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Recommended Citation

Hebertson, E., Jenkins, M. and Wadleight, L. (2005). Demonstration Plots for Comparing Fuels Complexes and Profile Development in Untreated Stands Versus Stands Treated for the Management of Spruce Beetle Outbreaks and Implications for Fuels Manipulation. Joint Fire Science, Project: 00-2-25, Final Report, 7pp.

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Demonstration Plots for Comparing Fuels Complexes and Profile Development in Untreated Stands verses Stands Treated for the Management of Spruce Beetle Outbreaks and Implications for Fuels Manipulation

Project: 00-2-25

Final Report

Submitted by

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Mortality resulting from recent spruce beetle outbreaks in Intermountain forests has altered the fuels complex of infested stands. Landscape-scale silvicultural treatments have provided one alternative to reduce the long-term susceptibility of spruce-fir stands to infestation and enhance tree vigor. The effect of various silvicultural treatments on fuels complexes, or fuels development in managed stands verses unmanaged stands, however, is not well understood.

For this project, we established permanent plots in untreated spruce-fir stands and stands managed for the spruce beetle to conduct fuel inventories and appraisals and demonstrate differences in the resulting fuel complexes. Based on these data, we also developed and implemented a fuel treatment on selected plots. We used the information derived from fuels inventories and appraisals to generate custom fuel models for both treated and untreated stands. Land managers may ultimately use these custom fuels models as input for BEHAVE or FARSITE runs. The results of output will provide insight into derivation of protocols used to measure and manipulate hazardous fuels on managed and naturally disturbed sites such as insect infestations and contribute information to spatially explicit data layers the Forest can use for fire management needs such as fuel consumption and smoke management.

The specific information and products we proposed to deliver included:

- Organized guided field trips to the demonstration area to provide participants from various agencies and organizations with an opportunity to examine the fuels

treatments and discuss important management implications associated with fire/bark beetle relationships.

- A brochure with a schedule of site visits, project information, and a site map for distribution to agencies and organizations involved with wildland fire and forest insect management.

- An interpretive sign installed at selected sites in the demonstration areas describing the study.

- The creation of a website to provide project information and updates.

- The development of web-based and Microsoft Powerpoint© presentations on fuels in general and specifically the influence of bark beetles on fuels complexes.

- A technical report with recommended guidelines developed from resulting information and fire behavior prediction models for managing fuels in treated and spruce beetle-killed stands that can be utilized by land managers in other areas experiencing similar perturbations.

- Oral and/or poster presentations in nationally recognized fire, forest insect and disease or ecological symposiums.

- Annual written progress reports to the JFSP.

- Publication of a research paper in a peer-reviewed journal.

With the completion of this project, the information and deliverables we produced satisfied what we proposed to accomplish.

Accomplishments

<u>2000-2001</u>

1. In 1999-2000, the Fishlake National Forest in cooperation with the Utah State Division of Forestry, Fire and State Lands implemented two density management treatments in several spruce-fir stands in the vicinities of Niotche Creek and Monument Peak. We established two permanent, 2.5 acre (1 ha) plots in each of the treatments and in control areas at two locations on the Fishlake NF and private lands in 2001. We also completed initial fuels inventories and appraisals on each plot (Photos Appendix 1).
2. In June, we hosted the Society of American Foresters, Wasatch Chapter, and members of the Nature Conservancy on a field tour of our demonstration site. A similar tour was given to a number of Forest Service entomologists from R2 and R4 later that month.

2. We created an informative/educational poster was distributed to local FS districts, Utah State University and the Utah State Division of Forestry, Fire, and State Lands for display and presented the JFSP PI Workshop in spring 2002*.

2002

1. During the winter of 2002 we created a project website linked to JFSP, Forest Health Protection and Utah State University web sites. Our web site received the 'Best Web site Award' given by the JFSP at the PI Workshop later that year.
2. We two organized site visits during the summer. The first visiting group consisted of forest health specialists from Poland, Russia, the Rocky Mountain Research Station, and Forest Health Protection interested in bark beetle/fire relationships. The second group was included members of the Fishlake National Forest, Fremont River Watershed Assessment Team and local community leaders including Wayne and Sevier County Board members to discuss management issues in the watershed (Figure 1).
2. We also re-inventoried fuels on each plot.

