United States
Department
of Agriculture

Forest Service

**Rocky Mountain
Research Station**

General Technical
Report RMRS-GTR-187

May 2007

Accomplishing and Applying National Fire Plan Research and Development From 2001-2005

A Summary of Critical Fire Research Findings and New Tool Developments in Four Key Areas:

- ❖ Firefighting Capacity
- ❖ Rehabilitation and Restoration
- ❖ Hazardous Fuel Reduction
- ❖ Community Assistance

National Fire Plan research is working with fire managers to improve fire management through tools and models developed to predict activities such as: wildfire behavior, intensity, and effects; smoke transport; and fire-weather forecasting. Results of this research are helping managers and national forest personnel to: fight fires efficiently, increase firefighter safety, plan and conduct prescribed burns, and reduce wildfire damage to natural resources and society.

Baldwin V. Clark, Jr., ed. 2007. **Accomplishing and applying National Fire Plan research and development from 2001–2005**. General Technical Report RMRS-GTR-187. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 46 p.

Abstract

This report highlights selected accomplishments achieved by USDA Forest Service National Fire Plan Research and Development projects from 2001 through 2006. The projects highlighted here are examples of the broad range of knowledge and tools developed by the National Fire Plan Research and Development, beginning in 2001.

Author

V. Clark Baldwin, Jr. is the retired National Program Leader for Silviculture Research, U.S. Department of Agriculture, Forest Service, Washington Office.

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Accomplishing and Applying National Fire Plan Research and Development From 2001-2005

A Summary of Critical Fire Research Findings and New Tool Developments in Four Key Areas

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"The decision support tools that you are working on regarding fire, fuels, and aquatic resources are exactly what forest managers are looking for to make better decisions and to identify both short- and long-term benefits and risks… Your research is making forest managers think before just going out and treating vegetation and fuels—so that we are able to answer the vital questions like: Why here? Why now?"

John Thornton, Forest Hydrologist
Boise National Forest

Commenting on Rocky Mountain Research Scientists Bruce Rieman, Charlie Luce, and Kerry Overton's National Fire Plan Research and Development findings on fire's role in aquatic ecosystems within northern Rocky Mountain streams.

Contents

Acknowledgments

The Forest Service National Fire Plan Team Leaders featured in this report were the primary authors of this publication. We thank all of these people—and their research teams—for the research projects summarized here. Clark Baldwin compiled, reviewed and edited text to produce the final document. Substantial writing, editing, and technical fire science expertise contributions were also made by Susan Conard, Michael Hilbruner, and Paul Keller. We thank Nancy Chadwick for design and layout and Lane Eskew for overall document editing.

1. Background

This report highlights selected accomplishments achieved by USDA Forest Service National Fire Plan Research and Development projects beginning in 2001. These highlights are illustrative of the broad range of knowledge and tools developed by the National Fire Plan Research and Development.

Today, the National Fire Plan—initiated in great part in response to the devastating 2000 fire season—continues to support these vital fire management and fire research activities for the benefit of land managers and policymakers in their ongoing stewardship of our public lands.

These fire research activities benefit land managers and policymakers in their ongoing stewardship of our public lands.

Our country's recent severe fire seasons—*and the potential for more*—have reinforced this essential need for:

- An aggressive and coordinated management response;
- The science needed to support this response; and
- More knowledge regarding fuel conditions that predispose landscapes to large, uncharacteristically destructive wildfires.

National Fire Plan Research Projects Occur in All 50 States

National Fire Plan-funded research and development work continues to be conducted in all 50 states. Forest Service research scientists continue their work to:

- Establish new agreements with universities and other research partners;
- Produce decision-analysis tools;
- Provide training; and
- Transfer new information and technologies to managers, policymakers, and the public through web sites, field tours, presentations, and other means.

National Fire Plan Continues to Support Wildland Fire Management

The **National Fire Plan**, developed in August 2000 in response to escalating wildland fire—especially the landmark 2000 fire season—continues to address and respond to severe wildland fires and their impacts on communities and resources, while simultaneously ensuring sufficient firefighting capacity for the future.

To most effectively accomplish this necessary original purpose and objective, the **National Fire Plan** continues to address four key significant areas:

1. Firefighting Capacity,
2. Rehabilitation and Restoration,
3. Hazardous Fuel Reduction,
4. Community Assistance and Accountability.

At the completion of its fifth year, the **National Fire Plan** is providing invaluable technical, financial, and resource guidance and support for wildland fire management across the United States by:

1. Assuring that necessary firefighting resources and personnel are available to respond to wildland fires that threaten lives and property;
2. Conducting emergency stabilization and rehabilitation activities on landscapes and communities affected by wildland fire;
3. Reducing hazardous fuels (dry brush and trees that have accumulated and increase the likelihood of unusually large, severe fires) across this country's forests and rangelands;
4. Providing assistance to communities that have been—*or could be*—threatened by wildland fire; and
5. Committing to the Wildland Fire Leadership Council, an executive-level interagency team created to set and maintain high standards for wildland fire management on public lands.

A Wide Spectrum of Research Products and Accomplishments

The Forest Service's **National Fire Plan Research and Development Program**—initiated in 2001—continues to meet this program's original goals and objectives by exhibiting a wide spectrum of research products and accomplishments. This report highlights an array of these science-based projects—summarizing their tools and vital new knowledge—that Forest Service research scientists are providing land managers and policymakers. As illustrated in specific detail in this report, these researchers' efforts are leading to improvements in firefighter capabilities and capacities, rehabilitating and restoring ecosystems, reducing hazardous fuels, and assisting communities.

Forest Service Fire Research Addresses Crucial Needs in the Four Key National Fire Plan Focus Areas

Guided by the strategic goals outlined in the National Fire Plan and the *10-year Comprehensive Strategy and Implementation Plan,* fire research continues to actively address crucial needs in these four key areas:

Firefighting Capacity

Provide better models of weather, fire behavior, smoke and other tools for improving firefighter decisions.

Hazardous Fuel Reduction

Develop improved analysis tools for determining the effects and economic tradeoffs of treatments intended to reduce fire risk by removing hazardous fuels (combustible forest materials).

Rehabilitation and Restoration

Provide rapid response information and models to help restore landscapes and protect communities from the aftereffects of fire.

Community Assistance

Work with communities to understand their needs and priorities, develop new approaches and materials for education, and recommend acceptable approaches to ensure adequate community protection from wildfire.

Fire Research Provides: Significant New Information, Products, and Tools

As discussed in this report, significant new information, products, and tools from Forest Service Fire Research projects are helping:

- Communities—as well as individual homeowners—to better understand what actions can be taken to reduce wildland fire risk.
- Wilderness managers better predict where to allow fires to burn naturally *without* causing severe ecosystem damage or hazard to communities.
- Aquatic biologists build our understanding of the impacts of fire and fuel treatments on aquatic systems and fish populations.
- Managers to better determine the short and long-term benefits and risks of fuel treatments on ecosystems, and aquatic and air resources.

This report's National Fire Plan research project summaries illustrate the science-based knowledge and tools that are being provided to this country's land managers.

II. Introduction

As illustrated in this report's research project summaries, science-based knowledge and tools developed by National Fire Plan Research and Development are being used by this country's land managers to:

- Better predict potential fire hazard, fire growth, and smoke impacts;
- Evaluate fire behavior and fire severity more accurately and rapidly;
- Improve planning for post-fire rehabilitation;
- Better understand the effects of fuel treatments on fire behavior; and
- Evaluate the economic costs and benefits of fuel treatments and alternative forest products.

This new National Fire Plan-generated research information and associated tools also help our:

- Communities and homeowners better understand what can be done to reduce wildland fire risk,
- Wildland managers understand how to best work with these communities in collaborative planning efforts,
- Wilderness managers to better predict where fires can be allowed to burn naturally *without* causing severe ecosystem damage or hazards to communities, and
- Scientists better understand the impacts of fire and fuel treatments on aquatic systems and fish populations.

