

Research Accomplishments 2005



Rocky Mountain Research Station

Front Cover Photo: Blowup of the Black Mountain 2 Fire, August 2003, on the Lolo National Forest in Montana. Forest Service Research and Development sustains an active program of fire research and is the world's leader in fire science and related fields. The Station's Fire Sciences Laboratory in Missoula, Montana is dedicated to studying fire behavior, wildland smoke, and the effects of fire on ecosystems. Research related to ecological effects of fire and fuels treatments is underway throughout our territory. Learn more about the Station's fire research program, beginning on page 3. (photo by Kari Greer, National Interagency Fire Center, contract photographer)

Rocky Mountain Research Station

2005 Research Accomplishments



From Former Station Director Marcia Patton-Mallory



Fire has always been a major disturbance process shaping the development of western ecosystems. National organized fire suppression began following the 1910 fires in Idaho and Montana, called the “Big Blowup.” Catastrophic fires in the Interior West have had a major impact on national policy ever since.

The Rocky Mountain Research Station supports an active program of fire research and remains the world’s leader in wildland fire science and related fields. A large part of the Station’s fire research program supports the National Fire Plan. Together with cooperators from national, state, and local agencies and organizations, efforts continue to address four strategic goals: firefighting capacity, rehabilitation and restoration, hazardous fuels reduction, and community assistance. This *2005 Research Accomplishments Report* features, in part, research in support of the National Fire Plan, along with recent accomplishments in the areas of fire behavior, wildland smoke, and the effects of fires on communities and ecosystems. I hope you find it informative and a good reference source.

I also take this opportunity to announce that I have left my position as Station Director and taken on a new assignment as the USDA Forest Service’s National Woody Biomass and Bioenergy Coordinator. I will oversee and coordinate national efforts to find new and better ways to use wood residue from forest thinning and other hazardous fuels reduction and forest health restoration efforts. Thanks to the many who have supported and contributed to the success of the Station’s research program over the years. I look forward to continued cooperation with many of you in the years ahead.

Marcia Patton-Mallory

From Station Director Dave Cleaves



During 2005, the USDA Forest Service celebrated its Centennial, recognizing 100 years of successfully caring for the land and serving people. The Rocky Mountain Research Station has been, and continues to be, an integral part of the Forest Service mission, dating back to the Agency's beginning, with the establishment of the Santa Rita Experimental Range near Tucson, Arizona in 1903. Since then, the Station has grown, adapted, modernized, diversified, and transitioned into a world-class leader in natural resources research and development. It is the largest, most diverse station in the largest natural resource research organization in the world.

As the new Director of the Rocky Mountain Research Station, I am committed to building upon the legacy that the Station has established. Our mission: "develop and deliver scientific knowledge and technology that will help people sustain our forests, rangelands, and grasslands," and our vision: "provide society with options on the sustainable use and appreciation of forests and rangelands," are based on our values. Those values include: quality science that is objective, unbiased, credible and independent—we are dedicated to professional integrity and ethics; quality service that is responsive, timely, relevant, and customer-driven—we continually look for better ways to share state-of-the-art knowledge that stakeholders can understand and use; and quality relationships with partners and among employees—we recognize that listening to our customers and employees helps us meet the expectations of our stakeholders and the public.

I look forward to working shoulder-to-shoulder with our many partners, land managers, other researchers, and employees to further enhance our research program. We will continue to use science to find better ways to care for the land and serve people.

Dave Cleaves

Contents

A Look at RMRS	1
2005 National Fire Plan Research Update	3
Accomplishments	10
Research Highlights	11
Designing Prescribed Fire Projects for Reducing Fuels and Maintaining Wildlife Habitat	11
Bridging the Molecular and the Landscape in Forest Pathology	12
Tools to Plan Hazardous Fuels Treatments	13
Restoring Western Ranges and Wildlands	15
Public Perspectives on Wildfire and Fuels Management in the Southwest	16
Pinyon-juniper Woodland Expansion and Sagebrush Ecosystem Decline in the Great Basin	17
Where Our Water Originates	18
Social and Institutional Influences on Fire Stewardship in the Northern Rockies	20
Seasonal Migration and Home Ranges of Female Elk in the Black Hills of South Dakota and Wyoming	21
Microbial Impacts of Fire and Thinning	22
Reintroducing Fire into Southwestern Desert Grasslands	23
Our Research Programs	25
Arizona	25
Colorado	30
Idaho	36
Montana	42
Nebraska	52
Nevada	53
New Mexico	56
North Dakota	60
South Dakota	61
Utah	63
Wyoming	67
Honors and Awards	68
Community Involvement	71
Outreach to Under Represented Segments of Society	72
Natural Resources Conservation Education Program	72
Grants and Agreements	73
To find out more about the Rocky Mountain Research Station	75

