

Barriers to Implementation of Risk Management for Federal Wildland Fire Management Agencies in the United States

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Abstract

In this presentation we review progress towards the implementation of a risk-based management framework for U.S. Federal wildland fire policy and operations. We first describe new developments in wildfire simulation technology that catalyzed the development of risk-based decision support systems for strategic wildfire management. These systems include new analytical methods to measure wildfire risk to human and ecological values and to inform fuel treatment investment strategies at national, regional, and local scales. Application of risk assessment to support wildfire incidents has been dramatically advanced with the Wildland Fire Decision Support System and allowed policy modifications that encourage management of incidents for multiple objectives. The new wildfire risk management tools we discuss provide Federal agencies in the U.S. the ability to integrate risk-informed approaches to a wide range of wildfire management responsibilities and decisions. While much progress has been made, there remain several barriers that need to be addressed to fully integrate risk science into current wildfire management practices. We conclude by identifying five primary issues that, if properly addressed, could help public land management better realize the opportunities and potential payoffs from fully adopting a risk management paradigm.

1. Introduction

Over the last 10 years, unprecedented wildland fire activity in the United States has increased suppression expenditures and resulted in significant ecological and financial damage to public and private resources (e.g., Calkin et al. 2008; Prestemon et al. 2008). U.S. Federal agencies with wildland fire responsibilities have seen increasing portions of

their budgets consumed by fire management expenditures, challenging their ability to fulfill a wide range of other resource management functions. In a recent joint statement to Congress, five former U.S. Forest Service Chiefs stated that the practice of borrowing funds for wildfire management from other programs has disrupted planning and severely impacted accomplishments (Peterson et al. 2008). Numerous reports by budgetary oversight agencies such as the U.S. Government Accountability Office (GAO) and the Office of Inspector General (OIG) have been critical of the U.S. Forest Service (responsible for approximately 70 percent of federal wildfire suppression expenditures) due to the agency's inability to justify investments with quantifiable outcomes (see for example US GAO 2009).

In response, the U.S. Forest Service has ramped up investments in tools, technology, and research to implement risk-based wildfire management practices that consider the benefits of management action (or inaction) relative to the impacts on short- and long-term wildfire risk (see for example: <http://www.wfmrda.org/nfdsc.php>). Current wildland fire management policy states that, "sound risk management is a foundation for all fire management activities" (Fire Executive Council 2009). Managing fire risk involves analyzing both exposure and effects (i.e., likelihood of wildfire causing potential beneficial or negative effects), and then developing appropriate management responses to reduce exposure and/or mitigate adverse effects (Kerns and Ager 2007; Fairbrother and Turnley 2005; Finney 2005). Assessing wildfire risk on wildlands in the U.S. requires the simultaneous consideration of multiple human and ecological values, including public/firefighter safety, homes and other private structures, energy infrastructure, habitat for threatened and endangered species, and cultural resources.

2. Wildfire Risk Assessment Tools

Wildfire simulation models are being widely used by fire and fuels specialists in the U.S. to support tactical and strategic decisions related to the mitigation of wildfire risk (Andrews et al. 2007, McDaniel 2009). Recent advances in fire behavior modeling, geospatial analysis, remote sensed biophysical data sets (e.g., LANDFIRE (Department of Interior Geological Survey 2009)), weather and climate forecasting, coupled with the internet has made information sharing and decision support more possible. Outputs from wildfire simulation models have been coupled with geospatial identification of human and ecological values to build risk-based decision support systems (Calkin et al. 2010, Calkin et al. in review). The result has been a rapid advance in the application of risk analysis across a full range of wildfire management activities, from the individual fuel treatment project (Ager et al. 2007) to national interagency budgeting (Fire Program Analysis 2010).

While numerous wildfire risk models have been proposed and applied over the years a formal definition of quantitative wildfire risk assessment incorporates three major elements: 1) Estimation of the probability of fire and intensity through landscape scale fire simulation modeling; 2) Spatial identification of the resources that may experience value change due to fire; and 3) Estimation of resource value change in response to fire intensity level (Finney 2005).

