Joint Fire Science Program pilot project report for (JFSP Project # 06-3-3-11)

Fuel Treatment Effectiveness in the United States

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Overview: The fire situation in the United States is well documented with a growing prevalence of larger and more intense fires that have increasingly severe consequences for affected ecosystems and human health and well being. Wildland fire managers have the task of mitigating the impacts of wildfires that will inevitably occur. Increasingly, fuels management has been put forth and implemented as part of an integral strategy for minimizing fire risk, extreme fire behavior, area affected by wildfire and both the economic and ecological costs of fires. These activities take a multitude of forms, from stand alone prescribed fires to various types of thinning or combinations of treatments. However, managers need to know how cumulative wildland fuels treatments act at the landscape level and, furthermore, how long effective life spans of treatment are.

Executive Summary: This pilot project was requested by the JFSP Governing Board to provide the necessary ‘proof of concept’ for our proposed national assessment of fuel treatment effectiveness. Specifically, we were requested to address concerns about the utility of both NFPORS and LANDFIRE data for the proposed study and prove our ability to successfully assess the effectiveness of specific fuels treatments at both local (i.e. fire effects on the treated acres) and landscape scales (i.e. changes in fire extent). Our approach to assessing the local effects of the fuels treatments builds on the burn severity information for large fires supplied by the Monitoring Trends in Burn Severity (MTBS) project. To validate the measurements of treatment effectiveness obtained from satellite imagery, we compared satellite-based Differenced Normalized Burn Ratio (dNBR) and field-based composite burn index (CBI) estimates of burn severity within and near fuels treatment areas. To assess treatment effectiveness at a local level, we carried out a spatial statistical analysis of the relationship between the dNBR maps and the fuel treatment polygons. To assess the landscape effect of fuels treatment on fire extents we implemented FARSITE models of the fires utilizing LANDFIRE datalayers and spatial polygons of fuels treatments with appropriately altered fuel models. Once a fire was calibrated successfully, the exact simulation scenario was repeated without the existing fuels treatments by running the simulation using the unaltered LANDFIRE datalayers, which did not reflect the fuels changes resulting from treatment.

Our preliminary results are described in detail in this report. These results can be summarized as follows. Our analysis of the utility of NFPORS data on fuels treatments showed that, although many of the fuels treatments are incorporated in the NFPORS database, the lack of spatial

information (GIS data on treatment polygons), inconsistent incorporation of treatment information and multiple records of individual treatments limit the utility of NFPORS for this research. NFPORS data can be used for an initial screening of which fires are likely to have affected treatments but local land managers must be contacted to determine the type and availability of treatment data, as well as to understand the local context of the fire. We have had excellent success interacting with local land managers and acquiring the necessary fuels treatment data as well as helpful ancillary data (e.g. fire progression maps, roads, stand exams, etc). There has been considerable interest from local land managers to receive the results of our analyses of their fuels treatment effectiveness.

To validate the MTBS dNBR maps in both treated and untreated areas, we conducted field studies on three separate fires (Camp32 fire (MT), School fire (WA) and Warm fire (AZ)). In all cases, composite burn index (CBI) plots correlated well with dNBR image values both within and outside of fuels treatment areas, demonstrating that dNBR is suitable for measuring fuel treatment effects on burn severity. Our preliminary statistical analyses showed that a combination of thinning and prescribed burning reduced burn severity in all three fires, whereas thinning without subsequent treatment of slash increased burn severity in two of the fires.

The LANDFIRE data has proven effective for use in our FARSITE modeling, especially after the recently released revision of the datalayers. However, it is still necessary for a skilled analyst to apply the information and determine whether or not corrections are needed. Through completion of the FARSITE Fire Area Simulator (S493) course (Destin, FL) and training directly with Mark Finney at the USFS Fire Lab in Missoula, MT for the specific needs of this research, we have gained the necessary expertise for conducting the fire modeling component. In order to account for the stochastic nature associated with severe fire behavior inherent in large fires (e.g. torching and spotting), all final simulation scenarios were run 10 times for both the treated and untreated landscapes to provide more robust estimations of landscape-level treatment effectiveness. In all three locations, FARSITE modeling has shown a substantial landscape level effect of the fuels treatments on fire extent. Although intriguing, we stress that no firm conclusions can be made yet based on such a small sample.

In summary, we have successfully tested and validated all components of the proposed research. Our team of research scientists, technicians and students are now appropriately trained and experienced enough to complete the proposed national assessment of fuels treatment effectiveness. In anticipation of the continued funding of this project we have already started the analysis of fuels treatment effectiveness for 30 more fires. We currently have all of the necessary data for analyzing 19 of these fires and have been informed by 11 other land managers that the remaining fuels treatment data will soon be delivered. We respectfully request the remainder of the requested funding so that we can fully implement the project at this point.

Personnel:

Dr. Mark A. Cochrane is a professor at South Dakota State University (SDSU) and the Principal Investigator for the project with overall responsibility for coordination and implementation of the project. He has been responsible for supervising the analyses of NFPORS and LANDFIRE utility and the subsequent FARSITE simulations.

Dr. Michael C. Wimberly is a professor at SDSU and has responsibility for spatial statistical data analysis for the project. He has supervised the comparative analyses of the dNBR and CBI data and the local analysis of treatment effectiveness for each of the three fires investigated in the pilot study.

Dr. Zhi-Liang Zhu is a senior scientist and is the project's lead federal cooperator and is also the PI for the MTBS project and CO-I for the LANDFIRE project. As such, he has been integral in the implementation of the pilot project.