A Look at RMRS

The Rocky Mountain Research Station is one of six regional units that make up the USDA Forest Service Research and Development organization—the most extensive natural resources research organization in the world. We maintain 12 field laboratories throughout a 14-state territory encompassing the Great Basin, Southwest, Rocky Mountains, and parts of the Great Plains. The Station employs nearly 500 permanent full-time employees, of which over 100 are research scientists.

We administer and conduct research on 14 experimental forests, ranges and watersheds, and maintain long-term databases for these areas. We also oversee activities on more than 260 Research Natural Areas (<http://rna.nris.state.mt.us>) and lead five ecosystem management and research partnership projects in Arizona, Colorado, Montana, New Mexico, and Nevada.

Our research program serves the Forest Service as well as other Federal agencies, State agencies, international organizations, private groups, and individuals. Research results are made available through a variety of technical reports, journals, publications, seminars, symposia, demonstrations, exhibits, and personal consultations. These help resource managers and planners balance economic and environmental demands for forest and rangeland resources worldwide.

Our work is guided by the following:

- Quality science that is objective, unbiased, credible, and independent.
- Quality service that is responsive, timely, relevant, and customer-based.
- Quality relationships with partners and among employees.

Our scientists are working to:

- Provide knowledge on the productivity, risks, and uncertainties associated with ecosystem disturbances.
- Assist planners and managers to better assess social values and how to manage among conflicting values.
- Develop computer models and other tools that help managers understand fire behavior, wildland smoke, and their effects on ecosystems and communities.
- Evaluate the dynamics of a healthy environment and provide guidelines for resource specialists to ensure the sufficient availability of clean water and air.
- Develop guidelines for land managers and policymakers that help restore and maintain wildlife and fish habitats.

Communicating with Stakeholders

Credible, useable, and effective scientific information is our product. We recognize that the scientific information we produce must be packaged, promoted, and delivered so that our stakeholders can understand it and use it effectively. As we disseminate information, we solicit feedback as to its relevance and usefulness, monitor the success of our communication efforts, and adapt strategies as needed.



Administration and Support Services Staffs

Station scientists rely on a contingent of administrative and technical personnel who support the Station's research program. Most are located at Station headquarters in Fort Collins, Colorado, and at the Ogden, Utah, Service Center; others work at laboratory locations. These staffs include: Civil Rights; Budget; Public Affairs; Science and Technology Applications; Acquisition Management; Facilities Management; Human Resources; Library; Publishing Services; Safety, Health and Environment; Senior, Youth and Volunteer Program; and Statistics.

Director's Office Staff

Station Director: Marcia Patton-Mallory

(Dave Cleaves, Station Director as of October 1, 2005)

Deputy Station Director: John Toliver

Assistant Station Directors for Research:

Alison Hill

Janine Powell

Jim Saveland

Mike Wilson (Forest Inventory and Analysis)

Assistant Station Director for Operations:

Galen Hall (Position vacant as of July 22, 2005)

"This publication is a great example of what cooperative efforts between National Forest Systems Regions and Research Stations can achieve. The authors are all to be commended on this joint effort." (Regional Vegetation Ecologist, USDA Forest Service, Utah)

2005 National Fire Plan Research Update

When the management of the forest reserves (now called National Forests) was transferred to the new Forest Service in 1905, the agency took on the responsibility of creating a formal program for addressing wildfires.

The Forest Service was still in its infancy when the Great Idaho Fires of 1910, called the “Big Blowup,” burned over 3 million acres, shaking forest administrators and the public alike, and awakening everyone to the fact that our natural resources needed protection.

In 1916, the Forest Service issued an appeal to its experiment stations to initiate research on forest fires. The appeal proposed a general program to study meteorological and climatic conditions; evaluate the rate of fire spread under various conditions of weather, fuels, topography, and cover; and endeavor to predict dangerous wildfire conditions. The devastating 1919 fire season, together with the launching of a national forestry policy, was the beginning of a formal long-range fire research effort.

