

National Fire Decision Support Center

Annual Report 2009



**Rocky Mountain Research Station,
Fire and Aviation Management**

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Introduction

Large fire suppression costs within all wildland fire management agencies continue to grow dramatically each year. Efforts to control causes of rapid cost escalation are expanding and becoming more focused on improving initial strategic as well as subsequent tactical decisions. New efforts are being implemented to advance the capabilities of fire decision making for federal agencies. These efforts are designed to:

- Improve the science basis for large fire decision making
- Improve fire management decision support tools and processes
- Improve agency capability to manage fire expenditures
- Develop centralized decision support capability to conduct decision analyses for all large fires
- Develop a safety culture in the Forest Service that is highly reliable, resilient and takes a proactive and systematic approach to managing risk.

To accomplish these goals under a comprehensive effort, the National Fire Decision Support Center (NFDSC) has been established. This Center will serve as a single focal point to support strategic and tactical decision making by providing consistent decision support information on large and long duration wildland fires. The NFDSC is a collaborative effort between Fire and Aviation Management (FAM) and Research and Development (R&D) to provide corporate decision support information and monitoring on wildland fires; directed research on strategic decision making capability and risk modeling; and improved awareness and application of decision support information for risk-informed decision making.

The NFDSC is a virtual organization comprised of team members from multiple U.S. Forest Service research and management programs and potentially other cooperator organizations (figure 1). In support of the NFDSC goals,

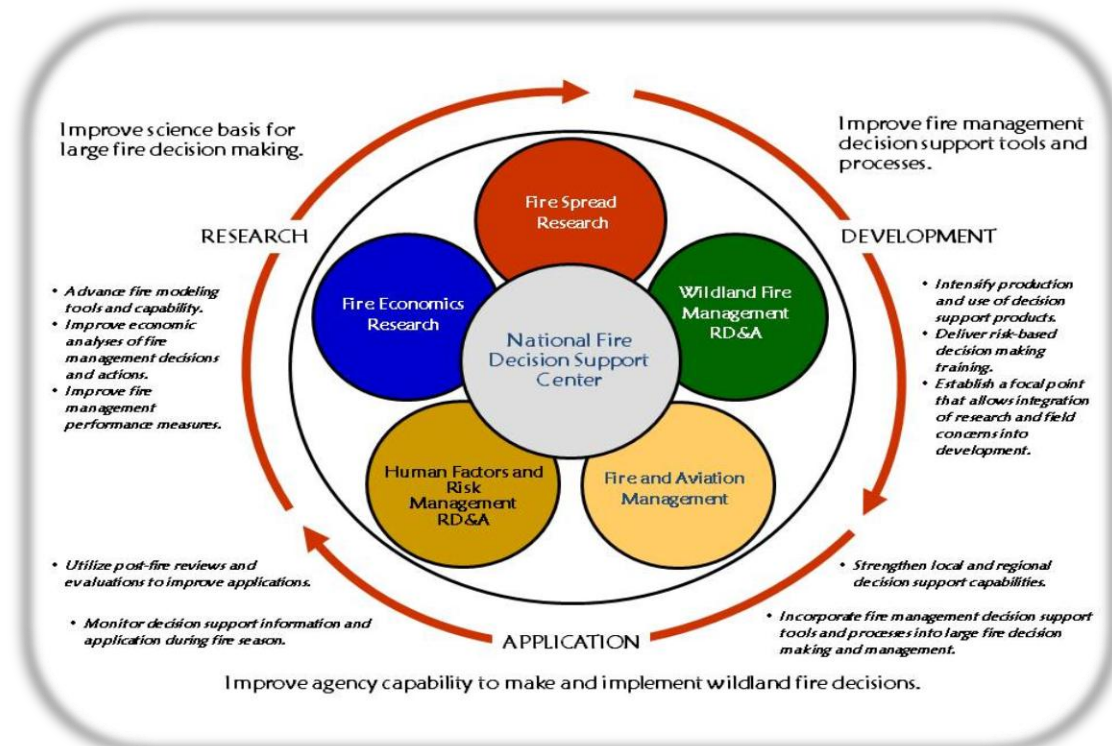


Figure 1. NFDSC composition showing collaborating programs (DOI involvement is associated with their partnership with the WFM RDA – two DOI individuals are situated in the WFM RDA).

team members will be added as appropriate, by mutual agreement of the parties. The Rocky Mountain Research Station (RMRS) coordinates oversight and hosts a major portion of the NFDSC positions; the remaining positions are hosted by Washington Office State and Private Forestry. Existing Forest Service units that will provide staff for integration in this effort include, but are not limited to: WFM RDA (RMRS and Department of Interior (DOI) involvement); Human Factors and Risk Management RD&A (RMRS); Fire Research (Fire, Fuels, and Smoke Program, RMRS); Fire Economics Research (Human Dimensions Program, RMRS); and Fire and Aviation Management (Headquarters Office). Other research and management program areas may be involved as warranted and available.

