University of Nebraska - Lincoln
DigitalCommons@University of Nebraska - Lincoln

JFSP Briefs U.S. Joint Fire Science Program

2011

Assessing Fuel Treatment Effectiveness After the Tripod Complex Fires

Shari Anstedt
US Forest Service, sanstedt@comcast.net

Follow this and additional works at: http://digitalcommons.unl.edu/jfspbriefs

Part of the Forest Biology Commons, Forest Management Commons, Other Forestry and Forest Sciences Commons, and the Wood Science and Pulp, Paper Technology Commons

Anstedt, Shari, "Assessing Fuel Treatment Effectiveness After the Tripod Complex Fires" (2011). *JFSP Briefs*. 138.
http://digitalcommons.unl.edu/jfspbriefs/138

This Article is brought to you for free and open access by the U.S. Joint Fire Science Program at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in JFSP Briefs by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

Joint Fire Science Program

Fire Science Brief

RESEARCH SUPPORTING SOUND DECISIONS

The 2006 Tripod Complex fires in north-central Washington provided researchers with a timely opportunity to study the efficacy of pre-wildfire fuel treatments. Credit: Lisa Poncelet, Tripod Emergency Medical Technician.

Assessing Fuel Treatment Effectiveness After the Tripod Complex Fires

Summary

Over the past 50 years, wildfire frequency and area burned have increased in the dry forests of western North America. To help reduce high surface fuel loads and potential wildfire severity, a variety of fuel treatments are applied. In spite of the common use of these management practices, there have been relatively few opportunities to quantitatively measure their efficacy in wildfires. That changed with the 2006 Tripod Complex fires in the Okanogan-Wenatchee National Forest in Washington—one of the largest fire events in Washington state over the past five decades. A serendipitous involvement of recent fuel treatments and the availability of pre-wildfire data provided a rare chance to study the effects of different types of fuel treatments on wildfire severity. In this project, tree mortality, and tree damage were assessed and differences in wildfire severity were evaluated in units with thin-only treatments, thinning followed by prescribed burning treatments, and no treatment. With this study, researchers aimed to provide resource managers with the definitive evidence and specific scientific information needed to determine which fuel treatment methods will be the most successful at reducing fuels and mitigating wildfire severity.

Key Findings

- Compared to thin-only and untreated units, units treated with thinning followed by prescribed burning had the lowest wildfire severity.
- Percent change in tree mortality did not differ significantly by treatment. However, tree mortality did differ considerably by species, with western larch and ponderosa pine experiencing the lowest mortality and lodgepole pine and Engelmann spruce experiencing the highest.
- Three years post fire, over 57 percent of trees survived in thin/prescribed burn units compared to 19 percent in thin-only units and 14 percent in untreated units.
- There was no significant difference in treatment results between thin-only units and untreated units.
- Treatment unit size does not appear to affect treatment effectiveness. In the study, even small treated units (less than 20 acres) successfully reduced fire severity.

Fuel treatments and fire severity

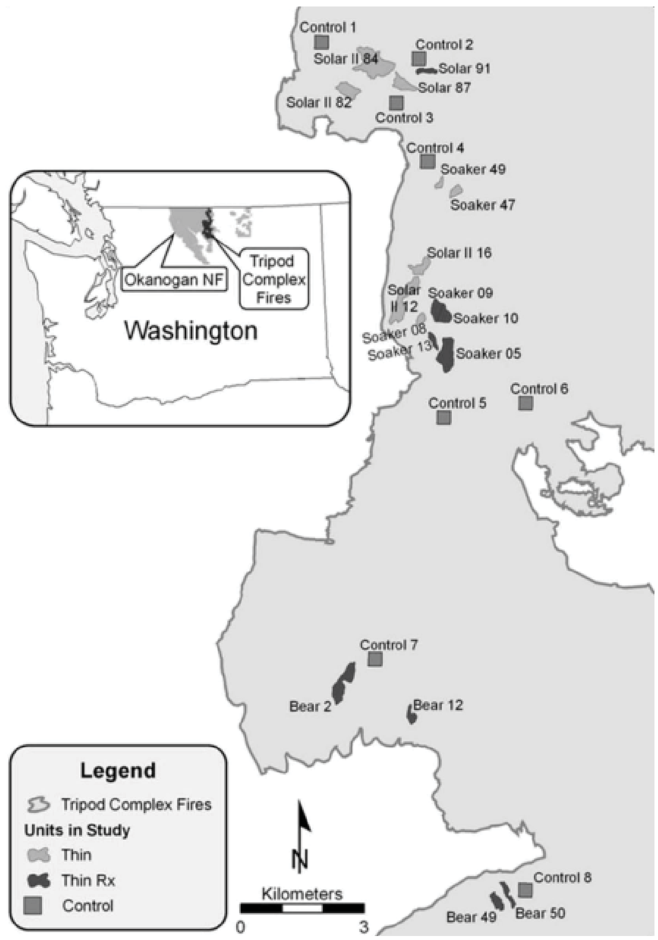
In the forests of western North America, a legacy of fire exclusion has contributed to high surface fuel loads. In fact, wildfire frequency, severity, and acreage burned in this region have increased considerably over the past 50 years—and this trend is likely to continue as the climate becomes warmer and drier.

