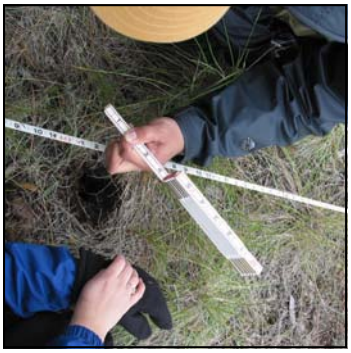
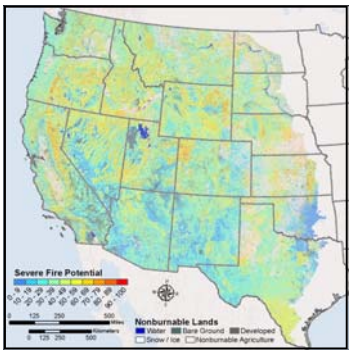


Fire Modeling Institute

Rocky Mountain Research Station
Missoula Fire Sciences Laboratory

FY2012 Annual Report

Bridging Scientists and Managers



http://www.firelab.org/fmi

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Introduction

Fire Modeling Institute—A Bridge Between Scientists and Managers

The Fire Modeling Institute (FMI) brings the best available fire and fuel science and technology developed throughout the research community to bear in fire-related management issues. Although located within the Fire, Fuel, and Smoke Science Program of the U.S. Forest Service Rocky Mountain Research Station, FMI is a national and international resource, serving fire managers all over the world.

Resource management must be based on the most accurate, current knowledge, data, and technology available, especially in today's arena of rapidly changing ecosystems and resource issues. Because of the increasing number and complexity of wildland fire computer tools and the large, growing body of fire and natural resources research, land managers are challenged to stay current with the skills and knowledge needed for resource management. FMI provides a bridge between scientists and managers by increasing and improving the application of science in fire and resource management. FMI helps managers incorporate the best science available to address land management problems.

The three branches of FMI—**Application Team, Information Team, and Modeling Team**—provide different roles and assistance to managers and scientists in the application of fire science, including physical fire processes, fuel dynamics, smoke emissions and dispersion, fire ecology, and fire and fuels management.

The staff at FMI works with a range of national and international partners, including other agencies, state and local governments, academia, and nonprofit groups. The information and technology developed by FMI is available to the public for its benefit and use. Information about FMI projects, data products, and applications can be accessed at http://www.firelab.org/fmi. FMI is funded largely by the U.S. Forest Service, Washington Office, Fire and Aviation Management.

This issue of FMI's Annual Report summarizes the results of our activities for the 2012 fiscal year.

Contact Information

If you have any questions about this report or the Fire Modeling Institute, please contact us.

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Email: fmi@fs.fed.us
Website: http://www.firelab.org/fmi

Application Team

The **Application Team** provides analysis, development, training, and support in fire behavior, fire ecology, modeling, and fuel treatment effectiveness. It is comprised of technical experts from the U.S. Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory and U.S. Forest Service, Washington Office, Fire and Aviation Management and works directly with managers on current fire-related land management problems. The Fire Sciences Laboratory provides expertise from its three research units—Fire Ecology and Fuels, Fire Behavior, and Fire Chemistry—and from its personnel in the LANDFIRE program.

Hazardous Fuels Prioritization and Allocation System

The Hazardous Fuels Prioritization and Allocation System (HFPAS) assists the U.S. Forest Service (USFS), Washington Office, Fire and Aviation Management (WO FAM) staff by helping inform the distribution of hazardous fuels funding among USFS regions. Members of the Fire Modeling Institute, WO FAM, and the Pacific Northwest Research Station collaborate each fiscal year to complete the analysis at national and regional scales.

The decision process takes into consideration the following factors: wildland fire potential, population density, smoke emissions, water supply, and performance measures. These data elements are compiled at a national spatial extent for input into the Ecosystem Management Decision Support system (EMDS 4.2), which incorporates a logic model (Netweaver) and a decision model (Criterium Decision Plus). EMDS assigns priority scores to each USFS region based on the importance assigned to the data elements by an expert panel. Data and models are available to regional level managers who wish to use it to help inform fuels funding allocation within their region.

In 2012, FMI staff presented the HFPAS decision process to regional fuels specialists and WO FAM staff at the USFS National Fuels Meeting. They also provided data and models to several regional fuels specialists for their regional-level prioritization strategies.

The HFPAS analysis process continues to evolve. In an effort to better represent areas that are adjacent to populated areas, FMI analysts are exploring and testing new logic to delineate analysis zones. Specifically, they are evaluating a new spatial layer that describes administrative boundaries. In addition, they are exploring using the new Wildfire Potential Map (details on page 4) as an alternative to the current HFPAS wildfire logic model.

FMI Lead: Eva Karau
Collaborators: WO FAM, Pacific Northwest Research Station
Agency Contacts: Frank Fay (WO FAM), Jim Menakis (WO FAM)
Status: Analysis results, models, and data are delivered each fiscal year

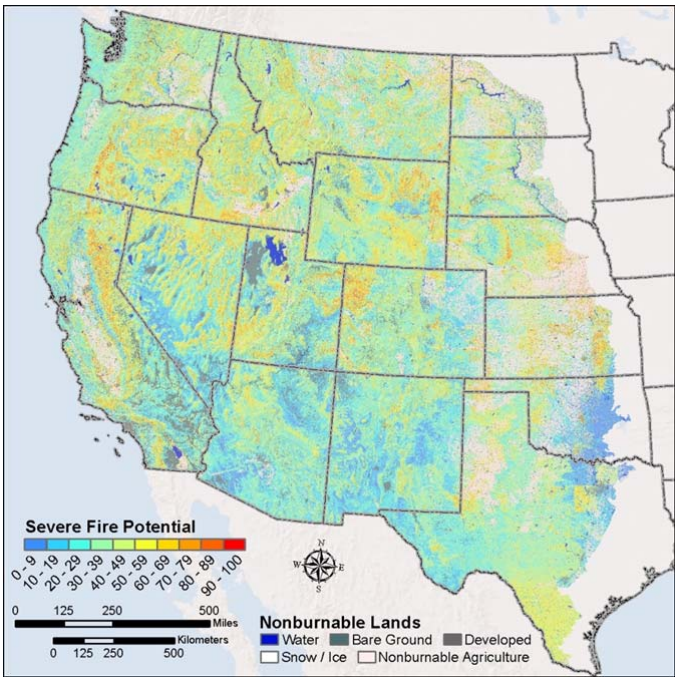
Mapping Burn Severity Potential in the Western United States

In 2012, FMI analysts continued their collaboration with researchers from the University of Idaho and the U.S. Forest Service (USFS), Rocky Mountain Research Station (RMRS) and Northern Region (Region 1) to map the potential for high-severity fire in the western, conterminous United States.

Completed and released in December 2012, the Severe Fire Potential Map (SFPM) quantifies the potential for fires to burn with high severity if they should occur. Developed as a 30 m-resolution raster dataset, the map is an online resource that managers can download and use to evaluate the potential ecological effects associated with new and potential fire events. The geospatial data, map graphics, and more information about the SFPM can be found at http://www.frames.gov/firesev.

FMI Lead: Greg Dillon
Collaborators: University of Idaho, USFS Region1, RMRS, Systems for Environmental Management
Agency Contacts: Greg Dillon (FMI), Bob Keane (RMRS, Fire, Fuel, and Smoke Science Program)
Status: Product development complete; documentation and tech transfer ongoing
Presentations:

1. Dillon, G. K.; Herynk, J. M.; Holden, Z. A.; Morgan, P.; Silverstein, R. P. 2012. Potential for high severity fire: a new 30 m raster dataset for the western United States. Poster session presentation at the 5th International Fire Ecology and Management Congress, 3-7 December 2012, Portland, OR.
2. Dillon, G. K. 2012. Thresholds for classifying the RdNBR across the western United States. Oral presentation at the 5th International Fire Ecology and Management Congress, 3-7 December 2012, Portland, OR.



Left: The Severe Fire Potential Map (SFPM) for the western, conterminous United States.

Application Team

Wildland Fire Potential for the Conterminous United States

Both fire managers and policy makers increasingly want tools and information to help them evaluate when and where wildfires are likely to burn, and what the potential consequences of those wildfires may be. To begin filling this need for information, the national interagency Fire Program Analysis System (FPA) has developed national geospatial data representing the likelihood and potential intensity of wildfires for the Conterminous United States (CONUS), using a simulation model called the Large Fire Simulator (FSim).