III. Summary Accomplishments in the Four Key Research and Development Areas

Section One

Firefighting Capacity

Highlight Projects

Firefighting Capacity Accomplishments

Section One
Firefighting Capacity

1. Fire Consortia for Advanced Modeling of Meteorology and Smoke-Enhancing Firefighting Capability and Preparedness

Providing the Difference Between Disaster and Success

"The Eastern Area Modeling Consortium team breaks down theories and 'what-ifs' into hard facts and 'what's next' for those of us in the field. When fighting wildland fires, the information they provide can make the difference between disaster and success."

Gary Curcio, Fire Staff Specialist
North Carolina Division of Forest Resources

Didn't Believe It Until I Saw It

"The RMC (Rocky Mountain Center) model did a superior job of catching both thunderstorm activity and, somewhat surprisingly, RH during the last two weeks in July. For whatever reason, [your] model crushed all competitors during this time frame…It also correctly identified areas where thunderstorms did not form, which is impressive in late July (and even I didn't believe until I saw it)."

Charles S. Maxwell, GACC Meteorologist
Southwest Area Predictive Services

The National Fire Plan has supported the development of five regional Fire Consortia for the Advanced Modeling of Meteorology and Smoke (FCAMMS) research centers that study the interaction of fire, smoke, and the atmosphere to develop and deliver regionally tailored, weather- and science-based decision support products for use by fire, land, and air quality managers.

Scientists working at FCAMMS integrate numerical weather simulations with both satellite and land-based observations to predict weather, fire danger, fire behavior, and smoke behavior at high resolution, operationally relevant spatial scales—in time to inform key management on-the-ground decision-making.

Continental U.S. coverage is provided by the five FCAMMS centers:

- The Southern Research Station's Southern High Resolution Modeling Consortium,

"I just wanted to compliment you on what is by far one of the best web sites dedicated to fire weather I have seen. … We are in constant need of boundary layer meteorological data. And being in our infancy as far as developing specific products in dealing with smoke management and air quality, your site really does help."

Dar Mims, Air Pollution Specialist
California Air Resources Board

"The CANSAC MM5 has proved quite valuable here at North Ops Predictive Services. Taken as a whole, we can now put more detail into our forecasts—and have more confidence in those details—than before. We no longer have to rely on just personal experience or 'rules-of-thumb' in areas where … terrain isn't resolved well by the coarser models."

John P. Snook, Program Manager
Fire Weather and Predictive Services
Redding, California

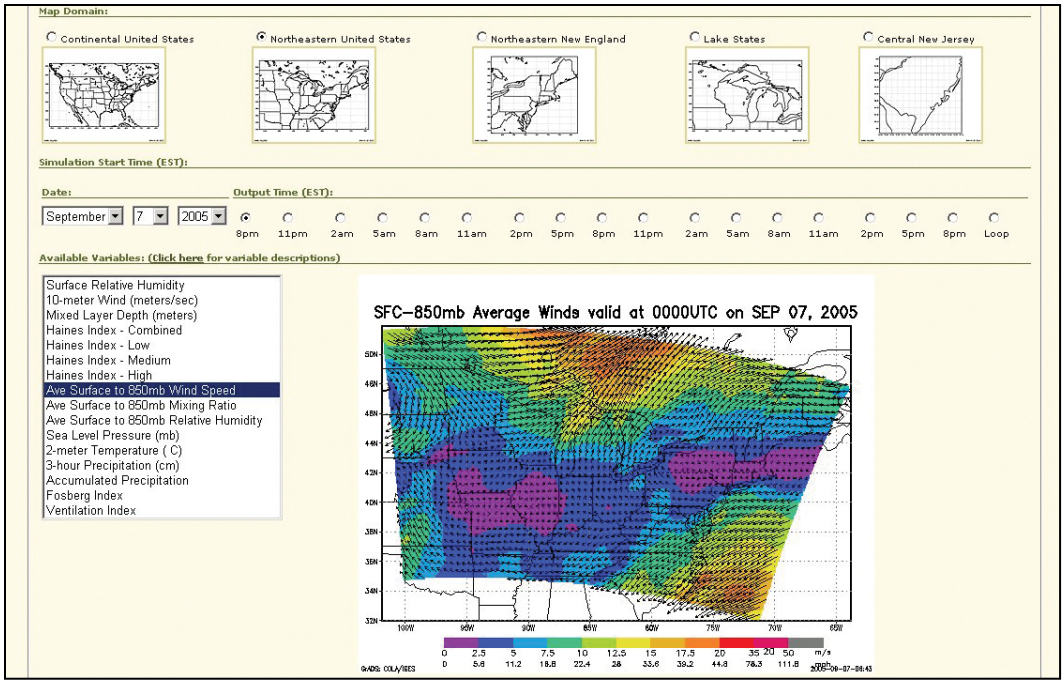

Figure 1. Daily predictions of fire-weather variables and smoke transport over different regions of the country are available from the FCAMMS web sites. The EAMC web site (above) provides users with fire-weather predictions over various spatial domains in the north central and northeastern United States.

- The Pacific Northwest's Air Fire Team and the Northwest Regional Modeling Center,
- The Northern Station's Eastern Area Modeling Consortium (EAMC),
- The Rocky Mountain Research Station's Rocky Mountain Center, and
- The Pacific Southwest Research Station and the California and Nevada Smoke Air Committee.

Providing Improved Fire Weather Predictions

Every day, the FCAMMS produce maps of weather patterns (three-dimensional temperatures and winds, precipitation, and other relevant meteorological factors) for display on the Internet.

These predictions support research in improving resolution and accuracy of smoke, fire danger, and fire behavior prediction. These improved predictions are then provided operationally to Geographic Area Coordination Centers (GACCs) and fire weather forecasters.

For example, all teams have adapted for their region the regional-scale modeling system BlueSkyRAINS, an interactive web-based tool that allows users to overlay predicted weather, smoke, and fire activity with geographic or political information.

Contacts

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2. Multidisciplinary Approach Improves Fire Behavior Prediction in New Jersey's Volatile Fuel Type

Implementing regional climate and fire danger modeling for the New Jersey Pine Barrens

The 1.1 million acres of New Jersey's Pine Barrens—dominated by pitch pine, mixed oak species, and understory shrubs—represents 22 percent of this state's entire land area. Compared with most forests in the Eastern United States, this is a highly volatile fuel type with a short fire return cycle.

Figure 2. These New Jersey tower sites have instrumentation to measure fire weather and fluxes of turbulence, energy, water vapor, and carbon dioxide.

New Jersey's wildland fire managers identified the need for an improved fire danger rating system that will enable fire managers to strategically place firefighters and machinery.

To better meet these needs, under this project, a multi-disciplinary approach is improving the existing fuel model. Scientists have coordinated with New Jersey Forest Fire Service and the New Jersey State climatologist to establish a network of Pine Barrens fire weather stations.

This project's sensitivity analysis of these fire indices is providing better decision-support tools for predicting fire danger.

Analysis of long-term (1930-present) weather records and wildfire history data indicates that wildfire occurrence in this region is largely decoupled from traditional danger and risk measurements.

This project's sensitivity analysis of these fire indices is providing better decision-support tools for predicting fire danger.