To help reduce fuels and mitigate the potential for severe wildfires, a variety of fuel treatments are applied, such as mechanical thinning, biomass removal, and prescribed burning. Existing studies generally agree that thinning followed by prescribed burning is the most effective at lessening wildfire severity, however, using prescribed fire is not always feasible. Principal investigator Susan Prichard stated, “Fire and fuel managers face numerous challenges in developing strategies for fuel reduction treatments. Prescribed fire is less expensive than mechanical or manual fuel removal but is often difficult to implement due to smoke management concerns and narrow windows of safe burning conditions.”

There have been relatively few opportunities to quantitatively measure the effects of fuel treatments subjected to wildfires. If managers had more definitive evidence on fuel treatment success, they would be better equipped to reduce the severity of future wildfires, plan for and prioritize fuel treatments, and ensure the optimal use of resources.

A rare opportunity

In 2006, lightning struck in north-central Washington, initiating one of the largest fire events in five decades—and providing researchers with a rare and timely opportunity to study fuel treatment effectiveness in mitigating wildfire severity. The Tripod Complex fires burned nearly 180,000 acres of mixed conifer forest in the Okanogan-Wenatchee National Forest and were the culmination of hot dry weather, strong gusty winds, and an ongoing mountain pine beetle (*Dendroctonus ponderosae*) outbreak. The fires were especially intense, with over 60 percent of the areas burned classified as moderate to high severity.



Located within the southwestern section of the Tripod Complex Fire area, treatment units studied consisted of thin-only (Thin), thinning followed by prescribed burning (ThinRx) and untreated controls (Control).

The study location consisted of low- to mid-elevation forests in the Methow Valley Ranger District in the Okanogan-Wenatchee National Forest. Tree stands in this area are multi-aged and dominated by Douglas-fir (*Pseudotsuga menziesii*), ponderosa pine (*Pinus ponderosa*), and lodgepole pine (*Pinus contorta* var. *latifolia*) tree species, with some presence of grand fir (*Abies grandis*) and western larch (*Larix occidentalis*).

Specific study areas included eight thin-only units, eight units that had been thinned followed by prescribed burning, and eight untreated, or control, units. In addition, to help limit variability in fire weather and behavior, researchers chose to investigate the unmanaged stands that were adjacent to, or bordering, the primary treatment units. This included six thin-only units with adjacent unmanaged controls and six thinned/prescribed burned units with adjacent unmanaged controls.

Mechanical thinning prescriptions included both thin-from-below harvests that targeted small diameter and understory trees and shelterwood harvests that removed both understory and overstory trees. All timber harvests were completed 8 to 15 years prior to the wildfire and were mostly whole-tree harvested by tractor. Four thin units were helicopter logged, with tree crowns left on site. Most thin units were scheduled for prescribed burning and had recent estimates of woody fuel loading. Prescribed burns were conducted on thin/prescribed burn units between 0 to 6 years prior to the wildfire event. Hand lines were constructed around each unit, and units were either hand or helicopter ignited. Burning took place either in the spring or fall, and all burns were recorded as successful in accomplishing fuel reduction objectives.

Since fuel treatments had already been conducted and pre-wildfire data had been collected, researchers were able to use this valuable information to help answer the following questions:

- What type of fuel treatment successfully mitigated wildfire severity?
- How did results from the treated units compare to the control units?
- How did large-diameter trees fare relative to small diameter trees?
- Did tree mortality differ by tree species?