Don Ohlen is a senior scientist and a SAIC contractor at USGS/EROS. He implements the CBI/dNBR analysis for the MTBS project and has assisted this project's analysis of dNBR and CBI in fuels treatment areas and participated in field work.

Dr. Mark Finney is a USFS research forester with the Missoula Fire Sciences Lab. He facilitated the inclusion of project personnel in the FARSITE Fire Area Simulator (S493) course (Destin, FL) and also provided several days of personal FARSITE training in Missoula, MT to project personnel on materials pertinent to this research.

Dr. Matt Reeves (USFS) is a member of the LANDFIRE Product Quality Working Team and has assisted the project with making adjustments to the LANDFIRE data where necessary and providing access to beta-versions of the new LANDFIRE data products that were subsequently released on 5/31/07.

Kari Pabst (Cochrane) is a Geography Master's degree student at SDSU and an SAIC contractor at USGS/EROS who works on the MTBS project. She has conducted the NFPORS analysis, created all dNBR maps for the project and participated in all field collections of CBI data.

Adam Baer is a geospatial analyst at SDSU. He attended the FARSITE Fire Area Simulator (S493) course (Destin, FL) and has implemented all FARSITE simulations under the supervision of Cochrane and provided spatial data management and analysis under the supervision of Wimberly.

Christopher Barber (Cochrane) and Narayana Ganapathy (Wimberly) are doctoral students at SDSU who have participated in field collection of CBI data.

Actions, Accomplishments and Results

Fieldwork: As outlined in the proposal for the pilot study, three fires were identified to serve as test cases for the pilot study. As part of this effort, the three fire sites were visited for field verification of the burn severity estimates presented in dNBR maps of the fires. At each site, multiple Composite Burn Index (CBI) plots were established within burned fuels treatment areas and at other untreated locations throughout the fire's extent. For each of these fires, contact was made with local land managers to determine the suitability of the site, presence of fire-affected fuels treatments, accessibility, and availability of spatial data. In all cases, we were provided with excellent collaboration and liaison personnel to facilitate our work and provide detailed understanding of how the fires progressed through the landscape. A short description of each site follows, for more detailed information please see the individual trip reports in the appendices.

> Camp 32 Fire: This fire occurred on August 7th, 2005 in Kootenai National Forest, Montana. The fire burned through 918 acres of forest comprised primarily of Douglas fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*) with minor representation of western larch (*Larix occidentalis*). Fuels treatment areas of thinning and prescribed burning included both commercial and non-commercial cuts. Slash from the thinning operations was treated by piling and burning. This was a relatively small fire with easy rolling terrain and was chosen as our initial training site for these reasons. A team of five project personnel visited the site from September 25-29, 2006 and were assisted by Megan Strom and Don Hammack from the Rexford Ranger District. Data from a total of 36 CBI plots was collected. (See Appendix **I**)

> School Fire: This fire burned from August 5th to 13th, 2005 in the Umatilla National Forest, Washington. The fire burned 49,104 acres of ponderosa pine (*Pinus ponderosa*), Douglas fir (*Pseudotsuga menziesii*), and western larch (*Larix occidentalis*), with grand fir (*Abies grandis*) prevalent in the understory of many locations. The fire covered several drainages across complex terrain in the Blue Mountains. Fuels treatments included areas of prescribed burning, mechanical thinning, grapple piling, and combinations of treatments. A total of 31 CBI plots were collected in 4 fuels treatment types and untreated forest. Four project personnel visited the site from October 23-27, 2006 and were assisted by Steve Carlson and Shane Severs from the Rexford Pomeroy District and Eric Twombly from the Pine Ranger District Field Office. (See Appendix **II**)

> Warm Fire: This fire began June 8th, 2006 and burned for 26 days in the Kaibab National Forest. It was initially treated as wildland fire use until a blow up on June 26th**,** when it was designated as a wildfire. By the time it was contained, the fire had burned a total of 57,772 acres. Forests affected by the fire included, Ponderosa pine (*Pinus ponderosa*), quaking aspen (*Populus tremuloides*), and small amounts of Douglas fir (*Pseudotsuga menziesii*) and white fir (*Abies concolor var. concolor)* at higher elevations as well as Colorado Pinyon pine (*Pinus edulis*), Utah juniper (*Juniperus osteosperma)*, and Rocky Mountain juniper *(Juniperus scopulorum)* at elevations below 2400 meters. Fuels treatments within the Warm Fire included: a) prescribed burning; b) thinning; and c) thinning and piling. A total of 31 CBI plots were collected in the fuels treatments and untreated forest. Seven project personnel visited the site from June 18-22, 2007 and were assisted by Russ Truman from the North Kaibab Ranger District. (See Appendix **III**)

Fuel treatments and dNBR: For each of the three fires (Camp 32, School, and Warm) two Landsat TM images were obtained for each fire from the Monitoring Trends in Burn Severity Project (MTBS). Pre-fire and post-fire scenes were selected for each fire in order to create an extended assessment. Post-fire scenes were selected from the growing season following the fire (Key and Benson 2006). The pre-fire scenes were selected to match the date of the post-fire scene as closely as possible. All images were terrain corrected and converted to at-sensor reflectance. The dNBR index was calculated from Landsat TM bands 4 and 7 using the equations presented in appendix **IV**.

