Optimal Fire and Fuels Management

Highlight Contacts

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Relation to Strategic Plan

The work reported here is primarily related to Portfolio C: Social fire science, Element C2: Socioeconomic aspects of fire and fuels management but is also relevant to Portfolio D: Integrated fire and fuels management research.

Background

Record suppression costs have led to a multitude of fire cost reviews and cost studies by oversight agencies, and new rules and regulations. One of the most important and elusive issues in fire management is defining the "best" amount of fuel treatments to apply to a forested landscape. Research is developing tools and information that address a wide variety of issues related to fire suppression costs and fuels management.

Tools have been developed to address a variety of fire suppression costs and fuels management issues.

Approach

Scientists have addressed several issues related to fire suppression costs: developing cost indices for gauging performance in cost containment, evaluating crew costs, developing models to optimize deployment of suppression resources, evaluating estimates of fire size and suppression costs, and developing short-term and long-term forecasts of suppression costs.

Several studies have developed models for evaluating and optimizing fuel treatments. One study incorporates fuel treatment into a stand-level model to determine planting density, timing and intensity of fuel treatment, and rotation that maximize net discounted value. The model not only includes product values and costs measured at the time of treatment but also the value of damage reduction if a fire occurs after fuel treatment. This is important because a valuation that does not include the expected value of damage reduction will underestimate the economic value of fuel treatment and distort the prioritization of fuel treatment projects. Another fuel treatment study incorporates data on forest resources, meteorology, fire occurrence, and economic impacts into a probabilistic modeling framework to build a state-of-the-science assessment of prescribed burning efficacy in Florida. The capstone analysis, applied to Volusia County in Florida, defines the optimal prescribed burning regime for a range of potential fire scenarios.

Computer analysis systems (MAGIS and MAGIS eXpress) have been developed that incorporate multiple objectives and optimize landscape level, spatial schedules of fuels treatments. MAGIS and MAGIS eXpress have been used to address trade-offs among various fuel-treatment goals for the protection of property, human life, wildlife, and hydrology. An additional project is predicting available biomass from fuel and treatments, costs to deliver this biomass to markets, and comparing net quantities of greenhouse gases and particulate matter produced if this biomass is used for energy as opposed to disposal by burning onsite and using fossil fuels to produce the equivalent useable energy.

Products and Tools

A stratified cost index (SCI) was developed to compare the costs of large fires. The SCI is being used by the Forest Service and (tested by the Department of the Interior [DOI]) as a performance measure for suppression cost containment; by Fire Program Analysis; and is being tested for use in wildland fire decision support system (WFDSS).

MAGIS and MAGIS eXpress are “deployed” via an Rocky Mountain Research Station Web site (http://www.fs.fed.us/rm/econ/magis/).

Results and Applications

A study of fire suppression crew costs showed that agency crews are less costly than contract crews, although agency crew costs differ widely. An assessment of the past accuracy of wildland fire situation analyses found that fire size and suppression cost estimates are systematically biased. These results have been useful in training fire managers.

A system for projecting annual suppression expenditures for the Forest Service throughout a fire season has been used by the Forest Service in meeting antideficiency regulations with regard to fire suppression expenditures and is also being implemented for the DOI agencies with fire suppression responsibilities. Procedures are being developed for making long-term suppression cost forecasts that could be used in the fire suppression budgeting process. A collaborative study of long-term climate and cost trends showed that suppression costs are closely correlated with weather conditions and that although total suppression costs have been rising in recent years, suppression costs expressed on a per-acre basis have not been increasing.

For loblolly pine (*Pinus taeda* L.) in the Southern United States, the optimal levels of fuel treatment and rotation age were found to increase as fire risk increases. The expected economic gain from fuel treatment increases with fire risk and is four times the value of the stand without fuel treatment when annual fire risk is 4 percent per year. We also evaluated two kinds of financial incentives for fuel treatment: compensating landowners for the cost of fuel treatment and requiring landowners to share the cost of fire suppression. We found that cost-sharing of fire suppression is more effective at reducing total social cost than cost sharing of fuel treatment.

A Florida study demonstrated that increasing the prescribed burning program from the current annual 4 to 5 percent of forests to 13 percent annually result in economic gains. The results also define broader policy and program implications such as (1) expanding the supply of fuel treatment services could have a great effect on managers' ability to meet goals, (2) optimal policies depend heavily on potential fire severity in addition to area, and (3) when public land managers use private sector services to prescribe burn, they drive the cost of these services higher for private forests, an unintended consequence that reduces fuels management on private lands. This study provides a methodological breakthrough and demonstrates a complete cost-benefit analysis of a fuels treatment program.

Awards and Recognition

Chief's award for excellence in budget and financial accountability, for fire suppression forecasting, 2003.

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Key Partners

Forest Service Washington office Fire and Aviation Management; Department of the Interior; Boise Wildland Fire Research and Development Unit; Scripps Institute, University of California at San Diego; University of Montana; Washington State University; National Forest Systems (regional offices and national forests)

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Additional Readings

Amacher, G.S.; Malik, A.S.; Haight, R.G. 2005. Not getting burned: the importance of fire prevention in forest management. Land Economics. 81: 284–302.