This report describes annual accomplishments for fiscal year 2009 and planned activities for FY 2010 for the NFDSC. All activities are described for each participating unit in the Center. Each unit has made successful efforts to hire personnel, implement projects, write publications, and perform training, while emphasizing a collaborative approach to achieve their goals and objectives. Planned activities for FY2010, as outlined in this report, demonstrate the broad range of activities of continuing development and involvement. FY 2010 will be the first full year for the NFDSC to be fully staffed, operational, and supporting research, training, large fire decision making, and monitoring on fires.

The Report is structured as a single Annual Report that provides the complete 2009 Accomplishments and the 2010 Planned Activities. It is structured in a tabular format that allows readers to move vertically to view the NFDSC accomplishments or planned activities in total or to move horizontally to view accomplishments or planned activities in a specific area for each participating program.

2009 Accomplishments

In 2009, the National Fire Decision Support Center went through the process of initial establishment, delineation of processes and procedures, clarification of cooperative mechanisms, definition of funding and organizational responsibilities. Major accomplishments surrounded the completion of a Service Level Agreement (SLA) between the Washington Office Fire and Aviation Management and Washington Office Research and Development and the completion of a formal amendment to the Wildland Fire Management RD&A Charter. These were completed, approved, and signed and are on file at the RMRS Headquarters and the Wildland Fire Management RD&A at NIFC.

The primary objectives for FY 2009 in the NFDSC were to:

- Set up operating procedures, including defining the governance and oversight structure,
- Acquire necessary staffing,
- Put in place agreements with research partners,
- Develop initial decision support products for fire season 2009,
- Implement and evaluate fire decision support procedures on wildland fires as fire conditions permit and
- Develop the work plan for 2010.

The following sections provide descriptions of accomplishments in 2009 for each participating program and are subdivided into appropriate functional topics.

Staffing

Staffing, as shown in this section, represents new staff positions added to the existing programs and not the total organization for each of the specific programs.

Economics Research

Research Forester (GS-12)
Data Service Specialist (GS-11)

Fire Research

Research Forester/Operations Research – unfilled, advertised
Research Mechanical Engineer– Combustion (GS-12)
Physical Scientist – Fluid Dynamics (GS-11)
Physical Scientist – Electrical Engineer (GS-11)
Statistician/mathematician (GS-12)
Lab Technician (GS-5)
Machinists (term), (WG-9) 2 positions

Wildland Fire Management RD&A

1 Fire Management Specialist – (GS-14)
3 Fire Application Specialists – (GS 9/11)
3 Fire Application Specialists (GS 12/13) positions will be filled during FY 2010.

Human Factors and Risk Management RD&A

Developed PD for Social Science Analyst position (GS-13)

Cooperative Agreements/Partnerships

Economics Research

Challenge Cost Share and Joint Venture Agreements with Professor Tyron Venn (The University of Montana) to continue to staff two GIS and one database analysts working directly with the Economics Research group to support Venn's research on valuation of fire effects to non-market resource values.

Challenge cost share agreement with Dr. John Duffield (The University of Montana) to explore the potential applicability of benefit transfer methodologies.

Challenge cost share agreement with Professor Claire Montgomery (Oregon State University) to support research on quantifying the benefit cost relationship of fire suppression. Benefits represent the current reduction in direct resource loss and the cost represents current suppression costs. The future change in expected loss (resource loss and suppression costs) is due to the effects of suppressing the current fire on future fire events.

Fire Research

Challenge-cost-share agreement was developed with Professor David Lignell (Brigham Young University) for investigating the use of One Dimensional Turbulence for modeling turbulent flame structure.

Wildland Fire Management RD&A

Continued participation in the Wildland Fire Science Partnership (WFSP). Continued partnership efforts with the National Center for Landscape Fire Analysis, University of Montana.

Continued partnership with the FRAMES program, University of Idaho. Increased collaboration with the Airfire Program, Pacific Northwest Research Station.

Cooperative work with the LANDFIRE Program to validate fuel models for annual updates into WFDSS.

Projects

Economics Research

RAVAR

Continued acquisition, improvement, and transition of spatial data to the WFDSS development team. The group supported all field requests for the 2009 fire season.

Performance Measurement

Developed and evaluated performance measures to quantify the production efficiency of fire suppression efforts on individual wildland fires. Efforts included:

Collaboration with Dr. Tom Holmes (Southern Research Station) to evaluate production functions for alternative suppression resources.

Development and implementation of a daily report for real time tracking of firefighter exposure, fire suppression costs, and summary fire risk measures for senior fire leadership.

Assessment of the relationship between production based performance measures and fire suppression cost.

***Early Warning
Cost Models***

The objective was to evaluate the predictability of expensive fires and to investigate development of methods for constructing an early warning system to be used in the Wildland Fire Decision Support System (WFDSS) to identify potential high cost wildland fires. Many of the decisions that lead to the high costs of these events are determined relatively early during the fire. By improving our ability to identify the large, long duration events early, increased decision support and risk sharing between local forest managers and regional and national leadership can improve the management efficiency of these events.

