Quantifying the Potential Impacts of Fuel Treatments on Wildfire Suppression Costs

R-CAT Pilot Study

Deschutes National Forest CFLRP Project

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Study Participants (in alphabetical order)

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- Jessica Haas, Rocky Mountain Research Station
- Keith Stockman, USFS Northern Region
- Matt Thompson, Rocky Mountain Research Station
- Nicole Valliant, Pacific Northwest Research Station, Western Wildland Environmental Threat Assessment Center

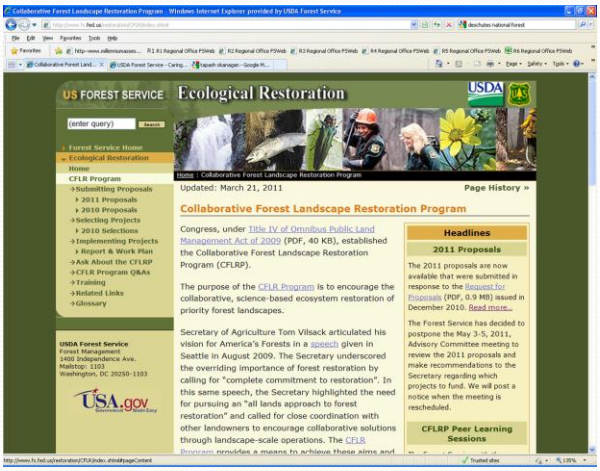
Fuel Treatments

- The development of the National Fire Plan produced an increased interest in the economics of fuel reduction treatments as land managers attempt to deal with high fuel loads.
- The primary purpose of the Healthy Forest Restoration Act of 2003 (Public Law 108-148) is: "to reduce wildfire risk to communities, municipal water supplies, and other at-risk Federal lands through a collaborative process of planning, prioritizing, and implementing hazardous fuel reduction projects."
- Currently being emphasized through the Cohesive Strategy and the Collaborative Forest Landscape Restoration Program (CFLRP)

Do Fuel Treatments Work?

- While there is overall agreement that fuel treatments can affect fire behavior by reducing intensity and/or size of fire (Graham et al. 2004, Agee and Skinner2005, Stephens and Moghaddas 2005, Martinson and Omni 2011), it is still uncertain whether the benefits of these treatments outweigh the costs.
- Benefits include the restoration of ecosystem health, which is difficult to value, as well as avoided costs such as reduced suppression expenditures and reduced property damage.
- Thinning and burning seems the most effective at affecting fire behavior/severity but can be very expensive

Collaborative Forest Landscape Restoration Program (CFLRP)



Under Eligibility Criteria

(4) analyze any anticipated cost savings, including those resulting from--

(A) reduced wildfire management costs; and

(B) a decrease in the unit costs of implementing ecological restoration treatments over time;

(5) estimate--

(A) the annual Federal funding necessary to implement the proposal; and

(B) the amount of new non-Federal investment for carrying out the proposal that would be leveraged;

Under Selection Criteria

(C) the strength of the collaborative process and the likelihood of successful collaboration throughout implementation;

(D) whether the proposal is likely to achieve reductions in long-term wildfire management costs;

(E) whether the proposal would reduce the relative costs of carrying out ecological restoration treatments as a result of the use of woody biomass and small-diameter trees; and

(F) whether an appropriate level of non-Federal investment would be leveraged in carrying out the proposal.

Here's what some of the CFLR teams claimed when they submitted proposals

SW Crown: Wildfire will continue to be managed commensurate with seasonal fire activity, resource availability, and cost of suppression actions versus the potential environmental losses. Wildfire caused by natural ignitions will be actively managed where resource management objectives can be met. Fire managers will establish a strategy based on topography, weather, fuels, and seasonal conditions under which the fire will be managed…. Fire managers, due to reduced fire intensity, will have a greater array of tactical responses so that individual fires can be man-aged with variable levels of resources, **potentially reducing costs**.