Amacher, G.S.; Malik, A.S.; Haight, R.G. 2006. Reducing social losses from forest fires. Land Economics. 82: 367–383.

Butry, D.T.; Mercer, D.E.; Prestemon, J.P.; Pye, J.M.; Holmes, T.P. 2001. What is the price of catastrophic wildfire? Journal of Forestry. 99: 9–17.

Calkin, D.E.; Gebert, K.M.; Jones, J.G.; Neilson, R.P. 2005. Forest Service large fire area burned and suppression expenditure trends, 1970-2002. Journal of Forestry. 103(4): 179–183.

Donovan, G.H. 2005. A comparison of the costs of Forest Service and contract fire crews. Western Journal of Applied Forestry. 20(4): 233–239.

Donovan, G.H. 2006. Determining the optimal mix of federal and contract fire crews: a case study from the Pacific Northwest. Ecological Modeling. 194: 372–378.

Donovan, G.H. 2007. Comparing the cost of contract and agency fire crews. Fire Management Today. 67(1): 9–12.

Donovan, G.H.; Noordijk, P. 2005a. A comparison of wildland fire situation analysis (WFSA) predictions and actual outcomes. Fire Management Today. 65(2): 25–27.

Donovan, G.H.; Noordijk, P. 2005b. Assessing the accuracy of wildland fire situation analysis (WFSA) fire size and suppression cost estimates. Journal of Forestry. 103(1): 10–13.

Gebert, K.M.; Calkin, D.E.; Yoder, J. 2007. Estimating suppression expenditures for individual large wildland fires. Western Journal of Applied Forestry. 22(3): 188–196.

Gebert, K.M.; Schuster, E.G. [In press]. Forest Service fire suppression expenditures in the Southwest. In: Narog, M.G., tech. coord. Proceedings of the 2002 fire conference on managing fire and fuels in the remaining wildlands and open spaces of the Southwestern United States. Gen. Tech. Rep. PSW-189. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station.

Haight, R.G.; Fried, J.F. [In press]. Deploying wildland fire suppression resources with a scenario-based standard response model. INFOR: Information Systems and Operational Research.

Hyde, K.; Jones, J.G.; Silverstein, R.; Stockmann, K.; Loeffler, D. 2006. Integrating fuel treatments into comprehensive ecosystem management. In: Andrews, P.L.; Butler, B.W., comps. Fuels management—how to measure success: conference proceedings. Proceedings RMRS-P-41. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 549–561.

Jones, G.; Chew, J.; Silverstein, R.; Stalling, C.; Sullivan, J.; Troutwine, J.; Weise, D.; Gardwood, D. [In press]. Spatial analysis of fuel treatment options for chaparral on the Angeles National Forest. In: Narog, M.G., tech. coord. Proceedings of the 2002 fire conference on managing fire and fuels in the remaining wildlands and open spaces of the Southwestern United States. Gen. Tech. Rep. PSW-189. Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station.

Loeffler, D.; Calkin, D.E.; Silverstein, R.P. 2006. Estimating volumes and costs of forest biomass in Western Montana using forest inventory and geospatial data. Forest Products Journal. 56(6): 31–37.

Mercer, D.E.; Prestemon, J.P.; Butry, D.T.; Pye, J.M. 2007. Evaluating alternative prescribed burning policies to reduce net economic damages from wildfire. American Journal of Agricultural Economics. 89(1): 63–77.

Prestemon, J.P.; Mercer, D.E.; Pye, J.M.; Butry, D.T.; Holmes, T.P.; Abt, K.L. 2001. Economically optimal wildfire intervention regimes. Paper presented at the American Agricultural Economics Association annual meeting. Chicago, IL: American Agriculture Association. 18 p.

Prestemon, J.P.; Pye, J.M.; Butry, D.T.; Holmes, T.P.; Mercer, D.E. 2002. Understanding broad scale wildfire risks in a human-dominated landscape. Forest Science. 48(4): 685–693.

Silverstein, R.P.; Loeffler, D.; Jones, J.G.; Calkin, D.E.; Zuuring, H.R.; Twer, M. 2006. Biomass utilization modeling on the Bitterroot National Forest. In: Andrews, P.L.; Butler, B.W., comps. Fuels management–how to measure success: conference proceedings. Proceedings RMRS-P-41. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 673–688.

Troutwine, J.M. 2005. Forest fuel management: a spatial decision-support system developed by Rocky Mountain Research Station provides forest managers with the tools to effectively remove a build-up of fuels while adhering to principles of ecological multiple-use forest management and responding to public interests. Geospatial Solutions: 22–27.

Zuuring, H.; Troutwine, J.M.; Jones, J.G.; Sullivan, J. 2005. Decision support models for economically efficient integrated forest management. Proceedings: 2005 ESRI international user conference. [Place of publication unknown]: [Publisher unknown]. 22 p.