In FY 2009, several methods for predicting high cost fires (those costing \$5 million or more) were evaluated. A report of the results was presented to WO-State and Private Forestry. The methods to predict high cost fires included logistic regression, classification and regression tree analysis (CART). Stratified Cost Index (SCI) estimates were used in conjunction with FSPro acreages to estimate the fire's cost which were then used to identify high cost fires. The logistic regression and CART methods failed to provide useful results. The SCI approach, when used with FSPro median acreages, proved the most reliable method. This method was employed during the FY 2009 fire season. Daily reports predicted if a fire would be a high cost fire. An analysis of the performance of this method during FY 2009 is currently underway.

***Develop Tools to
Predict Fire
Effects for
WFDSS***

Fire intensity distributions from FSPro were evaluated for performing risk analysis for high priority natural resource values in 2009. A framework developed to assess fire effects on municipal watersheds to quantify fire effects to other highly valued resources was evaluated.

***Prospect Fire or
(Strategic Risk
Assessment)***

Geospatial tools and economic models were evaluated by Agency Administrators and Incident Management Teams to improve the development of strategic risk assessments and appropriate performance targets for implementation of the selected fire strategies.

Fire Research

Joint work with Economics Unit of NFDSC

Early Warning system – The use of FSPro and appropriate fire behavior modeling tools were evaluated for use in early warning prediction of final fire sizes.
Performance Metrics – worked with Missoula Technology Development Center (Bob Roth) on acquisition and analysis of data from large air tanker retardant drop locations.
Development of fire simulation data and methodology for calculating insurance and incentive systems for national fire suppression expenditures.

FSPro

Implemented model for Fire Containment Probability into WFDSS. The statistical model describes a relationship for historic fires between periods of fire activity and probability of containment. This model was incorporated into WFDSS to evaluate decision making on large wildland fires.
Implemented fire intensity distributions into FSPro. The FSPro model was modified to produce probability distributions of fireline intensity for each pixel. These distributions will be used for performing risk analysis for natural resources, such as watersheds and habitat.

Wildland Fire Management RD&A

Manage the National Fire Decision Support Center

Completed an amended program charter to clarify the management of the NFDSC by WFM RDA; and the establishment of a Service Level Agreement (SLA) to document the purpose, funding, staffing, and focus areas of other programs participating in the NFDSC.
Established of the new WFM RDA NFDSC organization to support the NFDSC and recruited four of the seven positions.
Attained semi-operational status for the RD&A production component of NFDSC attained by August 15, 2009.
Continued development and marketing of the NFDSC organization, support for all new staff, and clarification of the funding agreement.
Continued Interagency Coordination with the DOI Office of Wildland Fire Coordination to determine interest and funding opportunities in support of the NFDSC and WFDSS implementation.

2009 Incident Support

Incident support was provided by members of the WFM RDA development team during the 2009 fire season. Analysts assisted incident management staff and local fire resources with running fire behavior modeling systems such as FSPro and providing feedback on the interpretation of those models.

Human Factors and Risk Management RD&A

Key Decision Log

An appropriate suite of performance measures for fire captures how well outcomes match intentions. These cover the basic facets of incident management - from operations to finances, from safety to ecology, and both internal and external relationships. In 2009, HFRM staff participated in a Science Panel (Tom Quigley, lead) developing and testing performance measures for large fire, specifically testing the utility of existing

information to provide insight into the ecological impacts of wildland fire incidents, and to develop and test measures to track Risk Management and Decision Making.

***Science Panel
on Performance
Measures***

An appropriate suite of performance measures for fire captures how well outcomes match intentions. These cover the basic facets of incident management - from operations to finances, from safety to ecology, and both internal and external relationships. In 2009, HFRM staff participated in a Science Panel (Tom Quigley, lead) developing and testing performance measures for large fire, specifically testing the utility of existing information to provide insight into the ecological impacts of wildland fire incidents, and to develop and test measures to track Risk Management and Decision Making.

Publications and Reports

Economics Research

Unpublished report presented to WO-State and Private Forestry in April 2009 on the development of a High Cost Early Warning System. Publication on spatial-estimation process for the state of California was accepted for publication in the International Journal of Wildland Fire.

Fire Research

The primary research publication documenting the construction and performance of FSPro has been produced and submitted to the scientific journal, Environmental Modeling and Assessment. The title of the paper is "A method for ensemble wildfire simulation" (Finney, Grenfell, McHugh, Seli, Tretheway, Stratton, and Brittain). Paper presented at the Western States Combustion Conference: Critical Mass Flux for Ignition of Dead, Dry Wood as a Function of External Radiant Heat Flux (McAllister, Finney, and Cohen).

Wildland Fire Management RD&A

Zimmerman, T. 2009. Wildland fire management policy, learning from the past and present and responding to future challenges. Yellowstone Science. 17(2):31-34.
Zimmerman, T. 2009. Wildland fire management policy—learning from the past and present and responding to future challenges [abstract]. Page 6 in R.E. Masters, K.E.M. Galley, and D.G. Despain (eds.). The '88 Fires: Yellowstone and Beyond, Conference Proceedings. Tall Timbers Miscellaneous Publication No. 16, Tall Timbers Research Station, Tallahassee, Florida, USA.