Contacts

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3. Real-Time Remote Sensing of Fire Properties Improves Firefighter Operations and Safety

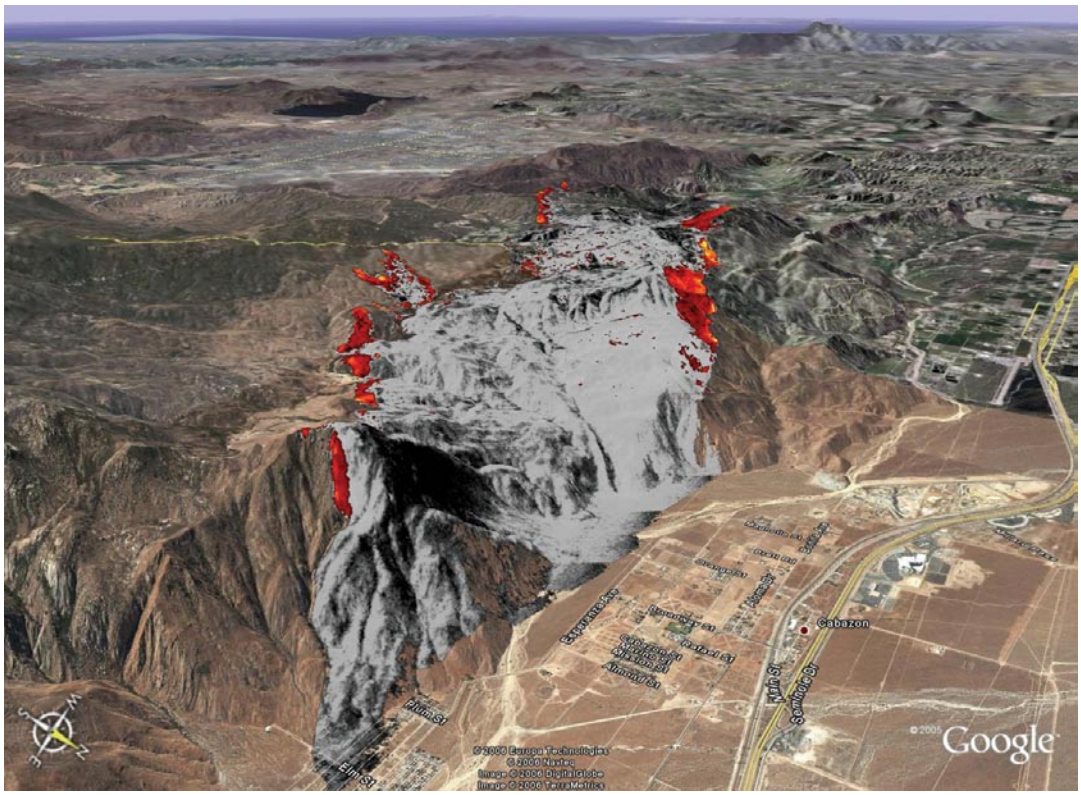

Figure 3. This image from the 2006 Esperanza Fire in Southern California shows its proximity to local communities. Gray areas have already burned; red and orange depict active burning at the time of the imagery. The Incident Command Team used fire activity maps such as this one to determine the location of multiple fire events, to prioritize deployment of firefighting resources, and to locate potential hotspots to be extinguished.

The Pacific Southwest Research Station and its partners are developing and applying the "FireMapper®" thermal-imaging radiometer for strategic fire mapping to improve fire suppression operations, firefighter safety, and our understanding of the behavior and impacts of wildland fire.

The airborne FireMapper uses new remote sensing technology to measure thermal radiation from spot fires and intense flame fronts. The resulting fire images are transmitted by satellite communications, then rapidly processed and displayed via the Internet to provide a current, detailed, and synoptic view of fire spread and related fire activity that has not previously been available to fire managers.

This new imaging is therefore providing rapid-fire intelligence to improve firefighter safety—make firefighting more effective *and* reducing wildfire damage to natural resources and society.

Contact

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4. Helping Managers Devise Effective Strategies for Managing Fire and Fuels for Wilderness and Adjacent Lands

Identifying the benefits and risks of fire improves planning

"The importance of this kind of work has been driven home to me this fall. We converted two of our fire use fires to suppression due to smoke concerns and then spent more than five million dollars putting them out."

Fire Ecologist
National Park Service

A cross-disciplinary team of biologists, ecologists, social scientists, and science delivery experts at the Rocky Mountain Research Station's Aldo Leopold Wilderness Research Institute in Missoula, MT, has been studying wilderness to determine how to best utilize fire as a cost-effective management strategy that is both socially acceptable and beneficial to natural ecosystems.

This research is weaving together both the ecological and social sciences and is focused in three areas:

1. Understanding natural fire regimes and their alteration by management,
2. Developing information and tools to improve fire and fuel management planning, and
3. Anticipating consequences of management alternatives.

Results from this research are therefore helping managers devise effective strategies for managing fire and fuels across the full spectrum of lands—extending from wilderness to the wildland-urban interface.

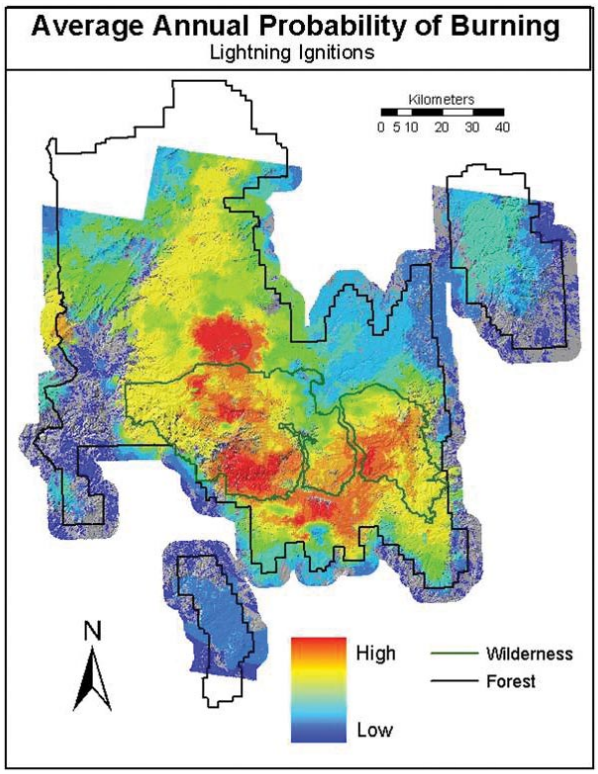

Figure 4. Map of probability of burning for New Mexico's Gila National Forest shows that some of the greatest opportunities for wildland fire use may be located outside wilderness.

Results from this research are helping managers devise effective strategies for managing fire and fuels across the full spectrum of lands.

Geospatial decision-support tools being used in this project (including BurnPro and Fire Effects Planning Framework) are helping managers incorporate Wildland Fire Use into fire management plans. BurnPro estimates the probability of burning to help identify where opportunities for Wildland Fire Use are greatest. The Fire Effects Planning Framework helps determine the expected benefits or risks of Wildland Fire Use to resources or species of concern.

Improved Public Involvement

The improved understanding of public trust and values is helping managers more effectively involve the public in fire management decisions that simultaneously meet ecological and social objectives.

For instance, managers on Montana's Bitterroot National Forest are now using a collaborative public process to plan a landscape-scale fuels treatment adjacent to wilderness in the Bitterroot Valley. Maps of "meanings" that community members attach to the Bitterroot Front's landscape are providing managers with information about site-specific social values and have helped community members articulate their values and expectations at collaborative planning meetings.

With a science-based understanding of the factors that influence fire management decisions, managers and policymakers can now work to resolve long-term barriers to fire use.

Contact
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5. Reducing Risks to Ecosystems and Human Communities

Accomplishments continue for the Southern Center for Wildland-Urban Interface Research and Information Center

Figures 5 and 6. Firewise retrofitted homes—before (left) and after (right). An interactive presentation that provides pictures and narrative about this interagency project is one feature of the new information that this research project is disseminating.

The Southern Center for Wildland-Urban Interface Research and Information Center opened in Gainesville, FL, in January 2002. The center's mission is to develop and communicate guidelines, models, and tools needed by natural resource managers, policymakers, planners, and citizens to reduce risks to ecosystems and human communities in urban and urbanizing landscapes.

To accomplish this significant mission, the center focuses on:

1. Disseminating new and existing information,
2. Serving as a clearinghouse of wildland-urban interface information,
3. Building partnerships and collaborative efforts and approaches, and
4. Facilitating and creating linkages between people interested in creating partnerships and those who have successfully done so.

The center's web site (http://www.InterfaceSouth.usda.gov) provides access to information that includes a monthly bulletin and a Wildfire Risk Assessment Guide.

This popular web site also facilitates the exchange of ideas and opportunities and links people and projects involved with wildland-urban interface issues.