The territory now served by the Rocky Mountain Research Station is home to some of the earliest wildfire studies, led by Forest Examiner Harry T. Gisborne. During the 1920’s, 30’s and 40’s, his investigations in the Northern Rockies laid much of the groundwork for today’s fire research programs.

In 1921, the Forest Service moved its Priest River Forest Experiment Station headquarters from

Idaho to Missoula, Montana. Studies focused on fire behavior, lightning, fire weather forecasting, damages and values, fire control planning, and aerial fire control.

In 1948, the agency created a Division of Fire Research. Twelve years later, the new Northern Forest Fire Laboratory on the outskirts of Missoula, Montana, was dedicated by President Eisenhower. Work centered on fire control systems, fire physics, and fire behavior.

Over the next four decades, giant strides in fire research were made throughout the Rockies and Southwest. Studies were conducted on fire retardant; the National Fire Danger Rating System was established; and several fire effects, fire behavior, and fire chemistry models were developed.

Forest Service Research and Development (R&D) sustains an active program of fire research and remains the world’s leader in wildland fire science and related fields. In Fiscal Year 2005, R&D received \$22 million through the National Fire Plan to continue to address four strategic goals: **fire fighting capacity, rehabilitation and restoration, hazardous fuels reduction, and community assistance**. With this funding, R&D conducted 435 studies (new or continued) in all 50 states, hired 5 new scientists and 46 technicians, and established 40 new cooperative studies and contracts with universities and other partners totaling \$1.4 million.

Following is a sampling of the many recent Station research accomplishments based on the goals of the National Fire Plan and the Healthy Forests Restoration Act.

- The Station continues to support the Rocky Mountain Center (RMC) that provides comprehensive, real-time, high-resolution fire weather intelligence and smoke forecasts for



Harry Gisborne was considered by many to be the “father of forest fire research.”



the interior western United States. Based in Fort Collins, Colorado, RMC (www.fs.fed.us/rmc) assists in fire and smoke management through regional simulations of specific fire-weather phenomena, including fire danger, fire behavior, and smoke dispersion.

Products are specifically tailored to meet operational needs of fire managers, incident commanders, and air resource specialists during periods of intense firefighting and prescribed burning.

- Scientists at the Fire Sciences Laboratory in Missoula, Montana, established an automated system to routinely retrieve, process, and store real-time satellite data and provide daily maps of active fire locations in most of the continental U.S. The latest information on active fire perimeters is routinely processed and displayed daily on the Fire Sciences Laboratory web site to provide support for firefighting activities.
- A new method for mapping burn scars of large fires in real time using Terra and Aqua satellite data was developed in conjunction with colleagues at NASA that helps determine the amount of fuel consumed and the amount of pollutants produced.
- At the Station's Aldo Leopold Wilderness Research Institute in Missoula, Montana, the co-funded National Fire Plan/Joint Fire Science Project "Wildland Fuels Management—Evaluating and Planning Risks and Benefits" implemented the Fire Effects Planning Framework (FEPF) for identifying where and under what conditions fire may create benefits or pose threats to ecological conditions or management goals. This system addresses the need to integrate fire management with land management planning. Several Forest

Service and National Park Service fire managers are using or plan to use FEPF.

- The project "Interactions Among Fire, Exotic Plants and Bio-control Agents" produced important results showing that the roots of exotic



The Rocky Mountain Center provides simulations of fire weather phenomena, including fire danger, fire behavior, and smoke dispersion.

knapweed plants treated with a bio-control agent produced increased amounts of a natural herbicide, thus potentially inhibiting the growth of native grasses. This research show promise in dramatically changing the way managers practice post-fire weed control and rehabilitation.

- The project "Comparing Fire-scar Analysis, Fire Atlas Records and Fire

Simulations in the Saguaro-Rincon Mountain Wilderness" (AZ) provided accurate information about historic fire regimes, thus helping managers and planners set management goals and prescriptions. This project also corrected some biases associated with fire history data, refuting some recent criticisms about the methods used for reconstructing fire history.