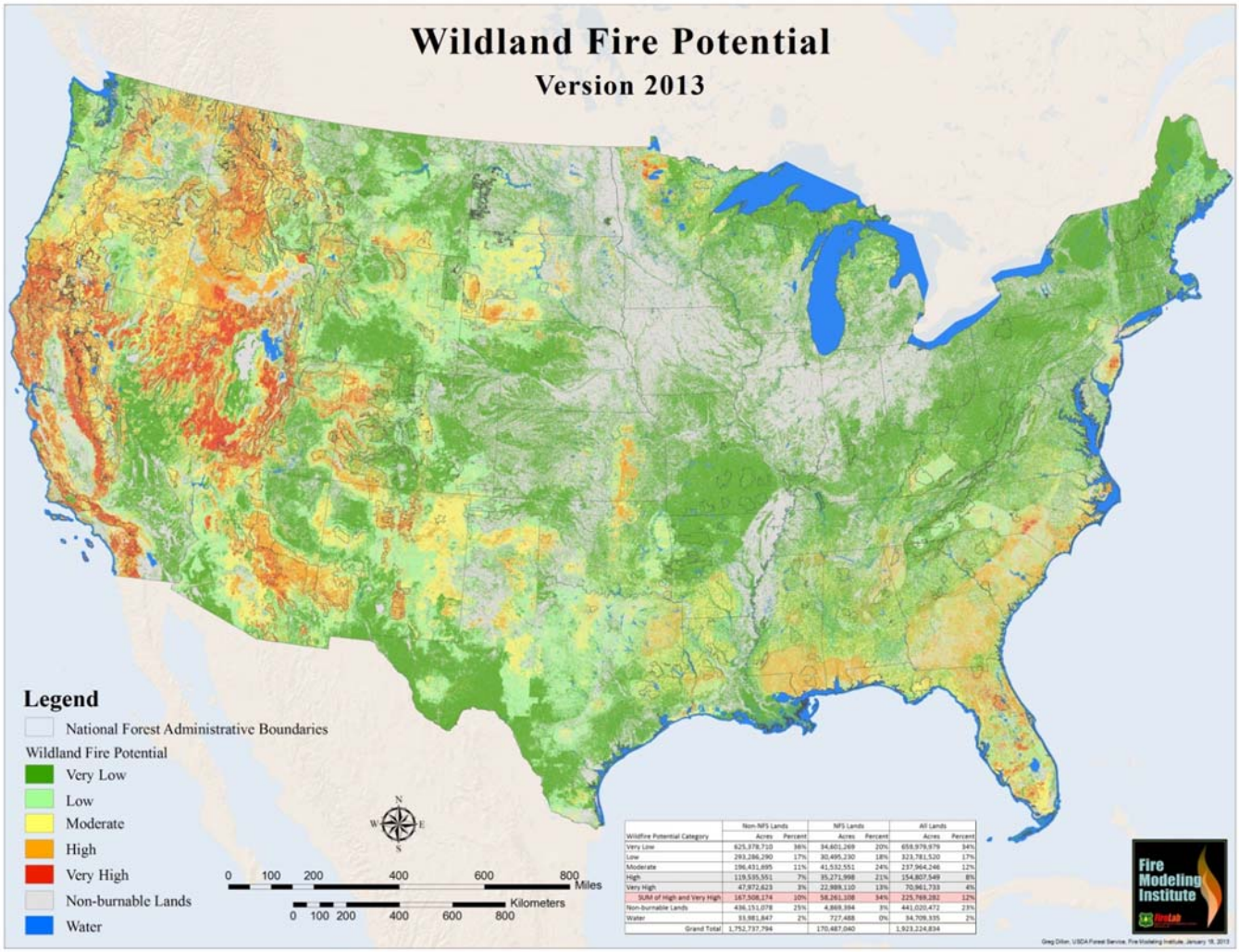
FMI's Wildland Fire Potential (WFP) map builds upon, and integrates, the FPA FSim products. The primary objective of the WFP map is to depict the potential for wildfire that would be difficult for suppression resources to contain, based on past fire occurrence and estimates of likelihood and intensity from FSim. The WFP map is not, however, an explicit map of wildfire threat or risk, because no information on the effects of wildfire on specific values such as habitats, structures, or infrastructure were incorporated in its development.

Using the FPA FSim products as inputs, as well as spatial data for vegetation and fuels characteristics from LANDFIRE 2008 and point locations of fire occurrence from FPA, an index of WFP for all of CONUS was produced at 270 m resolution. The final WFP map was presented in two forms: as continuous integer values and in five classes (very low, low, moderate, high, and very high).

The WFP map is not meant to take the place of any of the FSim products; rather, it provides a useful addition to the information available to scientists, managers, and policy makers interested in wildland fire risk analysis in the United States. By combining the WFP map with geospatial data representing any particular value, users could effectively create a wildfire risk map for that value. Completed in 2012, the WFP map is designated as the 2013 version because it is based on the FPA FSim products for 2013. It takes the place of previous versions of the WFP map from 2007 and 2010.

More information about WFP mapping methods, as well as links to download GIS data and map graphics can be found at: http://www.firelab.org/fmi/data-products/229-wildland-fire-potential-wfp.

FMI Lead: Greg Dillon
Collaborators: Rocky Mountain Research Station, Fire, Fuel, and Smoke Science and Human Dimensions Programs
Agency Contacts: Frank Fay (Washington Office, Fire and Aviation Management (WO FAM)), Jim Menakis (WO FAM)
Status: Completed; updated as warranted by new FPA FSim data



	Non-NFS Lands		NFS Lands		All Lands	
Wildfire Potential Category	Acres	Percent	Acres	Percent	Acres	Percent
Very Low	625,378,710	36%	34,601,269	20%	659,979,979	34%
Low	293,286,290	17%	30,495,230	18%	323,781,520	17%
Moderate	196,431,695	11%	41,532,551	24%	237,964,246	12%
High	119,535,551	7%	35,271,998	21%	154,807,549	8%
Very High	47,972,623	3%	22,989,110	13%	70,961,733	4%
SUM of High and Very High	167,508,174	10%	58,261,108	34%	225,769,282	12%
Non-burnable Lands	436,151,078	25%	4,869,394	3%	441,020,472	23%
Water	33,981,847	2%	727,488	0%	34,709,335	2%
Grand Total	1,752,737,794		170,487,040		1,923,224,834	

Above: The classified version of the 2013 Wildland Fire Potential (WFP) map.

Application Team

Fire in the Crown? Monitoring Fire Behavior in Montana's Southwestern Crown of the Continent

The Southwestern Crown of the Continent (SWCC) straddles the southern boundary of the Bob Marshall Wilderness Complex and includes a diverse array of ecosystems ranging from broad river valleys to upper timberline. The 1.5 million-acre SWCC is centered within several large contiguous roadless areas that link the Canadian Rockies with the Selway-Bitterroot Wilderness and Greater Yellowstone Ecosystem. Fire management operations in SWCC run the spectrum from full suppression within the wildland-urban interface to flexible zone/point protection or monitoring strategies within wilderness areas. The SWCC area includes portions of the Flathead, Lolo, and Helena National Forests.

As part of the Collaborative Forest Landscape Restoration Program (http://www.fs.fed.us/restoration/CFLRP/index.shtml), a landscape restoration strategy has been developed for the SWCC including a range of proposed activities designed to reestablish natural fire regimes and reduce the potential for uncharacteristic fire.

Landscape-scale fire behavior analyses are important to inform decisions on resource management projects that meet land management objectives and protect values from adverse consequences of fire. SWCC monitoring objectives include quantification of pre- and post-implementation fire behavior metrics to determine if project and landscape objectives have been satisfied and reporting on the degree of change towards desired conditions based on the identified ecological indicators. This project evaluates geospatial fire behavior analyses for the SWCC in western Montana using two different data sources: LANDFIRE and a local dataset built from regional remote sensing data and plot data.

Rulesets were developed to account for disturbances across the landscape, such as wildfires and mortality due to insect activity. Performance of the data sources were evaluated by comparing modeled fire growth to actual fire growth.

Based on feedback from local fire management personnel, the local dataset was the best fit because it provided information at multiple scales for both project-level and landscape-level analyses and has a regular update and accuracy assessment schedule.

FMI Lead: LaWen Hollingsworth
Collaborators: U.S. Forest Service (USFS), National Forest System district fire and fuels personnel; USFS Region 1, Analysis Team and Geospatial Group
Agency Contact: LaWen Hollingsworth (FMI)
Status: Initial products created; ongoing support provided

LANDFIRE 2010 Data Products

LANDFIRE, also known as Landscape Fire and Resource Management Planning Tools, is a joint program between the wildland fire management programs of the U.S. Forest Service and the U.S. Department of the Interior (DOI). LANDFIRE applies consistent methodologies and processes to create comprehensive spatial data and models describing vegetation and wildland fire and fuel characteristics across the entire United States. LANDFIRE data products facilitate national, regional, and large landscape-level fire planning activities and provide managers with data needed for planning and implementation using a collaborative, cross-boundary, interagency approach.

In 2012, FMI-LANDFIRE staff developed the production and delivery plan for the LANDFIRE 2010 data products. This included development of a revised product suite and attribution plan as well as production scheduling and setting of product delivery dates. The LANDFIRE 2010 data products update will incorporate significant refinements to data layers including:

- Incorporation of the Cropland Data Layer (CDL) and Common Land Unit (CLU) data into the agriculture mapping process
- Use of the National Land Cover Database (NLCD) ca. 2006 to map expansion of urban areas
- Use of National Wetlands Inventory Data (NWI) to improve mapping of wetland vegetation
- Existing Vegetation Type (EVT) legend revisions to facilitate crosswalks to National Vegetation Classification Standard (NVCS) and other vegetation classification systems

In 2012, FMI-LANDFIRE staff coordinated ongoing innovations oriented toward future versions of LANDFIRE data products including:

- Fuel model modulation for seasonal annual grass growth and drought severity
- Landscape change mapping using new Multi-Index Integrated Change Analysis (MIICA) algorithms
- Increased collaboration with National Gap Analysis Program, NVCS, and Forest Inventory and Analysis data

LANDFIRE 2010 data products are scheduled to be released in 2013.