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Section Two

Rehabilitation and Restoration

Highlight Projects

Rehabilitation and Restoration Accomplishments

Section Two

Rehabilitation and Restoration

6. Ensuring the Correct Native Seed Supplies Are Available to Land Managers for Burned Area Restoration

Restoring sagebrush steppe and pinyon-juniper communities

Figure 7. Yarrow and flax field in Idaho—Scientists are working to identify and characterize native species' potential for regenerating fire areas and are also developing practices for seed production and protocols for seed warehousing.

Large areas burn annually in sagebrush steppe and pinyon-juniper communities throughout the Western United States. Because of the introduction of exotic weeds—especially cheatgrass (*Bromus tectorum*)—the fire frequency and intensity in these communities has increased dramatically since presettlement times. This transition has increased the continuity and volume of fine fuels.

Native plant and animal species populations throughout these areas have therefore been diminished and, in some cases, put at risk by the combination of more frequent fires and increase of exotic weeds.

Native Plant Species Availability Is Low

Management objectives increasingly require burned areas to be restored using native plant species. The availability of these species, however, is low.

Furthermore, little information is available on what native species would work best on specific burn areas.

Scientists are therefore working to identify and characterize native species' potential for use and are also developing practices for seed production and protocols for seed warehousing.

This effort will help ensure that native seed supplies are available to land management agencies.

To date, three synthesis publications have evolved from this important project:

- *Restoring Western Ranges and Wildlands*. 2004. Rocky Mountain Research Station General Technical Report RMRS-GTR-136, 3 volumes, 884 p. +appendixes.
- *Wildland Shrubs of the United States and Its Territories: Thamnic Descriptions, Volume 1*. 2004. International Institute of Tropical Forestry and Rocky Mountain Research Station, General Technical Report IITF-GTR-26, 830 p.
- *Big Sagebrush: A Sea Fragmented into Lakes, Ponds, and Puddles*. 2005. Rocky Mountain Research Station General Technical Report RMRS-GTR-144, 210 p.

Contact

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7. Characterizing the Risks of Wildfire and Fuels Management in Aquatic Systems

Helping Forest Managers Make Better Decisions

"The decision support tools that you are working on regarding fire, fuels, and aquatic resources are exactly what forest managers are looking for to make better decisions and identify both short- and long-term benefits and risks. Your research is making forest managers think before just going out and treating vegetation/fuels so we are able to answer the questions of 'why here?' and 'why now?'."

John Thornton, Forest Hydrologist
Boise National Forest

Providing a Foundation for Forest Biologists

"I don't think it is a stretch to say that this information provides the foundation for forest biologists involved in endangered species recovery planning and consultation linked to the National Fire Plan."

Linda Ulmer, Columbia River Basin Coordinator
USDA Forest Service
Portland, OR

Significant resources are used to manage fire and fuels and to mitigate the effects of past fire suppression. At the same time, substantial resources have been invested in restoring watersheds and fostering recovery of sensitive species.

Limited information on the effects of fires and fire-related management on aquatic systems makes it difficult to determine the benefits of the substantial costs that are incurred. Scientists in central Idaho are therefore working to quantify the influence of large fires, post-fire climatic events, and post-fire management on watershed processes and the persistence of sensitive aquatic species.

This research has changed the way we view fire and its implications for aquatic systems.

Better understanding of when and where fire represents a threat to aquatic ecosystems is enhancing the managers' ability to characterize risk and prioritize fire and fuels management and post-fire rehabilitation efforts.

This research has changed the way we view fire and its implications for aquatic systems. Fire can produce catastrophic ecological effects, but it is also a source of spawning sites, nutrients, and structural diversity that can maintain aquatic community productivity.

Photo by Rodger Nelson, Payette National Forest

Figure 8. Severe wildfire can generate dramatic, immediate effects on mountain streams—as well as on the biological communities that depend upon these streams. Through this research project, scientists in central Idaho are therefore working to quantify the influence of large fires, post-fire climatic events, and post-fire management on watershed processes and the persistence of sensitive aquatic species.

The ideas and information emerging from this work have become an important resource for managers, biologists, students, and other researchers. This project's web page (http://www.fs.fed.us/rm/boise/research/fisheries/fire/workshop_products.shtml) which contains publications and various other materials, has received more than 7,000 downloads since its establishment in 2003.

Contacts

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8. Measuring the Effectiveness of Post-Fire Emergency Rehabilitation to Help Managers Select Effective Treatments

Because the effectiveness of many of these rehab methods has never been tested quantitatively, it is difficult for BAER teams to realistically assess the short- and long-term benefits.

"Results from this research have been invaluable. The research is directly applied to assessing burned area responses, estimating effectiveness of treatments at protecting values-at-risk, and appraising the cost-effectiveness of implementing treatments. These studies have improved the efficiency of BAER teams. They have benefited the general public as well as all the resources affected by fires."

Nick Gerhardt, Hydrologist
Nez Perce National Forest

Each year, after wildfire, millions of dollars are spent on emergency stabilization and rehabilitation treatments to protect life, property, and natural resources from increased erosion and flooding. Yet, because the effectiveness of many of these rehabilitation methods has never been tested quantitatively, it is difficult for Burned Area Emergency Response (BAER) teams to realistically assess the short- and long-term benefits of their prescribed treatments relative to their economic and ecological costs.

While expenditures for post-fire rehabilitation—including contour-felled logs, surface raking, and native grass seeding—have increased dramatically in recent years, little quantitative information actually exists on the effectiveness of these treatments in reducing sediment movement and water output from burned areas.

Researchers involved in this project are conducting studies to measure runoff and sediment production from watersheds that are receiving various emergency rehabilitation treatments. This information is helping managers to select future emergency treatments that are the most likely to be effective.

Essential data from this research has contributed to the web-based "Disturbed-Water Erosion Prediction Project model" and "Erosion Risk Management Tool model," both now used by BAER teams and land managers to predict erosion risk as well as the benefits of mitigation treatments after wildfire.

At the request of Forest Service national and regional BAER leaders, this project also helped to provide the treatment effectiveness monitoring strategy for the southern California BAER effort following the 2003 fires.

This study's research results have helped BAER teams determine the appropriate treatment selections.

Major Shift in Treatment Selection

Rainfall intensity has proven to be one of the most important drivers for the erosion response. Results from multiple sites with log erosion barriers indicate that although they can reduce erosion from moderate intensity storms, high-intensity rainfall overwhelms the logs' ability to slow runoff and sedimentation.

Thus, this labor-intensive treatment may not be cost effective if high-intensity storms are the major threat to downslope values. Based on these results, there has been a major shift in treatment selection in the past few years.

As a direct result of communicating this study's research results with BAER teams and specialists, the use of hillslope erosion barriers has declined and the use of mulches has increased.

Figure 9. This study has determined that surface mulch application is preferable to the labor-intensive hillslope erosion barriers.

Contacts

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Section Three

Hazardous Fuel Reduction

Highlight Projects

Hazardous Fuel Reduction Accomplishments

Section Three

Hazardous Fuel Reduction

9. Reducing Fire Risks in Forests: Increasing the Incentive to Reduce Hazardous Fuels Through Harvesting and Utilizing Small Diameter and Crooked Trees

Removal of forest undergrowth can help to sustain healthy forests. Currently, however, much of this type of material is felled and left on the ground or is simply chipped and burned.

To reduce fire risks in forests, researchers involved in this study are therefore working to develop marketable products from forest undergrowth and underutilized timber.

To date, three methods have been developed for using small trees that currently have little value and are seldom used.

Figure 10. Reducing fire risks—Scientists in this research project have illustrated that marketable products *can* be developed using the forest undergrowth and underutilized material that has previously been left behind after commercial tree harvest operations—adding to the fuel accumulation problem.

Utilization of "No-" or "Low-Value" Forest Thinnings

Research from this project has also developed information being considered by the private sector for a low-cost processing method for the raw material (with bark) that confirms that fibrous material can be made using a chip, fiberization, and refining process.

Under this research, the potential strength properties have been evaluated and shown to be equal or greater than the minimum standards for hardboard.

This research is also modifying an existing commercial product made by Wyoming Sawmill Inc. in Sheridan, WY.

Figure 11. Success story—No- or low-value materials are glued and fabricated together at a Wyoming sawmill.

