

National Fire Decision Support Center

FY2014 Annual Report



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

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Introduction

The National Fire Decision Support Center (NFDSC) (Figure 1) is a collaborative effort between Fire and Aviation Management and Research and Development. It was created to support wildland fire decision making by directly linking fire and economic sciences to operational applications and has been operational since 2009. The NFDSC provides a key link between wildland fire science and the application of that science to benefit field practitioners, decision-makers, and agency stakeholders.

The purpose of the NFDSC is to:

- Improve the science to support large fire decision-making
- Improve fire management decision support tools and processes
- Improve agency capability to make and implement wildland fire decisions
- Improve agency capability to manage fire expenditures
- Maintain centralized decision support capabilities for fires
- Continue development of a safety culture that systematically approaches management of risk.

The NFDSC is a virtual organization comprised of team members from multiple USFS research and management programs, Department of Interior (DOI), and other cooperators. Existing units that provide staff for integration in this effort include the Wildland Fire Management Research

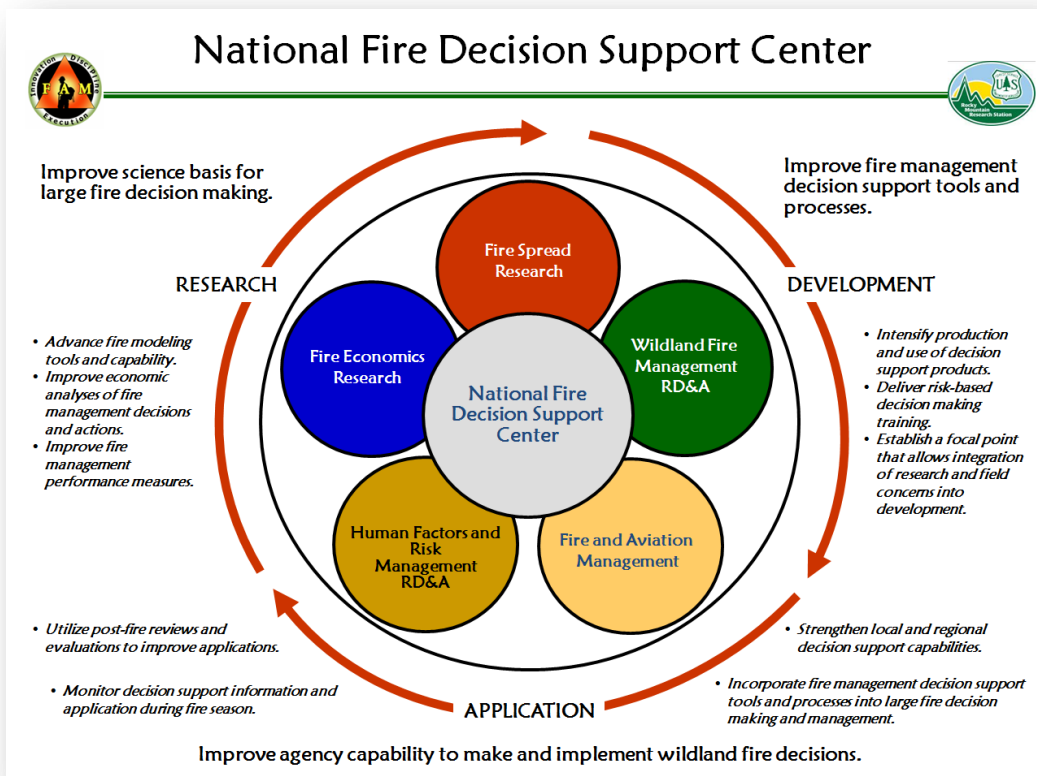


Figure 1 – NFDSC Organizational Involvement

Development and Application (WFM RD&A) program which has Rocky Mountain Research Station (RMRS), WO-Fire & Aviation Management (WO-FAM), and Department of Interior (DOI) involvement; the Human Factors and Risk Management RD&A, Fire Spread Research – Fire, Fuels & Smoke Program, and Fire Economics Research - Human Dimensions Program all comprised of RMRS employees

This report describes the NFDSC's accomplishments for fiscal year 2014.



Fire and Aviation Management

The US Forest Service (USFS) provides exemplary natural resource research at stations and labs across the US leading research in the many facets of wildland fire management. The NFDSC works to leverage this science for improved risk assessment and decision making for the all levels of the fire organization.

The FS Fire and Aviation Management program provides funding and oversight as needed to the units within the NFDSC. This oversight, funding, and integration allow the NFDSC to work collaboratively and produce meaningful and useful research and applications for a wide variety of internal and external audiences.



Figure 2 – Fire and Aviation Management Focus Areas



Fire Spread Research

The goal of the fundamental fire research program is to understand how wildfires spread so that practical improvements in modeling, training, and mitigation can be developed based on the actual physics of fire phenomena. For decades, models of wildfire spread have been developed and used, but they lack a common approach to representing and organizing the fundamental physical processes. The physical processes that produce fire spread can be easily listed (heat transfer, combustion, and ignition, entrainment etc.) but the organization, order, and required amounts are subjectively and speculatively applied in models because the experimental basis has never determined. This deficit in basic knowledge cripples our ability to make advancements in prediction, train and educate fire fighters in understanding their field observations, and mitigate fire losses and behaviors. Without knowing how fire spread depends on fuels, topography, and weather, management decisions are dependent upon empirical and often incorrect formulations.

FY 2014 Accomplishments

By the end of FY2014, our research program has uncovered new and previously undescribed mechanisms of wildfire spread. Specifically, we obtained experimental evidence from the field and laboratory that fire spread depends upon buoyant dynamics of the flame zone rather than the steady-state combustion and heat transfer or energy balance concepts that dominated approaches up to this point. Such a simple explanation implies that simple but physically-based modeling advances are within reach that can describe many of today's un-modeled fire behaviors.

Buoyant Dynamics of Wildland Fires

Fire spread experiments conducted in Missoula by the NFDSC, and cooperators at the University of Kentucky and the University of Maryland have found that flame structure and heat transfer is dependent upon buoyant instabilities. Instabilities represent the interplay between the hot gasses of the flame zone and the in-drafts to the fire front. They produce very clear patterns that are recognizable from well-known features of fluid flow in boundary layers. Thus, the surprising conclusion is that fire behavior is little different from other well-known fluid problems and not unique as a natural phenomenon. Flame fluctuations produced by buoyant instabilities result in non-steady heating by the flame (pulsation) that ignites fuels by intermittent convection. The first publications of these results were made in summer 2013 (see Finney et al. 2013 and Adam et al. 2013). The exciting implication of this work is that scale modeling based on other buoyant phenomena could rapidly lead to the ability to develop practical tools that apply equally well to small surface fires and to large-scale crown fires.

Particle Heating and Ignition

For several years now, we have been working to substantiate the details of fuel particle heating and ignition because work by the NFDSC has shown unequivocally that particle heating requires flame contact. This finding directly contradicts the assumptions used in almost all fire modeling for the past half-century. Previously, radiation has been assumed to be sufficient and necessary for heating and ignition of wildland fuel particles (grasses, leaves, needles, small branches) – but that is now known to be false. These fine particles that dominate wildland fuel complexes are able to cool so efficiently from ambient air flow that they will not ignite from radiation. Thus, the remarkable conclusion is that flame contact (convective heating) is required for particle ignition and spread – and is only occurring in very close proximity to the active flame edge.



Burning Rates of Fuel Complexes

The flame residence time is critical to the spread of wildland fires because if it is less than the ignition time, the fire won't spread. This is of particular concern when discussing the thresholds for crown fire spread (but even surface fires demonstrate spread thresholds), a currently poorly understood aspect of wildland fire. Curiously, no one theory exists for the prediction of residence time. The burning rate of wood cribs is pursued as an avenue toward a better understanding of the residence time because the two quantities are inversely related and the burning rate of cribs is highly repeatable. To vary the burning rate, cribs are built with different stick thicknesses and densities. Even though wildland fuels do not have the same predictable arrangement as wood cribs, we are interested in whether a fundamental understanding of what governs the burning rate of a crib will apply to the wildland fire context.