Human Factors and Risk Management RD&A

2009. Black, A.E. The Key Decision Log: facilitating high reliability and organizational learning. Fire Management Today 69(2)5-10.
2009. Black, A.E., K. Gebert, S. McCaffrey and T. Steelman. The interplay of fire management strategy, suppression costs, community interaction and organizational performance - a multi-disciplinary approach. Fire Management Today 69(2)11-14.
Unpublished report 'Experimenting with ways to report and improve

alignment of Incident Objectives with Incident Outcomes' for the Red Rocks wildland fire presented to the Klamath National Forest in September, 2009.

Unpublished white paper report for the Backbone fire, presented to the Trinity, Six Rivers and Klamath National Forests July, 2009.

Training and Support

Economics Research

Training was conducted for decision support tools for risk based fire management, including:

National Incident Management Organization (NIMO) teams.

S-495, Geospatial Fire Analysis, Interpretation, and Application.

S-580, Advanced Fire Use Application.

Bureau of Land Management WFDSS Oversight Group. "Economic valuation within the Wildland Fire Decision Support System". Boise, Idaho, September 15, 2009.

Large incidents were provided technical support to include:

Backbone

Okanogan-Wenatchee – assisted fire staff with tools to improve incident prioritization during heavy fire load

LaBrea

Red Rocks

Station (BAER team)

Fire Research

Training was conducted on decision support tools for risk based fire management. Major training activities included:

National Incident Management Organization (NIMO) (February 2009).

S-495, Geospatial Fire Analysis, Interpretation, and Application (March 2009).

Wildland Fire Management RD&A

Local Fire Management Training. Decision Making and the Wildland Fire Decision Support System. NIFC. Boise, ID.

S-520, Advanced Incident Command. Decision Support, WFDSS. NAFRI. Tucson, AZ.

S-620, Area Command. Area Command Organization. NAFRI. Tucson, AZ. Fire Management Leadership. Decision Making and the Wildland Fire Decision Support System. NAFRI. Tucson, AZ.

S-495, Geospatial Fire Analysis, Interpretation, and Application. Wildland Fire Decision Support System - The Larger Picture and the Future.

Wildland Fire Training Center. McClellan, CA.

F422, Wildland Fire Use. (Humboldt State University for R5 Training Academy). Wildland Fire Decision Support. Wildland Fire Training Center. McClellan, CA.

S-580, Wildland Fire Decision Support System. Tucson, AZ.

R2 Fire Use Workshop, Wildland Fire Decision Support System. Cheyenne WY.

R5 Line & Fire Management Officer Meeting, *Wildland Fire Decision*

Support System. Sacramento, CA

Catalonia Bombare – International, *Wildland Fire Decision Support System.* Missoula, MT.

Fire Behavior Sub-Committee, *Wildland Fire Decision Support System.* Ft. Collins, CO.

Payette National Forest, *Wildland Fire Decision Support System*

Documentation and decision support. McCall, ID.

R4 WFDSS Meeting, *Wildland Fire Decision Support System.* Ogden, UT.

Salmon-Challis NF, WFDSS Feedback and Fire Support. Salmon, ID

Interagency Fuels Treatment Decision Support, Worked with IBM and IFTDSS Teams to look for areas to cooperate and consolidate efforts with WFDSS. Boulder, CO.

Webinars, *Wildland Fire Decision Support System.* Interagency, Nationwide.

Conference presentations

2009 Wildland Urban Interface Conference, International Association of Fire Chiefs. *Challenges of the 2008 Northern California Fire Siege - Area Command Perspectives.* March 2009. Reno, NV.

Pacific Coast Fire Conference: Changing Fire Regimes, Goals, and Ecosystems. Appropriate Management Response Session: Supporting and Documenting Wildland Fires Decisions and Implementing Management Actions - The Wildland Fire Decision Support System. December 2008. San Diego, CA.

Human Factors and Risk Management RD&A

Presentations/trainings on the Key Decision Log to managers (A.E. Black)
Regional Fire Directors (Nov 3-5, 2008, Tucson, AZ)
Line Officer Team (Nov 3-5, 2008, Tucson, AZ)
Lolo National Forest (Nov 14, 2008, Missoula, MT)
AC/IC annual fall meeting (Dec 9, 2008, Sparks, NV)
Rockies Geographic Area Local Fire Management Leadership course (new
line officer's course, Missoula, MT)
NRCG ICs and Liaison Officers (4/5/09, Missoula, MT)
Northern Rockies Geographic Area, Incident Management Teams meeting;
presentation to the Incident Commanders and Planning Section Chiefs
(4/7/09, Missoula, MT).
USFS Region 4 Regional Leadership Team and Fire Management Officers
Meeting, (5/6/09, Ogden, UT).
Black, A.E. Key Decision Log – 2009. A short PowerPoint presentation for
use by the four NIMO teams as part of their pre-season Regional and
Forest workshops for Improving Large Fire Management.