Called "LamHeader," it is an I-beam structural product that uses nominal 2 x 4 material that is then remanufactured into a more efficient structural product.

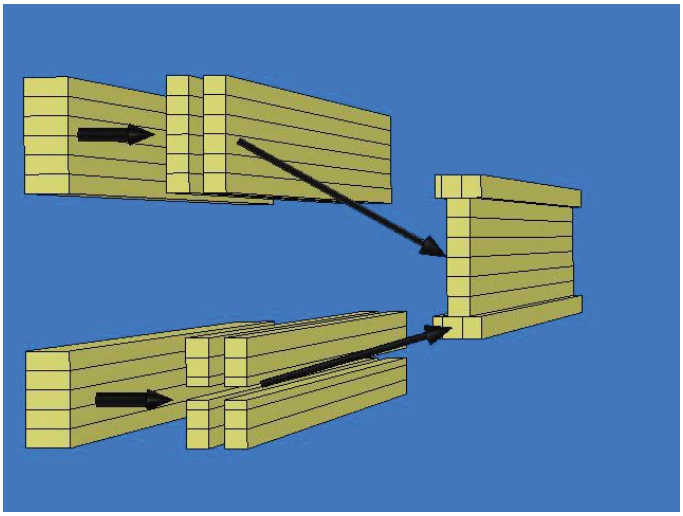
This remanufacturing process works well with small-diameter and low-value curved material. The product's performance is equal to that of existing commercial products.

The results also show that it is possible to improve properties of the I-beam through selective placement of stiffer material on the flanges.

Feasibility of Using Curved Materials for Structural Products

One of this project's original objectives was to determine if curved material could be straightened to be successfully processed through sawmills and then used in I-beams or other engineered products.

This project's research has confirmed that it *is* possible to straighten curved wood using the microwave press. After evaluating the "strength" properties of the straightened wood—as well as developing more accurate guidelines for controlling the microwave process—consistently produced thermally straightened wood can now be useable in a conventional process.



I-Beam

Figure 12. This remanufacturing process works well with the small-diameter and low-value curved material. The product's performance is equal to existing commercial products.

Contact
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10. Developing New Tree Mortality Models to Enable Managers to Determine How Fire and Thinning Can Best Restore Fire-Dependent Ecosystems

An interdisciplinary team of scientists is developing new models to understand how fire and thinning can best be used to restore fire-dependent ecosystems.

The application of past models was limited to the species, site conditions, and fire behavior from which model parameters were estimated. This research is developing general tree mortality models with much broader applicability.

To date, models for the following four species have been developed and tested: Douglas-fir, ponderosa pine, chestnut oak, and red maple. Study results suggest that this modeling approach will prove to be widely applicable because different species are similar in their thermophysical properties and their responses to heating.

In addition, this research has created the basis of "FireStem" which combines stem heating and tissue response models developed for field testing by the Missoula Fire Sciences Laboratory—with funding from the Joint Fire Science Program.

Users can select a species, run FireStem, and review the stem mortality predictions for a range of tree diameters and fire behavior scenarios.

This research undertaking is developing general tree mortality models with much broader applicability.

Contacts

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11. Providing Ground-Based Support for Mapping Fuel and Fire Hazard

Helping fire and fuels managers rapidly estimate fuel loading and other characteristics for fire planning and fire hazard and risk assessment

Figure 13. Field work underway to produce a photo series and collect data for use in the Fuel Characteristic Classification System.

Knowledge of fuel characteristics is critical to assess fire hazard potential and, thus, enable land managers to maximize fuel treatment effectiveness. Each time it is necessary to predict events or make decisions, however, it is expensive and time consuming to inventory all fuelbed characteristics.

After consulting with managers through a needs assessment process, three specific research efforts were undertaken to provide procedures for characterizing and classifying fuels:

1. The first action was to expand on existing fuel photo series to represent a range of natural conditions, fuel loadings, and other fuelbed characteristics in a variety of forest-, woodland-, shrub-, and grassland-dominated ecosystems throughout the United States.

2. Next, a Fuel Characteristic Classification System was completed that offers consistently organized fuel data—along with numerical inputs to fire behavior, fire effects, and dynamic vegetation models.

3. Finally, a 1-kilometer fuelbed map was developed that represents the contiguous United States.

Among this research project's products is a natural fuels stereo photo series that displays a range of natural conditions, fuel loadings, and other fuelbed characteristics in a wide variety of forest-, woodland-, shrub-, and grass-dominated ecosystem types.

A total of six new photo series volumes were completed that will help fire and fuels managers to rapidly estimate fuel loading and other characteristics for fire planning and fire hazard and risk assessment.

The Fuel Characteristic Classification System (FCCS) is designed as a simple interactive program to build, store, catalog, and calculate fuel characteristics and fire potentials for both simple and complex fuelbeds across the United States.

The Okanogan and Wenatchee National Forests are currently building fuelbeds using the FCCS. These forests are mapping the fuelbeds and assessing hazard to efficiently deploy fuel treatment applications. The FCCS is linked directly with the fuel consumption software product Consume 3.0 and will be linked to other products such as FVS/FFE, FOFEM, and FETM.

In addition, this project's 1-kilometer fuelbed map is being used by the Environmental Protection Agency as the fuelbed baseline for a national wildland fire smoke emissions inventory. The protocols used to develop this map have also been used to map fuelbeds at a finer resolution on the Okanogan and Wenatchee National Forests.

Contact

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12. Quantifying the Ecological and Economic Tradeoffs of Fire and Fire Surrogate Options

In the Gulf Coastal Plain and Southern Appalachian Mountains

Fuel Reduction Treatments

Figure 14. Fuel reduction treatments created four distinctive communities and stand structures on the Appalachian study site.

Widespread fuel reduction treatments are needed throughout the South, particularly within the rapidly growing wildland-urban interfaces of the Coastal Plains.

For decades, prescribed burning has been used in the Coastal Plain to reduce fuel loads. Now, however, this treatment is under regulatory pressure.

At issue are adverse air quality and transportation safety impacts from prescribed burning smoke, as well as the potential for property losses if these burns should escape into the wildland-urban interface.

While alternative fuel reduction treatments are attractive, the appropriate balance among cutting, mechanical fuel treatment, herbicide, and prescribed fire is often unclear. This study therefore examines the tradeoffs and effects of alternative fuel treatments. Results will provide managers with a broader array of options for achieving management goals.

National Fire Plan Funding

National Fire Plan funding was used to add two sites to the network of study sites in the National Fire and Fire Surrogate Study.

One is in a longleaf pine-dominated community in South Alabama at the Solon Dixon Forestry and Educational Center of Auburn University. The other site is dominated by Appalachian hardwoods and pines, located in western North Carolina on the Green River Game Lands—managed by the North Carolina Wildlife Resources Commission.

"This study has helped us to understand that we have many management options that will improve habitat for wildlife and reduce hazardous fuel loads."

Dean Simon
North Carolina Wildlife Resources Commission

Early results from the Alabama site reveal that hazardous fuels *can* be reduced without significant overstory damage by using a combination of thinning and prescribed burning via commercial timber sales that generate enough income to cover the cost of burning.

Fire is needed to control understory hardwoods while thinning is needed to reduce larger midstory hardwoods.

At the North Carolina site, fuel-reduction treatments changed vegetative structure and composition and affected potential fire behavior, bird populations, and the incidence of fungal disease.

Contacts

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13. Improved Guidelines Developed for Fuel Management in Wildland-Urban Interface Southwestern Ponderosa Pine Forests

To protect communities, this project's efforts are well underway to reduce the risk of catastrophic wildfire through forest fuel management.

A variety of strategies are being tested for hazardous fuel reduction and other resource management goals. Scientists are responding to a critical need to better understand the effects of these fuels management strategies from both risk mitigation and ecological perspectives.

To assess prior treatment effectiveness, scientists located comparable treated and untreated areas on five recent large-scale fires on National Forests in Arizona and New Mexico. Observed burn severity was greatest in untreated areas. Areas that had received a thinning treatment—but no follow-up treatment to remove thinning debris—also experienced high burn severity.