Figure 3 - Photograph of large wooden crib (2'x4'x52') burning for the study of flame structure and burning rate.



Figure 4 - Flame structure from gas burner shows features and behaviors similar to wildland fires.

Convective heating and heating chemistry of live fuels

Recent evidence demonstrates that fine fuels require flame contact (very rapid convective heating) before ignition because convective cooling offsets radiative heating sufficiently to prevent ignition. Unlike dead fuels, live foliage can be up to half non-structural carbohydrates like sugars and starches which vary from

physiological changes throughout the growing season. There is a complicated and unknown relation between the chemical composition and moisture content that has a significant effect on the ignition of live fuels. In the first set of experiments, a wide range of both live and dead forest fuels were convectively heated with air temperatures ranging from 100°C to 600°C. In collaboration with the University of Montana, a high accuracy, fast response mass spectrometer was used to sample and analyze the pyrolysis products. The evolution of both water and carbon dioxide was measured along with the ignition time.



Cooperative Agreements/Partnerships

- University of Montana, Department of Chemistry
- University of Kentucky, Department of Mechanical Engineering
- University of Maryland, Department of Fire Protection Engineering

FY 2015 Planned Activities:

- Buoyancy Scaling – Test existing buoyant-instability scaling relationships outside of the range of laboratory experiments with data collected from field burns and large-scale artificial fuel beds.
- Burning Rates – Extend crib-scaling to test applicability to spreading fires and to large scale artificial fuel beds
- Ignition Experiments and Modeling – Use of thermal camera to examine heating dynamics in spreading laboratory fires, continue experiments on individual particles in the laboratory with forced and natural convective cooling, continue numerical modeling of particle response to radiant heating, convective, heating, and convective cooling
- Flame fluid dynamics – continue work with experiments and modeling of fluid flow in flame zone.



Fire Economics Research

The wildfire economics team is a leader in the development and application of knowledge and tools to understand the economic implication of wildfire management and wildfire risk assessment to improve the science basis for wildfire management. The team explores the costs and benefits of investments across the spectrum of wildfire management. Primary research topics include integrated spatial risk assessment modeling, econometric modeling of fire management expenditures, and the effectiveness of suppression resource utilization, managerial incentives, and performance measurement.

FY 2014 Accomplishments

Risk and Decision Analysis

In 2014 the team leveraged previous investments in capacity and decision support, and continued to build networks with partners to apply state-of-the-art wildfire risk science. A primary effort was facilitating a region-wide wildfire risk assessment process for the Southwest Region, which entailed members of the team traveling to Albuquerque to meet host workshops and present preliminary results to the Regional Leadership Team. In the same geographic area, the team worked collaboratively with USGS and TNC to prospectively evaluate the potential for post-wildfire debris flows in the Sandia Mountains outside of Albuquerque, NM, resulting in a [USGS publication](#). These results can be used to facilitate prioritization of at-risk landscapes and in particular protection of municipal water supplies. Other risk modeling efforts focused on human communities and transmission of risk across ownerships (Figure 5), leading to a [publication in Risk Analysis](#) (that could set the stage for future work evaluating the potential exposure and risk associated with ignition locations. Analysis of risk to human communities also focused on realistic

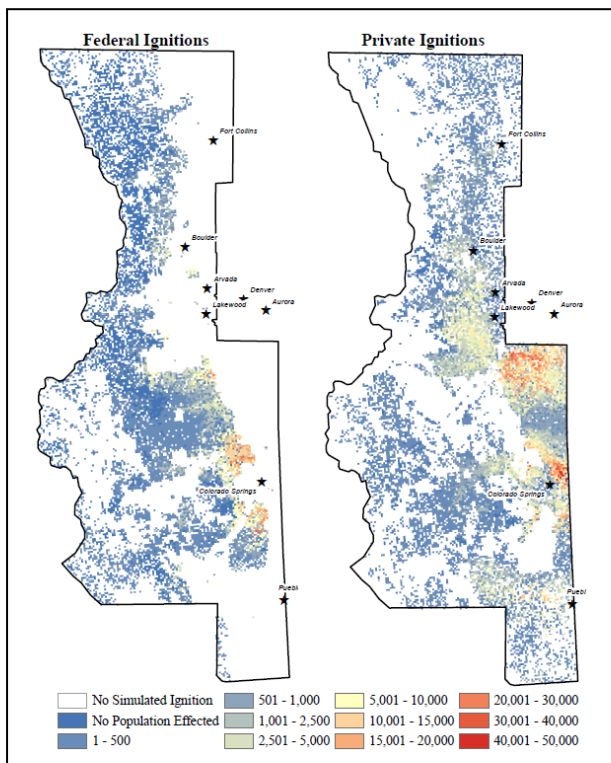


Figure 5 – Population effected by wildland fire spread from ignition locations across different landowners.

mitigation opportunities and reemphasized the importance of clear objectives and shared roles and responsibilities for reducing home loss, resulting in a publication in [Proceeds of the National Academy of Sciences](#). The team provided guidance to the WO FAM and S&PF leadership team on how to prioritize communities at risk for fuel mitigation efforts. Ongoing research is evaluating alternative ways to apply the “biophysical fireshed” concept as well as newer approaches to probabilistically depict a range of possible fire outcomes; much of this work was presented at various conferences and workshops throughout the year. Forthcoming publications stemming from work in 2014 include a review of a geospatial risk calculation tool and its application to the budgetary planning in the Rocky Mountain Region (to be published in *Environmental Modelling & Software*), a paper describing the application of risk management and actuarial principles to wildfire management expenditures (to be published in *Forest Policy and Economics*), and a RMRS Research Note



describing the integration of vegetation condition assessment and risk assessment to characterize vegetation response on the Bridger-Teton National Forest.

Suppression resource use, cost, and effectiveness

The team continues to explore economic issues related to cost and effectiveness of using suppression resources to manage wildland fires. FY 2013 activities included the development of a suppression expenditure model using spatially explicit data to improve expenditure predictions and provide a more detailed understanding of the determinants of suppression expenditures for large fires. The team also engaged with other scholars to summarize the state-of-the-art for suppression expenditure modeling and point a way forward for future research on this topic, which resulted in the following book (<http://www.springer.com/economics/environmental/book/978-1-4939-0577-5>). The team conducted research on the determinants of the level of suppression resource use across incidents and incident management teams, and the use of suppression resources to effectively contain fire growth. These results were incorporated into the Risk Console that provides F&AM leadership with real time risk based performance measures on individual fires throughout the fire season. Ongoing research efforts include analyses of initial attack success rates to better predict conditions under which potentially large and costly fires can (and cannot) be contained in initial attack efforts, and the tradeoffs associated with using different types of suppression resources, to contain fires during initial attack.

The team continued its research into the effectiveness and safety implications of aerial firefighting resources. Research describing the characteristics of use and outcomes of large airtanker (LAT) usage were published in [IJWF](#) and methods to estimate expected aviation accident rates on individual fires were published in the *Journal of Forestry* and incorporated within the Risk Console. Additionally, several members of the team are providing research expertise to the Aerial Firefighting Use and Effectiveness (AFUE) Study. The AFUE study is a 5 year investment in field based data collection and research analyses that aims to improve the Agency's understanding of the conditions that lead to effective and efficient use of aerial resources.

At the request of F&AM leadership, team members participated on the large fire review teams evaluating the West Fork Complex on the San Juan and Rio Grande NFs in Colorado and the Ranch Fire on the Sequoia NF in California. Additionally, a joint venture agreement with Colorado State University was initiated to examine characteristics of suppression resource movement across space and time. Researchers at CSU will develop network models that better explain suppression resource demand and improve the efficiency of resource movement to better meet that demand.