- The co-funded National Fire Plan/Joint Fire Science Project effort titled "Can Wildland Fire Use (WFU) Restore Historical Fire Regimes in Wilderness and Unroaded Lands" applies the decision support modeling tool BurnPro to help plan for WFU and to measure and model the effectiveness of WFU for meeting management objectives in wildernesses, national parks, and beyond. Wildland Fire Use is rapidly expanding. BurnPro creates maps of the probability of burning from information on ignitions, historical fire weather, topography, and fuels. These maps are used to identify areas where management objectives can be most easily met through natural ignitions, versus areas where managers will face more difficult challenges in meeting objectives.

Findings help managers to understand and anticipate where the current fire management plan is likely to meet management objectives and where it might fall short.

- A 3-year project is developing methods to measure and track the cumulative consequences of past fire suppression decisions. Fire behavior models determine where fires will spread and what effects will result if they are not suppressed. Results from this research, posted at <http://leopold.wilderness.net/research/fprojects/F006.htm>, will improve the prioritization and planning of fuels management activities, allow managers to track the cumulative effects of suppression, and communicate tradeoffs to the public.
- Studies are underway to determine how fire management tactics (e.g. hand lines, dozer lines, fire retardants, etc) influence short-term, fine scale, post-fire weed establishment and long-term, landscape scale, post-fire vegetation patterns. This work evaluates the use of Forest Inventory and Analysis (FIA) sampling methods for the short term detection of weeds following fire, and augments existing FIA data with remotely sensed imagery to track changes in landscape patterns. Such findings help managers understand the unintended effects of fire management, such as introducing weeds and altering vegetation patterns.
- Scientists are investigating the influence of climate on the occurrence of large regional fire events. A collaborative study with the University of Idaho identifies regional fire years from multi-century fire scarred tree-ring reconstructions and 20th century fire atlases. Preliminary results suggest that there are climate indices that are predictive of regional fire events, and that fires tend to be larger under certain climatic conditions. Results



Fire behavior models determine where fires will spread and what effects will result if they are not suppressed.

help determine how often, and why, regional fire events have occurred in the past, and where and under what climatic conditions fuels management is most likely to be successful.

- A national survey and phone interviews of wilderness fire managers identified the incentives and disincentives for wildland fire use (WFU) facing fire managers. The cooperative project with the University of Idaho identified key factors that influence fire management decisions and found that decisions to implement WFU are influenced by organizational culture, environmental factors, resource availability, and public support. Results suggest that individuals who overcome the barriers and disincentives to WFU have a strong belief and commitment to restoring fire to the land. Such information can help improve organizational effectiveness and the quality and consistency of decisions.
- Station researchers investigated the causes and consequences of lack of public trust in management agencies and their ability to carry out fire and fuels management consistent with land management objectives. Study results help fire and fuels managers understand the social context within which they make and implement decisions, and better involve the community in the collaborative planning process.
- Scientists developed methods for collecting data on the meanings that residents place on areas being considered for fuel treatments, and mapped this information in a GIS so human values can be



integrated into planning fire and fuels treatments. In addition to their use in planning fuels treatments, these results provide a framework for the public to use when expressing their needs at planning meetings.

- At the Southwest Forest Science Complex in Flagstaff, Arizona, data from watershed hydrologic response studies are validated with the MIKE-SHE and MIKE-FLOOD watershed models to give burned area emergency rehabilitation teams real-time estimates of flood potential. The models are particularly useful for post-wildfire analyses since they can incorporate characteristics such as rainfall, soil conditions, burn severity, and subsurface flow.
- Station scientists worked with the White Mountain Apache tribe in Arizona to develop rehabilitation plans for affected riparian wetlands following the Rodeo-Chediski wildfire (2002), the largest in Arizona history. Research has helped tribal staff apply for grants and provided training in survey techniques so they can monitor the outcomes of mitigation treatments. Plants to help rehabilitate burned areas are being raised in Station greenhouses for transplanting.
- Scientists evaluated the effects of the Three Forks Fire on fish in streams of the White Mountains, Arizona. These waters harbor native fish, including threatened species, as well as non-native fish. Monitoring studies provide information that helps understand how streams respond to wildfires in the Southwest.
- At the Station's Shrub Sciences Laboratory in Provo, Utah, studies on using native plant materials to restore big sagebrush steppe and pinyon-juniper communities following wildfire

show: aerial seeding of grasses is much more effective when the seeding is followed by chaining than when no postfire treatment is administered; unburned sagebrush sites support a larger number of bird species than burned over sites dominated by perennial grasses; and biological control of the invasive cheatgrass may be possible with a headsmut fungus.