FMI Lead: Donald Long
Collaborators: Washington Office, Fire and Aviation Management (WO FAM); DOI
Agency Contact: Frank Fay (WO FAM)
Status: Ongoing

Application Team

Using Twentieth-Century Climate Trends to Evaluate Fire Potential in the Eastern Region

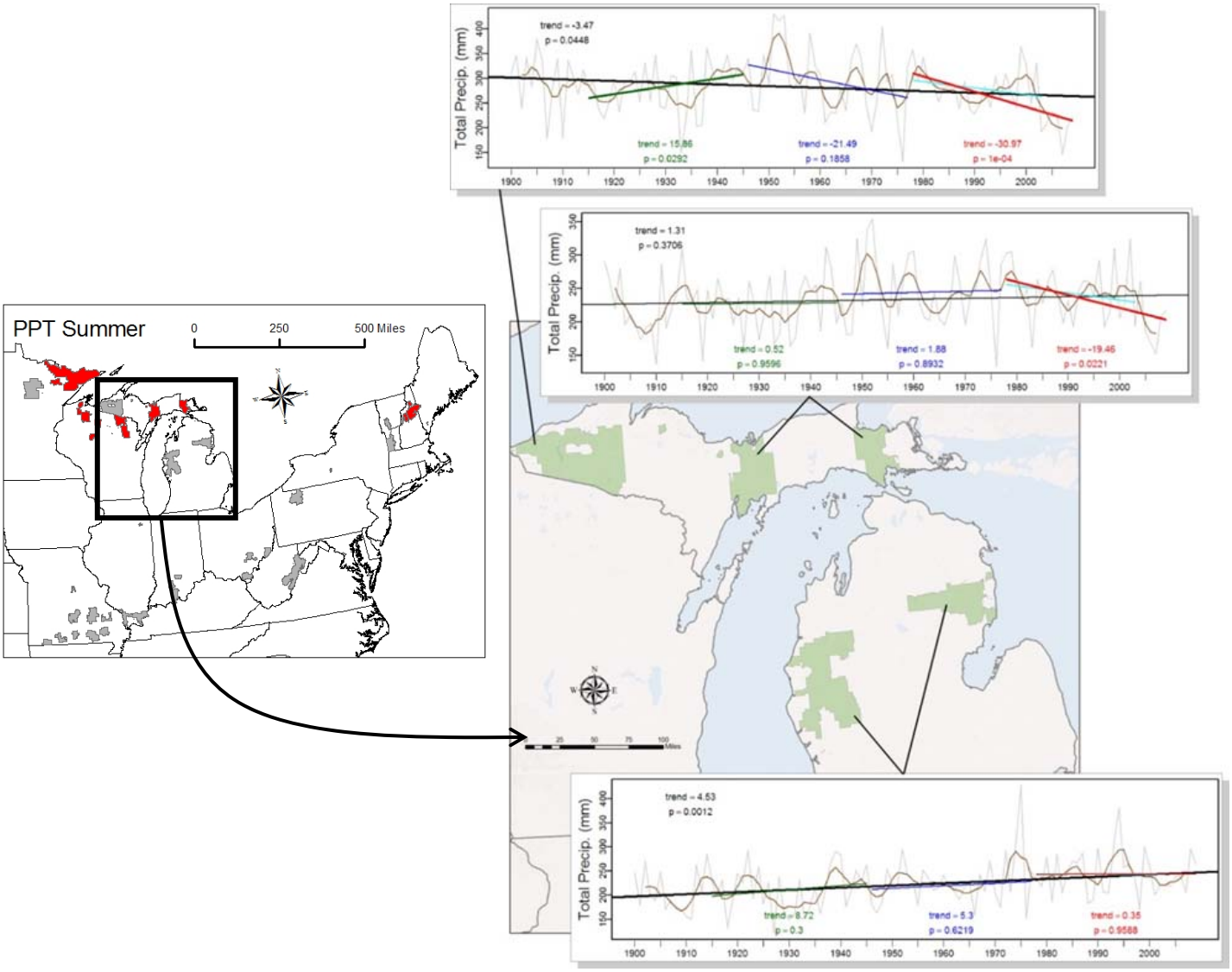
Changes to the Earth's climate and consequential changes in weather and vegetation patterns are likely to have implications on the frequency and severity of wildfires. While there is an increasing amount of data and projections about climate change at broad spatial scales, the information available at the scale of individual national forest units is limited. Through an intensive on-site internship at the Missoula Fire Sciences Laboratory, followed by an ongoing collaborative effort, FMI partnered with fire planner Erin Lane from the White Mountain National Forest to address the question of how climate change may affect fire programs across the U.S. Forest Service Eastern Region (USFS Region 9) in the near future.

The main objective of this effort was to determine historical trends in temperature, precipitation, and an integrated moisture index over the twentieth century specifically for national forests in the Eastern Region. By correlating these trends with fire occurrence records, we also set out to develop a simple index for each national forest reflecting the potential for increased fire activity in the near future, given recent climate trajectories.

Results highlight the high spatial and temporal variability of climate trends in the Eastern Region. Plans are underway to provide all national forests in the Eastern Region with information they could use for future fire and forest management planning. This project is an example of the type of collaboration between research and management that is central to FMI's mission of science synthesis and technology transfer.

FMI Lead: Greg Dillon
Collaborator: Erin Lane (USFS Region 9)
Agency Contact: Erin Lane (USFS Region 9)
Status: Ongoing
Presentations:

1. Lane, E. 2012. How will climate change affect fire programs across USFS Region 9? Oral presentation at the USFS Region 9, Regional Office, 23 August 2012, Milwaukee, WI.
2. Lane, E.; Dillon, G. 2012. How will climate change affect fire programs across USFS Region 9? Webinar presentation to the Northern Institute of Applied Climate Science, 28 September 2012.



Above: For each national forest in the Eastern Region (USFS Region 9), correlations were evaluated between climate variables and fire occurrence records from 1992-2010. In the map on the upper left, National Forests where lower summer precipitation was positively correlated with number of fires are highlighted in red. On the right are trends calculated for summer precipitation for the national forests in Michigan. Trends were calculated across the twentieth century, and across three sub-time periods. Statistically significant trend lines are shown in bold. Declining precipitation trends for the two forests on the Upper Peninsula in recent decades suggest that managers might expect more fires if those trends continue.

Application Team

Summary, Analysis, and Interpretation of National Wildland Fire Geospatial Data

With FMI's expertise in geospatial analyses and experience working with national-scale datasets, FMI is often called upon to analyze, summarize, and/or distribute wildland fire data covering the conterminous United States (CONUS). The following are examples of requests to which FMI responded in 2012.

In May, FMI received a request from Washington Office, Fire and Aviation Management (WO FAM) for CONUS summaries of data representing either wildfire risk or wildfire potential for lands in or adjacent to the Wildland Urban Interface (WUI). FMI analysts developed maps and tabular summaries of acres in different categories of wildfire risk or potential by categories of population density and land ownership and adjacency.

In July, FMI received a request from WO Media Relations for a map showing areas in CONUS with the most hazardous fuels, and thus those areas most in need of treatment. The map was intended to accompany a story being developed by CBS Evening News about restoration projects and the Collaborative Forest Landscape Restoration Program (CFLRP). FMI analysts considered available data sources, including the 2010 Wildland Fire Potential, LANDFIRE fuels layers, and burn probability and conditional flame length probability layers from the Fire Program Analysis System's (FPA) Large Fire Simulator (FSim), and in so doing identified a need for data layers to depict hazardous fuels and wildfire risk.

In August, FMI received a request from the U.S. Forest Service's Automated Lands Program (ALP) about getting a national Fire Risk Assessment layer to add to a map of proposed energy corridors in the western United States. FMI analysts provided the latest FPA FSim burn probability layer in both its original form and grouped into 10 classes. They also provided individuals at ALP with descriptive information about burn probability and how to interpret it, as well as caveats about its intended uses.

In September, FMI received a request from WO FAM for a summary of the most recent LANDFIRE Vegetation Condition Class (VCC) for National Forest System lands in CONUS and Colorado. FMI analysts provided tabular summaries and maps of VCC, as well as the 2010 Wildland Fire Potential along with information about its use and interpretation

Also in September, FMI received a request from WO FAM for a CONUS map of wildfire risk to put on a national map of CFLRP projects. FMI analysts provided the latest FPA FSim burn probability layer, along with information about its use and interpretation.

FMI Leads: Greg Dillon, Eva Karau
Collaborators: Rocky Mountain Research Station, Fire, Fuel, and Smoke Science and Human Dimensions Programs
Agency Contact: Frank Fay (WO FAM)
Status: Ongoing

Characterizing Surface Fuels and Stand Structure and the Influence on Fire Behavior within Mountain Pine Beetle-Affected Stands in Oregon

The mountain pine beetle (MPB) has caused extensive lodgepole pine mortality in south-central Oregon, peaking at over 1,000,000 acres of mortality in 1986 and over 500,000 cumulative acres in the past decade (U.S. Forest Service (USFS), Forest Health Protection Aerial Detection Survey data). Widespread mortality has raised concerns about potential fire behavior, effective fire management strategies, and firefighter safety as forest structure is altered following MPB epidemics. These concerns are magnified as previous research has provided equivocal evidence concerning post-MPB fire behavior. In addition, there is uncertainty as to whether available research and observational data from Rocky Mountain lodgepole pine forests should be applied to lodgepole pine forests in south-central Oregon.

Using a chronosequence approach, fuels and forest structure were sampled on 215 plots to evaluate how fuel profiles (ground, surface, ladder, and crown fuels) in lodgepole pine forests in the Deschutes and Fremont-Winema National Forests change over time following MPB activity. Using multivariate cluster analysis, post-MPB environments were delineated based on fuel complexes. Fire behavior analyses were completed using custom fuel models created from plot data to quantify changes in predicted fire behavior over time since MPB activity. The fire behavior outputs (flame length, rate of spread, and type of fire) using the custom fuel models were then compared with outputs from a spectrum of standard fuel models.

Results from these point fire behavior analyses will help inform changes to the landscape spatial data to improve accuracy. Geospatial fire behavior analyses will then be completed in selected pilot areas, thereby providing the means to compare fire behavior predictions with observed fire behavior during future wildfires. Results from these efforts will directly aid managers on both the Deschutes and Fremont-Winema National Forests by framing potential fire behavior in these post-disturbance environments.

FMI Lead: LaWen Hollingsworth
Collaborators: Travis Woolley (Oregon State University (OSU)), Dave Shaw (OSU), Stephen Fitzgerald (OSU), Andy Eglitis (USFS Region 6)
Agency Contact: LaWen Hollingsworth (FMI)
Status: Ongoing

Below: Mountain pine beetle-caused lodgepole pine mortality in south-central Oregon. Photo courtesy of Travis Woolley.