Reduced burn severity was observed in many fuels treatment areas (Figure 1). In both the Camp 32 and School fires, severity measured by both CBI and dNBR was significantly lower in the plots treated with both thinning and prescribed burning (TB) than in either the untreated plots (U) or the plots treated with only thinning (T) (Figure 2). In the Warm fire, both CBI and dNBR were significantly lower in plots treated with prescribed burning (B) than in plots treated with thinning alone (T). CBI was significantly lower in the plots treated with burning only (B) than in the untreated plots (U), and significantly higher in the plots treated with thinning only (T) than in the untreated plots (U). Although the differences in dNBR were not significant for either of these two contrasts, their magnitudes were similar to those for CBI and the 95% confidence intervals only slightly overlapped zero. These results show that analyses of treatment effects using dNBR produce similar results as analyses using field-based fire severity indices. We also developed spatial and non-spatial statistical models to assess local fuel treatment effects for each fire using the dNBR maps, LANDFIRE datasets, and fuel treatment polygons (Appendix **V**). These pilot studies demonstrate the feasibility of assessing fuel treatment effectiveness using dNBR and other GIS datasets.

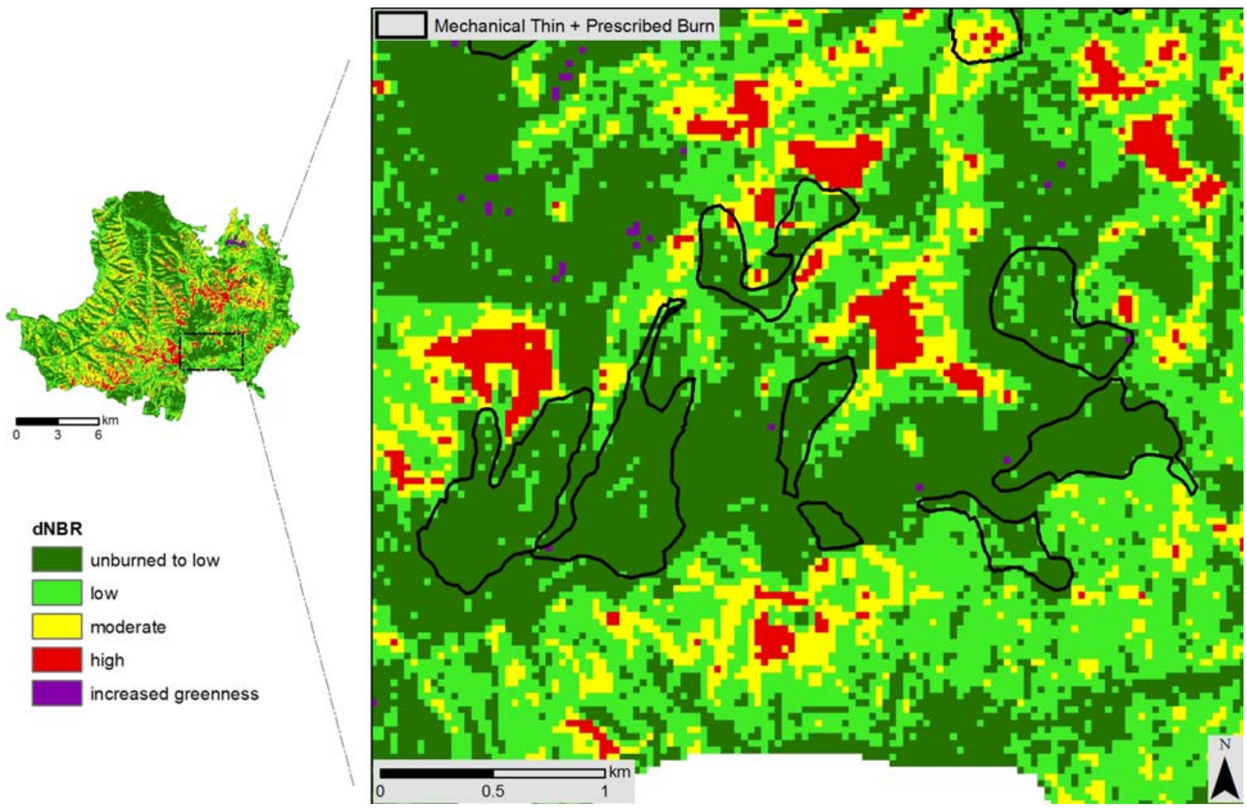

Figure 1: A dNBR depiction of fire severity for a portion of the School fire. Polygons in black show several fuels treatment areas that were within the fire perimeter.