Conference presentations

2009. Black, A.E. "High Reliability Organizing in the wildland fire
community: consolidating the foundation to further the dialogue." Oral
presentation at the 10th Wildland Fire Safety Summit. April 27-30; Phoenix,
AZ.
2009. Black, A.E.; Gebert, K.; Steelman, T.; McCaffrey, S. 'Integrating
understanding: how multiple perspectives enhance fire research'. The 4th
International Fire Congress, December 3, 2009, Savannah, GA. Symposium
organizer and moderator.
2009. Black, A.E. 'The Key Decision Log – developing and testing one
aspect of a 'Balanced Scorecard' to facilitate continuous improvement in
fire management.' Oral presentation The 4th International Fire Congress,
December 3, 2009, Savannah, GA.
2009. Black, A.E.; Steelman, T.; Gebert, K.; McCaffrey, S.; Canton-
Thompson, J. Using multiple perspectives to understand changing federal
wildland fire management. (poster) Joint Fire Science Program 10 year
review, Nov 30 –Dec 4, 2009; Savannah, GA.

2010 Planned Activities

Staffing

Wildland Fire Management RD&A

Three additional USFS Fire Application Specialists will be filled in FY 2010. DOI will provide two positions that will work directly for the RD&A, sponsored by the National Park Service.

Cooperative Agreements with University and Research Partners

Economics Research

The economics group will host and fund Dr. Tom Holmes (Southern Research Station) for the summer of 2010. Dr. Holmes will collaborate on the Wildland Fire Outcome Analysis study and Societal and Managerial Preference studies.

Wildland Fire Management RD&A

Collaboration will continue with partners at the Desert Research Institute (DRI) and Pacific Northwest Research Station (PNW) to develop national forecast products for smoke management in WFDSS.

Planned Activities

Economics Research

National Wildfire Risk Assessment and the Cohesive Strategy

Complete and publish results from the National Wildfire Threat and Risk Assessment. Work was initiated in 2008 with a group of collaborators to establish baseline measures of wildfire threat and risk to highly valued resources. Publication in technical reports and peer reviewed outlets and delivery to WO F&AM staff of this national risk assessment will be conducted. Additionally, opportunities for this framework to inform the development of the new Cohesive Strategy on Fire and Fuels Management will be explored.

RAVAR

Continue spatial data acquisition and improvement and finalize transition of data, operation and maintenance responsibilities to the WFDSS development team. The group will train additional RAVAR analysts within the NFDSC and Geographic Areas. Peer reviewed publication opportunities will be pursued.

***Wildland Fire
Outcome Analysis
(performance
measurement)***

A field study to evaluate the effectiveness of wildland fire-fighting resources to suppress wildfires will occur during the 2010 fire season. The study will use geo-spatial records of fire location, suppression resource activities, and final fire outcomes to address the following objectives:

Develop a quantitative analysis of the productivity of labor and capital resources that are employed in fighting large wildfires.

Identify the key factors that enhance or impede the productivity of labor and capital resources used in fighting large wildfires.

***Manager
Incentives and
Insurance Based
Approaches to
Wildfire
Suppression Cost
Management***

Objectives for this project are to evaluate existing incentives for land and fire managers and explore an insurance based approach for funding wildfire suppression activities. Further, we will collaborate with professors of actuarial sciences within the University of Wisconsin Business School to explore how expected fire cost data could be used to develop a premium based approach to large wildfire suppression. The premium approach will be conceptually established such that the existing suppression account would be allocated out to the national forests and then each national forest would be required to purchase an insurance policy that would cover suppression costs for the fire seasons. Performance measures would then be established to allow updating of forest premiums based on wildfire management risk outcomes. For example, a forest that conducted significant fuel reduction activities and experienced large wildfires that were managed at lower than modeled cost would see their premium reduced, thus providing additional funds for other management activities. By establishing the premium approach, the true cost of increased suppression expenditures would be experienced by the local unit and not simply affect the national accounts.

***Develop Tools to
Predict Fire
Effects for WFDSS***

Staff within the Economics Research group will work with fire intensity and extent data generated by the Fire Research group to develop models that quantify potential fire effects on municipal watersheds. This effort represents the first application of FSPro to predict fire severity and effects on highly valued resources.

***Societal and
managerial
preferences for
fire and fuels
management
outcomes***

The evaluation of alternative fuel treatments requires objective performance measures and the simultaneous consideration of multiple values at risk to wildfire. Decision support systems provide a framework to quantitatively assess the performance of treatments with risk-based measures. Decision makers seek to identify the treatment alternative that best achieves social welfare objectives based upon the evaluation of treatment cost and reduced wildfire risk to multiple, non-commensurate, possibly conflicting values. Although quantifying treatment effects to multiple resource values in a common unit of measurement (e.g., \$) would simplify decision making, the presence of significant uncertainty makes it quite difficult to collapse integrated risk calculations into a common monetary measure. Using a multi-criteria decision analysis (MCDA) can facilitate the exploration of tradeoffs and the quantification of preferences (or weights) to inform prioritization. This work entails the design and application of MCDA decision support techniques intended to facilitate fuel reduction treatment evaluation. Our proposed system integrates and provides information on a suite of human and ecological values at risk to wildfire. Pairing state-of-the art wildfire risk analysis and assessment tools with hybrid MCDA approaches designed to handle uncertainty allows decision makers to objectively assess the performance of various treatment alternatives and will support prioritizing treatments on the basis of reduced risk to a myriad of highly valued resources. Application of these techniques will be applied on the Deschutes National Forest, Oregon.