Application Team

FFI: Ecological Monitoring Software Development and Support

FEAT-FIREMON Integrated: Ecological Monitoring Software (FFI) is an interagency, science-based, ecological monitoring software application that is designed to assist managers in meeting monitoring requirements as mandated by federal law. It is used in the U.S. Forest Service (USFS), National Park Service (NPS), Bureau of Land Management (BLM), U.S. Fish and Wildlife Service (USFWS), U.S. Geological Survey (USGS), and Bureau of Indian Affairs (BIA), and by tribes, state and local governments, nongovernmental organizations, and universities.

FFI is a robust ecological, vegetation, and fuels monitoring tool used to consistently describe ecological systems and monitor change over time. It incorporates the components necessary to conduct a successful monitoring program, including an integral database, analysis and reporting tools, and modular GIS component.

In July 2012 the FFI development team released FFI v1.04.02, which added customizable tree data reports, ability to save data queries, bug fixes and other minor user requested updates. Additionally, work is underway on "FFI-lite", which is a more compact installation of FFI to be used on field computers and by users that do not need the full functionality of SQL Server. The team is also updating the GIS toolbar to make it ArcGIS10 compatible and updating the Natural Resources Conservation Service's PLANTS Database stored in FFI.

An FMI representative led a classroom training session in Boise, Idaho, attended by 20 participants from USFS, NPS, BLM, BIA, and the Warm Springs Tribe. The class provided a complete overview of FFI software, giving participants enough information to start incorporating FFI in their monitoring projects.

Above: Students learning how to sample tree crowns during a FFI training course. Photo courtesy of Duncan Lutes.

FFI technical support is accomplished through a Google discussion group, email, and phone "help desk". The FFI technical support lead in FMI recorded over 150 technical support contacts in 2012.

FMI Lead: Duncan Lutes
Collaborators: NPS, Systems for Environmental Management, Axiom IT Solutions
Agency Contact: Duncan Lutes (FMI)
Status: Ongoing

FOFEM and FuelCalc Application Development

The **First Order Fire Effects Model (FOFEM)** is a computer program developed to meet needs of resource managers, planners, and analysts for predicting and planning fire effects. FOFEM simulates four basic effects: 1) consumption of surface and ground fuels and the resultant fire intensity over time using the BurnUp model, 2) emissions and emission rate of PM_{10}, $PM_{2.5}$, CO, CO_2, CH_4, NO_X, and SO_2 for flaming, smoldering, and total combustion, 3) soil heating across a range of soil depths over time since ignition, and 4) tree mortality from surface fire, based on flame length or scorch height, and tree species and size.

FOFEM v6.0 was released in December 2012 and introduced to managers in a workshop at the 5th Annual Fire Ecology and Management Congress in Portland, Oregon. Updates included a completely redesigned user interface, redesigned reports and graphs, a switch from six-letter SPECIES codes to Natural Resources Conservation Service's PLANTS Database codes, a new fire intensity output graph, a new longleaf pine tree mortality equation, updated duff consumption logic, and a utility for importing tree data exported from FEAT-FIREMON Integrated: Ecological Monitoring Software (FFI) into the mortality model.

Below: Students measuring the duff layer during a FFI training course. Photo courtesy of Duncan Lutes.

FuelCalc is designed to help managers assess changes in ground, surface, and canopy fuel loading as simulated thinning, pruning, piling, and prescribed fire treatments are applied. Initial fuel loading can be entered manually or using files exported from FFI. Outputs include canopy fuels (canopy bulk density and crown base height), load of surface and ground fuels, emissions, and a fire behavior fuel model.

FuelCalc was initially released in August 2012. Version 1.1 was released in December 2012 and introduced to managers in a workshop at the 5th Annual Fire Ecology and Management Congress. The new version includes calculation of torching and crowning index and minor bug fixes.

FuelCalc was developed in collaboration with the National Interagency Fuels, Fire, and Vegetation Technology Transfer (NIFTT) team.

FMI Lead: Duncan Lutes
Collaborators: NIFTT, Systems for Environmental Management
Agency Contact: Duncan Lutes (FMI)
Status: Ongoing

Information Team

The **Information Team** is comprised of ecologists and technical information specialists at the U.S. Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. The team develops scientific literature reviews and other synthesis documents on how fire interacts with plants and animals of the United States. Products cover fire effects on individual species and historical fire regimes in plant communities, with all reviews published online in the Fire Effects Information System (http://www.fs.fed.us/database/feis/). To support synthesis preparation, the Information Team also maintains a comprehensive library of fire ecology research and an online library catalog, the Citation Retrieval System (http://www.feis-crs.org/).

FireWorks for Missouri River Country

"FireWorks for Missouri River Country" was developed with support from the Bureau of Indian Affairs (BIA) to provide reservation educators with hands-on activities for teaching scientific and cultural aspects of wildland fire to children in first grade through twelfth grade. The completed curriculum and eight boxes of materials, developed by Jane Kapler Smith, Nancy McMurray, and Ilana Abrahamson, were delivered in June 2012 to BIA staff from the Pine Ridge, Fort Berthold, and Fort Washakie Reservations.

"FireWorks for Missouri River Country" was created by adapting and enhancing materials originally created by Smith and McMurray in 2000 for teaching about fire in Rocky Mountain forests. The new curriculum covers ecosystems in the Missouri River basin, from the forests on the Front Range of the Rocky Mountains to the oak savannas in the eastern Great Plains.

At a two-day workshop in Rapid City, South Dakota, Smith and McMurray showed BIA partners how to teach with the materials and more than 30 activities in the curriculum. Materials included laboratory equipment, botanical specimens, essays for children about fire ecology, and a seven-foot-wide felt "story board" for illustrating ecology, fire, and succession in the Missouri River basin.

FMI Lead: Jane Kapler Smith
Collaborators: Nancy McMurray, Ilana Abrahamson (FMI), Jim Rodriguez, Dave Bell, Peter Jim Hanley (BIA)
Agency Contact: Jane Kapler Smith (FMI)
Status: Completed

Below: Participants at a two-day workshop on "Fireworks in the Missouri River County" in Rapid City, South Dakota. Photo courtesy of Jane Kapler Smith.

Annotated Bibliographies for Experimental Forests in the Rocky Mountains

Experimental forests and ranges administered by the Rocky Mountain Research Station (RMRS) are sites for innovative and long-term research conducted by the research and development arm of the U.S. Forest Service (USFS) Research and its partners. Publications about the research and management conducted on these experimental forests date back to nearly a century in some instances. In order to consolidate, search, and access hundreds of publications, FMI was requested to create a library and annotated bibliography for the Tenderfoot Creek, Coram, and Manitou Experimental Forests.

EndNote libraries for each experimental forest are available for use by USFS personnel. Each library contains:

- Complete citation information
- Searchable references (via keyword, author, title, etc.)
- Abstracts or summaries
- Attachments or links to digital documents, if available

Annotated bibliographies for each experimental forest are available online. Each annotated bibliography contains:

- Complete citation information
- Abstracts or summaries
- Links to digital documents, if in the public domain

By creating a comprehensive library of publications for each experimental forest, this project allows researchers and managers to access relevant research and showcases the important work conducted on experimental forests to the public.

FMI Lead: Ilana Abrahamson
Collaborators: Robert Keane (RMRS, Fire, Fuel, and Smoke Science Program (FFS)), Helen Smith (FFS), Elaine Sutherland (Forestry Sciences Laboratory), Michael Ryan (RMRS, Forest and Woodland Ecosystems Science Program)
Agency Contact: Ilana Abrahamson (FMI)
Status: Completed
Publications:

1. Abrahamson, I. A. 2012. An annotated bibliography of scientific literature on research and management activities conducted in Tenderfoot Creek Experimental Forest. Missoula, MT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 54 p. Available at: http://www.fs.fed.us/rm/tenderfoot-creek/docs/bibliography.pdf.
2. Abrahamson, I. A. 2012. An annotated bibliography of scientific literature on research and management activities conducted in Manitou Experimental Forest. Missoula, MT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 69 p. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5370724.pdf.
3. Abrahamson, I. A. 2012. An annotated bibliography of scientific literature on research and management activities conducted in Coram Experimental Forest. Missoula, MT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 68 p.

Information Team

Environmental Education

FMI staff teaches a variety of educational courses—from primary school to college-level—about fire ecology, behavior, history, and physics among other topics. In 2012, FMI staff taught courses of varying lengths to the following groups:

- Lolo National Forest (Nature Walk Week)
- University of Montana (Wilderness and Civilization class)
- Montana Natural History Center (Summer Science Day Camps)
- Missoula and Kalispell Elementary Schools (FireWorks)
- Seeley Lake Middle School (FireWorks)
- Girl Scouts (Centennial Celebration)

In addition, educator workshops and presentations on the FireWorks Curriculum are offered each year, teaching educators, community leaders, and agency communicators about the program and how to use it. This year, more than 50 professional educators and agency staff attended these events.

FMI Lead: Jane Kapler Smith
Collaborator: Rocky Mountain Research Station Fire, Fuel, and Smoke Science Program (FFS)
Agency contact: Jane Kapler Smith (FMI)
Status: Ongoing

Fire Effects Information System: Now Spatially Searchable

In 2012, the Information Team introduced a new spatially searchable user interface for the Fire Effects Information System (FEIS) to better serve the needs of scientists, managers, students, and the general public seeking information about fire effects. The new user interface, FEIS-Spatial, can be found at http://www.feis-crs.org/beta/. It was launched in January following a webinar presentation showcasing the new features.

Currently in the testing and refinement phases, FEIS-Spatial offers its users many new features, including the ability to search for species reviews and fire studies by:

- State, province, or country
- Plant community
- Park, forest, refuge, reservation, or other federal land
- Plant, animal, lichen, or fungus
- Invasiveness or nativity

Users can use the new user interface and the usual FEIS website, http://www.fs.fed.us/database/feis/, while the testing and refinement phases are completed.