Figure 1. Fremont River Watershed Assessment Team site visit Fall 2002

2003

1. In June 2003, mechanical fuel treatments were implemented on subplots (0.7 acres) within demonstration plots. This treatment consisted of chipping 10, 100, and remaining 1000 hour fuels (Photos Appendix 1).
2. We presented an updated poster at SPF Forest Health Protection Washington Office Review. This poster was also presented at the International Western Forest Insect and Disease Work Conference held in Guadalajara, Mexico during the fall of 2003, and at the JFSP PI workshop spring of 2004 (Appendix 2).
3. The brochure with a schedule of site visits, project information, and a site map was completed by mid-summer with 150 copies mailed to agencies and organizations involved with wildland fire and forest insect management (Appendix 3).
3. Site visit in August with Forest Service Fishlake NF and State cooperators.
4. Re-inventoried fuels on all permanent plots.

* The electronic copy of this poster is no longer available.

2004-2005

1. Information derived from this project was presented in a talk given at the USDA Forest Service R4 Integrated Silviculture/Fuels Workshop, Ogden, Utah in April.
2. Fuels data were compiled and summarized for each plot with in the demonstration area. These data were then used to generate custom fuel models for both treated and untreated stands. Based on this information, we created guidelines presented in a Microsoft Powerpoint© presentation entitled 'Fuels and Fire Behavior Related to Thinning Spruce Stands to Decrease Susceptibility to the Spruce Beetle'. We subsequently created two other Powerpoint© presentations, the first entitled 'Fuels: An Introduction to Fuels and Fuels Classification' and the second 'Bark Beetles Fuels and Fire' (Appendix 4). These presentations are available on CDs that we distributed to agencies and organizations involved with wildland fire and forest insect management. Land managers may use these presentations as a reference or to familiarize fire/fuel crews or other personnel with basic fuels terminology and to provide information concerning the potential effects of bark beetle-induced mortality on fuels and fire behavior in three Intermountain conifer forest types. An individual student can use this training module as a self-paced educational tool, and an instructor can use it for group trainings.
3. We finally produced a 3' x 5' interpretive sign that we intend to install summer 2005 at the demonstration area (Appendix 5).

Information Derived

The objectives of this project were to 1) compare fuel complexes in permanent, demonstration plots established in spruce-fir stands that are untreated and where density management treatments will be implemented 2) use the fuel inventory results to make appraisals, and 3) use these data to develop and implement fuels modification strategies including prescribed fire and mechanical treatments for demonstration purposes 4) to develop and transfer information related to the effects of bark beetles on fuel complexes using web based and Powerpoint training.

The results of this project are summarized in the 'Fuels and Fire Behavior Related to Thinning Spruce Stands to Decrease Susceptibility to the Spruce Beetle' presentation in Appendix 5 and satisfy the objectives of this project.

Fuels and Fire Behavior

We found that implementing thinning treatments to reduce the susceptibility of stands to spruce beetle can increase the fire hazard of treated stands. In both demonstration areas, the silvicultural treatments resulted in higher loadings of 1, 10, and 100 hour fuels, with the greatest amount of total fuel accumulating in the heavily thinned plots when compared to untreated plots (Figures 2 and 3). Heavy thinning also resulted greater fuel depths than that of moderately thinned and untreated plots. The 1000 hour fuels were quite variable among treatments. This may be attributed to natural differences

in the stands, or the different methods used by landowners to treat larger diameter slash (i.e. pile and burn verses lop and scatter). As expected, the amount of available crown fuel and crown bulk densities was less in the treated plots.

Predicted fire behavior (rates of spread, flame length) was generally greatest in the heavily thinned plots. This was attributed to greater fuel depth, higher amounts of fuel, and higher estimated mid-flame wind speeds in these plots. The exception was the untreated control plots in the Monument Peak demonstration area where fuel depths were greater than in the heavy thin. Lower fuel depths in the heavily thinned plots in this location were attributed to fuel bed compaction by logging machinery. A highly compacted fuel bed would not support combustion as well as in untreated plots. Thus, rates of spread and flame lengths can be expected to increase if thinning residuals remain uncompacted.

The sensitivity of BEHAVE to fuel depth may explain the results of custom fuel modeling in these plots. Also, fire behavior in the heavy thin plots was likely under-predicted because the fuel moistures used in the model do not account for the effect of increased solar radiation reaching the exposed fuel bed.

Plots that were moderately thinned had intermediate fire behavior characteristics when compared to the heavy thin and untreated plots. The untreated control plots had the greatest potential to sustain a crown fire of some kind (i.e. lowest crown fire index).