Tapash: On the Tapash landscape 401,202 acres are in the dry forest type, making up 25% of the total landscape. Our proposal plans on returning 50% of these acres back into ecological balance where fire plays its natural role. The estimated cost of all proposed treatments is $50 million. Compare this to a 10 year average of 226,000 acres burned, at a cost of $206 million to suppress. **When these projects are completed the estimated suppression costs will be 50% of current expenditures**, based on the ability of line officers to take advantage of fire playing a more natural role in the ecosystem.

4FRI: The 4FRI mission to treat fuels strategically across the 2.4 million acre planning area would not only maximize restoration effectiveness, but enhance the ability to manage fires for restoration objectives, while **simultaneously protecting values-at-risk and minimizing fire management costs.**

R-CAT (Risk and Cost Analysis Tool)

- To help CFLR teams meet these requirements, a team of NFS economists and fire modelers from the Rocky Mountain Research Station and the Western Wildlands Environmental Threat Assessment Center developed:

  1) **a set of analysis procedures** based upon the coupling of two peer-reviewed models used by the Forest Service and other federal land management agencies: FSim (Finney et al. 2011), a spatially explicit large fire spread model, and a large fire cost model (SCI) (Gebert et al. 2007), and

  2) **a tool** for estimating wildland fire management cost savings using the analysis outputs and other information on treatment costs and revenues.

Possible large fire cost savings opportunities

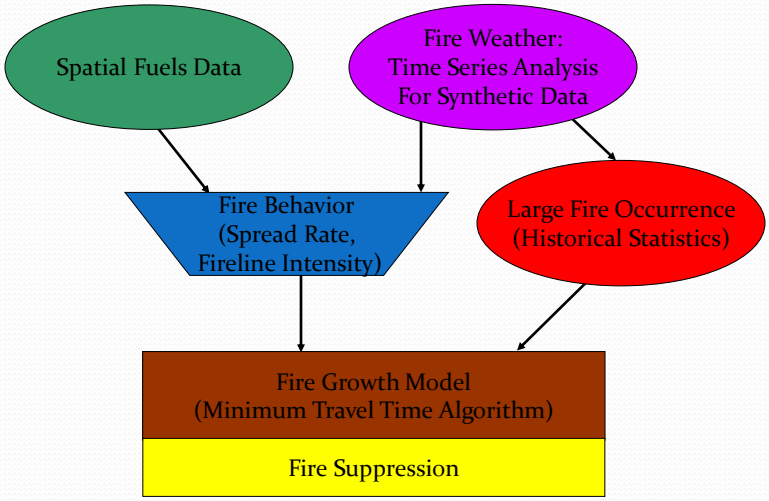
Mechanism	Potential Evaluation Approaches
Fuel treatments reduce fire spread potential and fire size distributions	1. Wildfire model outputs quantify changes to final fire sizes 2. Cost regression model quantifies expected suppression costs 3. Scenario analysis explores range of possible cost savings
Fuel treatments reduce fire intensity, enhancing suppression effectiveness (largely for treatments intended as fuel breaks)	1. Wildfire model outputs quantify changes to fireline intensity 2. Expert judgment identifies where suppression tactics and effectiveness might change (e.g., Penman IJWF; Plucsinski IJWF) 3. Scenario analysis explores range of possible cost savings
Fuel treatments reduce fire intensity, enabling increased use of fire for beneficial purposes	1. Wildfire model outputs quantify changes to fireline intensity 2. Expert judgment combined with consultation of Land and Fire Management Plans identify areas of the landscape where fire may be promoted 3. Scenario analysis explores range of possible cost savings

The Basic Steps of the R-CAT Analysis Procedure

- Data needs include an up-to-date map of landscape fuels, delineation of treatment polygons and prescriptions, and projected fuel conditions after treatment.
- Design and spatially lay out prospective fuel treatments.
- Modify input fuels data for FSim appropriately given the nature of the treatment.
- Generate FSim wildfire simulation model outputs with and without fuel treatments.
- Aggregate and feed variables output from FSim into the regression cost model to estimate the expected suppression cost for each simulated fire.
- Compare expected suppression costs with and without fuel treatments, across fires and across simulated fire seasons.