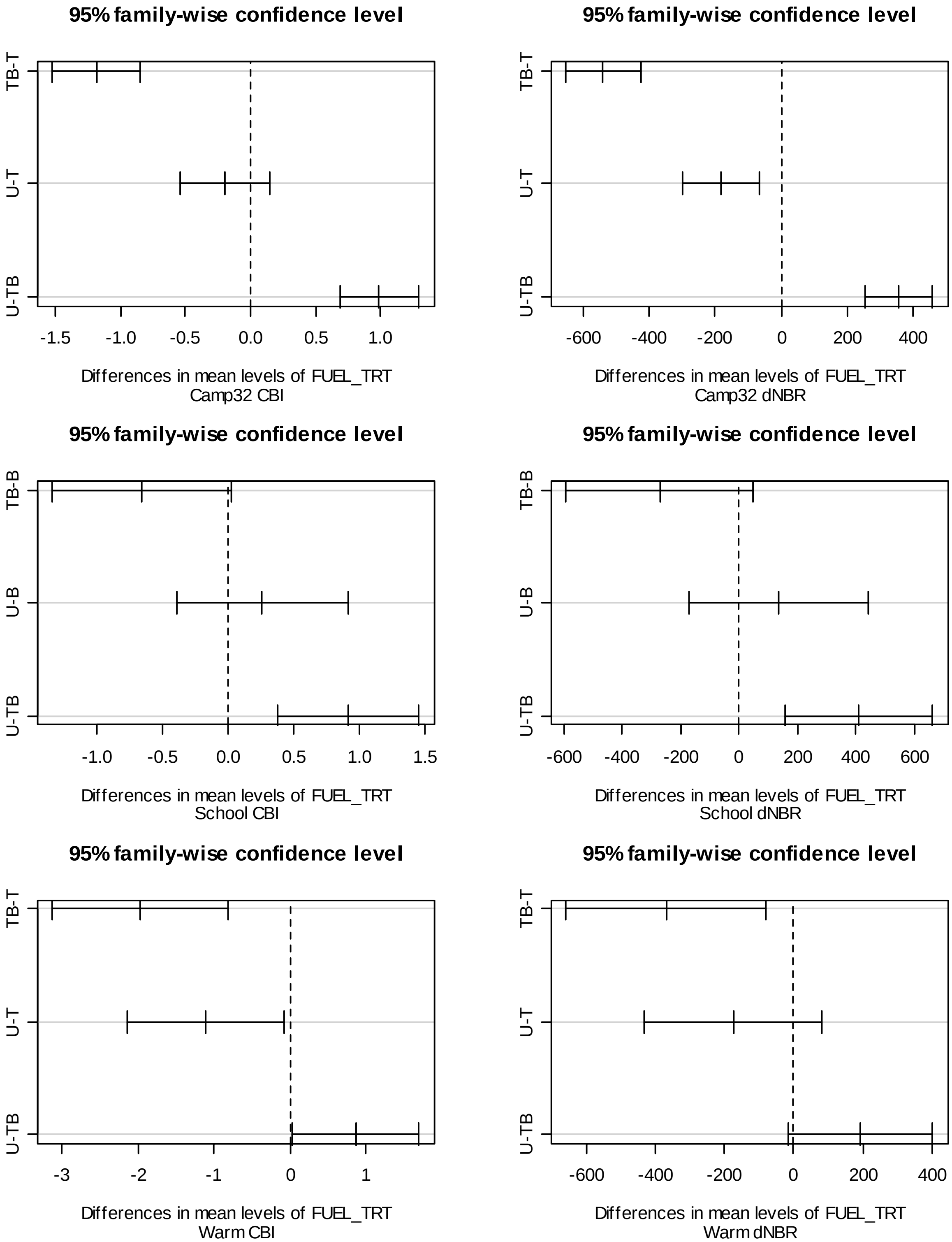

Figure 2: 95% confidence intervals for contrasts among the treatment classes computed using Tukey's studentized range test. Horizontal bars indicate the mean difference between two treatment classes (center tick) and the 95% confidence interval for the mean difference. When this confidence interval does not overlap zero (the dashed horizontal line), the null hypothesis of no difference in fire severity for the two treatment classes is rejected at $p = 0.05$

NFPORS Analysis: In order to test the utility of the NFPORS database for the purposes of this research, we randomly selected 100 large fires (>1,000 acres) from the 982 that occurred in 2005. The full list of 2005 fires was provided by Brad Quayle at the USDA Forest Service Remote Sensing Application (RSAC), a collaborator with the MTBS Project. The 100 selected fires were then overlaid on a GIS layer of Federal Land Boundaries, which were obtained from the National Map (http://nationalmap.gov/). The Federal Land Boundaries helped determine what land management agency was responsible for each fire. After the land management agencies were determined, a search for the appropriate land manager's contact information was performed. This was fairly straightforward on federal lands, but for fires that occurred on state lands it was often difficult to find the correct contact person for information on particular fires. The state's Department of Forestry was the usual starting point. All states that we contacted reported no fuel treatments within the area of the fires in question. Since it was found that most states did not even have fuel treatments, the focus was placed on fires partially or completely within federally managed lands. As such, the random list of 100 fires was regenerated for only fires involving federal lands. Contacting Department of the Interior (DOI) and United States Forest Service (USFS) land managers was straightforward. Individual forests were searched for on the internet to acquire initial contact information. All DOI land management agencies and the USFS were always very helpful in finding the cognizant Fire Management Officers, Assistant Fire Management Officers, Fuel Specialists, Fire Ecologists, or GIS Specialists.

Land managers were initially contacted by email to set up a follow on telephone interview. In both the email and phone conversations, we explained that our JFSP project had the objective of assessing the effectiveness of fuels treatments in mitigating large fires. Land managers were very interested in supporting this research and several asked to be updated as the research progressed and informed of the project's results. At times land mangers even requested that we add specific fires from their districts to our study. During phone conversations and/or follow on emails, land managers were asked a series of questions, including:

1) Were fuels treatments of any age contacted by the fire in question?
2) What types of fuels treatments occurred within the fire in question?
3) Could they provide spatial perimeters of treatments (i.e. polygons for a GIS) and ancillary data (e.g. specific details of treatments) that were contacted by the fire? and
4) Did they have any fuel treatments recorded in the NFPORS database?

The questions were designed to determine;
1) What was the availability of spatial and ancillary data for fuel treatments?;
2) What percentage of large fires was encountering fuels treatment areas?
3) What percentage of fires affecting fuels treatments had entries in the NFPORS database?