Cooperative Agreements/Partnerships

- University of Montana
- Oregon State University
- West Virginia University
- Southern Research Station
- Pacific Northwest Research Station, Threat Center
- Pacific Southwest Research Station
- US Geological Survey
- Colorado State University

FY 2015 Planned Activities:

- Continued research on the factors that determine suppression resource use across incidents, including an analysis of the determinants of resource demand efficiency and its role determining suppression expenditures.
- Examination of initial attack success rates and the factors associated with early fire containment. This project leverages data gathered over the past two years that links a census of fire occurrence on Forest Service lands with data describing near-term fire potential, fire outcomes, and initial attack resource use (including airtankers).
- Continued development of expenditure models using spatially and temporally explicit data for use in research, decision support tools, and cost benchmarking.
- Expand research on the characteristics and effectiveness of retardant drops from large airtankers and provide initial analyses of field data collected during the 2014 fire season by AFUE team members.
- Explore development and testing of wildfire simulation studies to examine risk-risk tradeoff decisions by Incident Management Teams.
- Provide research leadership to enhance and expand the Agency's risk based training curricula through participation in the Wildfire Risk Summit and other training activities.
- Continued collaboration with Region 3 on wildfire risk assessment, downscaling to forest level where appropriate, and enhancing approaches to characterize ecologically beneficial fire
- Continued collaboration with USGS and TNC to assess post-wildfire debris flow potential for landscapes in the Sangre de Cristo and Jemez Mountains
- Expanded analysis of the "biophysical fireshed" concept with applications for fuel treatment and response planning
- Engagement with fire and fuel planners in Region 5 to apply risk modeling results to wildfire response planning
- Provide guidance and economic datasets for the WFIPS program development



Human Factors & Risk Management RD&A

FY 2014 Accomplishments

Understanding and Improving performance

Activities in FY14 continued along four intersecting and mutually supportive strategies: accessing and improving the science-basis of safe and high performance in Forest Service operations; developing and fielding experiments in organizational interventions; delivering new concepts and practices via existing organizational venues (such as – training centers, leadership programs); and building the necessary relationships to facilitate continued organizational change.

The RD&A concentrated on setting the foundation for the next five years of work (in a new Charter with leadership support and buy-in from all facets of the USFS, not just Research and Development), initiating new research partnerships to better understand opportunities and gaps in current knowledge, culture and Agency work environments, and testing and delivering previous research results.



Figure 6 - Comprehensive Wellbeing and Resilience Workshop

Cooperative Agreements/Partnerships

- Valparaiso University, Department of Communications
- Portland State University, Department of Industrial and Organizational Psychology
- Texas State University, Department of Communications
- Bradley University, Department of Communications
- Oregon State University– College of Health and Human Sciences, Department of Nutrition and Exercise Sciences
- Case Western Reserve University, Weatherhead School of Management
- Joint Fire Science Program
- National Advanced Fire Resource Institute (NAFRI)
- National Wildland Fire Coordinating Group (NWCG)
- S-520 HRO Faculty Cadre
- Wildland Fire Lessons Learned Center
- Northern Rockies Fire Science Consortium



- Organization Development Enterprise Team
- USFS's Safety Core Working Team
- Country Fire Authority, Victoria AU
- Latrobe University, Australia
- University of Melbourne, Australia
- Renoveling, Inc.
- Guidance Group
- Digital Visions Enterprise Team
- Organization Development Enterprise Team

FY 2015 Planned Activities

Authority and funding for the continuation of these efforts is continuing under the Human Performance Research, Development and Applications Unit.



Figure 7 - Forest Service Apprentice Academy's 'Amazing Race' – A module that introduces participants to a suite of human factors.



Wildland Fire Management RD&A

The WFM RD&A welcomed three new faces in FY 2014. Mark Hale and Caroline Noble filled vacancies as Lead Fire Technology Transfer Specialists and Reginald Goolsby filled a fire Technology Transfer Specialist position.

FY 2014 Accomplishments

Develop, improve, and increase production & use of decision support products

The Wildland Fire Information and Technology (WFIT) Executive Board approved the Interagency Fuels Treatment Decision Support System (IFTDSS) in May 2014. The WFM RD&A will lead further development and eventual operational deployment. IFTDSS will be managed as a beta test for the next two years with operational deployment planned in 2017. Four critically important work flow processes have been identified for inclusion: Hazard Analysis, Risk Assessment, Fuels Treatment Assessment, and Prescribed Burn Planning.

Enhancements and improvements continued in FY 2014 in the Wildland Fire Decision Support System (WFDSS). Fire behavior features were added, improvements were made to the user interface, the Relative Risk and Organizational Assessment was improved to be consistent with the NWCG approved Risk & Complexity Analysis, and WFDSS was connected with the Integrated Reporting of Wildland-Fire Information (iRWIn) program. A User Center Design Review was completed with recommended actions which are expected to vastly improve user experience. It will be released to WFDSS next fiscal year.

Examination of random wildland fire incident decisions revealed that incident objectives are written in a way that they could be applied to any fire in the country. A systematic evaluation was undertaken to better understand the situation and recommend solutions which included site visits to 23 fires. Agency administrators, incident commanders and WFDSS authors were interviewed. Follow-up to this review will take place in FY2015 in the form of additional fire reviews, training documentation, help content in WFDSS and updates to the Line Officer's Guide.

Provide mentoring and other means to strengthen decision support capacity

The WFM RD&A hosted five mentees and five detailers from four agencies. Mentees worked with WFM RD&A staff and were provided opportunities to gain and improve skills in fire analysis and assessment for ongoing wildfire incidents. Detailer assignments worked on many projects within the WFM RD&A, allowing for critical work to be accomplished while providing training and experience to the detailer.

Staff attended the International Association of Wildland Fire's Large Wildland Fires: Social, Political and Ecological Effects conference in Missoula, MT. They coordinated and hosted workshops, presented oral and poster presentations, and coordinated special sessions relating to Risk Assessment, Decision Support, Land Management Planning, and Fire Behavior.

Integrate new knowledge into existing wildland fire curricula

In an effort to integrate new knowledge into existing wildland fire curricula, 22 WFDSS specific modules (\$130 to \$590) were developed for inclusion in existing NWCG training courses as supplemental aids. As courses are updated the modules can be included in the standard course materials.



Provide Decision Support Analyses

Staff supported 49 incidents, the majority of which were Type 1 and Type 3 fires, although all fire types were supported (Fig. 8). The Northwest Geographic Area received the most assistance followed by the Northern Rockies. Eight Geographic Areas were supported in all (Fig. 9). Support included fire behavior products, decision support assistance, and a range of other services and products summarized below (Fig. 10). 28 individuals were mentored and coached by WFM RD&A staff in direct support of incidents, prescribed fire planning, and fuels planning.

Incident Type FY2014

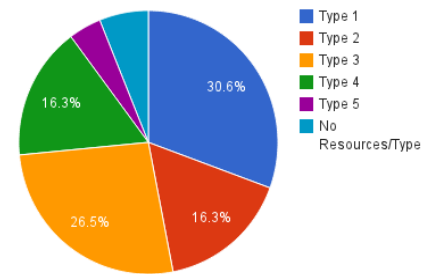


Figure 8 – National Decision Support Center statistics by incident type.

Geographic Area Distribution FY2014

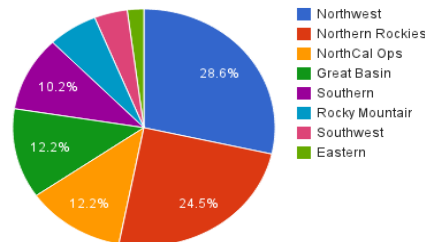


Figure 9 – National Decision Support Center statistics by geographic area.

Support Provided FY2014

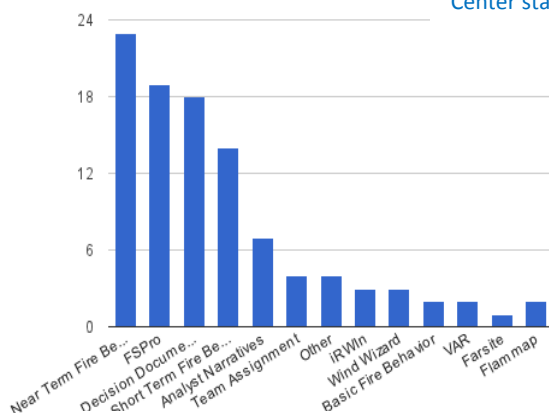


Figure 10 – National Decision Support Center statistics by product.