FSIM – What is it?

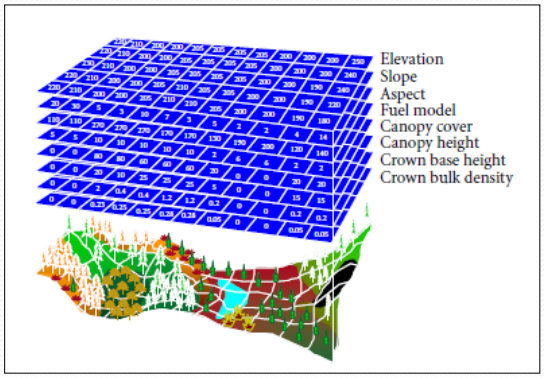
- FSIM is the large fire simulation system and is used by Fire Program Analysis (FPA) System (Finney et al. 2011)



Landscape file to run FSim for the RCAT research project.

The landscape file consists of a grid sandwich with data themes for:

Elevation
Slope
Aspect
Fuel model
Canopy cover
Crown height
Canopy base height
Crown bulk density

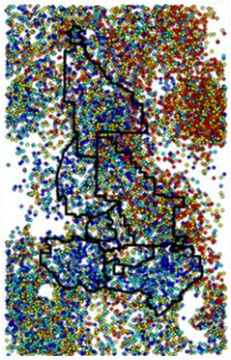


Two landscape files are required:

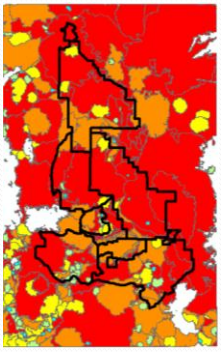
1 Existing condition
2 Post-treatment

FSim – All outputs

- **<u>Fire size list (*.txt)</u>**
- **<u>Fire perimeter shapefile(s) (*.shp)</u>**
- Flame length probability (*.txt)
- Annualized burn probability (*.asc)
- Annualized mean fireline intensity (*.asc)



Existing conditions fire size list



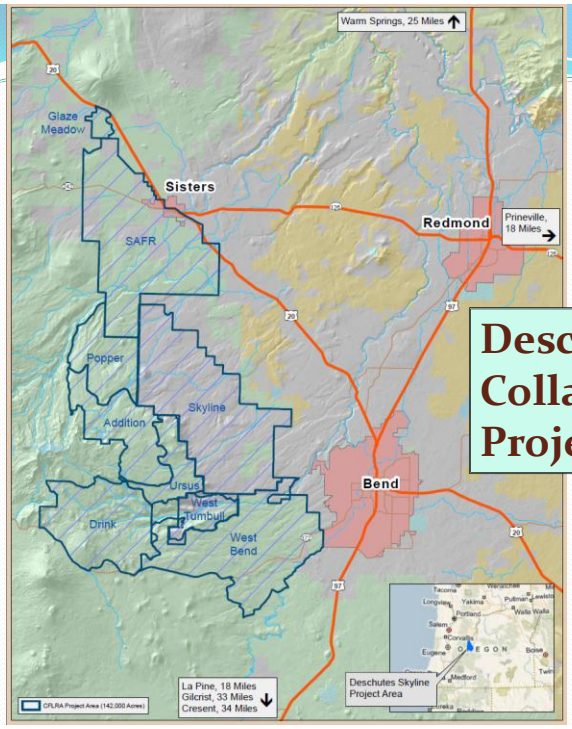
Existing conditions fire perimeters

What is the SCI?