All contact information, question responses and notes were entered into an ACCESS database in order to facilitate future analysis as the project grows (contingent on continued funding) to incorporate hundreds of fires. Unfortunately, due to the Congressional Continuing Resolution(s) of 2006 that delayed the approved 2007 federal budget, our federal cooperator USGS only released 12% of the project's funds prior to March 26, 2007. Therefore, it was not possible to implement this survey until the 2007 fire season had already begun in many regions. This may be reflected in our 67% rate of response for our initial information requests. However, responses received to date indicate that approximately 39% of the selected fires had fuels treatment areas affected by fire. Based on this percentage, we estimate that, in 2005, approximately 380 fires involved fuels treatment areas. This large number underlines the growing importance of understanding the effectiveness of fuels treatments at mitigating fire spread and severity. Fully 88% of the fires with treatments did have treatment data entered into the NFPORS database. However, we discovered that not all fuels treatments at any site are entered into NFPORS for a variety of reasons. For example, fuels treatments implemented prior to NFPORS initiation are not recorded. In other cases, the recording of fuels treatments in NFPORS is dependent on the funding source used to accomplish the treatments. Furthermore, fuel modifying activities such as commercial timber harvests and even previous wildfires are frequently not entered into NFPORS.

Table 1. Reported information from land managers who have been contacted.

How many Land Managers contacted? (answered or messages left)	100
How many Land Managers responded? (as of July 20, 2007)	67
How many had fuels treatments within fire perimeters?	26
How many had fuels treatments recorded in NFPORS?	*23
How many had spatial datasets including fire perimeters and fire histories?	**30 (26)
How many spatial datasets do we have “in hand?”	19
How many spatial datasets are we waiting to receive?	***11

* The remaining 3 areas had older fuels treatments from the 1980s that were affected by the fires but that were not required to be entered into NFPORS.

** In addition to the 26 fires with fuels treatment areas, includes 4 areas without fuels treatments but with perimeter data for previous wildfires in wilderness areas.

*** These are datasets for which delivery has been promised but that were still incomplete at the time of this report.

Based on the incompleteness of the fuels treatment/modification data in NFPORS and the lack of spatial detail on the configuration of the recorded treatments (i.e. geolocated polygons), it was determined that NFPORS alone would be insufficient for the purposes of the proposed research. Although many of the recorded fuels treatments in NFPORS have point locations indicated, these data would only be usable as a rough screening tool for selecting fires likely to have involved fuels treatments. Overall, our discussions with many land managers about NFPORS indicated that there is considerable confusion about what NFPORS is, why it is needed and what if any utility it has, especially for local districts.

However, it was found that, in all cases where fires had affected fuels treatments, local districts had spatial information on fuels treatments and additional ancillary data (e.g. roads, fire progression maps, grazing allotments, timber sales, previous fire perimeters.). Land managers have shown considerable interest in this project and have been very forthcoming with their knowledge, data and even recommendations for additional fires to consider. All land managers (100%), have agreed to send us the requested spatial fuels and ancillary materials. We have received complete materials for 73% of these fires to date. Therefore, despite the limitations of NFPORS, no significant obstacles are posed for the acquisition of the data necessary for conducting the proposed research.

Fire Spread Modeling: The landscape level effect of the fuels treatments on real-world fires was assessed through modeling of fire spread. The methodology was to first modify existing fuels information (i.e. LANDFIRE datalayers) to reflect existing fuels treatments and then calibrate a fire simulation such that its spread and behavior closely matched the progression of the actual fire event. Once the fire simulation was judged adequate, the fuels treatments were removed from the simulation as the only change in the fire scenario. This was done to evaluate how the resultant fire spread differed without treatments from what occurred with fuels treatments under the same conditions and with the total time of the simulation held constant. Due to the stochastic nature of these fires caused by random spotting activity, all scenarios were run multiple times both with and without treatments.

FARSITE (Fire Area Simulator - Version 4.1.052) was used to model the impact of fuels treatments on fire extents for the three previously mentioned large wildfires in the western United States – Camp 32, School, and Warm. See field trip reports (appendices **I, II, III**) for more information on these wildfires. Simulations were performed on a Dell Precision 490 Workstation equipped with two dual processors and four megabytes of RAM. The five types of data used in FARSITE simulations consist of the following: (1) LANDFIRE fuels and vegetation; (2) RAWS weather and wind; (3) FARSITE generated files (e.g., fuel moisture and rate of spread adjustment); (4) MTBS fire perimeters; and (5) DOI/USFS fuels treatment and ancillary data (e.g., roads and fire progression maps).

LANDFIRE fuels and vegetation data were downloaded for each fire from the National Map at www.landfire.gov and also via the LANDFIRE Data Access Tool in ArcGIS 9.1. These data were then converted into FARSITE landscape files (.LCP) for each simulation area. RAWS weather and wind data were collected for each fire from the Fire and Aviation Management Web Applications (FAMWEB) website http://famweb.nwcg.gov/ and the Western Regional Climate Center (WRCC) of the Desert Research Institute (DRI) www.raws.dri.edu. The landscape files, weather/wind (.WTR and .WND) files, and fuel moisture and adjustment files (.FMS and .ADJ) were combined to form a FARSITE project files (.FPJ). MTBS fire perimeter and forest service files were added to the simulations as ancillary data.