Findings help fire managers understand the social context within which they make and implement decisions, and better involve the community in the collaborative planning process.

- Studies based in Flagstaff, Arizona, investigated the impacts of two fungal pathogens (a rust and a powdery mildew) and a parasitic whitefly on the growth and reproduction of leafy spurge. Leafy spurge and other exotic weeds often invade areas following wildfire and prescribed burns. Findings show that reproductive ability of spurges was significantly lower in the presence of the rust, the mildew,

the whitefly, and with various combinations of the three. Scientists conclude that these native pathogens and insects may indeed have the potential to be used as native biocontrol tools for leafy spurge in parts of Arizona.

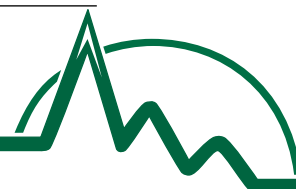
- Scientists in Albuquerque, New Mexico have just completed a 10-year study on the effects of natural wildfire and prescribed burning on grasslands and woody plant species in arid southwestern grasslands. Findings, which have been presented at various outlets nationally and internationally, are helping grasslands managers determine areas where fire might be used to meet management goals; set realistic goals for woody plant management; and determine proper fire return intervals.
- A web interface for a new model to estimate probabilities of runoff and gully initiation after fire and fire mitigation was completed by scientists in Boise, Idaho. The Fire Enhanced Runoff

and Gully Initiation Model allows managers to estimate expected changes in runoff/erosion given information on fire severity, selected treatments, and climatic events. These estimates help determine where benefits from proposed treatments can be realized and where efforts are essentially wasted.

- The Station's Fire and Aquatic Ecosystems website (www.fs.fed.us/rm/boise/teams/fisheries/fire/firehome.htm) provides links and resources from multiple research efforts that are being incorporated in regulatory consultation, forest planning, and burned area emergency rehabilitation planning. In 2005, there were more than 1,700 downloads of publications generated from this project.
 - The Great Basin Native Plant Selection and Increase Project, based out of Boise, Idaho, develops new native plant materials for Great Basin restoration efforts. Results improve the composition of degraded plant communities, improve diversity, slow the spread of invasive species, and restore more natural fire regimes.
 - Work in Boise, Idaho was completed on a major revision of the Water Erosion Prediction Project that predicts the impacts of fuel management on peak and annual flows. This is of vital importance to over 3,000 communities that rely on forest watersheds for their water supply.
 - Scientists with the Forest and Grassland Research Laboratory in Rapid City, South Dakota, are investigating fuel loading associated with roundheaded pine beetle infestations. Results indicate that bark beetle mortality can cause
- increased fuel loads, influence fire behavior, and will likely increase the severity of a fire by increasing large coarse woody debris. Findings have profound implications for managing tree mortality resulting from bark beetle outbreaks.
 - The Station co-sponsored a workshop to share information and discuss issues surrounding chipping and mastication of thinned trees as a fuels mitigation approach in Colorado's forests. The workshop has facilitated a network of interested parties. Preliminary reports have been shared with other resource managers and work is on-going to complete a synthesis of the current state of the ecological knowledge on these treatments. Workshop presentations are available at www.frftp.org/chip_mast_workshop.htm.
 - Work is underway to help understand the dramatic increase in woodborer populations in the Black Hills of South Dakota. Recent fires in the Black Hills led to eruptive populations and raised questions related to sampling and monitoring approaches, species of woodborers present, status of trees preferred, and the suitability of mountain pine beetle-infested trees compared to fire-killed trees. Findings help provide inventory and monitoring tools to better sample woodborer densities, understand their relationships to post-fire environments, and their interactions with mountain pine beetle-infested and fire-killed trees.
 - Studies on the Manitou Experimental Forest in Colorado investigate how fuel loading impacts prescribed fire intensity, duration, depth of heat pulse into the soil, and magnitude of soil temperatures caused by a fire. Research results

"I wanted to send out a quick note on what a great job you all did as members of the Rapid Response Decision Support Team and the service you provided to the Blossom Complex down here on the Siskiyou. You provided products that really connected with the Incident Management Team, the local agency administrators, and folks from Fire and Aviation. This was a great opportunity for us to get our feet wet with some of the concepts you have been working on. Thanks so much for a great job. I know how hard you all worked to get the information together."
(National Wildland Fire Technology Transfer Specialist, National Interagency Fire Center, Idaho)

provide tools to assist land managers in the use of prescribed fire to benefit ecosystems, and to reduce the potential for harm by examining how the soil's physical properties and different fuel amounts, geometries, and loading



densities influence soil recovery and forest regeneration after fire.