***Structure
Identification in
Wildfire
Management***

The economics group has ongoing interest in developing and promoting new methodologies for structure identification in wildland fire management. The group will continue collaboration with the National Cadastre Subcommittee on the collection, processing, and application of cadastre data for wildland fire management. Additionally the group is conducting studies to determine the appropriateness of using LANDSCAN USA data, developed by the Oak Ridge Laboratories, for wildfire fire management purposes. The LANDSCAN data are probably not as precise as the cadastre data for structure identification; however, they do provide nationally consistent, relatively fine scale (90x90m) data.

***Early Warning
Cost Models***

Development of methods for constructing an early warning system to identify potentially high cost wildland fires is continuing in FY 2010. In FY 2009, our dataset of fires consisted of fires that had used FSPro in FYs 2007 and 2008. This dataset may have been biased, because the application of FSPro occurred most frequently on fires that had potential to get larger, possibly contributing to the problematic identification of high cost fires using statistical methods. For FY 2010 there is a larger, more representative dataset of fires for inclusion in the analysis. Different methods are being tried for estimating final fire size, an important variable in determining the cost of the fire. In the FY 2010 analyses, the Short-Term Fire Behavior (STFB) model within the WFDSS system will be used to estimate fire size after a three day period. Collaborate work will continue with Dr. Anthony Westerling (UC-Merced) and Dr. Haiganoush Preisler (PSW Research Station) who are developing statistical models for estimating spatially explicit forecasts (one to six months ahead) of the expected numbers and costs of large fires on a 1/8-degree grid with vegetation, topography and hydro-climate data. This work is specific to California Geographic Areas, in FY 2010, this work may be extended to include other regions.

***Spatial Stratified
Cost Index***

The Stratified Cost Index is a statistical model for predicting costs of individual wildland fires. It is currently used as a performance measure for both the FS and the DOI and is included in the WFDSS system. The current models were developed using fire occurrence information, that is based on the ignition point of the fire. In FY 2010, plans are to develop models for predicting expenditures on large wildland fires using spatially-explicit fire information from within and adjacent to the fire perimeter. The hope is that the use of spatially- explicit data will enable us to both improve the predictive power of the models and to develop models that are more intuitively understandable to users. Currently, this study is limited to developing models for the Forest Service. This work may be extended to the DOI in subsequent years.

***DOI Stratified Cost
Index for use in
WFDSS***

In FY 2010, the DOI Stratified Cost Index (SCI) Models for use in WFDSS will be revised and updated. Prior to FY 2010, the model was developed as a post-season performance measure and was not included in WFDSS because the DOI had not committed to using the system. The DOI SCI models consist of separate models for each DOI agency (BLM, BIA, FWS, NPS),

which will be built using fire occurrence information. A spatially-explicit approach may be attempted in subsequent years (see Spatial Stratified Cost Index).

Fire Research

Continued Laboratory Research

Flame structure and intermittent convective heating of fuel particles is being investigated for stationary flame sources in the absence of wind and with constant and variable winds. Investigations are being conducted for radiant heating and convective cooling for particles and groups of particles using laboratory experiments and theory. Requirements for sustainable ignition are being investigated using the lean combustion limits of live and dead particles and clusters of particles using experiments at multiple scales. The dependency of sustainable ignition on gas production and live and dead solid fuel heating rates is the subject of experimental work using a specially constructed apparatus. Use of One Dimensional Turbulence for modeling turbulent flame profiles – work conducted jointly by BYU and the Missoula Fire Sciences Laboratory.

Ecological Fire Effects in WFDSS

Convert predicted fire intensities from FSPro to estimates of severity and compare them with Monitoring Trends in Burn Severity (MTBS) data as measured from wildfires.

Performance Metrics

Documentation and analysis of Large Air Tanker effectiveness. Work will continue to acquire and analyze data on drop location relative to fire perimeter expansion.

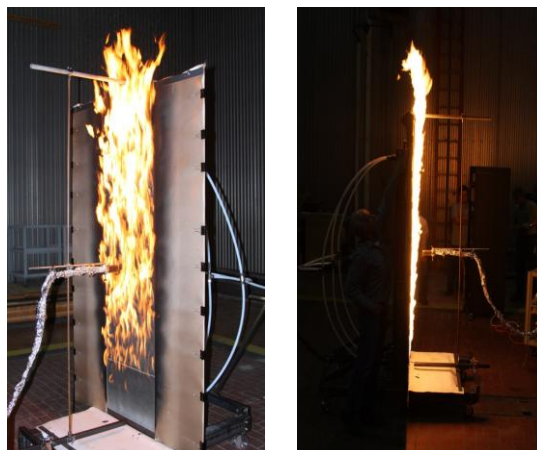


Figure 2. A vertical panel (0.61 X 1.83 m) was constructed for producing a stationary source of diffusion flames. Front and side views are shown for ethylene gas flames burning $175 \text{ liters min}^{-1} \text{ m}^{-2}$. Flame structure was sampled using heat flux sensors and thermocouples at different heights and distances from the surface.