FMI Leads: Robin Innes, Jane Kapler Smith
Collaborators: University of Montana, National Center for Landscape Fire Analysis; Axiom IT Solutions
Agency Contact: Robin Innes (FMI)
Status: Ongoing

Right: Example of the kinds of searches possible in FEIS-Spatial (http://www.feis-crs.org/beta/).

FEIS-Spatial example: What information does FEIS have on invasive grasses likely to occur in Louisiana?

Search for Species Reviews

Select from these criteria to search for species reviews:

- ☑ **Life form**
- ☐ **Nativity**
- ☑ **Invasiveness**
- ☑ **Geographic Area - search by one of these criteria:**

State

FEIS Search Results

Results for: Invasive AND Graminoid AND State=LA
Number of taxa returned: 27

Review Acronym	Scientific Name	Common Name	Review Date
AGRGIG	Agrostis gigantea	redtop	1995
ARUDON	Arundo donax	giant reed	2004
BROJAP	Bromus japonicus	Japanese brome	1994
BROTEC	Bromus tectorum	cheatgrass	2003

SPECIES: Arundo donax

Table of Contents

- Introductory
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- Botanical and ecological characteristics
- Fire ecology
- Fire effects
- Management considerations
- References

James H. Miller, USDA Forest Service, www.forestryimages.org

James H. Miller, USDA Forest Service, www.forestryimages.org

Information Team

Fire Effects Information System: New and Updated Species Reviews

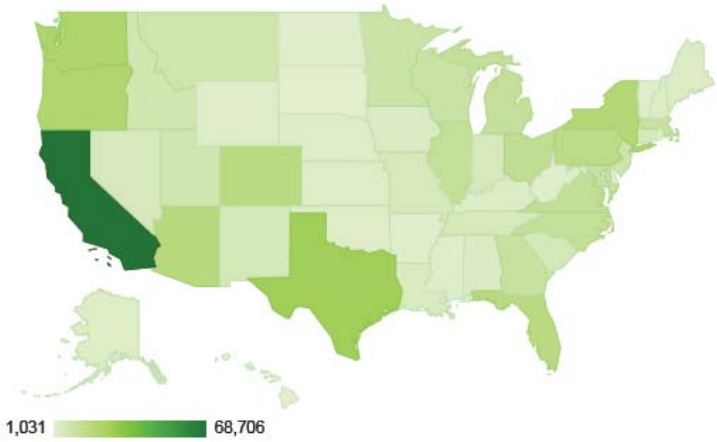
The Fire Effects Information System (FEIS) continued to serve managers in 2012, its twenty-sixth year. FEIS provides online syntheses of scientific knowledge about more than 1,100 species and their relationships with fire. Reviews cover plants and animals throughout the United States, providing a wealth of information for resource management, restoration, rehabilitation, and fire management.

In 2012, 455,685 users visited FEIS, an increase of 17.6% over the previous year. The system had visitors from all of the United States, with most visits from California. FEIS received visits from more than 90 countries outside the United States.

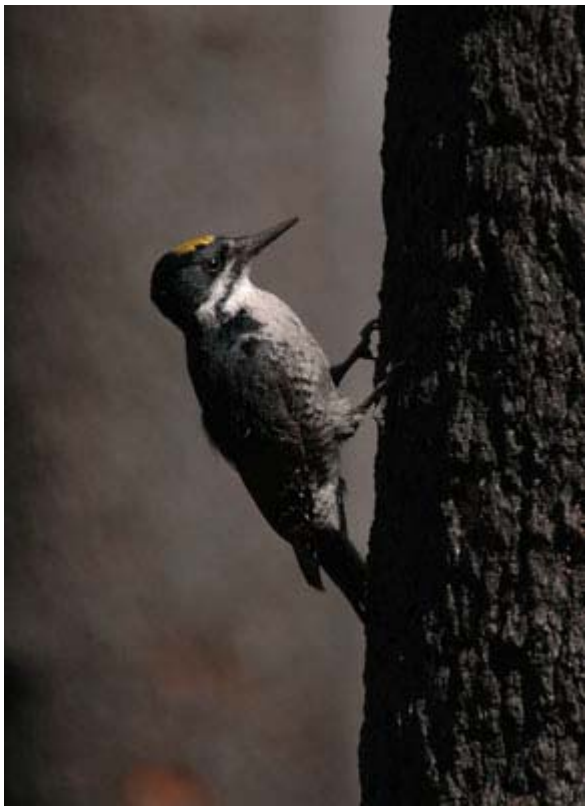
In 2012, 13 reviews covering 16 species were published in FEIS. Printed out, the reviews comprised 576 pages and cited a total of 2,707 references. Most of these reviews were rewritten from earlier versions published in the late 1980s and early 1990s. A review of elk originally published in 1991 was rewritten; the new version includes 89 pages of up-to-date information and cites 359 references, in contrast to 12 pages and 53 citations in the original review. Other important reviews published this year covered poison-ivy, tobosa, several California oaks, and the black-backed woodpecker.

Literature used for FEIS reviews is stored in the Fire Effects Library at the Missoula Fire Sciences Laboratory and documented in the Citation Retrieval System (CRS). CRS contains more than 60,000 citations. In 2012, FEIS staff added approximately 2,300 new citations to CRS.

FMI Lead: Jane Kapler Smith
Collaborators: Ilana Abrahamson, Janet Fryer, Corey Gucker, Robin Innes, Nancy McMurray, Rachelle Meyer, Katharine Stone, Kris Zouhar (FMI)
Agency Contact: Jane Kapler Smith (FMI)
Status: Ongoing
Publications: 13 reviews and 1 fire study published at http://www.fs.fed.us/database/feis/



Left: A map of the United States depicting the number of users visiting FEIS, either via http://www.fs.fed.us/database/feis/ or via http://www.feis-crs.org/beta/. The system had visitors from all of the United States, with the most numerous visits from California.



Reviews of elk (top right), bigleaf maple (middle right), tobosa (bottom right), and black-backed woodpecker (top left) were some of the species reviews published in FEIS during 2012. Elk photo courtesy of John McColgan, Alaska Fire Service, Bureau of Land Management. Bigleaf maple photo courtesy of City Pictures. Tobosa photo courtesy of Travis Neppl, National Park Service. Black-backed woodpecker photo courtesy of Richard Hutto.

Information Team

Characteristics of Information Available on Fire and Invasive Plants in the Eastern United States

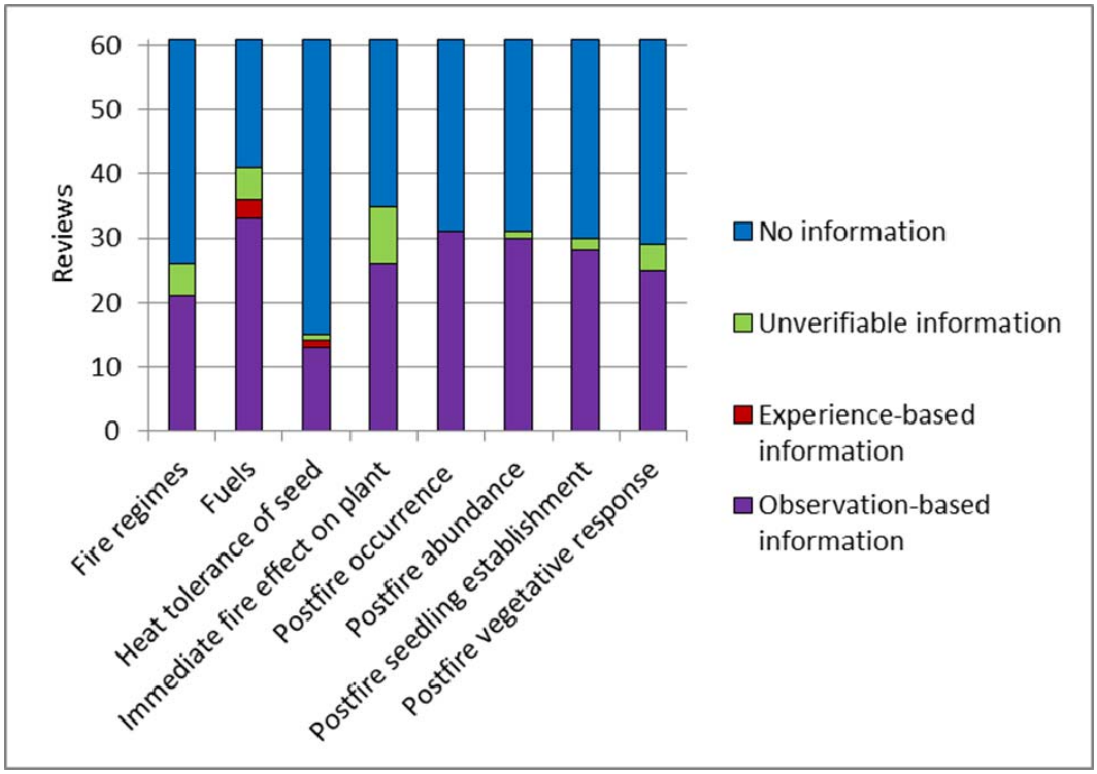
In order to effectively manage fire without introducing or increasing populations of invasive plants, wildland managers need detailed information about the responses of invasive species to fire and the conditions that increase site invasibility. Literature reviews and syntheses of original research are important sources of this information, but the usefulness of a review is limited by the quantity, quality, and geographic coverage of information available when it is written.

An analysis of the information available for 61 reviews written for the Fire Effects Information System (FEIS, http://www.fs.fed.us/database/feis/) between 2008 and 2011 and covering 74 species of invasive plants in the eastern United States was published in *Fire Ecology*'s August 2012 issue.

The analysis focused especially on the origin of information available in source documents, particularly whether or not it was based on actual observations. Observation-based information available on fire and eastern invasive species was sparse, typically came from a small portion of the species' North American range, and had many other limitations. Nine of the 61 reviews contained no observation-based information on fire at all. Observations of postfire abundance of invasive species were constrained by inconsistent metrics and short postfire time frames, making it difficult for reviewers to assess patterns or evaluate the relevance of the research to long-term fire effects and land management strategies.