Almost 700 informal contacts and 2285 formal contacts were made with WFDSS users to assist with decision support. Informal contacts consist of emails, phone calls, face to face and online chats. Formal contacts consist of helpdesk tickets, formal feedback through the WFDSS applications, and direct contact made to the Helpdesk.

Provide a link between scientists and field managers & advisor to program administrators

The WFM RD&A has partnered with numerous agencies, universities, organizations, and committees in efforts to link scientists and field managers. For example, a partnership with the NWCG Fire Behavior Subcommittee and the Desert Research Institute (DRI) has yielded studies and deliverables relating to critical fire weather patterns, PocketCards, and the Southwest monsoon.

The WFM RD&A functions as an advisor to program administrators, for example: providing training to agency line officers and coordinating with Geographic Area Editors. The WFM RD&A has been working closely with the National Line Officer's Team (NLOT) to develop a USFS Line Officer Desk Reference for Fire Program Management and to further communications around decision making on wildland fires.

A full report of the 2014 WFM RD&A activities is available at www.wfmrda.nwcg.gov



Cooperative Agreements/Partnerships

- LANDFIRE Program
- Desert Research Institute (DRI)
- National Oceanic and Atmospheric Administration and the National Weather Service
- University of Idaho Wildland Fire Science Program
- Fire Research And Management Exchange System (FRAMES)- University of Idaho
- National Center for Landscape Fire Analysis (NCLFA)- University of Montana
- Department of Interior- Office of Wildland Fire Coordination (OWFC)
- Bureau of Indian Affairs (BIA)
- Bureau of Land Management (BLM)
- Fish and Wildlife Service (FWS)
- National Park Service (NPS)
- US Geological Survey (USGS)
- Joint Fire Science Program (JFSP)
- Northern Rockies Fire Science Network
- National Wildfire Coordinating Group (NWCG)
- National Predictive Service Program (NIFC)
- USFS Fire & Aviation
- Pacific Southwest Research Station
- Pacific Northwest Research Station
- The Nature Conservancy (TNC)
- International Association of Wildland Fire (IAWF)

FY 2015 Planned Activities

Projects are listed based on the WFM RD&A's three main focus areas and associated goals for FY15.

Integrate research and technology into decision support systems for better decision making.

- Support interagency Spatial Fire Planning efforts.
- Work with partners to support and improve the Incident Risk Console (RisC).
- Partner with the RMRS Fire Economics group to develop a “prototype” forest example for risk assessments, support fire decision-making, and spatial fire planning.
- Test Amazon Web Services (AWS) for potential use in the future.
- Develop and test the TwitterFire application.

Assist the field to increase and improve inputs for timely risk based decisions.

- Provide training and implementation support for spatial fire planning.
- Develop documents and information that link risk analysis to spatial fire planning.
- Expand expertise in tools and processes for risk analysis (FSIM, ArcFuels, LFTFC).
- Investigate how to assist managers with developing objectives in Land and Resource Management Plans and spatial fire plans to ensure relevant WFDSS guidance.
- Provide daily phone support for ongoing fire incidents, and on-site support as needed.
- Develop Advanced Fire Behavior Lessons Learned workshops at conferences and meetings.
- Edit and distribute the Line Officer's Desk Reference through the Forest Service National Line Officer Team.



Evaluate, test, identify and suggest WFDSS enhancements that support the field.

- Support development and award of a new WFDSS contract.
- Develop applications for fuels treatment planning.
- Continue support for the Fuels Management and Fire Planning Portal.
- Support development and award of an IFTDSS contract.
- Incorporate fire effects into decision making.
- Continue work with the FireSev project to evaluate use in WFDSS.

Train the wildland fire community in utilization of the products we create/sponsor.

- Provide webinars, papers and help content to assist managers in writing better fire decision objectives.
- Develop a WFDSS Guidebook for the user community.
- Provide good WFDSS Decision examples to the field for reference and use in spring training.
- Develop curriculum for WFDSS refreshers and Line Officer certification.
- Coordinate WFDSS releases with help content updates, testing and training material dissemination.
- Automate WFDSS GIS mapping features to assist GISS position on incidents.
- Provide training and support to RisC and risk products in WFDSS.
- Support national/regional level courses.
- Provide training opportunities for the field through the WFM RD&A detailee/mentee program.
- Support IFTDSS technology transfer/help documentation.
- Partner with the Aldo Leopold Wilderness Research Institute, USFS Region 1, and the Northern Rockies Fire Science Network to “tell the story” about decision-making on fires managed for resource benefits through a series of video modules.

Increase awareness and effectiveness of the Rocky Mountain Center.

- Provide oversight to RMC through the newly chartered Steering Committee.
- Develop RMC training and outreach.
- Develop a weather verification model for RMC products.
- Develop a dynamic weather map to host on the RMC website.

Provide assistance to other countries as invitees, participants and contributors.

- Support fire training in Indonesia.

Improve data delivery mechanisms for broader audiences

- Automate and manage WFDSS data processing and acquisition.
- Coordinate with others regarding data standards.
- Continue collaboration with IrWin, the Geospatial Subcommittee, and the Data Management Committee.

Communications with collaborators improve WFM RD&A functions.

- Coordinate monthly calls with interagency Geographic Area Editors regarding WFDSS functionality.
- Participate on various National Wildfire Coordinating Group (NWCG) committees.
- Develop a marketing plan for the WFM RD&A.
- Determine the potential role of the WFM RD&A in supporting the Cohesive Strategy.
- Provide developmental opportunities for our staff through details.



Figure 11 – WFM RD&A Team Member Tonja Opperman providing a briefing on a fire.

Appendices

Appendix 1 – Fire Spread Research

Presentations

- Mark Finney presented Operational Fire Modeling and Critical Research Questions at a special session of International Smoke Symposium, in Adelphi, Maryland. October 2013.
- Chuck McHugh presented “spatial analysis of fuel treatment for fire hazard reduction” to USFS Region 1. November 2013.
- Chuck McHugh made a presentation on FARSITE and FlamMap for supporting fuel specialists in Federal agencies at the NWCG Fire Behavior Committee. December 2013.
- Mark Finney presented “Current state of operational fire modeling”, Univ. California San Diego as part of the WIFIRE project. January 2014.
- Mark Finney presented Landscape fuel management and risk reduction at the Forest Vegetation Management Conference in Redding CA. January 2014.
- Mark Finney presented workshop on Extreme Fire Behavior conducted as part of the Intl. Assoc. Fire Safety Science in Christchurch, New Zealand. February 2014.
- Mark Finney, Dave Calkin, and Alan Ager presented Advances in Wildland Fire Risk Analysis to Senior Fire Leadership meeting, Denver CO. February 2014.
- Mark Finney presented “Experimental Evidence for Buoyancy Controlled Wildland Fire Spread” to the Chemical Engineering Department graduate seminar, Brigham Young University, Provo UT. March 2014.
- Mark Finney presented ‘Wildfire risk simulation methods and application to protected area management’ at the BIORARE conference, Antalya, Turkey. April 2014.
- Diane Trethewey and Kyle Shannon presented current capabilities of the WFIPS system at the Annual Fire Planners meeting in Portland OR. April 14-16 2014.
- Missoula MT, Mark Finney and Karen Short presented “Improved simulation of probabilistic wildfire risk components for the conterminous US” at the Large Fire Conference. May 2014.
- Mark Finney presented “Advancing knowledge and theory on wildland fire spread”, University of Sassari, Sardinia. July 2014.
- Mark Finney presented “landscape considerations for fire behavior and fuel treatments”, University of Sassari, Sardinia. July 2014.
- Jason Forthofer presented a webinar to BC, Canada fire managers and modelers, about WindNinja. June 2014.
- Jason Forthofer presented a webinar to National IMETS, about WindNinja. April 2014.
- Jason Forthofer presented at Northern Rockies Fire Behavior Workshop, about wind modeling and fire behavior. April 2014.
- Jason Forthofer presented to participants in the Large Fires Conference in Missoula, about wind modeling, fire whirls, field sensor deployment. May 2014.
- Jason Forthofer presented to a public group from Red Lodge, MT, about fire whirls, wind modeling. May 2014.
- Chuck McHugh presented information on tools and curriculum for supporting fuel specialists to the Interagency Fuels Curriculum Task Team. February 2014.