**Wildland Fire
Management RD&A**

***Manage the
National Fire
Decision Support
Center***

Acquire remaining staff equipment (computers, printers, projectors, etc.) and office space.
Stand up NFDSC by March 1, 2010.
Develop Standard Operating Procedures for the NFDSC and organize staff work areas and operations to support this plan.
Inform users of standard protocols for requesting decision support analysis preparation and opportunities for the NFDSC.
Evaluate field use, output, and performance of decision support analysis tools. Provide appropriate feedback to research.
Add NFDSC employees as cadre and steering committee members to national and regional training courses pertaining to decision support analysis, risk assessment, and incident management. Develop and prepare materials for training delivery in FY2010.
Develop a formal process for training and refreshing future and current analysts from Incident Management Teams (IMTs), field units, Geographic Area Coordination Centers (GACCs), etc. through detail assignments, direct field support, and other means as appropriate. Develop a Fire Behavior Analyst/Long-term Analyst (FBAN/LTAN) and technical specialist list for use by the NFDSC, Geographic Area Editors and Geographic areas, for determining support and training opportunities.
Conduct evaluation of the 2010 fire season activities, review procedures and develop improvements as appropriate, and develop 2010 accomplishments and input for annual report.

**Human Factors and
Risk Management
RD&A**

Key Decision Log

Update application based on feedback from 2009 season.
Develop and test process for pulling narrative decision records from WFDSS into KDL and develop report that dumps both strategic and tactical decisions and rationale for each incident.
Provide field support.
Develop a formal process for training Incident Management Teams and Administrative unit staff.
Analyze and publish 2009 findings and science-basis for the Key Decision Log.

***Performance
measures***

Identify staff to develop and conduct a literature review and study plan for ecological measures.
Develop and field test measures of performance for decision-making and working relationships.

Publications and Reports

Fire Research

Abstracts have been submitted for the following conference papers:

Design and Construction of Gas-Fed Burners for Laboratory Studies of Flame Structure (Jimenez, D., Finney, M., Cohen, J.)

Structure of Diffusion Flames from a Vertical Burner (Finney, M., Jimenez, D., Cohen, J., Grenfell, I.)

Critical Mass Flux for Ignition of Dead, Dry Wood as a Function of External Radiant Heat Flux (McAllister, S., Finney, M., Cohen, J.)

Fuel Particle Response to Rapid Convective Heating Fluctuations (Forthofer, J., Shannon, K., and Finney, M.)

An Examination of Fuel Particle Heating During Fire Spread (Cohen, J., Finney, M.)

Simulating spatial and temporally related fire weather (Grenfell, I., Finney, M., Jolly, M.)

Modeling Flame Structure in Wildland Fires Using the One Dimensional Turbulence Model (Lignell, D., Monson, E., Finney, M.)¹

Wildland Fire Management RD&A

Zimmerman, Thomas and Tim Sexton. 2010. Organizational Learning Contributes to Guidance for Managing Wildland Fires for Multiple Objectives. *Fire Management Today*. 70(1):9 - 14.

Larkin Narasimhan K., (U.S. Forest Service) Tim Brown, (Desert Research Institute), Pete Lahm, (U.S. Forest Service), Tom Zimmerman, (U.S. Forest Service). In press. Wildland Fire Decision Support System Air Quality Tools. *Fire Management Today*. 70(x):xx.

Planned Training

Economics Research

RAVAR analyst training for Forest Service Regions 1, 5, and 6
NFDSC new analyst training (RAVAR and performance measurement reports)
BAER national leadership training.

Fire Research

Training and support will continue for decision support tools for risk based fire management.

Training and refresher of NFDSC Fire Analysts (May 2010).
S-495, Geospatial Fire Analysis, Interpretation, and Application (April 2010).

Wildland Fire Management RD&A

National IC/AC Meeting
R3 Incident Management Team Meeting
S-520, Advanced Incident Command
S-580, Advanced Wildland Fire Management Applications
S-590, Advanced Fire Behavior Interpretation
Fire Management Leadership
Northern Rockies Dispatcher Workshop. *Wildland Fire Decision Support System*. Great Falls, MT
National Fire Use Module Meeting
M581 Fire Program Management. *Wildland Fire Decision Support System*. Tucson, AZ
S495 Geospatial Fire Analysis, Interpretation, and Application. *Wildland Fire Decision Support System Fire Behavior Tools*. Tucson, AZ
Technical Fire Management (TFM). Wildland Fire Decision Support System and National Fire Decision Support Center. Bothell, WA

Human Factors and Risk Management RD&A

NIMO 2010
National Area Command/Incident Command meeting
R5 Interagency Incident Management Team meeting
Washington Type 2 team meeting
Northern Rockies Type 1 and 2 team meetings

Planned Presentations

Economics Research

Association of Fire Ecology Conference (Savannah, GA) presentations by Calkin - Risk assessment (2), Gebert - Effects of media and political influence on suppression costs (1), Effects of AMR on cost and community relations (2), and Thompson - Incentives and insurance approaches to suppression expenditures (1)
Northwest WFDSS Workshop, BLM, Portland, OR

