic analyses. Further investment in this type of modeling system will improve our ability to model the costs and benefits of fuel treatment projects at both the landscape and regional levels.

Conclusion

We will continue to work with Alan Ager and others to improve the methods we have developed and to produce a system that can be used in conjunction with RandIg/FlamMap to evaluate treatment costs and suppression costs resulting from fuel treatment projects.