- Chuck McHugh presented a poster “Strategic operations planning – it’s not just for wilderness anymore” at the Large Fire Conference, Missoula MT. May 2014.
- Chuck McHugh presented a “Estimating historical annual wildland fire burning rates for the contiguous US using LANDFIRE data” at the Large Fire Conference, Missoula MT. May 2014.
- Chuck McHugh presented a talk on fire behavior in spruce beetle killed stand in Colorado for the GMUG in Colorado. August 2014.
- Karen Short presented a seminar on “Sources and implications of bias and uncertainty in a century of US wildfire activity data” Missoula Fire Sciences Laboratory. March 2014.
- Karen Short presented “Sources and implications of bias and uncertainty in a century of US wildfire activity data” at the Large Wildfires Conference: Social, Political, and Ecological Effects, Missoula, MT, 19-23. May 2014.
- Karen Short presented “Sources and implications of bias and uncertainty in a century of US wildfire activity data” at 7th International Conference on Forest Fire Research, Coimbra, Portugal. 2014

Workshops

- Mytilini, Greece, Mark Finney and Alan Ager presented seminars on fire risk analysis at the University of the Aegean. April 2014.
- Mark Finney and Jack Cohen presented “Experimental Investigation of Fire Behavior at Laboratory and Field Scales”, at the 7th International Conference on Forest Fire Research, Coimbra Portugal. November 2014.
- Karen Short represented USFS at workshop co-hosted by the National Fire Protection Association (NFPA) and the National Institute of Standards and Technology: Collecting, analyzing, and using fire experience data to reduce the nation’s fire problem, Gaithersburg, MD. March 2014.

Technology Transfer

- Chuck McHugh performed wind modeling for the Yarnell Hill fatality investigation, Oct 2013.
- Chuck McHugh provided data from the Fourmile Canyon Fire Report (RMRS-GTR-289, 2012) to the National Building Museum, Washington DC for an exhibition on Designing for Disaster.
- Chuck McHugh participated in a review of fuel treatment effectiveness for the Funny Fire on the Kenai USFWS Refuge.
- Chuck McHugh provided wind modeling expertise on the Chiwaukum Complex in Washington State, the Rain and Crow fires on the Nez Pearce NF, the Duncan, 790 fire, Carlton Complex in WA, August 2014.
- Chuck McHugh provided fire behavior analysis for the Mission-Upland prescribed burn on the Flathead National Forest, and a long term season assessment for the Madison wildfire on the Beaverhead Deerlodge NF in Montana.
- Chuck McHugh conducted analysis of aircraft use on the Rim Fire in CA, Feb 2014
- Karen Short represented USFS on NWCG Fire Reporting Subcommittee during meetings in December 2013, January, April, August 2014.
- Karen Short represented the USFS on NFPA 901 Technical Committee on Fire Reporting during meeting in Knoxville, TN, in May 2014, and subsequently in June, July, August, September.
- Karen Short represented the USFS at IRWIN Prototype Demo and Discussion (Perimeters, Unit IDs, and Resources), Boise, ID, 24-25. September 2014.
- Karen Short contributed to two FSim (fire modeling system) Users Group Meetings, February 2014.

Publications

- Michele Salis, Alan A. Ager, M.A. Finney, Bachisio Arca, Donatella Spano. 2014. Analyzing spatiotemporal changes in wildfire regime and exposure across a Mediterranean fire-prone area. *Natural Hazards*. Published Online 23 Nov. 2013.
- Calkin, D.E., J.D. Cohen, M.A. Finney, M.P. Thompson. 2014. How risk management can prevent wildfire disasters. *Proc. Nat. Acad. Sci.* December 16, 2013, doi:10.1073/pnas.1315088111.
- Canfield, J.M., R.R. Linn, J.A. Sauer, M. Finney, J. Forthofer. 2014. A Numerical investigation of interplay between fire line length, geometry, and spread rate. *Ag. For. Met.* 189-190:48-49.
- Kalabokidis, K., P. Palaiologou, M.A. Finney. 2014. Fire behavior simulation in Mediterranean forests using the minimum travel time algorithm. *Proc. 4th Fire Behavior and Fuels Conference*, July 1-4, 2013, St. Petersburg Russia. Intl. Assoc. Wildl. Fire.
- Brillinger, D. and M.A. Finney. 2014. An exploratory data analysis of the temperature fluctuations in a spreading fire. *Environmetrics*, DOI 10.1002/env.2279.
- Saito, K. and M.A. Finney. 2014. Scale modeling in combustion and fire research. *J. Comb. Soc. Japan* 56(177):194-204.
- Forthofer J, B Butler, C McHugh, M Finney, L Bradshaw, R. Stratton, K. Shannon, N Wagenbrenner. 2014. A comparison of three approaches for simulating fine-scale surface winds in support of wildland fire management. Part II: an exploratory study of the impact of simulated winds on fire growth simulations. *Intl. J. Wildland Fire*.
- Ager, AA, MA Day, CW McHugh, K Short, J Gilbertson-Day, MA Finney, DE Calkin. 2014. Wildfire exposure and fuel management on western US national forests. *J. Env. Mgt.* 145:54-70.
- Monson, E.I., D.O. Lignell, M.A. Finney, C Werner, Z Jozefik, A.R. Kerstein and R.S Hintze. 2014. Simulation of an ethylene wall fire using the spatially-evolving one-dimensional turbulence model. *Fire Technology* DOI:10.1007/s10694-014-0441-2.
- M.P. Thompson, J.R. Haas, M.A. Finney, D.E. Calkin, M.S. Hand, M.J. Browne, M. Halek, K.C. Short, I.C. Grenfell. 2014. Development and application of a probabilistic method for wildfire suppression cost modeling. *Forest Policy and Economics* 50:249-258.
- Finney, M.A., J.D. Cohen, J.A. Forthofer, S.S. McAllister, B.A. Adam, N.K. Akafuah, J. English, K. Saito, D.J. Gorham, M.J. Gollner. 2014. Experimental evidence of buoyancy controlled flame spread in wildland fires. 7th Conf. Intl. Conf. Forest Fire Research.
- Grenfell, I.C., M.A. Finney, and K.S. Shannon. 2014. Generation of simulated ignitions for the continental United States. 7th Conf. Intl. Conf. Forest Fire Research.
- Cohen, J.D., and M.A. Finney. 2014. Fine fuel particle heating during experimental laboratory fires. 7th Conf. Intl. Conf. Forest Fire Research.
- Adam, B.A., J.D. English, N.K. Akafuah, K. Saito, M. Finney, J. Forthofer, J. Cohen. 2014. The Strouhal-Froude number scaling for wildland fire spread. 7th Conf. Intl. Conf. Forest Fire Research.
- D.J. Gorham, R. Hakes, A.V. Singh, J. Forthofer, J. Cohen, S. McAllister, M.A. Finney, M.J. Gollner. 2014. Studying wildland fire spread using stationary fires. 7th Conf. Intl. Conf. Forest Fire Research.
- McAllister, S.S. and M.A. Finney. 2014. Effect of layout and ventilation on burning rate of porous fuel beds. 7th Conf. Intl. Conf. Forest Fire Research.
- English, J., N.K. Akafuah, B. Adam, M.A. Finney, J. Forthofer, J. Cohen, K. Saito. 2014. Ignition behavior of cardboard fuel particles. 7th Conf. Intl. Conf. Forest Fire Research.