Three emerging wildfire risk assessment tools address different aspects of the fire management problem: 1) Rapid Assessment of Values At Risk (RAVAR) (incident strategic support); 2) ArcFuels (project level fuels management planning); and 3) the

National Wildfire Hazard and Risk Assessment (programmatic budgeting). These tools share this common risk assessment framework and leverage and/or build off of existing tools such as the Forest Vegetation Simulator, Farsite, FSPro, and FlamMap.

3. Current Barriers to Risk-Based Decision Making

Despite the advances in wildland fire risk assessment, there are several remaining institutional and socio-political barriers that will need to be addressed to fully realize the power of risk-based wildfire management. We have identified four primary issues that if properly addressed could help the agencies better realize the opportunities and potential payoffs from fully adopting a risk management paradigm.

1. Incentives faced by land and fire managers in wildland fire situations

A number of studies (Donovan and Brown, 2005 and 2007, and Thompson et al. in review) have identified the potential misalignment of incentives faced by wildfire managers. Selection of less aggressive wildfire management strategies may be constrained by intense social and political pressures as well as concern regarding the agency's support for managers who experience unintended consequences under less than full suppression strategies. Pressures faced by managers to select aggressive, and possibly expensive, strategies do not appear to be counteracted through pressure to avoid unnecessary expenditures of federal taxpayer dollars. That is, the cost of utilizing additional suppression resources is born by the Agency as a whole through the national suppression cost pools with only limited impact to local managers responsible for developing wildfire strategies. These incentives may encourage suppression expenditures in excess of the social welfare maximizing level for the U.S. public as a whole (Thompson et al. in review; Donovan and Brown 2007, 2005).

2. Goals within resource and fire management plans

Objectives for managing a single fire and/or fire on the landscape are defined within the land and fire management plans. Limited scientific understanding of how aggressive fire suppression response transfers risk to future periods along with local socio-political influences on fire management decisions may result in land and fire management plans that do not sufficiently consider the role of individual fires in achieving broader scale land management goals (Doane et al. 2006). Additionally, the planning process has placed multiple, potentially competing, goals on much of the landscape. When natural processes such as wildland fire conflict with one or more of these goals in the near term, management response tends towards aggressive suppression with limited consideration of the longer term effects to the resource values represented on the landscape. That is, short-term objectives within fire management plans that describe how wildfires under certain conditions should be managed may not align with the long-term desired future conditions described within the land management plans.

3. Risk management training

Application of risk management concepts requires training for both those charged with developing and implementing fire management strategies and their supervisors responsible for reviewing major strategies and individuals' performance. To our knowledge there is no formal risk management training offered within existing U.S. Interagency fire training programs or for line-officer career development. Leadership will

need to recognize that high-impact, hard-to-predict, and rare events will likely occur and those events must be evaluated based on how decision makers evaluated and addressed the risk inherent in the event, not the final outcome. There is also a lack of risk assessment training in the land management staff as well, especially in the fuel treatment planning process.

Appropriate risk management requires considerations of both negative and beneficial consequences to resources. Beneficial consequences could include both resource condition improvement and future risk reduction through reduced fuel levels. Prior to 2009 U.S. Federal policy reinterpretation (Fire Executive Council 2009), beneficial effects of wildfires managed under suppression were not allowed to be considered when developing management strategy. Therefore, it would not be surprising for managers to have limited understanding of and ability to quantify beneficial fire effects.

4. Socio-political influences

Public expectations regarding the role of federal agencies in fire management are evolving; however, there may be a long way to go until a majority of the public understands and accepts a risk management paradigm. Recent studies highlight the complexities of dealing with wildfire and the public. Canton-Thompson et al. (2008) found that many of the incident management team (IMT) members interviewed saw themselves as pulled in two ways. They saw residents of the wildland urban interface (WUI) as often not understanding the complexities of firefighting and, therefore, often demanding full suppression of fire events. However, once the fire was over, other entities such as government oversight agencies, want to know why less aggressive strategies weren't used. Socio-political influences are not limited to public perceptions, but also the need for U.S. Federal managers to cooperate with local and state governmental partners.