Results indicated that more high-quality, observation-based information is needed for fire managers to avoid exacerbating problems with invasive plant species. Long-term studies are needed that compare burned and unburned sites, evaluate postfire changes in plant communities, and report burning conditions and fire parameters. Reviews and syntheses of research can be improved by identifying patterns and knowledge gaps, and also by identifying sources of information so that readers can assess its quality and applicability to local management issues. It is important for managers to recognize the limitations of scientific information, monitor results of their management programs, and adapt plans for future work based on an integration of science-based knowledge with professional experience.

FMI Leads: Corey Gucker, Kris Zouhar
Collaborators: Jane Kapler Smith, Katherine Stone (FMI)
Status: Completed
Publication: Gucker, C. L.; Zouhar, K.; Smith, J. K.; Stone, K. R. 2012. Characteristics of information available on fire and invasive plants in the eastern United States. Fire Ecology 8(2): 57-81. Available at: http://treesearch.fs.fed.us/pubs/41394



Above: Distribution of information quality available for each fire topic in 61 Fire Effects Information System (FEIS) species reviews. Bars are divided to show the number of reviews for which each information quality category is highest.

Below: Some of the species reviews examined in this study. Common buckthorn photo (left) courtesy of Elizabeth J. Czarapata, Silk reed photo (center) courtesy of Dan Clark, National Park Service, Bugwood.org, and moneywort photo (right) courtesy of Louis-M. Landry.

Modeling Team

The **Modeling Team** is comprised of specialists in fire behavior, fire ecology, and forestry. The team maintains and develops a suite of fire behavior modeling systems that includes BehavePlus, FireFamilyPlus, FARSITE, and FlamMap. They manage the operation, support, and expansion of the Wildland Fire Assessment System (WFAS) and the Weather Information Management System (WIMS). They also develop and support systems used in analyses by the Application Team.

BehavePlus Fire Modeling System Support

The BehavePlus fire modeling system is a nationally supported desktop application that produces tables, graphs, and simple diagrams of modeled fire behavior, fire effects, and fire environment. BehavePlus is used to model surface and crown fire spread rate and intensity, transition from surface to crown fire, fire size and effect of containment efforts, tree scorch height and mortality, fuel moisture, wind adjustment factor, spotting distance, and more. BehavePlus is not limited to a specific application, but rather is designed to be used for any fire management application for which fire model results are useful. It is used by all land management agencies (federal, state, and county), universities, consultants, and others. BehavePlus is used for a range of applications including wildfire prediction, prescribed fire planning, and fuel hazard assessment, as well as communication, education, and training.

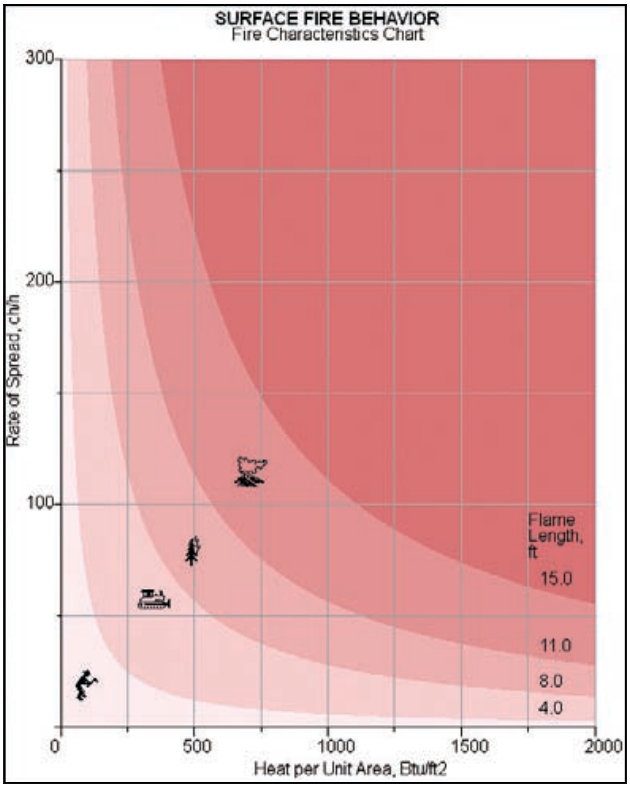
FMI staff led classroom and online training sessions on BehavePlus in 2012. A total of 66 participants from a variety of government agencies and universities participated in these sessions. In addition, a workshop was held in northern Montana to prepare approximately 15 students for the Advanced Fire Behavior Calculations (S-490) course, in which BehavePlus is extensively used. A questionnaire was created and disseminated during 2012 to assess current training in BehavePlus. Answers from the 256 respondents are being collated to determine needs and assess development of future training materials.

An agreement between Washington Office, Fire and Aviation Management (WO FAM) and FMI ensures FMI staff is available to assist the National Fire Applications Help Desk in answering questions regarding BehavePlus operation.

FMI Lead: Faith Ann Heinsch
Collaborators: Pat Andrews (FMI), Systems for Environmental Management
Agency Contact: Faith Ann Heinsch (FMI)
Status: Ongoing

Fire Behavior Characteristics Charts

A fire characteristics chart is a graph that presents primary related fire behavior characteristics—rate of spread, flame length, fireline intensity, and heat per unit area. It helps communicate and interpret modeled or observed fire behavior. The Fire Characteristics Chart software program plots either observed fire behavior or values that have been calculated by another computer program, such as the BehavePlus fire modeling system. A chart produced by the program is suitable for inclusion in briefings, reports, and presentations. Example applications include fire model understanding, observed crown fire behavior, ignition pattern effect on fire behavior, prescribed fire planning, and case studies. Separate charts are available for surface fire and crown fire because of differences in the flame length model used for each. The fire behavior chart is described in the publication "How to generate and interpret fire characteristics charts for surface and crown fire behavior" available at http://www.treesearch.fs.fed.us/pubs/37380.



Work on a new release for the Fire Characteristics Chart software program is currently underway. The surface and crown fire behavior characteristics chart options are being updated based on user feedback. A fire characteristics chart is also being created for the U.S. National Fire Danger Rating System. Improvements include addition of logarithmic chart scales, text boxes, improved color selections, and importation of fire danger rating indices.

Each year, FMI staff provides training on the use of the Fire Characteristics Chart software program. This year, approximately 60 participants from a variety of government agencies and universities participated in these training sessions. In addition, FMI works in collaboration with Systems for Environmental Management (SEM) to provide technical support for the program.

FMI Lead: Faith Ann Heinsch
Collaborators: Pat Andrews (FMI), SEM
Agency Contact: Faith Ann Heinsch (FMI)
Status: Ongoing
Presentation: Heinsch, F. A.; Andrews, P. L. 2011. Use of Fire Characteristics Charts for fire planning. Poster presentation at the Interior West Fire Ecology Conference, 14-17 November 2011, Snowbird, UT.

Left: An example of a fire behavior characteristic chart for surface fire.

Modeling Team

National Fire Danger Rating System Enhancements and Support

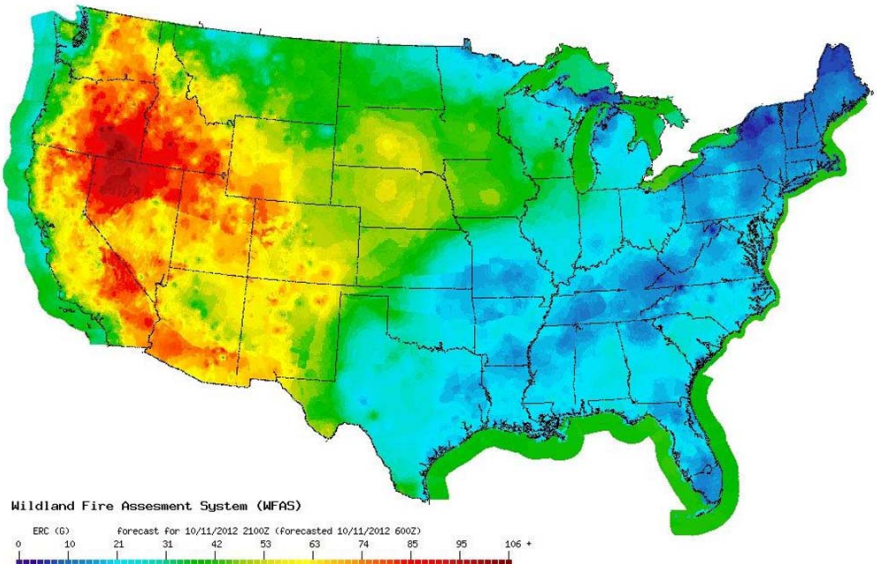
The National Fire Danger Rating System (NFDRS) is a system used by wildland fire management agencies to assess current fire danger at local and national levels. It consists of a variety of indices that portray current potential fire danger conditions. In 2012, FMI staff made several enhancements to the system.

The Wildland Fire Assessment System (WFAS) is an integrated, web-based resource to support fire management decisions. It has an extensive nationwide user base of federal, state, and local land managers. The system provides multi-temporal and multi-spatial views of fire weather and fire potential, including fuel moistures and fire danger classes from the NFDRS, as well as Keetch-Byram and Palmer drought indices, lower atmospheric stability, and satellite-derived vegetation conditions. It also provides fire potential forecasts from 24 hours to 30 days.