- Linn, R., J. Canfield, J. Sauer, M. A. Finney, J. Forthofer, C. Sieg, F. Pimont, J.L. Dupuy. 2014. Numerical investigations of 3D aspects of fire/atmosphere interaction. 7th Conf. Intl. Conf. Forest Fire Research.
- Kalabokidis, K., P. Palaologou, N. Athanasis, C. Vasilakos, M. A. Finney, A. Ager. 2014. Minimum travel time algorithm for fire behavior and burn probability in a parallel computing environment. 7th Conf. Intl. Conf. Forest Fire Research.
- Short, K. C. 2014. A spatial database of wildfires in the United States, 1992-2011. *Earth Systems Science Data* 6:1-27.
- Short, Karen C. 2014. Spatial wildfire occurrence data for the United States, 1992-2012. [FPA_FOD_20140428]. 2nd Edition. Fort Collins, CO: Forest Service Research Data Archive. <http://dx.doi.org/10.2737/RDS-2013-0009.2>
- McAllister, S. and D. Weise. 2014. "Effects of season on ignition of live wildland fuels using the FIST apparatus," Poster presentation at 35th *International Symposium on Combustion*, San Francisco, CA, August 3-8.
- McAllister, S. and D.R. Weise. 2014. "Effects of season of ignition of three species of live wildland fuels using the FIST apparatus," Spring Technical Meeting of the Western States Section of the Combustion Institute, Pasadena, CA, March 23-25.
- McAllister, S. and M. Finney. 2014. "Convection ignition of live forest fuels," *Fire Safety Science - Proceedings of the Eleventh International Symposium*.

Appendix 2 – Fire Economics Research Accomplishments

Presentations:

- Calkin, D. “Tradeoffs among wildfire management programs.” Presentation to USFS Senior Fire Leaders. Denver, CO. February 26, 2014.
- Calkin, D. M. Thompson, M. Finney, J. Haas, and A. Ager. Risk assessment and economic research to support wildland fire management. Keynote presentation by Calkin to International Society of Forest Resource Economics. St. Louis, MO. March 17, 2014.
- Calkin, D. “The economics of wildfire risk assessment.” Presentation to Region 1 Leadership Team meeting and Deputy Undersecretary Butch Blazer. Missoula, MT. April 9, 2014.
- Calkin, D. “Wildfire probability and consequences on the Superior Ranger District. Presentation to meeting of Mineral County Commissioners and Lolo National Forest. Superior, MT. April 17, 2014.
- Calkin, D., M. Thompson, M. Finney, J. Haas, and A. Ager. The economics of wildfire risk assessment. Keynote presentation by Calkin to Western Forest Economist Meeting. Missoula, MT. May 19, 2014.
- Calkin, D. Economics of Risk Management. Presentation to OMB Budget Examiners for the USDA and USDA Forest Service. May 20, 2014. Missoula MT.
- Calkin, D. Large Fire Suppression Effectiveness: What We Do and Don’t Know International Association of Wildland Fire Association for Fire Ecology Joint Conference. Missoula, MT. May 21, 2014. Oral Presentation by Calkin.
- Calkin, D. Integrated Risk Assessment to Facilitate Improved Decision Making. International Association of Wildland Fire Association for Fire Ecology Joint Conference. Missoula, MT. May 22, 2014. Oral Presentation by Calkin.
- Calkin, D. Risk assessment and economic research supporting wildfire management. VTC presentation to Region 2’s Resource, Restoration and Resilience leadership group. June 2, 2014.
- Calkin, D. “Wildfire risk transmission from federal lands in the Front Range of Colorado”. Presentation to Colorado Nature Conservancy Representatives and Deputy Chief Jim Hubbard, S&PF. Missoula, MT. July 30, 2014.
- Gilbertson-Day, J., Thompson, M., and D. Calkin. 2014. Planning for future ignitions in the Tenmile Watershed. Association for Fire Ecology & International Association of Wildland Fire Large Wildland Fire: Social, Political, and Ecological Effects Conference, Missoula, MT, May 19-23, 2014.
- Gilbertson-Day, J.W., M. Thompson, Cochrane, M., Freeborn, P., and J. Rieck. 2014. Wildfire Risk and Treatment Effectiveness of Protecting Highly Valued Resources and Assets with Fuels Management. Association for Fire Ecology & International Association of Wildland Fire, Large Wildland Fires: Social, Political, and Ecological Effects Conference, Missoula, MT, May 19-23, 2014.
- Gilbertson-Day, J., M. Thompson, D. Calkin. New methodology and applications of the fireshed concept for spatial wildfire planning. 2014 Intermountain GIS Conference. Billings, MT. April 7-11, 2014.
- Haas, J.R., Calkin, D., and M. Thompson. 2014. Exposure of Human Population to Wildland Fires: A Case for Multiple Landowner Mitigation. Association for Fire Ecology & International Association of Wildland Fire, Large Wildland Fires: Social, Political, and Ecological Effects Conference, Missoula, MT, May 19-23, 2014.

- Haas, J.R., Scott, J., and M. Thompson. 2014. Multi-Dimensional Hazard Analysis of Post Wildland Fire Debris Flows. Association for Fire Ecology & International Association of Wildland Fire, Large Wildland Fire: Social, Political, and Ecological Effects Conference, Missoula, MT, May 2014.
- Hand, M.*, M. Wibbenmeyer, D. Calkin, M. Thompson. "Risk preferences, probability weighting, and strategy tradeoffs in wildfire management." Invited seminar, Univ. of Montana, Dept. of Economics, March 7, 2014. Oral Presentation by Hand.
- Hand, M.S., Wibbenmeyer, M.J., Calkin, D.E., and M.P. Thompson. 2014. Risk preferences, inefficiencies, and opportunities in wildfire management. Selected paper at the Risk, Perception, and Response Conference, Harvard Center for Risk Analysis, Boston, MA, March 21, 2014. Oral Presentation by Hand.
- Hand, M.S., Katuwal, H., Calkin, D., and M. P. Thompson. 2014. The influence of incident management teams on suppression resource use. Western Forest Economist Meeting, Missoula, MT, May 18-20, 2014. Oral Presentation by Hand.
- Hand, M., H. Katuwahl, D. Calkin, and M. Thompson. 2014. The Influence of Incident Management Teams on Suppression Resource Use. International Association of Wildland Fire Association for Fire Ecology Joint Conference. Missoula, MT. May 21, 2014. Oral Presentation by Hand.
- Hand, M., H. Katuwahl, D. Calkin, and M. Thompson. Estimating Expected Suppression Costs (SCI) and Integration of Suppression Resource Use by Teams. International Association of Wildland Fire Association for Fire Ecology Joint Conference. Missoula, MT. May 22, 2014. Oral Presentation by Hand.
- Hand, M.* "Socio-economic vulnerability to wildfire hazards in the face of climate change: Comparisons from the Southwest and Northwest United States." Paper presented in the Social-Ecological Study of Western Fires special session, Large Wildland Fires: Social, Political and Ecological Effects Conference, Missoula, MT, May 20, 2014.
- Holmes, T. and D. Calkin. Econometric Analysis of Wildfire Suppression Production Functions for Large Wildland Fires. International Association of Wildland Fire Association for Fire Ecology Joint Conference. Missoula, MT. May 21, 2014. Oral Presentation by Calkin.
- Katuwal, H., Calkin David E. 2014 The Influence of Suppression Actions on the Development of Wildfire Perimeters. Large Fire Conference: Social, Political and Economic Effects. Association of Fire Ecology, Missoula, MT May 19-24, 2014
- Katuwal, H., Calkin David E. 2014 Suppression Effectiveness for Large Wildland Fire Suppression Effort. Western Forest Economists 49th Meeting, Missoula, MT, May 18 -20
- Riley, Karin L., Jessica Haas, John Abatzoglou, and Mark Finney (Riley presented). Modeling the effect of climate change on large fire size, counts, and intensities using the Large Fire Simulator (FSim). American Geophysical Union Fall Meeting, December 9-13, 2013, San Francisco, California.
- Riley, K., C. Stonesifer and D. Calkin. Predicting Wildfire Ignitions, Escapes and Large Fire Activity Using Fire Potential Forecasts in the Western USA. International Association of Wildland Fire Association for Fire Ecology Joint Conference. Missoula, MT. May 22, 2014. Oral Presentation by Riley.
- Scott, J., and M. Thompson. 2014. Emerging concepts in wildfire risk assessment and management. Association for Fire Ecology & International Association of Wildland Fire Large Wildland Fire: Social, Political, and Ecological Effects Conference, Missoula, MT, May 19-23, 2014.
- Stonesifer, C.S., M.P. Thompson, D.E. Calkin, C.W. McHugh. 2014. Characterizing large airtanker use in fire suppression. 49th Western Forests Economist Meeting, May 18-20. Missoula, MT.