- Researchers from Missoula, Montana sponsored the 15th North American Dendroecological Fieldweek workshop, held in McCall, Idaho. Students, professors, and natural resource managers were taught how to locate fire history samples in the field, prepare them for examination, and determine year and season of fires.
- Researchers at the Southwest Forest Science Complex in Flagstaff, Arizona, led a revision of the Mexican Spotted Owl Recovery Plan (http://www.fws.gov/ifw2es/mso/recovery_plan.htm) to include recommendations to reduce threats of stand-replacing fires on owl habitat, and provide guidelines for use of prescribed fire and thinning.
- Fort Collins, Colorado scientists jointly organized a workshop on wildfire risks and human reactions, held in Santa Fe, New Mexico. A result of the workshop is a book titled *Wildfire and Fuels Management: Risk and Human Reaction*. The volume is being submitted for review to Resources for the Future.
- Federal, state, and local communities continue to request the Station-produced “Wildfire: Preventing Home Ignitions” and “Protecting Your Home from Wildfire” videos. Over 10,000 copies have been distributed.
- In Albuquerque, New Mexico, studies are designed to gather historic and contemporary information on public knowledge, beliefs, attitudes, and practices related to fire use and fuels management in the Southwest, and provide this information to land managers in a user-friendly format. Results from this work is improving communication and understanding between land managers and the public concerning fire and fuels management. Reports on this work are available at www.irsolutions.net/beta/.
- The Fire Chemistry Unit in Missoula, Montana, is currently developing a versatile, real-time nationwide smoke dispersion forecasting system. The Weather Research and Forecasting (WRF)—Smoke Dispersion System, predicts the concentrations of particulates and pollutants downwind from large wildfires. Through cooperation with NOAA and the National Weather Service, the provisional version of the forecasting system will generate nationwide 12-36 hour forecasts of fire spread, fire pollutant emissions, smoke dispersion and pollutant concentrations in the United States and Canada. It is scheduled to debut prior to the 2006 fire season. Learn more at www.firelab.org.



Study results provide tools to assist managers in the use of prescribed fire to benefit ecosystems.



Research helps improve communication and understanding between land managers and the public concerning fire and fuels management.

“Thanks so much for bringing this to my attention. I’ve been trying to locate this kind of thing for a while. I knew it had to be out there somewhere. Actually, I was on a burn yesterday and word has it you guys at the Rocky Mountain Center nail it nearly every time!” (Southern California Chaparral Field Institute, California)



Accomplishments

During 2005, the Rocky Mountain Research Station:

- Produced 655 technical publications and journal articles (a partial listing is available on the Station's website at www.fs.fed.us/rm/main/pubs.html).
- Provided 163 tours to educational and professional groups.
- Presented 207 short courses and training sessions to educational and professional groups.
- Offered 745 presentations before scientific and professional organizations.
- Presented 180 audiovisual presentations on research findings.
- Gave 213 presentations to lay audiences.
- Completed 1,566 technology transfer activities.
- Developed 32 new inventory technologies.

Examples of Significant Accomplishments Include:

- In honor of the Forest Service's 100th Anniversary in 2005, the Station co-sponsored three regional centennial forums that addressed conservation, current challenges and opportunities, and future needs. Forums were held in Fort Collins, Colorado, Missoula, Montana, and Boise, Idaho.
- The Station co-hosted an aspen conference in Cedar City, Utah to provide information on managing aspen on western landscapes.
- Scientists in Moscow, Idaho, organized an Armillaria Root Disease workshop as part of an ongoing industry collaboration effort.
- The Station co-sponsored a Fort Collins, Colorado workshop on "Chipping and Mastication in Forest Ecosystems." The event brought together scientists and managers to discuss the potential ecological effects of fuel treatments along Colorado's Front Range. Presentations are available at www.rockymountainwildlandfire.info/frftp.htm.
- The Station was part of a ground-breaking ceremony for a new Forest Service complex in Rapid City, South Dakota. The facility will house the Station's Forest and Grassland Research Laboratory, along with the Black Hills National Forest's Mystic Ranger District, the Rocky Mountain Region's Forest Health Management Service Center, and a visitor center.
- Scientists and support staff in Missoula, Montana, co-hosted the Eighth International Wildland Fire Safety Summit in Missoula. The event brought together wildland firefighters and managers from different countries, agencies, and levels to discuss common problems and approaches to solving them.
- For the second year, researchers in Missoula, Montana, conducted a workshop on landscape level fuel treatment analysis for fire managers of the Greater Yellowstone Area.
- The Station's Publications web page (<http://www.fs.fed.us/rm/publications/>) received over 2,000 hits per month; the Station posted over 400 publications to its web site; and filled 120,000 requests for hard-copy Station publications.

Research Highlights

Designing Prescribed Fire Projects for Reducing Fuels and Maintaining Wildlife Habitat

The long-term persistence of many bird species, including several designated as management indicator species (MIS) and sensitive species by federal and state agencies, is dependent on landscape patterns created by fire. Most fuels reduction plans focus on reducing hazards of wildfire without much consideration given to effects on wildlife populations and their habitats. A lack of scientific information prevents managers from adequately predicting the effects of different fire management activities on bird communities and their habitats. This can present significant scientific, legal, and social ramifications for land management agencies attempting to implement the National Fire Plan and the Healthy Forests Initiative.

The link between fuels management and post-fire bird communities is of particular concern in ponderosa pine forests. For example, litigation over black-backed and Lewis's woodpeckers has threatened the implementation of land management plans on several National Forests. Thus, planning and implementing fire management programs require understanding of the cumulative effects of fire management on sensitive wildlife species. To ensure the continued persistence of fire-associated bird species, and achieve the goal of decreasing fire hazards on public lands, Station scientists in Bozeman, Montana, and Flagstaff, Arizona, are examining the extent to which different fire management activities contribute to achieving these goals. Researchers are conducting effectiveness monitoring for prescribed fire, and evaluating fire effects on habitats and populations of birds in ponderosa pine forests over multiple years and locations of the Interior West. This research is unique because fuels, wildlife habitat, and wildlife



Black-backed woodpeckers are responding favorably to prescribed fire. The species is nesting in high densities after prescribed fire in locations that were previously unoccupied before fire treatments.

populations are characterized under different pre- and post-fire conditions.

Studies are underway at 11 locations in 8 western states in partnership with 11 National Forests. At each location, at least 2 prescribed fire treatment units (600-1000 acres each) are paired with a control unit. Fuels and other vegetation characteristics are being measured to assess the effectiveness of treatments in reducing fire risk. To evaluate bird responses to fire treatments, bird point counts are being conducted to estimate songbird population sizes, and nests of cavity-nesting birds are monitored to determine nest densities and nest survival before and after prescribed fire. These data were collected for 2 years before prescribed fire treatments. Between 2004 and 2005, fire treatments were implemented on nearly 10,000 acres at 8 of 11 locations. One year of post-treatment data supported our expectations that fire-associated species at risk would respond favorably to prescribed fire treatments.



Pre- and post-fire vegetation characteristics are being used to predict post-fire distributions of MIS and sensitive species of birds. Research results were used to identify reserve habitats for MIS and proved defensible in court. Results are also helping resource managers: (1) design and implement effective post-fire management projects, prescribed burns, and fuel reduction treatments while maintaining wildlife habitat; (2) identify potential resolutions in management for MIS and sensitive species of birds in relation to fire management activities; (3) conduct NEPA analyses, consultations with regulatory agencies, forest planning, and litigation; and (4) evaluate effectiveness of fuels treatments in meeting their fuel reduction objectives.

More information on these studies can be found at <http://www.rmrs.nau.edu/lab/4251/birdsnburns/index.shtml> and in “Factors Influencing Occupancy of Nest Cavities in Recently Burned Forests.” *Condor* 106:20-36; “Fire and Avian Ecology in North America.” *Studies in Avian Biology* 30:1-197; and “Role of Prescribed Fire in Maintaining Breeding Bird Diversity in Ponderosa Pine Forests of the Western United States.” Published Abstract presented at The Ecological Society of America, 90th Annual Meeting, 11 August 2005.