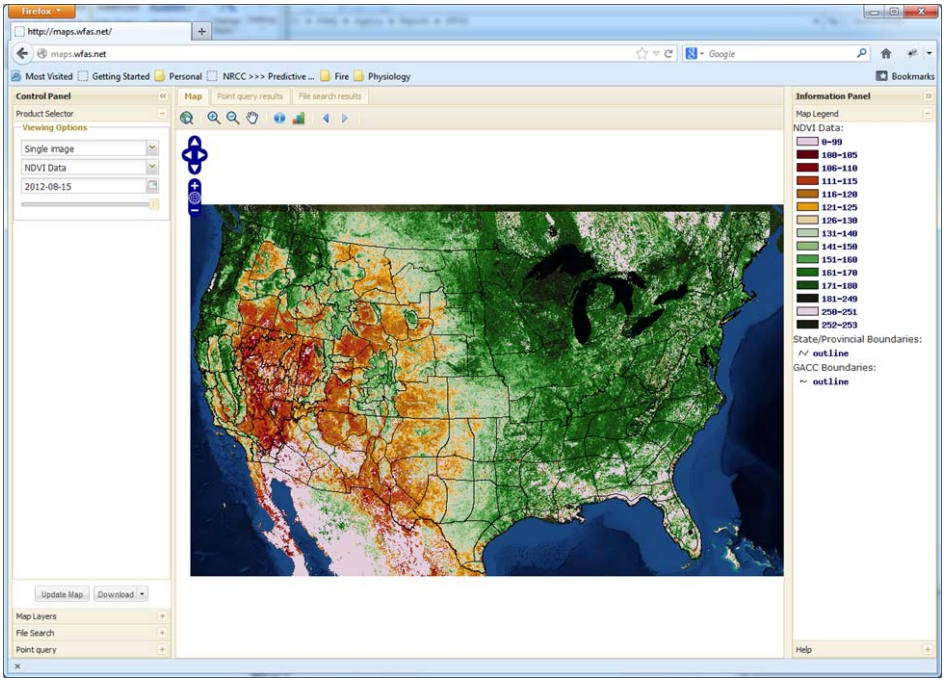
WFAS developers at FMI have been producing fire danger forecasts from the National Weather Service's National Digital Forecast Database (NDFD) for several years. This year, WFAS developers worked closely with Predictive Services meteorologists at the various Geographic Area Coordination Centers throughout the country to provide point forecasts for key Remote Automated Weather Stations (RAWS) located throughout the United States. WFAS now produces seven-day outlooks daily for over 1,000 weather station points. These outlooks are being used operationally to produce seven-day fire potential forecasts for every geographic area in the continental United States. These seven-day forecasts provide a much longer fire danger outlook than was previously available and are providing fire managers with tools to meet strategic planning needs. The point forecast interface that produces the seven-day fire danger forecasts from the NDFD can be accessed at http://www.wfas.net/.

Also in 2012, developers of the WFAS designed and implemented a state-of-the-art web mapping interface for the display and analysis of remotely sensed, spatial fire potential data. This new interface allows the rapid assessment of fuel conditions across a landscape, and it provides managers with several tools to assess fuel changes over time. The system is built on a suite of open-source tools that provide a means for efficient storage, display, and analysis of large spatial datasets. This new framework will be a building block for a new, integrated fire danger display and analysis system. The new interface complements the existing static LANDFIRE national maps and will provide more system flexibility by allowing users to define their own area of interest, link to weather station data in a tabular format, and perform searches for map features. The prototype for the interactive map can be accessed at http://maps.wfas.net/. This web mapping and analysis interface will provide the tools necessary for the rapid and effective dissemination of large spatial datasets to the fire management community and it will ultimately serve as the development platform for the next generation of fire danger rating systems.

Other improvements the NFDRS during 2012 pertain to the Washington Office, Fire and Aviation Management's (WO FAM) Weather Information



Above: An example of a next-day Energy Release Component forecast from the National Digital Forecast Database. These forecasts are now being used by Predictive Services meteorologists across the United States to produce seven-day fire potential forecasts.



Above: Improved WFAS fire danger web mapping interface (http://maps.wfas.net) for display and analysis of remotely sensed, spatial fire potential data.

Modeling Team

Management System (WIMS), located at the USDA National Information Technology Center in Kansas City, Missouri. WIMS ingests hourly weather observations from more than 1,800 RAWS across the continental United States, Alaska, Hawaii, and Puerto Rico. In 2012, FMI scientists working with the State Climate Office of North Carolina added 68 non-RAWS stations in North Carolina to WIMS using an Alternate Data Portal, which was prototyped by FMI staff several years ago. Opening WIMS to other weather networks is a high priority for the National Wildfire Coordinating Group (NWCG) Fire Environment Committee as they assess the future of the RAWS network.

In addition to development and maintenance of the NFDRS, FMI staff participated as core instructors for Intermediate NFDRS (S-491) and WIMS courses in four of the eleven NWCG Geographic Coordinating Areas, including Alaska, during 2012. Approximately 250 participants from a variety of government agencies and universities participated in these training sessions. FMI staff also led an effort in collaboration with the National Interagency Fuels, Fire, and Vegetation Technology Transfer (NIFTT) team to transition the three-day classroom WIMS course to an online, self-paced course.

Lastly, FMI staff provides national technical support for the NFDRS and associated programs through the National Fire Applications Help Desk and responded to over 45 elevated tickets on technical issues in 2012.

FMI Leads: Larry Bradshaw, W. Matt Jolly
Collaborators: Faith Ann Heinsch (FMI), NIFTT, NWCG Fire Danger Subcommittee, National Weather Service, Predictive Services, State Climate Office of North Carolina
Agency Contacts: Larry Bradshaw, W. Matt Jolly (FMI)
Status: Seven-day fire potential forecasts complete; support and tech transfer ongoing
Publications: http://www.wfas.net and http://maps.wfas.net

Above: The National Fire Danger Rating System provides a measure of the relative seriousness of burning conditions. Photo courtesy of the National Park Service.

Improvements to FireModels.org

National fire behavior systems and national fire danger system software developed and supported by FMI are housed at http://www.firemodels.org. Fire behavior systems available on this website include BehavePlus, FlamMap, and FARSITE. Fire danger systems include FireFamilyPlus. The website also houses several systems currently being developed by FMI staff, such as WindNinja. The website provides links to the latest releases and release notes, information about each system, training and tips for using the systems, bug reports, frequently asked questions, contact information, and publications related to each system. General information on fire behavior and fire danger rating systems is also available.

In 2012, new versions of FlamMap and WindNinja were made available on the website. In addition, FMI staff heightened visibility of systems-related publications available on the website. For example, fire behavior publications were added to the BehavePlus web page. In the future, several historical fire danger rating publications will be added to provide a history of the current U.S. National Fire Danger Rating System.

FMI Lead: Faith Ann Heinsch
Collaborator: Rocky Mountain Research Station, Fire, Fuel, and Smoke Science Program (FFS)
Agency Contact: Faith Ann Heinsch (FMI)
Status: Ongoing

Fire Incident Support

FMI staff provided fuels and fire behavior modeling, operations, and planning support during fire incidents occurring throughout the nation. In 2012, FMI staff contributed more than 800 hours in support of fire incidents in the U.S. Forest Service Northern Region (Region 1), Rocky Mountain Region (Region 2), and Southern Region (Region 8).

FMI Leads: Faith Ann Heinsch, LaWen Hollingsworth, W. Matt Jolly, Chuck McHugh
Collaborator: Rocky Mountain Research Station, Fire, Fuel, and Smoke Science Program (FFS)
Agency Contact: Kristine Lee (FMI)
Status: Ongoing

Right: Each year, FMI staff provide support during fire incidents. Photo courtesy of Rebecca Nore.

Modeling Team

FireFamilyPlus Development and Support

FireFamilyPlus (FFP) is an agency-independent desktop application. It supports the spectrum of analysis tools required by fire managers to successfully use the National Fire Danger Rating System (NFDRS) and the Canadian Forest Fire Danger Rating System from weather climatology data. It can be used to calculate fire danger rating indices and components and summarize both fire and weather data. The program can display data, compute values, and statistically analyze data in graph or report form. FFP can summarize weather climatology to produce climatological breakpoints for fire management decision making. It generates the Fire Danger Rating Pocket Cards required by the Thirtymile Abatement Plan and supports Predictive Services' functions at all the Geographic Area Coordination Centers.

FFP is the computational and analysis cornerstone for the Advanced Fire Danger Rating course at the National Advanced Fire and Resource Institute and the Intermediate Fire Danger Rating course (S-491) at the Northern Rockies Training Center (NRTC). It also provides climate summaries for techniques taught in the Long Term Fire Risk Assessment course (S-492) at NRTC.

A new version, FireFamilyPlus 4.1, was being developed and tested in 2012. The new version includes a new "Term Module" and other updates to match some recent changes in the Weather Information Management System (WIMS), such as a new Snow Flag and the ability to process unpublished observations with certain elements estimated by WIMS Gateway algorithms. The next-generation NFDRS live fuel moisture model based on a Growing Season Index is also prototyped in version 4.1, which will be released in 2013.

A service-level agreement between Washington Office Fire and Aviation Management (WO FAM) and FMI ensures FMI and Systems for Environmental Management (SEM) staff are available to assist the National Fire Applications Help Desk in answering questions regarding FireFamilyPlus operation. In 2012, FMI staff responded to more than 60 elevated tickets on FireFamilyPlus technical issues.

FMI Lead: Larry Bradshaw
Collaborator: SEM
Agency Contact: Larry Bradshaw (FMI)
Status: Ongoing

National Support for FARSITE and FlamMap Applications

The **Fire Area Simulator (FARSITE**) is a fire behavior and fire growth modeling system that incorporates spatial and temporal information on topography, fuels, and weather. It includes all of the operational fire behavior models, including surface fire, crown fire, spotting, fuel moisture, fire acceleration, and fuel consumption. Individually, the fire behavior models incorporated into FARSITE are classified as point-based or one-dimensional models because they produce fire spread rates, directions, and spread or spotting distances, based on properties of the environment obtained from one point on the ground at one point in time. When combined into FARSITE, the simulation generates fire growth and behavior in two dimensions using the varying values of the environment to calculate fire progress over time and space. This fire progression can be animated to show fire moving over landscapes.