4. Discussion and Concluding Remarks

A variety of challenges will need to be addressed to fully realize the potential of risk-based decision making to improve the ecological and financial health of public land agencies. Beyond the institutional and socio-political barriers to broad acceptance of the risk management paradigm, there remain myriad sources of scientific uncertainty challenging wildfire risk analysis. The challenges to fully implementing the current suite of models can be grouped into four categories: 1) temporal considerations are not evaluated within the risk framework upon which these models are based (see equation 1); for example increased future fire risk due to aggressive suppression that reduces the size of an ongoing fire is not considered within the existing suite of tools, 2) the effects of wildfire on many natural resource values depends on the location and spatial pattern of the values; these highly valued natural resources are defined and managed at local scales, making large scale assessments challenging, 3) estimating expected change in resource condition is difficult due to scientific uncertainty regarding resource response and confounding spatial and temporal considerations (Keane et al. 2008), and 4) substantial uncertainty remains regarding relative social preferences for non-commensurate resources (e.g. the value of a recreation area compared to wildlife habitat), and the state of non-market valuation is ill-equipped to incorporate price-based approaches within wildfire risk analysis (Venn and Calkin 2009). Though these challenges are substantial, a thorough review of scientific research needs is beyond the scope of this paper (see for example Thompson et al. in review(b)). In the future, resource scientists could synthesize extant challenges and identify

opportunities for the wildfire research community. In the preceding chapter we focused specifically on barriers to acceptance of a risk paradigm, not barriers to risk analysis themselves.

Despite these known scientific limitations, the challenges described within this paper primarily focus on the current environment in which fire managers operate; specifically a misaligned incentive structure, a lack of formal education in risk management, and (perhaps) excessive socio-political influence. It is our contention that by thoughtfully considering the recommendations introduced in this paper in order to better our ability to use developing risk-based frameworks, the U.S. Forest Service and other Federal agencies will be better able to effectively and efficiently manage wildfire. Improved understanding and management of risk is important across the range of fire management activities. For instance, ArcFuels and the National Wildland Fire Hazard and Risk Assessment provide opportunities to explore risk management concepts within a land management planning environment to develop background knowledge that could translate into better suppression decisions on active wildfires.

The recent development and application of wildfire risk models has been an important step in the agencies demonstrating their commitment to improved decision making. In 2009 the GAO published a report titled: “Federal Agencies Have Taken Important Steps Forward, but Additional Action Is Needed to Address Remaining Challenges” (US GAO 2009). One of the important steps highlighted was the success of the Wildland Fire Decision Support System (WFDSS) in enhancing the decision-making response to wildland fire through improved analytical tools and guidance to managers. Improved information delivery using risk-based frameworks has the potential to improve wildfire response; however, the suppression strategy is ultimately the responsibility of the local line officer and fire manager. Achieving the full potential of risk-based management will require that U.S. Federal agencies engage in a continuous improvement process with focus on the guidance, training and support for decision makers, as well as enhanced communication with partners and the affected community.