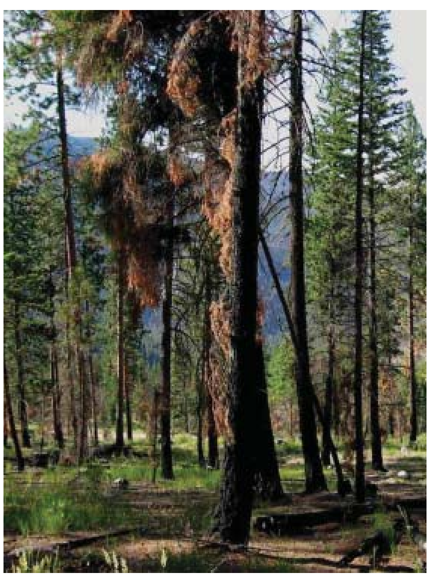
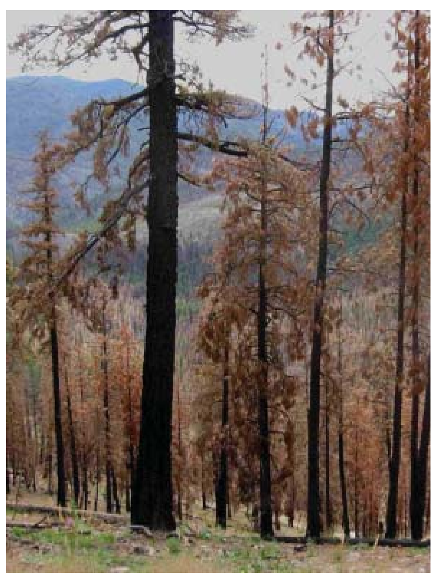
Fuel treatment success

After assessing fuel treatments, study results revealed that the thin-only treatment is not an effective surrogate for prescribed fire in these dry, mixed conifer forests. However, the combination of thinning followed by prescribed burning was proven as a viable method for reducing wildfire severity.

Three years post fire, more than 57 percent of the trees in thin/prescribed burn units survived, with 19 percent tree survival in thin-only units, and 14 percent tree survival in control units. Also, thin/prescribed burn units, compared to thin-only and control units, scored considerably lower in other severity measures such as maximum bole char, percent crown scorch, and burn severity index. Between thin-only and control units, however, there were no significant differences in fire severity measures. In addition, it appears that unit size is not a factor when determining treatment success. Even small thin/prescribed burn units (10 to 12 acres in size) had low fire severity, suggesting that treatment type, not unit size, is more influential when mitigating fire severity.

Even small thin/prescribed burn units (10 to 12 acres in size) had low fire severity, suggesting that treatment type, not unit size, is more influential when mitigating fire severity.

Prichard stated, "I was surprised that the small units fared as well as they did. Small units, less than 15 acres, that had been mechanically thinned and prescribed burned appear to have been just as effective as larger units (more than 37 acres). The reason I would expect small units to not perform as well as large units is that they have a greater amount of edge than larger units and therefore should provide less of a buffer from high-intensity fires surrounding the units. We didn't have a large enough sampling of units to statistically evaluate the effect of unit size, but it appears that overall tree mortality was similar across a range of unit sizes (11 to 55 acres)."


These photos demonstrate the striking difference in fire severity and treatment effectiveness between the three different methods (at different locations). From left to right: thin/prescribed burn, thin only, and control. Credit: Susan Prichard.

Treated vs. control units

Similar to other study findings, bole char height, percentage crown scorch, and burn severity index were much lower in thin/prescribed burn units than adjacent controls. But, for thin-only units and their respective adjacent controls, fire severity measures did not differ significantly.

Large vs. small diameter trees

Survival of large-diameter trees (more than 20 centimeters, or 8 inches, diameter at breast height) three years post-fire was over 73 percent in thin/prescribed burn units, 36 percent in thin-only units and 29 percent in control units. Compared to the thin-only and control units, all measures of large-diameter tree severity in the thin/prescribed burn units were dramatically lower. But for large-diameter trees in the thin-only and control units, there were still no significant differences in fire severity measures. Above all, the probability of mortality is considerably lower in thin/prescribed burn units than thin-only and control units.

Overall, researchers discovered that large-diameter trees are more likely to survive high-severity wildfire than small-diameter trees. Large-diameter tree survival is likely supported not only by thicker bark and greater crown heights, but the application of thin/prescribed burn treatments. That said, large-diameter trees that had been exposed to higher intensity fires in thin-only and control units may have been weakened and therefore become more vulnerable to secondary mortality agents such as drought stress and bark beetle outbreaks.