FlamMap is a fire behavior mapping and analysis system that computes potential fire behavior characteristics. It creates raster maps of potential fire behavior characteristics (spread rate, flame length, and crown fire activity) and environmental conditions (dead fuel moistures, mid-flame wind speeds, and solar irradiance) over an entire FARSITE landscape. FlamMap uses spatial information on topography and fuels to calculate fire behavior characteristics for a single set of environmental conditions. Outputs and comparisons can be used to identify combinations of hazardous fuel and topography, aiding in prioritizing fuel treatments.

FlamMap5 was released in July 2012. The new version includes a number of improvements: WindNinja is embedded into the new version, allowing for the inclusion of gridded wind fields in analyses. Spotting is now included and accounted for in the Minimum Travel Time. Burn probability analysis now includes outputs of individual fire perimeters, text files with information on individual fire size and locations, and flame length probabilities in several categories. Additionally, ignitions can now either be random or provided by the user.

FARSITE and FlamMap are widely used by the U.S. Forest Service, National Park Service, and other federal and state land management agencies, as well as by international groups, in support of fire management activities. In 2012, an FMI representative led a webinar training course on FlamMap5 that was viewed by nearly 100 participants. FMI scientists provide Tier II technical support for FARSITE and FlamMap applications through the National Fire Applications Help Desk. FMI staff responded to over 35 elevated tickets on FARSITE and FlamMap technical issues in 2012.

FMI Lead: Chuck McHugh
Collaborator: Rocky Mountain Research Station, Fire, Fuel, and Smoke Science Program (FFS)
Agency Contact: Chuck McHugh (FMI)
Status: Ongoing

Modeling Team

Do Mountain Pine Beetle Outbreaks Change the Probability of Active Crown Fire in Lodgepole Pine Forests?

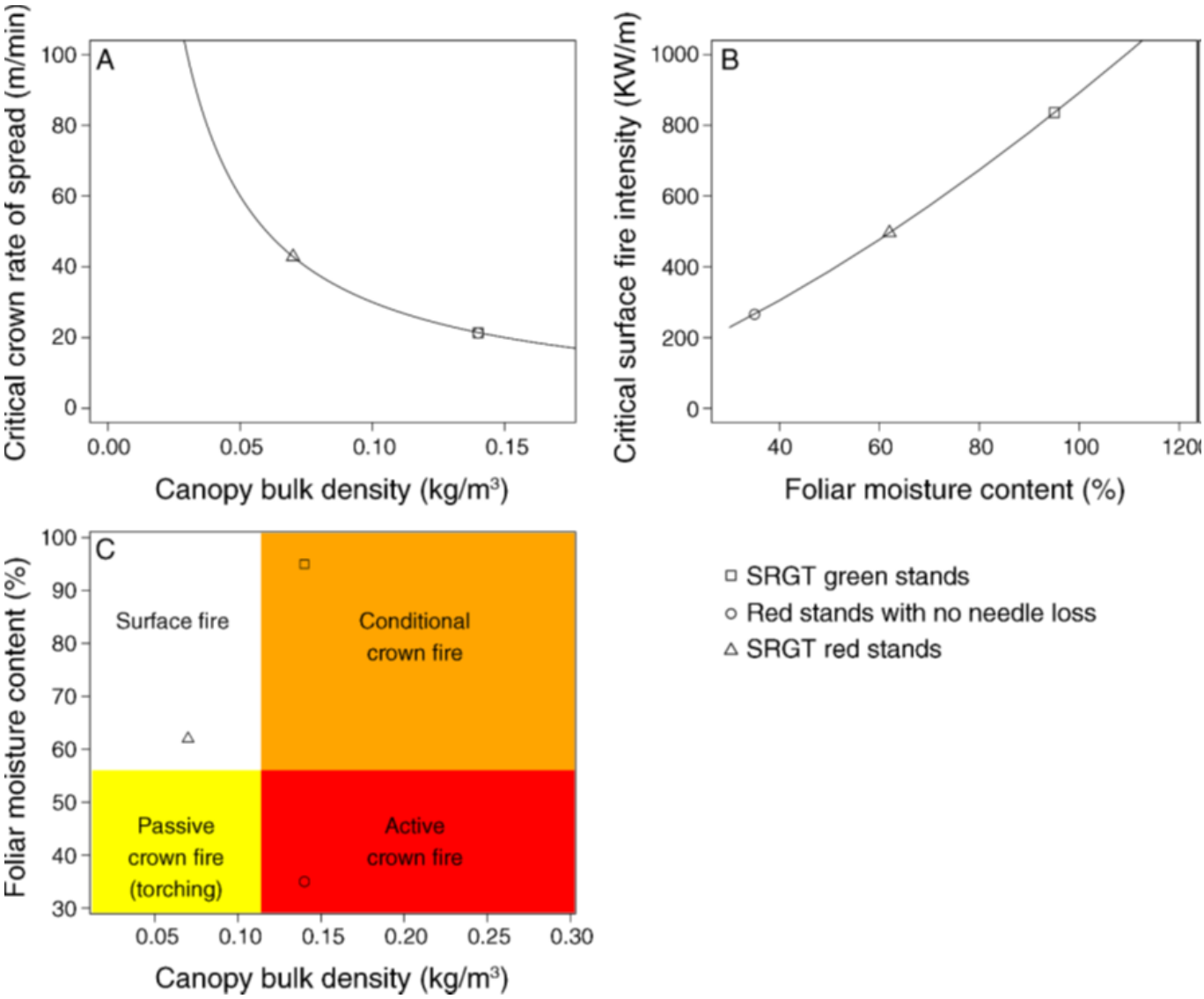
Millions of acres of forests in the western United States have been killed by mountain pine beetles and much work has been done to better understand expected fire behavior after an attack. Many of these studies use fire behavior prediction tools developed by FMI modeling team scientists, including NEXUS, BehavePlus, FARSITE, and FlamMap.

One such application was a recent study published in *Ecological Monographs* by Simard et. al (2011)*. This study represented a misapplication of the NEXUS fire behavior model. They used a fire behavior modeling framework with no mechanism for considering highly heterogeneous fuels, they omitted critical canopy and surface fuel changes in stands attacked by mountain pine beetle, and ignored potential increases in the inherent variability associated with fuels sampling in general and along a chronosequence. This led to a predicted reduction in crown fire potential in red-needle stands under moderate conditions.

Consequently, FMI scientists published a formal comment on this study documenting the difficulties of modeling mountain pine beetle-attacked fuels with existing fire behavior models. In their response, FMI scientists demonstrated that if Simard et. al (2011) had chosen estimates of surface and canopy fuel inputs that better described stands during the early stages of a mountain pine beetle attack, they would have found an increase in predicted crown fire potential in almost all cases, particularly during the first three years after an attack. This comment was published in the peer-reviewed journal *Ecology*.

** Simard, M.; Romme, W. H.; Griffin, J. M.; Turner, M. G. 2011. Do mountain pine beetle outbreaks change the probability of active crown fire in lodgepole pine forests? Ecological Monographs 81: 3-24.*

FMI Lead: W. Matt Jolly
Collaborators: Russ Parsons (Rocky Mountain Research Station Fire, Fuel, and Smoke Science Program (FFS)), J. Morgan Varner (Humbolt State University), Bret Butler (FFS), Kevin Ryan (FFS), Corey Gucker (FMI)
Agency Contact: W. Matt Jolly (FMI)
Status: Complete
Publication: Jolly, W. M; Parsons, R; Varner, J. M.; Butler, B. W.; Ryan, K. C.; Gucker, C. L. 2012. Do mountain pine beetle outbreaks change the probability of active crown fire in lodgepole pine forests? Ecology 93(4): 941-946. Available at: http://www.esajournals.org/doi/pdf/10.1890/11-1035.1.



Above: Crown fire modeling in mountain pine beetle-affected areas is complex and it is dependent on the inter-relationships between canopy bulk density and canopy moisture content. Consequently, it is crucial that care is given to selecting the inputs used in operational fire behavior prediction models. This figured illustrates the various types of fires that can be expected for a given range of canopy bulk density and canopy moisture content.

Modeling Team

Internship Program

The FMI internship program continues to be a successful partnership between research, universities, and management. FMI hosted 2 interns from The University of Montana. Matt Delany, part of the Climate Change minor program, focused on the calculation of National Fire Danger Rating System (NFDRS) indices in the Northern Rockies to look for trends related to climate change. His work was presented as part of The University of Montana showcase at the 5th International Fire Congress in Portland, Oregon, in December 2012. Rochelle LaMere, an undergraduate in the College of Forestry and Conservation, spent the summer working with the FMI Application Team and co-authored a poster on FMI, also presented at the 5th International Fire Congress.

FMI also hosted a U.S. Forest Service (USFS) intern from the White Mountain National Forest, Erin Lane, whose project is in part covered on page 8 of this report. The purpose of her internship was to address the question of how climate change may affect fire programs across the Eastern Region (USFS Region 9) in the near future.

Working with employees on a one-to-one basis provides FMI staff and fire scientists the opportunity to learn from representatives of the management community as much as they learn from FMI analysts and the interactions with the research scientists. This part of the program is at the heart of providing a bridge between managers and scientists. The internship program will continue to be one of FMI's priorities in 2013.

FMI Leads: Greg Dillon, Faith Ann Heinch, Kristine Lee
Collaborator: Rocky Mountain Research Station, Fire, Fuel, and Smoke Science Program (FFS)
Agency Contact: Kristine Lee (FMI)
Status: Ongoing

Rocky Mountain Research Station

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 the 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.

Station Headquarters
Rocky Mountain Research Station
240 W Prospect Road

Flagstaff, Arizona
Fort Collins, Colorado
Boise, Idaho

Moscow, Idaho
Bozeman, Montana
Missoula, Montana

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