In accordance with standard practices for simulating fires (FARSITE Fire Area Simulator (S493) course materials), calibration began with examination and adjustment of LANDFIRE data. Four LANDFIRE layers have been cited as potential candidates for adjustment (Stratton 2005). According to Stratton (2005), changes to these layers should be done in the following order: fuel models, crown base height (CBH), canopy cover (CC), and crown bulk density (CBD). While fuel models were largely accurate across the three fires, they had to be modified to reflect areas which had fuels treatments. Appropriate fuel models were assigned to the various fuels treatments at each wildfire site. For example, an area subjected to a prescribed burn could be converted to fuel model TL1 (Timber Litter 1: Low Load Compact Conifer Litter) to mimic the altered fuel amount and structure (Scott and Burgan 2005). Other treatments such as thinning were characterized by several different fuel models depending upon how much slash remained after operations.

The CBH, and CC, datalayers were found to be consistently high while the CBD was low in all locations (see http://www.landfire.gov/notifications.php) and required systematic modification in order to simulate each fire's observed fire behavior. Adjustments of these datalayers were made in accordance with the advice of Dr. Mark Finney, who provided several days of training on the specific aspects of FARSITE modeling critical for conducting this research. Dr. Matt Reeves also made available the early versions of the adjusted CBH, CC and CBD datalayers that were derived from the extensive calibration workshops conducted by the LANDFIRE project. These data have now been released to the fire community (http://www.landfire.gov/version_alerts.php).

Wind speeds recorded at RAWS stations for all three fires were found to be too low to generate observed fire behavior. Therefore, wind speeds were scaled to match reported wind speeds. Wind gusts (available in files from the Desert Research Institute (DRI)) supplemented the standard wind speeds and aided the simulation of extreme fire behavior for the three wildfires. Fire progression data greatly assisted the FARSITE model calibrations. Fire growth was incrementally modeled to roughly match each daily perimeter for the School and Warm fires, and approximated hourly perimeters for the Camp 32 fire.

Crown fire behavior (e.g. torching, spotting, crown fire spread) was observed during all the three of the simulated wildfire events. Crown fire complicates simulation of fire spread because there are no data sufficient to allow the modeler to know exactly where, when and how many spot fires are generated. Therefore, to better simulate the probabilistic nature of the fire spread and capitalize on the stochastic nature of the spotting option in FARSITE, multiple simulations were run. An equal number of simulations (10) were run for each fire both with and without fuels treatments. Outputs such as fire perimeters (extent), fire area tables, and raster layers depicting rate of spread and flame length (behavior) were generated in all cases. Maps created from these outputs for both treated and untreated scenarios are then used to estimate the impacts of fuel treatments on fire extent and behavior.

Preliminary results from the fire simulations (Table 2) indicate that the fuels treatments appear to have reduced the total area burned by each of the three fires by varying amounts. With results from just three fires, no firm conclusions can be reached but it is encouraging that not only did fuels treatments apparently reduce the area burned by each fire but the effect increased with increasing amounts of treated landscape in the fire perimeter We estimate that the 3% of area treated in the Warm fire reduced the area burned by roughly 5% while the 6% treated areas in the School fire reduced the area burned by 15.5% and the 12% treatment area in the Camp32 fire reduced burned area by 28.5%.

Table 2: Estimated effect of fuels treatments on area burned

Fire Name	**Camp32**	**School**	**Warm**
Area Burned (acres)	918	49,104	57,772
% Untreated	59%	94%	97%
% Incomplete treatment*	29%	0%	0%
% Complete treatment	12%	6%	3%
Area of simulated burn (with treatments) (acres)**	1,106 (55)	55,849 (1,581)	59,065 (5,100)
Area of simulated burn (without treatments) (acres)**	1546 (167)	66126 (1,672)	62173 (4,138)
% reduction in area burned due to existing fuels treatments	28.5% (10.0)	15.5% (4.1)	5.0% (6.3)

* A large area of fuels treatments in the Camp 32 fire perimeter had been thinned but were burned by wildfire prior to removal of slash and/or prescribed burning. The Warm fire also had similar burning of incomplete treatments but the relative area was <0.5% of the burned area.
** Area and standard deviation (in parentheses) from ten fire simulations under exactly the same conditions. Differences are due to the stochastic nature of fire spotting as implemented in FARSITE. Simulated fires with fuels treatments are larger than the actual fires due in part to fire suppression activities that were not incorporated in the simulations.

We will require data from many more fires in order to statistically analyze how factors such as treatment size, age and type influence these results or whether slope, aspect or weather conditions influence the effectiveness of fuels treatments to mitigate fire behavior and spread. However, compilation of the multiple simulations allows us to create probabilistic landscape files that can illustrate the reduction in fire risk due to fuels treatments for different regions for the given fire. In other words, we will be able to provide land managers with a map that not only shows them which areas burned but also which forested areas were most likely saved from burning in any given wildfire. Figure 3 show composites of 10 simulations of the School fire 'With' treatments and another 10 simulations 'Without' treatments. The treatment polygons are shown in both figures for reference purposes. The probabilities represent the number of times each pixel was burned for the 10 simulations (i.e. 5 times would equal 50%). Figure 4 presents the difference of these two composite images and is hence a representation of all 20 simulations that illustrates the regions which were most likely <u>not</u> burned due to the presence of the fuels treatment polygons on the landscape. Further analysis of multiple fires is necessary before we can attribute reasons as to why the treatments caused these changes but we hypothesize it is a combination of direct and indirect effects. Specifically, by directly preventing fire spread into some recently treated areas and also by effectively slowing fire progression as the fire passes through or around other treatments. This effectively protects forests at a distance from the treatments because the fire never progresses that far before weather conditions and suppression activities stopped the fire's spread.