Species and tree mortality

Tree mortality was surveyed for three years following the wildfire event. After the initial survey in 2007, an additional 18 percent of trees subsequently died in 2008 and 7 percent of trees died in 2009. Percent change in tree mortality between 2007 and 2009 did not differ considerably by treatment but mortality was markedly different by tree species. With thick bark and a reputation of being fire resisters, western larch and ponderosa pine had the lowest mortality, followed by Douglas-fir. Not surprisingly, thin-barked species such as lodgepole pine and Engelmann spruce had the highest mortality.

Management Q & A

1. Why was wildfire severity higher in thin-only units?

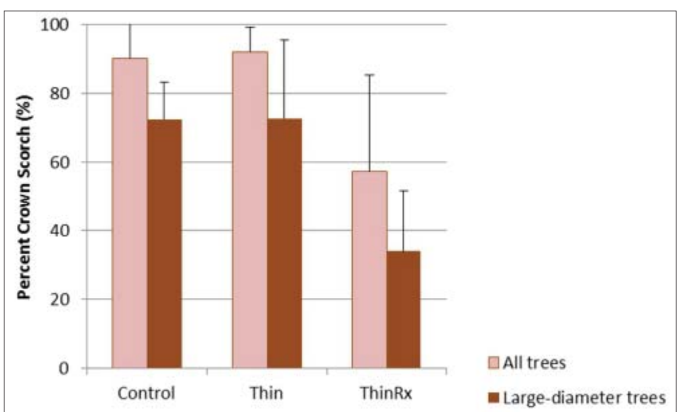
   With lower tree densities and fewer understory trees than unmanaged controls, thin-only units likely were effective at reducing crown fire potential but not tree mortality. Researchers did not observe evidence of crown fire in thin-only stands, however, control units displayed a mixture of scorched patches of trees and areas where needles and branchwood in tree crowns were consumed by fire. High tree mortality in thin-only units likely was associated with cambial heating and crown scorch from severe surface fires. Maximum bole char and crown scorch height both were highest in thin-only units, suggesting long flame lengths and particularly high-severity surface fires in those units.

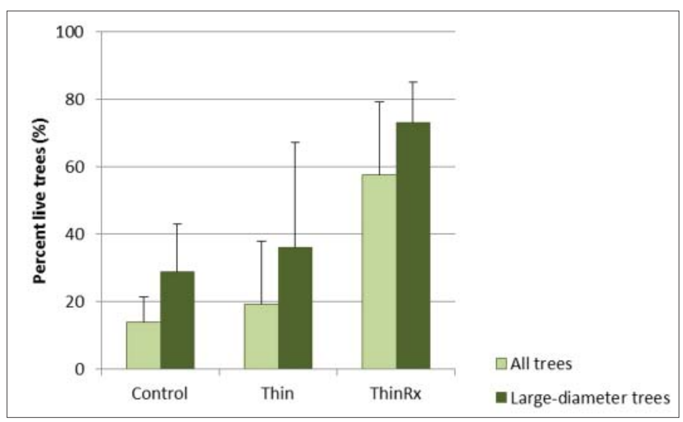
2. How can large-diameter trees be managed in dry forest landscapes?

   To protect large-diameter trees from future wildfire damage, study results indicated that thinning followed by prescribed burning is the most useful management tool.

3. Are the study results applicable to other dry forest types?

   Findings from this study as well as from other studies suggest that many dry forests with low to mixed-severity fire regimes in the western United States may benefit from the use of thin/prescribed burn treatments. However, researchers caution that these treatments may not be as helpful in forests with flammable shrub and/or grassland understories, as thinning and prescribed





Compared to control and thin-only units, thin/prescribed burn units (and specifically large-diameter trees) displayed the lowest percent crown scorch.

burning can create gaps in the forest canopy and therefore accelerate shrub growth.

4. Can these fuel treatment methods reduce wildfire severity and address climate change?

   According to Dave Peterson, co-principal investigator, "Managing for reduction of wildfire severity is perfectly compatible with management for climate change. One of the best things we can do to create resilient forests is reduce very large, severe disturbances. We can tolerate less severe forest fires, which forests experienced for hundreds of years before 1900. But having stopped for a century or so and then having very severe fires is not necessarily something these forests are adapted to. So, this management approach will help with climate change as well."