- Regression Models for Predicting Suppression Expenditures on Individual Large Fires (Gebert et al. 2007)
  - 6 basic models - Two FS models (western U.S. and eastern U.S) and four DOI models (one for each agency). Models differ slightly depending upon agency and use as performance measure or in WFDSS
  - Data: Historical fire expenditure and fire occurrence information for the past 5-10 years (varies according to use)
  - Currently used as a performance measure and for estimating fire costs in WFDSS and FPA

Variables (Fire Characteristics)

- **Size** (acres burned)
- **Fire Environment** (aspect, slope, elevation, fuel type, fire intensity level, energy release component)
- **Values at Risk** (distance to nearest town, total housing value 20 miles, in a reserved area (Y or N) and distance to area boundary)
- **Location** (FS Region or GACC)
- **Resource availability** (number of fires burning in the region at the time of the fire compared to average for the region that time of year) – **only in FS performance measure model**



Deschutes Forest Collaborative Project -DFCP

Summary statistics for historic* and simulated fire size (acres)

	Historic	Simulated		
		EC	PT	% Reduction
Mean	9,649	8,373	7,118	14.99%
Median	2,151	2,671	2,180	18.37%
Min	381	301	300	0.15%
25% Quartile	604	869	792	8.88%
75% Quartile	6,905	9,407	7,468	20.61%
Max	79,734	79,230	71,743	9.45%

*Historic fire data spans FY 2000-2011 across the entire Deschutes National Forest, including areas outside of the Skyline study

Summary statistics for historic* and simulated fire cost/acre.

	Historic	Simulated		
		EC	PT	% Reduction
Mean	2,117	2,447	2,480	-1.33%
Median	1,534	2,001	2,006	-0.25%
Min	382	324	346	-6.73%
25% Quartile	577	1,217	1,210	0.61%
75% Quartile	3,307	3,486	3,531	-1.30%
Max	6,461	9,154	9,159	-0.05%

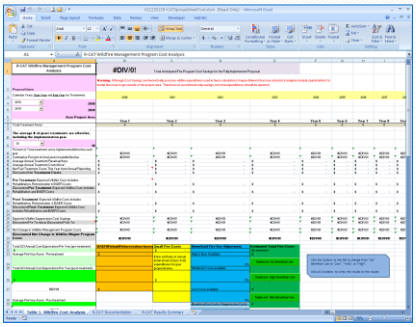
*Historic fire data spans FY 2000-2011 across the entire Deschutes National Forest, including areas outside of the Skyline study

Summary statistics for historic and simulated annual total fire cost ($)

	Historic	Simulated		
		EC	PT	% Reduction
Mean	6,169,476	$5,401,950	$4,512,393	16.47%
Median	2,876,921	$2,675,639	$2,282,279	14.70%
Min	253,343	$170,239	$21,150	87.58%
25% Quartile	1,624,362	$1,337,778	$1,224,218	8.49%
75% Quartile	7,735,954	$6,473,991	$5,203,485	19.62%
Max	30,587,468	$66,177,307	$51,585,439	22.05%

Filling in the R-CAT spreadsheet:

- Filling in the R-CAT spreadsheet: (Deschutes)
  - Fuel treatment acreages over time
  - Fuel treatment effectiveness
  - Fuel treatment costs and revenues
  - Pre- and post-treatment suppression costs



Suppression Cost Savings versus Fire Program Cost Savings

- Suppression costs decreased by approximately 15%, for a potential savings of around $550,000 per year
- However, treatment costs averaged around $1.4 million per year, while treatment revenues averaged around $101,000 per year
- Estimated total fire program cost savings = negative $5.5 million

Final Thoughts

- RCAT does not capture all of the benefits of fuel treatments. Other benefits could include:
  - Protection of values at risk
  - Greater ability to capture fires in initial attack
  - Greater ability to use less aggressive (less costly) suppression strategies
  - Other ecosystem benefits
- Deschutes example of suppression cost savings could be unique – project area contains 112,000 FS acres; 66,000 of which are being treated.
- All CFLR teams will go through this process over the next couple of years providing a better picture

Questions??

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