Generally, the most effective treatment was thinning of smaller trees followed by intensive treatment of thinning debris either by removal or prescribed fire.

Testing a New Physics-Based Wildfire Behavior Model

This project includes collaborators from the Los Alamos National Laboratory who are developing and testing a new physics-based wildfire behavior model—known as FIRETEC—to examine potential effects of various silvicultural systems.

FIRETEC predicts that groups containing trees of several sizes will provide ladder fuels that support the transition to canopy fire.

Scientists are responding to a critical need to better understand the effects of these fuels management strategies from both risk mitigation and ecological perspectives.

Experimental treatments have showed that thinning followed by prescribed burning is most effective in meeting fuels management objectives.

Specifically, prescribed burning created:

- Additional benefits of surface fuel reduction,
- A modest amount of lower branch pruning due to crown scorch, and
- Some snag creation for wildlife habitat.

Community-Based Forest Partnerships

Stand structure, spatial pattern, and density guidelines resulting from this project are being applied by Federal and State forests and community and agency partnerships in Arizona and New Mexico.

Before

Figure 15. No treatment—High risk of catastrophic fire.

After

Figure 16. Post treatment—Stand thinned and burned to meet effective fuel reduction objectives.

Examples of community-based forest partnerships using results for fire planning and forest rehabilitation include:

- The Greater Flagstaff Forests Partnership,
- The Community Wildfire Protection Plans for Flagstaff and several other communities,
- The cooperative Southwest Sustainable Forests Partnership; and
- The Los Alamos National Laboratory fuels management and wildfire protection project.

The Arizona Governor's Forest Health Advisory Council also incorporated this study's results into its guiding principles for forest restoration and recommendations for further restoration projects.

Contact

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14. Achieving Fuel Reduction Goals and Restoring Riparian Zones to Healthy Conditions

Riparian ecosystem dynamics in relation to fire in the Rocky Mountains

With fire exclusion and the consequent absence of fire-associated floods, many river and stream ecosystems throughout the Rocky Mountains have undergone hydrologic and vegetation changes.

While evidence of riparian and watershed deterioration varies by site and region, this phenomenon can include:

- Increased woody biomass,
- Uncharacteristic fire frequency and severity,
- Drying of channels,
- Reduced water yield,
- Loss of native plant and animal species,
- Invasions of exotic plants and fish, and
- Increasing pressure on threatened and endangered species populations.

Scientists Eye Fire and Drought Events

Both rapid assessments and long-term research were needed for understanding:

- The ecological costs and benefits of wildfires as well as fire use and prescribed fires, and
- Fuel removal in and adjacent to sensitive riparian ecosystems.

Under this research project, in New Mexico and Montana, scientists used research tools—such as tree-ring analysis of fire scar and tree age patterns, and "carbon-14" analysis of charcoal deposits in sediments and peat bogs—to estimate the frequency, intensity, and spatial extent of fires in riparian zones and adjacent uplands in past centuries and millennia.

"Legal challenges and public pressure demand that we apply management practices based on sound research—not on casual observations and opinions. This study is providing us with basic knowledge developed from robustly designed, peer-reviewed science for direction and support."

Catherine Stewart, Assistant Fuels Planner/Fire Ecologist
Northern Region, Fire, Air, and Aviation Management

Scientists are evaluating the relationship of fire to climate—with a focus on past and recent relationships between fire and drought events.

To better understand how these systems respond to fire—and, perhaps, even flooding—these scientists are also comparing current conditions in streams and riparian zones that burned at different times.

Researchers have also projected the ecological future of post-fire ecosystems by evaluating successional patterns of different-aged wildfires. In addition, research compared ecological responses to varied methods of fuel removal in a wide range of forest and shrub communities.

Figure 17. Workers remove exotic tamarisk and other fuels at RMRS study site near San Antonio, New Mexico.

Applying This Study's Results

Under this study, two 10-day workshops provided students, academics, and natural resource professionals an intensive, hands-on learning experience in tree-ring and fire scar analysis.

Scientists and partners also hosted three workshops and two training sessions that resulted in riparian restoration manuals now in use by city, State, and Federal agencies.

Managers frequently request and use this research's products, including:

- Slides and photos for preparing restoration plans,
- Information for educating partners and internal employees, and
- Plans and techniques that can be relayed to supervisors, staff, constituencies, and partners.

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Section Four

Community Assistance

Highlight Projects

Community Assistance Accomplishments

Section Four

Community Assistance

15. Determining this Country's Wildland-Urban Interface Area's Extent and Distribution Over Time — From 1940 to 2030

The wildland-urban interface is commonly known as *"the area where structures and other human developments meet or intermingle with undeveloped wildland."* In more general terms, it is where houses and dense vegetation are both present.

Recent fire policy recognizes what resource managers have known for years: fire in these interface areas poses a risk to life, property, and resources. To fully understand and comprehend the wildland-urban interface issue, however, requires better information about *where* this interface zone is *actually* located.

This research project maps this country's entire wildland-urban interface area (excluding Alaska)—determining its extent, distribution, and change over time.

Characterizing the Wildland-Urban Interface

Using the "wildland-urban interface" definition published in the Federal Register, scientists have combined U.S. Census data and the National Land Cover Dataset to map and characterize the wildland-urban interface (WUI) at high-spatial resolution.

Interface WUI is where housing is located in the vicinity of wildland vegetation. Some WUI is at risk of fire; some is not. This project's research data is overlaying fire risk maps with WUI areas at risk from fire.

In 19 of the 48 states mapped, more than half of all homes are in the WUI. Analysis of WUI's change over time indicates that between the years 1990 and 2000, 60 percent of new housing units in the United States were built in WUI areas.

The WUI maps and data were developed to serve the needs of planners and managers at the local, state, and national levels.

This project's analysis of this country's wildland-urban interface's change over time indicates that between the years 1990 and 2000, 60 percent of new housing units in the United States were built in wildland-urban interface areas.

The early version of Fire Program Analysis uses this project's WUI maps to determine which lands meet WUI criteria.

A variety of WUI information is available for non-technical users on the project's web site (http://silvis.forest.wisc.edu/projects/WUI_Main.asp). WUI and housing density map images can be downloaded for individual states, Forest Service regions, and for the contiguous 48 states.

WUI Areas Receive Priority in Fire Management

The developmental version of the new interagency fire management planning and budgeting system, Fire Program Analysis (FPA), requires a suite of characteristics describing the lands managed.

Because the WUI areas receive priority in fire management, the outcome of model trial runs was found to vary according to the way in which WUI was defined. As a result, the FPA steering committee recommended—and the National Association of State Foresters concurred—that this definition and analysis be designated as the "common currency" for WUI designation in the FPA system. The final version of FPA is yet to be released, so the way WUI information is used may change.

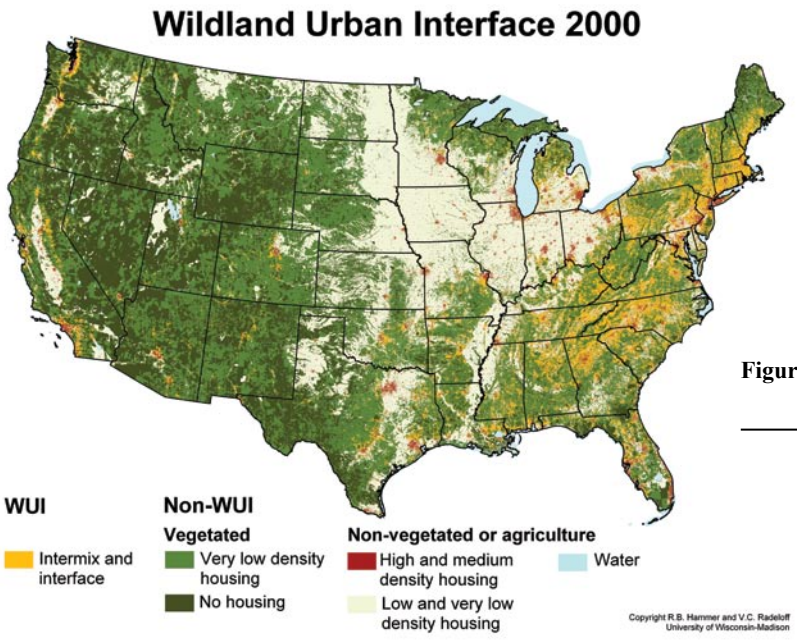

Figure 18. National map of wildland-urban interface areas.