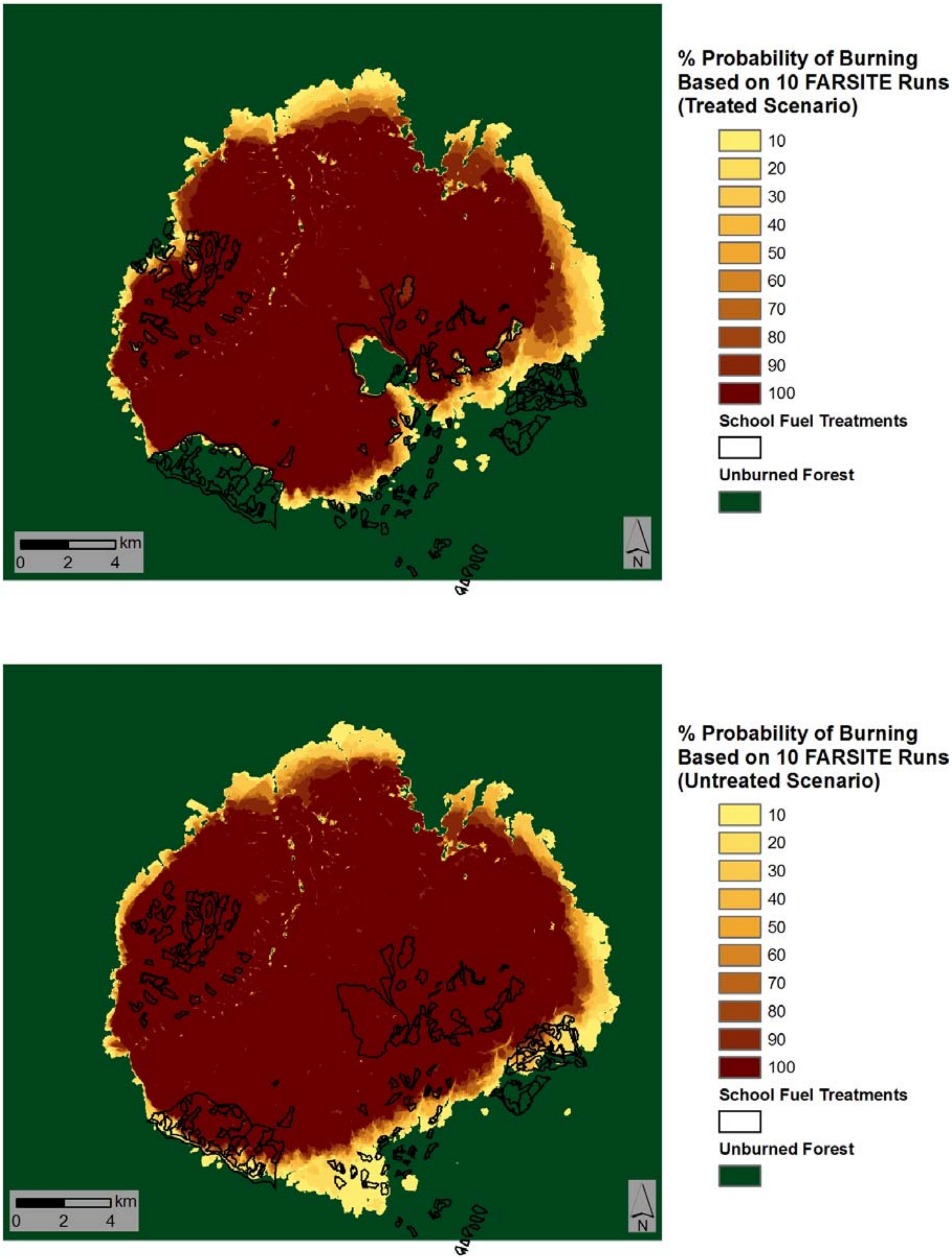

Figure 3: Composites of 10 FARSITE simulations of the School fire under identical model parameterization for both the 'With' treatments and 'Without' treatment conditions.