5. What are some additional tips for managers when conducting thin/prescribed burn treatments?

   To help optimize resources, researchers suggest targeting critical areas such as wildland urban interfaces and appropriate forest types (i.e., those that historically supported high-frequency, low-intensity fire regimes). Strategic placement of these fuel treatments may also help limit fire spread across critical landscapes.

Ongoing quest for knowledge

With any in-depth research project, there is always more to learn—more questions to answer and more variables to consider—and this study is no different. Researchers have already begun work on companion and expansion studies. In addition, further exploration of the following is encouraged:

- The interaction of bark beetles, fuels, and fire.
- Fuel treatment longevity across a variety of forest types, regions, and management situations.
- Fuel treatment effectiveness under extreme fire weather and in steep terrain.
- The efficacy of fuel treatments in areas that are commonly used as defensible space for firefighters.
- The implementation of ongoing fuel treatment monitoring on public lands.

Management Implications

To help reduce wildfire severity and tree mortality, researchers recommend:

- Performing thinning followed by prescribed burning. However, carefully consider the existing vegetation dynamics of an area as treatments may increase shrub dominance, especially in forests with flammable shrub or grassland understories.
- Piling and burning logging slash in places where broadcast burning is not possible.
- Prioritizing thinning and burning treatments in areas with large diameter trees (more than 8 inches in diameter).

Further Information: Publications and Web Resources

Fire and Environmental Research Applications Team:
http://www.fs.fed.us/pnw/fera/

Oregon Public Broadcasting Ecotrope article:
http://ecotrope.opb.org/2010/08/qa-how-to-reduce-wildfire-severity-even-in-a-warmer-climate/#more-919

Pacific Wildland Fire Sciences Laboratory:
http://www.fs.fed.us/pnw/pwfsl/

Research Project Website:
http://www.fs.fed.us/pnw/fera/research/treatment/tripod/index.shtml

Scientist Profiles

A Forest Ecologist, **Susan Prichard** currently works for the U.S. Forest Service, Pacific Wildland Fire Sciences Laboratory in Seattle, WA. With a PhD in Forest Ecosystem Analysis from the University of Washington, Dr. Prichard's main interests include the effects of fire and other disturbances on forest dynamics, climatic change on forest ecosystems, and the use of fuel treatment options to mitigate wildfire effects.

Susan Prichard can be reached at:
University of Washington
School of Forest Resources
Box 352100
Seattle, WA 98195-2100
Phone: 509-996-2408
Email: sprich@u.washington.edu

A Research Biologist, **Dave Peterson** works for the U.S. Forest Service, Pacific Northwest Research Station in Seattle, WA. He directs the Fire and Environmental Research Applications team which conducts research on fire science, fuels, and climate change. Dr. Peterson is a principal investigator for the Western Mountain Initiative and as a contributing author for the Intergovernmental Panel on Climate Change was a co-recipient of the Nobel Peace Prize in 2007.

Dave Peterson can be reached at:
U.S. Forest Service
Pacific Wildland Fire Sciences Lab
400 N. 34th Street, Ste. 201
Seattle, WA 98103
Phone: 206-732-7812
Email: peterson@fs.fed.us

Collaborators

Pete Soderquist, Forest Service, Okanogan-Wenatchee National Forest
Richy Harrod, Forest Service, Okanogan-Wenatchee National Forest
Paige Eagle, University of Washington
Kyle Jacobson, U.S. Forest Service, Tahoe National Forest
Robert Norheim, University of Washington

Results presented in JFSP Final Reports may not have been peer-reviewed and should be interpreted as tentative until published in a peer-reviewed source.

The information in this Brief is written from JFSP Project Number 07-1-2-13, which is available at www.firescience.gov.

An Interagency
Research, Development,
and Applications
Partnership

JFSP *Fire Science Brief*
is published monthly.
Our goal is to help managers
find and use the best available
fire science information.

Learn more about the
Joint Fire Science Program at
www.firescience.gov

John Cissel
Program Manager
208-387-5349
National Interagency Fire Center
3833 S. Development Ave.
Boise, ID 83705-5354

Tim Swedberg
Communication Director
Timothy_Swedberg@nifc.blm.gov
208-387-5865

Writer
Sheri Anstedt
sanstedt@comcast.net

Design and Layout
RED, Inc. Communications
red@redinc.com
208-528-0051

The mention of company names,
trade names, or commercial products
does not constitute endorsement
or recommendation for use
by the federal government.