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16. Developing Alternative Residential Landscape Designs to Meet Owners' Landscape Needs and Increase Fire Safety

As many as 42 million homes are located in the wildland-urban interface in this country. People who landscape and maintain these private properties can prevent loss from fires. While Federal and State agencies have developed regulations and guidance to help these efforts, they could conflict with plans for home exteriors, use of the land, views, privacy, and wildlife habitat.

With this research project, scientists have developed a set of alternative landscape designs that are enabling wildland-urban interface homeowners to successfully attain their personal landscape needs—*and simultaneously increase fire safety*.

They have developed "ecoSmart-Fire," an interactive, flexible, graphical tool designed to help residents make fire safety choices while simultaneously considering ways to:

- Enhance beauty,
- Retain native vegetation,
- Ensure privacy,
- conserve water, and
- Save energy.

This model incorporates physically based fire models with user-friendly interfaces for evaluating the relative fire hazard associated with alternative landscaping strategies.

They have also developed a prototype "ecoSmart Touchscreen" application for use in a kiosk at the High Desert Museum in Bend, OR, as well as possible installation at Home Depots and Lowe's in Southern California.

Creating Defensible Space Via Internet Connection

With ecoSmart-Fire, residents, landscape designers, and planners can explore different ways to create defensible space on wildland-urban interface properties via Internet connection to the http://ecoSmart.gov web site.

"This is a great visual tool for Fire Safe educators!"

Thom Porter, Pre-Fire Division Chief
California Department of Forestry and Fire Prevention

For instance, through this web site, the user places his or her home on the lot and interactively adds, removes, grows, and prunes trees. A bar shows the likelihood of structural ignition by changing from green (low), to yellow, to red (high)—in response to changing amounts of radiant heat on the house.

This ecoSmart-Fire model is currently being used by state foresters in New Mexico and Arizona with their FireWise Communities training programs. The California Department of Forestry and Fire Protection and the Fire Safe Councils are also working to enhance it for their use.

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17. Preventing Residential Fire Disasters at the Wildland-Urban Interface

This research shows that a home's location does not necessarily determine its vulnerability to wildland fire. It is, rather, the condition of the "home ignition zone" that determines this vulnerability.

Figure 19. Scientists are looking into what specific home design factors contribute to home ignitions. This information is critical to the development of "Firewise" homes and communities.

We've all seen it on the news reports: How fires—often dramatically—leave one house virtually untouched by fire standing among its completely ruined and incinerated neighbors. What characteristics enabled this one house to persist?

Scientists are looking into what specific home design and landscape characteristic contribute to home ignitions. This information is critical to the development of "Firewise" homes and communities. This project is nationally applicable, with research efforts and investigations conducted principally in the western United States, including Alaska, and in Alberta and the Northwest Territories, Canada.

This threat of residential fire destruction during wildland fires strongly impacts homeowners, communities, and our ability to manage fire in vegetated landscapes. Understanding how homes ignite during wildfires is therefore a key factor for preventing wildland-urban interface (WUI) fire disasters.

Investigating Relationships

Thus, this research is investigating the relationship between varying wildfire situations and the ignition of homes near the wildfire area. Modeling, experiments, and investigations of actual fire disasters reveal how home ignitions occur—as well as the disaster context. This understanding is then being incorporated into information products for both fire managers and WUI residents.

"The WUI Wildland Urban Interface Working Team [of NWCG] can be eternally grateful for Jack Cohen's research on the ignition of structures from wildfire exposure. Jack has helped 'de-mystify' many long-held and popular assumptions, including that crown fires were the primary ignition sources of structures in the wildland-urban interface."

Jim Smalley, Manager
Wildland Fire Protection
National Fire Protection Association

Among other products, tools, and applications, this WUI fire research project has provided the basis for two informational videos produced by the National WUI "Firewise" Program: *"Wildfire: Preventing Home Ignitions"* and *"Fire Behavior in the WUI."*

The first video is primarily intended for homeowners. To date, more than 6,000 copies have been distributed nationally. The second video is aimed at agencies involved in WUI fire response. More than 7,500 video sets have been distributed to fire departments. Both videos present information that explain how homes ignite during high intensity wildfires, as well as approaches that can be used to reduce a home's ignition vulnerability.

Keystone Project

Judith Leraas Cook, with the Firewise Program, and this project's lead scientist, Jack Cohen, have also developed the Firewise Communities USA Recognition Program. This keystone project of the National WUI Firewise Program focuses on engaging homeowners in preventing WUI fire disasters. It relies strongly on results from this project's WUI fire research that addresses ways of reducing the risk of home ignition during a wildfire.

In its three years of full implementation, the "Firewise Communities USA Recognition Program" has certified over 100 communities nationwide.

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18. Developing and Providing a Convenient Internet-Based Encyclopedia of Southern Fire Science and Management Knowledge

Much research information is available to help land managers make decisions about how and when to use prescribed fire in the South. But, for the most part, this information is scattered in various written reports that range from user bulletins to refereed journal articles.

This project's objective was to therefore gather the fragmented information contained in a mass of publications and develop a synthesized, centrally located database that is easily accessible and searchable by all users.

The project's end product, the *Encyclopedia of Southern Fire Science,* is organizing and synthesizing the southern United States' large body of fire science and translating this information into an Internet-based encyclopedia system.

The *Encyclopedia of Southern Fire Science* is now available on the web at http://www.fire.forestencyclopedia.net. It is a fully searchable knowledge base containing seven major sections:

- Fuels, weather, and fire behavior;
- Fire effects on air, water, soil, vegetation, and fauna;
- Fire ecology;
- Fire and people;
- Prescribed fire;
- Smoke management; and
- Wildland fire.

More than 1,000 pages of content in this "Fire Encyclopedia" synthesize southern fire science and provide an extensive reference list.

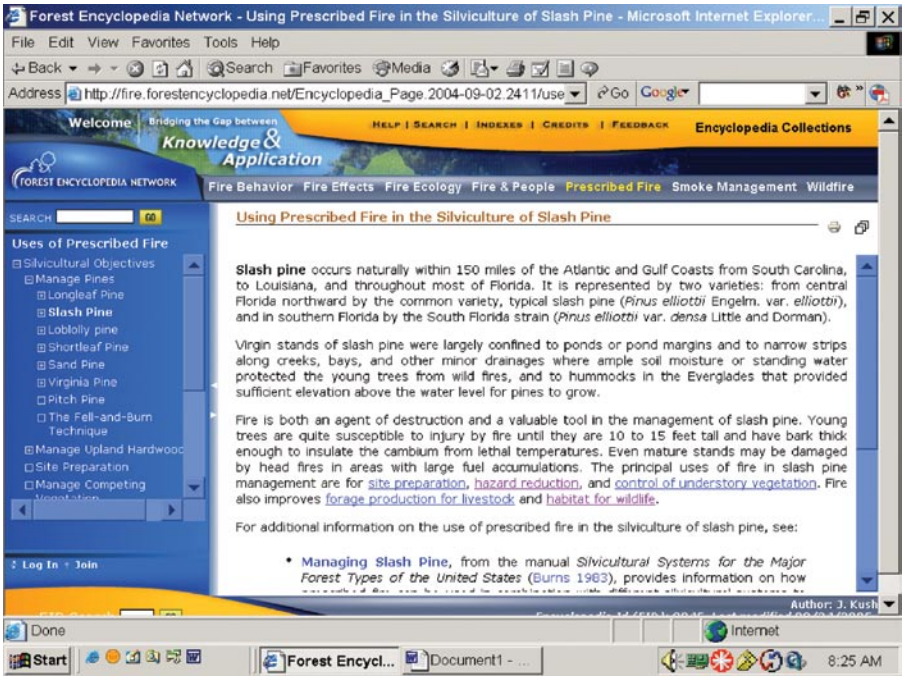

Figure 20. Encyclopedia of Southern Fire Science web page.