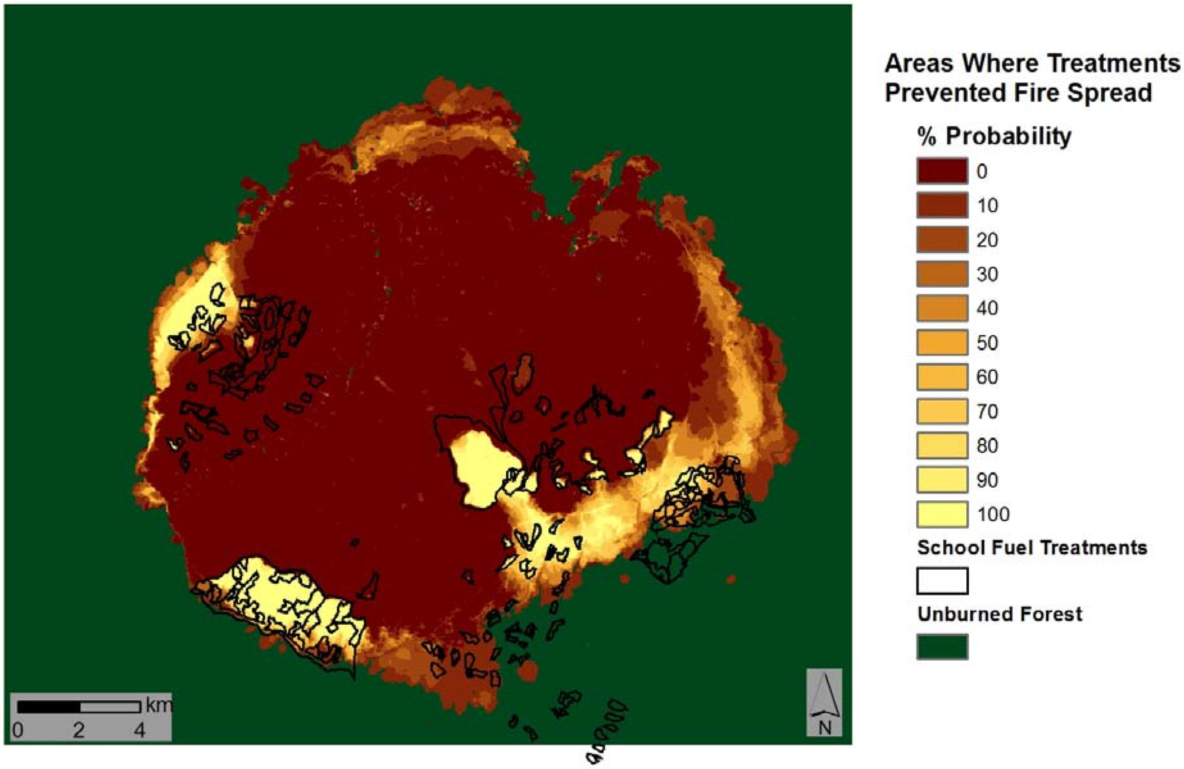

Figure 4: The composite of the ten ‘Without’ treatments minus the ten ‘With’ treatments simulations. The result is a spatial probabilistic map of the likelihood that existing fuels treatments protected given forest areas from burning.

Additional project related activities:

Jan 8 – 11, 2007: Dr. Mark Cochrane and Dr. Michael Wimberly traveled to Missoula, Montana to train with Dr. Mark Finney at the USFS Fire Sciences Lab on project related application of the FARSITE model and to consult with Dr. Matt Reeves regarding the LANDFIRE products and upcoming revisions.

February 19-23, 2007: Dr. Mark Cochrane and Adam Baer participated in the FARSITE Fire Area Simulator (S-493) course in Destin, Florida and received certificates of completion.

February 26-30, 2007: Dr Mark Cochrane participated in the 2nd Fire Behavior and Fuels Conference in Destin, Florida and presented the poster: Cochrane, M.A., M. Wimberly, Z. Zhu, M. Finney and M. Reeves. 2007. Fuel Treatment Effectiveness in the United States. The poster described the initial statistical comparisons of the CBI and dNBR data for the Camp32 and School fires as well as the early FARSITE model simulations. (Appendix **VI**)

April 9-13, 2007: Dr. Michael Wimberly participated in the International Association for Landscape Ecology, United States Regional Association Meeting in Tuscon, AZ and presented the poster: Wimberly, M. C., M. A. Cochrane, A. D. Baer, and Z. L. Zhu. 2007. Fuel treatment effectiveness in the United States. The poster described the initial spatial and statistical analyses of the dNBR representations of treated and untreated forests for the CAMP32 and School fires. (Appendix **VII**)

Next Steps: We have clearly shown the viability of the proposed work during this pilot project. Remotely sensed fire severity maps based on dNBR measurements are capable of accurately detecting the differences in fire severity within treated versus untreated forests, allowing us to quantify local differences in site-level fire severity due to fuels treatments. Although the data in NFPORS is insufficient for the purposes of the proposed research, we have demonstrated that we can acquire the necessary data from the local districts. Furthermore, these contacts at the district level will form our initial pool of candidates for our proposed training workshops. Perhaps most intriguing are the apparent landscape level effects of fuels treatments. Although encouraging, these few fires do not constitute proof and must be supported by many more examples before any firm conclusions can be reached about how effective fuels treatments are at mitigating fire behavior or spread or what factors moderate these affects.

Now that we have completed our initial analyses of the data from this pilot project, we will inform the Interagency Fuels Committee and the Fire Behavior Working Team of our results and solicit their advice on moving forward with the project. We will also communicate our findings and insights about NFPORS to the NFPORS Steering Committee. Contingent upon continued funding, we will begin our national assessment of fuels treatment effectiveness. Specifically, we will screen all fires in the MTBS Fire Atlases by contacting the appropriate land managers to determine which fires are candidates for assessing fuels treatment effectiveness. Fires selected during the screening process will be entered into our database and preprocessed for conducting the FARSITE simulations. As we add more fires to our dataset, we will gain added statistical power for understanding the factors influencing fuels treatment effectiveness. This will allow us to move beyond simply saying whether fuels treatments have been effective on specific fires to providing managers with more general assessments of the conditions under which fuels treatments perform best (e.g. type, size, age, location on the landscape etc.). As outlined in our original proposal, we will also conduct two technology transfer workshops to teach these techniques and provide the tools we are developing to land managers so that they can begin to use the information for planning purposes as well as post-fire assessment. Through our work on this project we are contacting and educating hundreds of potentially interested land managers about this project. To facilitate technical transfer of the products and knowledge gained during this study to the fire community at large, we will consult with John Szymoniak and Tim Swedberg to appropriately structure the training that we provide.

While we await word about continued funding of the full project, we will begin analyses of the 30 fires for which we have, or will soon have, all of the necessary data for conducting supporting fire simulations in addition to screening more fires for their suitability for inclusion in this research. Due to the restrictions of our federal cooperators agency (USGS) we will only have funding for the project until September 30, 2007. After that point, we will have to suspend the project while awaiting further funding. If funding cannot be reestablished before the end of the year, we will likely lose our trained staff and student which would seriously impact our ability to conduct the research and produce the project’s deliverables.

References

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