- Stonesifer, C.S., M.P. Thompson, D.E. Calkin, C.W. McHugh. 2014. Characterizing large airtanker use in US Fire Management. Association of Fire Ecology/Int'l Association of Wildland Fire, Large Fire Conference: Social, Political and Economic Effects, May 19-24. Missoula, MT. 19-23, 2014.
- Stonesifer, C.S., M.P. Thompson, R.C. Seli, M. Hovorka. 2014. Identifying opportunities for beneficial fire in WFDSS. Association of Fire Ecology/Int'l Association of Wildland Fire, Large Fire Conference: Social, Political and Economic Effects, May 19-24. Missoula, MT.
- Thompson, M.P. 2013. Wildfire Decision Making under Uncertainty. American Geophysical Union Fall Meeting. December 10, 2013, San Francisco, CA.
- Thompson, M. 2014. Modeling fuel treatment impacts on suppression costs: Where are we? Western Forest Economist Meeting, Missoula, MT, May 18-20, 2014.
- Thompson, M. 2014. Socio-economic, Political, and Ecological Impacts of Large Wildland Fires. (Invited Panelist). Association for Fire Ecology & International Association of Wildland Fire, Large Wildland Fire: Social, Political, and Ecological Effects Conference, Missoula, MT, May 19-23, 2014.
- Thompson, M. 2014. Decision Making under Uncertainty: Implications for the Wildland Fire Decision Support System (WFDSS). Association for Fire Ecology & International Association of Wildland Fire, Large Wildland Fire: Social, Political, and Ecological Effects Conference, Missoula, MT, May 19-23, 2014.

TRAININGS, WORKSHOPS and TOURS

- Developing Programmatic Performance Measures. Missoula, Montana December, 2013.
- Region 3 wildfire risk assessment response function workshop. Albuquerque New Mexico, April 23, 2014
- Region 3 wildfire risk assessment relative importance workshop. Albuquerque New Mexico, August 4, 2014
- Missoula Technical Development Center/National Weather Service/Smokejumper Center. As part of Association for Fire Ecology and International Association of Wildland Fire, Large Wildland Fires Conference, Missoula, Montana, May 21, 2014.
- The Fires of 2000: Revisiting Social, Political, and Ecological Issues. As part of Association for Fire Ecology and International Association of Wildland Fire, Large Wildland Fires Conference, Missoula, Montana, May 23, 2014.

Publications:

- Ager, Alan A.; Day, Michelle A.; McHugh, Charles W.; Short, Karen; Gilbertson-Day, Julie; Finney, Mark A.; Calkin, David E. 2014. Wildfire exposure and fuel management on western US national forests. *Journal of Environmental Management*, 145: 54-70.
- Calkin, D.E., Stonesifer, C.S., Thompson, M.P., and C.W. McHugh. 2014. Large airtanker use and outcomes in suppressing wildland fires in the United States. *International Journal of Wildland Fire* 23(2): 259-271.
- Calkin, D.E., Cohen, J.D., Finney, M.A., and M.P. Thompson. 2014. How risk management can prevent future wildfire disasters in the wildland-urban interface. *Proceedings of the National Academy of Sciences* 111(2): 746-751.
- Haas, J.R., Calkin, D.E., and M.P. Thompson. 2014. Wildfire Risk Transmission in the Colorado Front Range, USA. *Risk Analysis*. doi: 10.1111/risa.12270

- Hand, M., K. Gebert, J. Liang, D. Calkin, M. Thompson, M. Zhou, 2014. *Economics of Wildfire Management: The Development and Application of Suppression Expenditure Models*, Springer: New York, 71 pp.
- Loehman, Rachel A., Elizabeth Reinhardt, and Karin L. Riley. 2014. Wildland fire emissions, carbon, and climate: seeing the forest and the trees – a cross-scale assessment of wildfire and carbon dynamics in fire-prone, forested ecosystems. *Forest Ecology and Management* 317: 9-19.
- Tillery, A.C., Haas, J.R., Miller, L.W., Scott, J.H., and Thompson, M.P. 2014. Potential postwildfire debris-flow hazards—A prewildfire evaluation for the Sandia and Manzano Mountains and surrounding areas, Central New Mexico: U.S. Geological Survey Scientific Investigations Report 2014–5161, 24 p. with appendix, <http://dx.doi.org/10.3133/sir20145161>.
- Thompson, Matthew P.; Stonesifer, Crystal S.; Seli, R.C.; Hovorka, M. 2013. Developing Standardized Strategic Response Categories for Fire Management Units. *Fire Management Today* 73(1): 18-24
- Thompson, Matthew P.; Vaillant, N.M.; Haas, Jessica R.; Gebert, Krista M.; Stockmann, Keith D. 2013. Quantifying the Potential Impacts of Fuel Treatments on Wildfire Suppression Costs. *Fire Management Today* 73(2): 5-10.
- Thompson, M.P. 2014. Social, Institutional, and Psychological Factors Affecting Wildfire Incident Decision Making. *Society & Natural Resources* 27(6): 636-644
- Thompson, M.P., Haas, J.R., Gilbertson-Day, J.W., Scott, J.H., Langowski, P., Bowne, E., and D.E. Calkin. 2015. Development and application of a geospatial wildfire exposure and risk calculation tool. *Environmental Modelling & Software* 62: 61-72.
- Stonesifer, Crystal S., David E. Calkin, Matthew P. Thompson, and Jeffrey D. Kaiden. (2014) Developing an aviation exposure index to inform risk-based fire management decisions. *Journal of Forestry*. (Accepted July 23, 2014)

Appendix 3 – Human Factors & Risk Management RD&A

Presentations, Oral & Poster

Short-courses

- DeGrosky, M. High Reliability Organizing – Pathway to a reliable and resilient team. S520- Advanced Fire Management, National Advanced Fire and Resource Institute (NAFRI), Tucson, AZ. February 24, 2014.
- DeGrosky, M. HRO Simulation. S520- Advanced Fire Management , National Advanced Fire and Resource Institute (NAFRI), Tucson, AZ. February 24, 2014.
- DeGrosky, M. High Reliability Organizing – Pathway to a reliable and resilient team. HRO BLM Fire Leadership Team (Black/McBride Research), Salt Lake City, UT April 16, 2014.