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19. Providing a National Database of State and Local Wildfire Hazard Mitigation Programs

To create more fire-safe communities, fire officials are implementing a broad spectrum of policy mechanisms, incentive programs, and educational tools. As officials develop these wildfire mitigation strategies, a knowledge base of the obstacles that other communities have encountered can greatly enhance their planning efforts. Certainly, learning from others' experiences can reduce time and costs for program development.

This study has taken on the important task of compiling a large body of information on wildfire risk-reduction efforts into a user-friendly searchable web site: http://www.wildfireprograms.usda.gov.

This web site broadly disseminates information and serves as a central clearinghouse of ideas for fire protection officials, natural resource professionals, and community leaders. In addition, through the web site, as community officials formulate strategies to better protect their citizens, they can explore successful wildfire mitigation policies and programs currently at work in other communities.

This study has taken on this important task of compiling a large body of information on wildfire risk-reduction efforts into a user-friendly searchable web site.

In Spring 2006, the web site included more than 211 programs in 35 states. New information is being constantly updated. Program types defined in the database include:

- Community planning,
- Assessments of wildfire risk and designation of high risk areas,
- Public outreach and educational programs,
- Homeowner assistance,
- Regulatory programs, and
- Property insurance.

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20. Wildland Fire Preparedness: Learning From the Experiences of Other Communities

Increasing the effectiveness of fire management programs in communities at risk from wildfire

In recent years, many communities have used programs and initiatives to prepare for wildland fires and to manage hazardous fuels. Communities can easily find technical assistance and start-up funding through groups such as Firewise, FireFree, Fire Safe Councils, Firewise Communities USA.

But, how can communities *sustain* these programs over the long term?

Case study summaries were used by American Planning Association staff in workshops they conducted across the country to build understanding of wildland fire preparedness in the wildland-urban interface.

This research project responded to the fact that communities need a strong foundation to be successful over time. This "community capacity" is composed of the various networks, relations, and bonds that develop among individuals and organizations to strengthen cooperation and collaboration.

This research project conducted case studies in 16 communities in 12 states: Washington, Oregon, Nevada, Montana, Texas, Mississippi, Florida, South Dakota, Minnesota, Wisconsin, New Jersey, and New York.

These "case study communities" had two things in common: (1) They had experienced a wildland fire within the last five years, were located in landscapes classified as high fire risk, or both; and (2) They had taken steps to increase wildfire preparedness.

To ensure that the study's findings are relevant to a broad array of communities, the case study communities represented a wide range in levels of community capacity. The primary product from this project has been a set of case study summaries—one for each community (www.ncrs.fs.fed.us/4803/focus/fire/community_preparedness/cp_case_studies). These summaries include:

- A brief description of the social and ecological settings and the fire history of the community,
- A description of the keys to preparedness,
- A discussion of next steps to improve preparedness,
- Wildland fire preparedness lessons that could be applied in other communities, and
- A list of web sites that will provide more information on the community and on wildland fire preparedness.

In several communities, these summaries are being distributed to new property owners to help them understand the fire history of their new home and the specific actions that their community has taken to prepare for wildland fire.

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IV. Continuing Our Successes — A Strategic Plan to Anticipate This Country's Future Needs

At its initiation, the National Fire Plan Research and Development program comprised 78 projects spread across the four key National Fire Plan areas. The original five-year commitment of funds to these research teams began to expire in 2005. By the end of fiscal year 2006, all of the initial funding commitments were completed.

To continue planning for the future, back in 2004, Forest Service research and development managers engaged scientists, fire managers, and other interested parties to reexamine the existing program structure. Building on this initial collaboration, a team was formed to develop a strategic plan to guide future Forest Service National Fire Plan research and development for fuels and fire investments.

In the summer of 2006, the resultant report *Wildland Fire and Fuels Research and Development Strategic Plan: Meeting the Needs of the Present—Anticipating the Needs of the Future* was published. (The plan's strategic goals are outlined below.) This entire plan is also available on the web at: http://www.fs.fed.us/research/pdf/2006-10-20-wildland-book.pdf.

Wildland Fire and Fuels Research and Development Strategic Plan: Meeting the Needs of the Present andAnticipating the Needs of the Future

The following priorities are intended to guide the allocation of effort and resources for fire research, tool development, and delivering science-based knowledge and tools to managers and policymakers.

Strategic Goal 1

Advance the biological, physical, social, economic, and ecological sciences.

Research under this goal will improve the understanding of fire processes and interactions and deliver the basic scientific knowledge and understanding for developing the next generation of decision-support and predictive tools for fire and fuels management.

Core fire science:

Improved understanding of combustion processes, fuels, fire weather, fire behavior, and transitions.

Ecological and environmental fire science:

Interactions among fire, other natural disturbance processes, and the physical and biological components of ecosystems and the environment.

Social fire science:

Social and economic dimensions of fire and fuels management, including firefighter safety, risk analysis, and improved methods for biomass utilization.

Integrated fire and fuels management research:

Landscape analysis and integrated interdisciplinary research to quantify the interacting effects of management strategies on ecology, environment, and society.

Strategic Goal 2

Develop and deliver knowledge and tools to policymakers, wildland fire managers, and communities.

Activities under this goal will ensure that knowledge generated by the USDA Forest Service and its cooperators is translated into a form that is useable by managers and the public and that is transferred to—and adopted by—the user community.

Synthesis and tool development:

Accelerate and coordinate the development of science syntheses and decision-support and predictive tools that build on Strategic Goal 1 research.

Science application strategy:

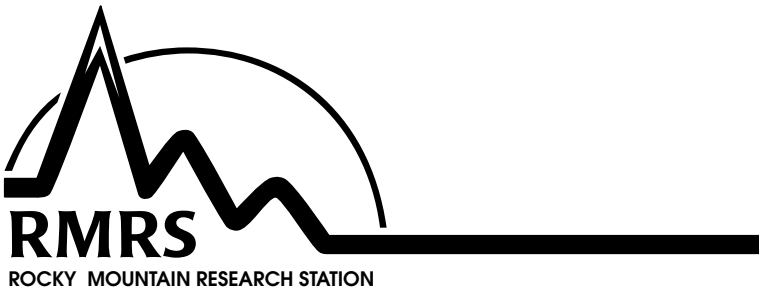
Develop and implement a comprehensive strategy for moving science into application, supporting and maintaining tools and models resulting from wildland fire and fuels R&D, and for evaluating success.

Strategic Goal 3

Provide Federal leadership for collaborative, coordinated, responsive, and forward-looking wildland fire-related Research and Development for all ownerships—now and in the future.

A new leadership structure and process for wildland fire and fuels research and development funding will support the implementation of a nationally coordinated wildland fire and fuels research and development program to address the priorities identified in Strategic Goals 1 and 2 (above).

The Forest Service's Research and Development program will also strengthen collaborations with other agencies and partners to ensure that all Federal wildland fire and fuels research and development actions support the nation's short-term priorities and long-term needs to reduce the negative economic, social, and environmental impacts of wildland fire—while improving the health of our country's ecosystems, environment, and communities.



The Rocky Mountain Research Station develops scientific information and technology to improve management, protection, and use of the forests and rangelands. Research is designed to meet the needs of National Forest managers, Federal and State agencies, public and private organizations, academic institutions, industry, and individuals.

Studies accelerate solutions to problems involving ecosystems, range, forests, water, recreation, fire, resource inventory, land reclamation, community sustainability, forest engineering technology, multiple use economics, wildlife and fish habitat, and forest insects and diseases. Studies are conducted cooperatively, and applications may be found worldwide.

Research Locations

Flagstaff, Arizona
Fort Collins, Colorado*
Boise, Idaho
Moscow, Idaho
Bozeman, Montana
Missoula, Montana
Reno, Nevada
Albuquerque, New Mexico
Rapid City, South Dakota
Logan, Utah
Ogden, Utah
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