Wildland Fire Management RD&A

The Wildland Fire Management RD&A staff continues to be requested for presentations and participation in many meetings, presentations, and conferences. Planned and completed presentations include:
CalFire Meeting. Wildland Fire Decision Support System. Riverside, CA.
DOI Office of Wildland Fire Coordination. Wildland Fire Decision Support System. Boise, ID.
Fire Equipment Committee/Working Group. Wildland Fire Decision Support System and National Fire Decision Support Center. Missoula, MT.
USFS Regions 2, 3, 4, and 10, Wildland Fire Decision Support System After Action Reviews. Denver, CO. Gila, NM. Ogden, UT. Fairbanks, AK.
USFS Region 6 Fire Management Meeting. WFDSS and the Future. Portland, OR.
BIA, Wildland Fire Decision Support System After Action Review. Billings, MT.
Predictive Services Meeting. Wildland Fire Decision Support System and National Fire Decision Support Center. Lake Tahoe, NV.
USFS Region 3 Regional FFMO Meeting. Wildland Fire Decision Support

System. Santa Fe, NM.
International Fire Ecology Conference: Fire as a Global Process. Wildland Fire Decision Support System, Savannah, GA.
International Fire Ecology Conference: Fire as a Global Process.
BehavePlus Fire Modeling Workshop. Savannah, GA.
Fire Behavior Subcommittee. Wildland Fire Decision Support System. Tucson, AZ.
Strategic Incident Decision Support Round Table. Wildland Fire Decision Support System and the National Fire Decision Support Center. Redmond, OR.
Fire Environment Working Team. Wildland Fire Decision Support System. Reno, NV.
Fire Congress. Catalonia Spain.
Alaska Interagency Coordination Group Meeting. WFDSS and the Future, AAR. Fairbanks, AK.
National Predictive Services Meeting. WFDSS and the NFDSC. Lake Tahoe, NV.
National Wildfire Coordinating Group. WFDSS status and update. Boise, ID. BLM National Fire Management Meeting. WFDSS and After Action Review. Boise, ID.
R1, R3, R4, R5 Fire Behavior Workshops.
WUI Mitigation Committee Meeting. WFDSS status and update.
Regional BAER Coordinator Meeting. Wildland Fire Decision Support Overview. Albuquerque, NM.
International Fire Ecology Conference: Fire as a Global Process. Integrating Science, Technology, and Fire Management- Pence, M., Amato, S., and E. Noonan-Wright.
Abstract submitted to Society of American Foresters National Convention, Albuquerque, NM
Abstracts have been submitted to the International Journal of Wildland Fire (IAWF) Spokane conference (3).
Association of Fire Ecology Conference (Savannah, GA), presentation, Pence.
S-580, Advanced Fire Use Applications Planning Meeting. Boise, ID.
S-520, Advanced Incident Management Planning Meeting. Boise, ID.
S-590, Advanced Fire Behavior Interpretation Planning Meeting. Tucson, AZ.
S-495, Geospatial Fire Analysis, Interpretation, and Application Planning Meeting. Tucson, AZ.
American Meteorological Society, Symposium on Fire and Forest Meteorology. Kalispell, MT.
The Nature Conservancy Fire Learning Network Partnership Meeting. Washington D.C.
WFDSS Interagency GIS Team Meeting. Missoula, MT.
Interagency GIS Team working meeting. Boise, ID.
Pacific Northwest Fire Environment Working Team. *Wildland Fire Decision Support System Trends*. Redmond, OR.
National Park Service Fire & Aviation Management Conference. *Wildland Fire Decision Support System*. San Antonio, TX.
National Incident Commander/Area Commander Meetings. *National Fire Decision Support Center, Roles of IMTs*. TBD.
Geographic Area IMT Meetings. *Wildland Fire Decision Support System*. TBD.

Human Factors and Risk Management RD&A

International Association of Wildland Fire- Human Dimensions of Wildland Fire Conference. *Wildland Fire Decision Support System*. San Antonio, TX.

National Incident Management Organization (NIMO) Team Meeting. Boise, ID.

Homeland Infrastructure Foundation-Level Data (HIFLD) Work Group Meeting. Boise, ID.

All Scientist Meeting, Rocky Mountain Research Station. Ft Collins, CO.

Association of Fire Ecology Conference (Savannah, GA), presentation by Black (2).

2nd International Human Dimensions in Wildland Fire (San Antonio, TX) by Black (2).

Organizational Representation

Wildland Fire Management RD&A

National Fire Directors' Meetings.

S-495, Geospatial Fire Analysis, Interpretation, and Application. Serve as member(s) of training cadre.

S-520, National Incident Management Training Course Steering Committee. Serve as member of S-520 Steering Committee, and S-620, Area Command Steering Committee.

S-580, Advanced Wildland Fire Use Applications. Serve as member of training cadre.

S-590 Advanced Fire Behavior Interpretation Steering Committee. Serve as a member of the S-590 Steering Committee, cadre, and Steering Committee Co-Chair.

FML, Fire Management Leadership. Serve as member of training cadre.

National Fire Performance Measures Work Group. Participate as member of this working group for State and Private Forestry.

National Wildfire Coordinating Group (NWCG). Represent WO R&D as member of NWCG at numerous meetings.