Training Sessions

- Introduction to Human Performance –
 - Mindfulness and Resilience Practices (Waldron)
 - Wildland Fire Apprenticeship Academy (3/17/2014, 3/24/2014), McLelland, CA
 - SHARP and Resiliency Training, (4/23/2014) Redding, CA
 - Margin of Maneuver and Resiliency (5/2/2104) Sawtooth National Forest Leadership Team
 - SHARP and Resiliency Training for Fire Refresher (3x April–July 2014) Big Bend National Park
 - Organizational Effectiveness and Human Performance (Black)
 - RMRS Leadership Team (6/9/2014)
 - Sub-committee on Disaster Reduction, Wildland Fire S&T Task Force Workshop, Washington, DC, (6/17-19/2014)
- Comprehensive Wellbeing and Resilience (Reugebrink and Livingston)
 - National Park Service Honor Guard AAR, Saguaro NM (1/15/2014)
 - ASC Human Resource Management (2/5/2014)
 - R3 Regional Leadership Team (2/13/2014)
 - R3 Cibola National Forest Employee Meeting (2/19/2014)
 - R3 Safety Manager Conference Call (2/27/2014)
 - R3 Cibola National Forest Staff Meeting (4/14/2014)
 - R3 FLT Update (5/21/2014)
 - Santa Fe Fire Department Chief Meeting (8/20/2014)
 - Risk Management Council (10/16/2014)
 - R5 Health & Safety Officers Workshop (1/29/2014)
 - R3 Prescott NF Employees (3/18/2014)
 - R3 Prescott NF Employees/FLT (3/19/2014)
 - R3 Coronado NF FLT (3/20/2014)
 - R1 Health & Safety Officers Workshop (3/26/2014)
 - Key Note Northern Region University (4/1/2014)
 - Region 5 RLT / Employee/ Vicki Minor Wildland Firefighter Foundation (5/6/2014)
 - Region 5 RLT (6/26/2014)
 - R3 Coronado NAFRI (7/22/2014)
 - R3 Coronado Benson (7/23/2014)
- Staff Ride Development (Harris), Color Country IC Meeting, Cedar City, UT (6/4/2014)

Conference Presentations

- Waldron, A. Developing wildland firefighters' leadership qualities through awareness-based processes: A qualitative investigation, IAWF Conference, Missoula, MT 5/23/2014
- Black, A.E. Toward understanding and managing the human condition in risk management. , International Association of Wildland Fire Conference, Missoula, MT, May 22, 2014

Training, Tool and Technology Development

- Human Performance/Refresher development - Yarnell Honor the Fallen Group (12/2013-5/2014)
- Leadership Sub-Committee Fall and Spring Meetings (12/2013, 4/2014)
- Supervisor Perceived Leadership Scale (SPLS) a leadership scale for Wildland Fire
- Big Hole Battlefield Virtual Staff Ride (7/7-11/2014)

Publications

- Lewis, A. B., & Ebbeck, V. (2014) Mindful and self-compassionate development: Preliminary discussions with wildland firefighters. *Journal of Forestry*, 112(2), 230-236. doi: 10.5849/jof.12-107.
- Waldron, A.L., & Ebbeck, V. (In press) The relationship of mindfulness and self-compassion to desired wildland fire leadership. *International Journal of Wildland Fire*.
- Waldron, A.L., & Ebbeck, V. (In press) Developing wildland firefighters performance capacity through awareness-based processes: A qualitative investigation. *Human Performance in Extreme Environments*.
- Thomas, D., Fox, Rebekah and Carol Miller. (In press) Voices from the field: Wildland fire managers and high reliability organizing mindfulness. *Society and Natural Resources*.
- Thomas, D. (In prep) Literature Review: Communication Practices and Crisis Management Links
- Gabor, E. (In press). Words matter: Radio misunderstandings in wildland firefighting. *Int. Journal of Wildland Fire*.

Appendix 4 – Wildland Fire Management RD&A

Presentation, Oral & Poster

- Integrating Fuel Treatments in Land Management Planning and Wildfire Incident Response. Large Wildland Fire Conference, Missoula, MT, May 19-23rd, 2014.
- The Evolution of Fire Behavior Analysis and Management of Large, Long duration Incidents as Experienced on the Mustang Complex. Moderated session at the Large Wildland Fire Conference, Missoula, MT, May 19-23rd, 2014.
- An investigation of LandScan Suitability for Strategic Decision Making in the Wildland Fire Decision Support System. Oral and Poster presentation at the Large Wildland Fire Conference, Missoula, MT, May 19-23rd, 2014.
- Evolution of Decision Making. Large Wildland Fire Conference, Missoula, MT, May 19-23rd, 2014.
- Strategic Operational Planner (SOPL). Large Wildland Fire Conference, Missoula, MT, May 19-23rd, 2014.
- Wildfire Risk Assessment and Decision Support. Moderated session at the Large Wildland Fire Conference, Missoula, MT, May 19-23rd, 2014.
- Strategic Decision Making for Wildfires using a Risk Management Process. Large Wildland Fire Conference, Missoula, MT, May 19-23rd, 2014.
- Applying the Wildland Fire Decision Support System to Support Risk-Informed Wildland Fire Decision Making: the Gold Plan Fire, Bitterroot National Forest, Montana. Large Wildland Fire Conference, Missoula, MT, May 19-23rd, 2014.
- Fire Perimeter Delineation and Reconstruction from Geo Referenced Photographs Using Google Earth Pro. Poster presentation at the Large Wildland Fire Conference, Missoula, MT, May 19-23rd, 2014.
- WFDSS and Risk Management. National Fire Management Leadership. March, 25th, 2014.
- WFDSS and Decision Making. Presentation to Undersecretary Harden. June 25th, 2014.
- The Wildland Fire Decision Support System. Presentation to members of Australian Fire Management. Sept. 15, 2014.
- Incident Risk Console (RisC) regional presentations. Spring/Summer, 2014.
- WFDSS Refresher for Line Officers, online presentations. June, 2014.
- An Introduction to Spatial Fire Planning. Regional Fuels Planning Meeting, Boise, ID, March 18-20, 2014.
- WFDSS and Line Officers. Presentation at Regional Line Officer Meeting, Ogden, UT.

Workshop/Conference Attendance

- Large Wildland Fire Conference, Missoula
- Synchronous Learning, by Association for Talent Development, Online
- AuthorIt Summit 2014, September 17-18, San Jose, CA.

Training/Course Instruction

- Advanced Fire Behavior Analysis through Lessons Learned. Workshop at the Large Wildland Fires Conference, Missoula, MT, May 19-23, 2014.
- Defining Fuel Treatments Success: Workflows, Metrics, and Evaluation. Co-host of workshop at the Large Wildland Fires Conference, Missoula, MT, May 19-23, 2014.
- Oregon state BLM westside WFDSS Training. Medford, Roseburg, Salem, OR, May 29th, 30th, June 3rd, 2014.

- Payette NF Leadership Team and Fire Management WFDSS training. McCall, ID, April 9th, 2014
- S590, Advanced Fire Behavior Interpretation, Tucson, AZ, March 10-21, 2014
- S495, Geospatial Fire Analysis, Interpretation, and Application, taught winter/spring, online & Tucson, AZ, 2014/2015.
- Rx510, Advanced Fire Effects, Tucson, AZ, Jan. 13-17, 2014.
- S520, Advanced Incident Management, Tucson, AZ, Feb. 23-March 1, 2014
- S620, Area Command, Tucson, AZ, Feb. 23-March 1, 2014.
- National Fire Management Leadership, Tucson, AZ, March 24-28, 2014.
- S482, Advanced Fire Management Applications, Boise, Idaho, Oct. 21-23, 2014.
- S390, Introduction to Wildland Fire Behavior Calculations, Boise, ID, Nov. 18-22, 2014.
- Northern Rockies Fire Behavior Workshop, Missoula, MT, April 29-May 1st, 2014.
- Facilitated recording and posting of S490 pre course workshop to online format for current and future student viewing.
- Facilitated recording and posting of Large Fire Conference (Missoula, MT, May 2014) presentations to online format for current and future practitioner viewing.

Publications

- Baily, A., Meyer, N., and Butler, B. 2014. *Data Sharing Leads to Powerful Tools for Fighting Fire*. Emergency Management, Dec. 3rd, 2013. <http://www.emergencymgmt.com/disaster/Data-Sharing-Tools-Fighting-Fire.html>
- Noonan-Wright, E., Vaillant, N. and A. Reiner. 2014. *The Effectiveness and Limitations of Fuel Modeling using FFE-FVS*. Forest Science 60 (2): 231-240.
- Vaillant, N., Reiner, A. and E. Noonan-Wright. 2013. *Prescribed fire effects on field-derived and simulated forest carbon stocks over time*. Forest Ecology and Management (310):711-719.
- NWCG Fire Behavior Field Reference Guide, RDA as Co-Sponsor, <http://www.fbfrg.org/>