Mechanical Fuel Treatments

This project also provided valuable information on the feasibility of implementing mechanical fuel treatments to mitigate the potential for greater fire behavior in treated stands. Our goal was to treat subplots within the treated demonstration plots using a variety of equipment. In the summer of 2003, we were able to treat 4 subplots with a mobile chipper we obtained from the Fishlake National Forest. This chipper was capable of chipping woody material up to 24” in diameter and equipped with directional chute for broadcasting treated material. There were several advantages associated with using the mobile chipper.

- A half-ton pick-up truck was able to pull the mobile chipper facilitating transportation along roads between sites, access to remote plots, and maneuverability within a site.

- The relatively small nature of the equipment resulted in little soil disturbance, tree damage, and other site impacts.

- The chipper was simple to operate and maintain requiring few technical skills.

- The purchase cost of the chipper was significantly less than that of other machinery.

Some of the disadvantages included:

- Chipping the material was labor intensive and relatively slow. The treatment required one day to chip fuels on approximately one acre. Thus, higher costs were associated with the greater amount of time and number of personnel required for completing the treatment.

- There were safety issues associated with hand-feeding materials into the hopper.

- We were unable to treat fuels on slopes steeper than about 30 percent.

Based on this experience, we concluded that mobile chipper would be most useful in treating fuels over smaller areas and where it is desirable to minimize costs and potential site impacts. Such areas would include urban-wildland interfaces, road corridors and recreation sites.

We encountered several problems in our attempts to acquire masticating, shredding, and self-propelled chipping machinery. The greatest obstacle was the lack of heavy equipment available in the Intermountain area. One alternative was to hire an operator to bring in equipment from other western states. The costs associated with this alternative were prohibitive. We worked with local Forests and the Utah State Division of Fire, Forestry and State Lands to develop a cost-sharing strategy to treat both Forest and private lands. This strategy would have generally reduced costs for the Forests and other landowners, however, logistically, this effort became problematic and not feasible.

We experienced additional difficulties in obtaining heavy equipment, skilled operators, and other personnel due to limited resources during the active fire seasons of in 2002 and 2003. Other obstacles associated with the use of heavy machinery in Intermountain locations included accessing remote sites, rough terrain, steep slopes, and wet summer conditions.

In spite of these difficulties, there remains a need for a variety of alternatives to treat fuels in Intermountain forests, particularly in stands affected by and managed for bark beetles. The lack of resources in the Intermountain area necessitates that land management agencies and other landowners continue cooperative efforts to develop strategies that incorporate the use of the most ecologically appropriate, efficient, and economically feasible tools.

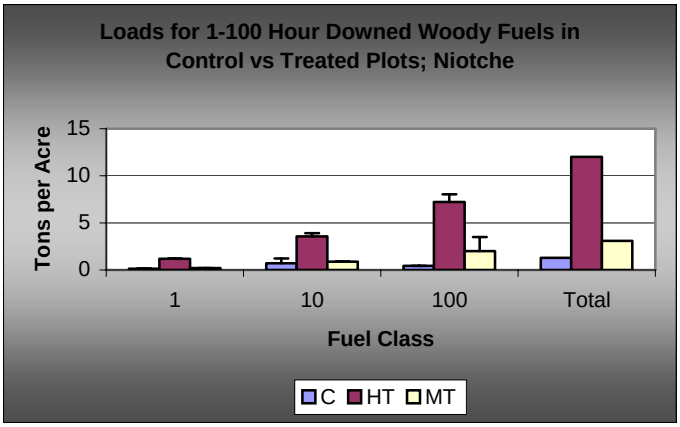

Figure 2.

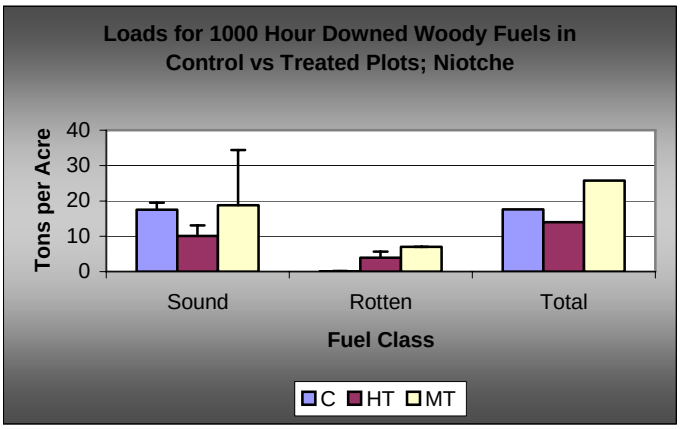

Figure 3.

Fuel loads by time lag category in each of the 3 treatments in Fall 2001
(C = control, HT= heavy thin; MT = moderate thin)