Citations

- Ager, A.A., Finney, M.A., Kerns, B.K., Maffei, H. 2007. Modeling wildfire risk to northern spotted owl (*Strix occidentalis cuariana*) habitat in Central Oregon, USA. *Forest Ecol. Manag.* 246: 45-56.
- Andrews, P.L., M.A. Finney, M. Fischetti. 2007. Modeling wildland fires. *Scientific American.* 297(2): 32-39.
- Calkin, D., A. Ager, J. Gilbertson-Day, J. Scott, M. Finney, C. Schrader-Patton, T. Quigley, J. Strittholt, J. Kaiden. 2010. Wildland Fire Risk and Hazard: Procedures for the First Approximation. RMRS-GTR-235. 62 p.
- Calkin, D.E., M.P. Thompson, M.A. Finney and K.D. Hyde. In Review. A real-time risk-assessment tool supporting wildland fire decision-making. *Interfaces.*
- Calkin, D., Jones, G., and K. Hyde. 2008. Nonmarket Resource Valuation in the Postfire Environment. *Journal of Forestry* 106(6): 305-310.
- Canton-Thompson, J., Gebert, K., Thompson, B., Jones, G., Calkin, D., and G. Donovan. 2008. External human factors in incident management team decisionmaking and their effects on large fire suppression expenditures. *Journal of Forestry* 106(8): 416-424.

- Doan, D., J. O'Laughlin, P. Morgan and C. Miller. 2006. Barriers to wildland fire use: a preliminary problem analysis. *International Journal of Wilderness*, 12: 36-38.
- Donovan, G.H., and T.C. Brown. 2007. Be careful what you wish for: the legacy of Smokey the Bear. *Frontiers in Ecology and the Environment* 5(2): 73-79.
- Donovan, G.H., and T.C. Brown. 2005. An Alternative Incentive Structure for Wildfire Management on National Forest Land. *Forest Science* 51(5): 387-395.
- Fairbrother, A., Turnley, J.G., 2005. Predicting risks of uncharacteristic wildfires: application of the risk assessment process. *Forest Ecology and Management* 211, 28-35.
- Finney, M.A. 2005. The challenge of quantitative risk assessment for wildland fire. *Forest Ecol. and Mgt.* 211: 97-108.
- Fire Executive Council. 2009. Guidance for Implementation of Federal Wildland Fire Management Policy. <http://www.nifc.gov/policies/guidance/GIFWFMP.pdf> Last Accessed May 28, 2010.
- Fire Program Analysis. 2010. Fire Program Analysis website. <http://www.fpa.nifc.gov/> Last accessed April 12, 2010.
- Keane, R.E., Agee, J.K., Fule, P., Keeley, J.E., Key, C., Kitchen, S.G., Miller, R., and L.A. Schulte. 2008. Ecological effects of large fires on US landscapes: benefit or catastrophe? *International Journal of Wildland Fire* 17: 696-712.
- Kerns, B., Ager, A.A. 2007. Risk assessment for biodiversity in Pacific Northwest forests. *Forest Ecology and Management* 246: 38-44.
- McDaniel, J. 2009. The Emergence and Potential of New Wildfire Risk Assessment Tools. Wildland Fire Lessons Learned Center. Fall 2009. <http://www.wildfirelessons.net/Additional.aspx?Page=285>
- Peterson, R.M., Robertson, F.D., Thomas, J.W., Dombeck, M.P., and D.N. Bosworth. 2008. Statement of R. Max Peterson, F. Dale Robertson, Jack Ward Thomas, Michael P. Dombeck, and Dale N. Bosworth, Retired Chiefs of the Forest Service, on the FY2008 Appropriation for the U.S. Forest Service. Available at: <http://www.arboday.org/replanting/firechiefs.cfm>. Last accessed 05 November 2009.
- Prestemon, J.P., Abt, K., and K. Gebert. 2008. Suppression Cost Forecasts in Advance of Wildfire Seasons. *Forest Science* 54(4): 381-396.
- Thompson, M.P, D.E. Calkin and M. Finney. In Review). A risk-based premium approach to wildland fire finance and planning. *Forest Science*.
- US General Accounting Office (GAO). 2009. Wildland Fire Management: Federal Agencies Have Taken Important Steps Forward, but Additional Action Is Needed to Address Remaining Challenges. GAO-09-906T. Washington D.C. July 21, 2009.
- Venn, T.J., and D.E. Calkin. 2009. Challenges of Socio-economically Evaluating Wildfire Management on Non-industrial Private and Public Forestland in the Western United States. *Small-scale Forestry* 8: 43-61.