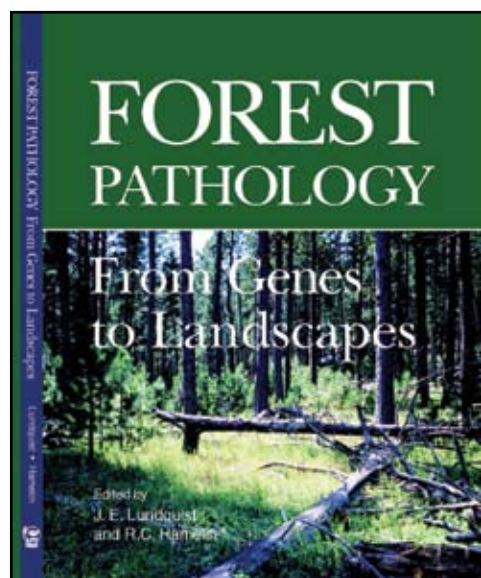
Bridging the Molecular and the Landscape in Forest Pathology

As ecological threats to forest health and sustainability intensify and new threats emerge, forest pathology is playing an increasingly important role. All who depend on forests must deal with forest diseases at one scale or another and many forest pathologists wear more than one hat—they are molecular biologists, spatial statisticians, geographic information specialists, remote sensing experts, and more. What unifies them is that they study the interactions of small, rapidly developing microorganisms within big, spatially heterogeneous, slow-developing forest landscapes. Spanning these vast scales makes forest pathology distinctly different than other fields in forestry, plant pathology,

or disturbance ecology, and creates many unique challenges.

Station scientists in Fort Collins, Colorado, along with cooperators at the Canadian Forestry Service, bring together in a single volume published by the American Phytopathology Press a comprehensive treatment of emerging topics in forest health. Titled *Forest Pathology—From Genes to Landscapes*, the book reviews both basic and applied research, covering new research technologies that are changing the traditional approaches to the study and management of forest diseases, and rapidly expanding our understanding of epidemiology, etiology, impact assessment, and other core areas of forest pathology and disease management. It illustrates how forest pathology is not just about controlling tree diseases, but has taken on many new dimensions, cutting across many disciplines. This book offers the most extensive, comprehensive, and complete treatment of many emerging topics in forest health, especially from the North American perspective.

Forest Pathology—From Genes to Landscapes highlights the integration of landscape ecology with the molecular biology of pathogens. Chapters describe genomics, molecular epidemiology, bark beetle/disease interactions, ecosystem impacts, physiology of pathogenesis and resistance, blue



stain, application of transgenics, operational disease resistance strategies, non-timber impacts, man-made exotic ecosystems, disease patterns in forest structure, and spatial analysis of diseased landscapes. It also establishes a framework for the study of landscape pathology. The book uses a mixture of literature reviews and case studies to show how pathologists are bridging the understandings gained from molecular biology to the landscape scale as well as understanding how landscape dynamics influence molecular genetics and population dynamics of diseases at fine spatial scales.

Understanding the dynamics of diseases in complex ecosystems and describing their impacts are major issues in plant pathology and natural resource management today. This book is an important contribution to the fields of forest pathology and ecology and an important reference for forest pathologists, scientists, forest managers, ecologists, molecular biologists, geneticists, landscape ecologists, and other professionals. The volume serves as a guide to previous work as well as a source of the most current information. The book will be of interest to students, scientists and managers attempting to understand new directions in phytopathology, providing clarity about these issues and the unique challenges they present to natural resource management.

Tools to Plan Hazardous Fuels Treatments

Station scientists in Missoula, Montana, and cooperators, are part of a new collaborative effort, called the Fuels Planning: Science Synthesis and Integration Project, that brings together scientists and professionals with the common goal of making the best science relating to fuel treatments available to managers. Emphasis is on: Social Considerations, Forest Structure and Fire Behavior, Economic Considerations, and Environmental Consequences.

The scope of the work centers on dry, interior forests with high fuel loads and potential for

uncharacteristically severe crown fires (i.e., ponderosa pine, Douglas-fir/mixed conifer, and dry lodgepole pine types). Products, designed to be used to plan activities at the project level, include peer-reviewed publications (syntheses of existing information, annotated bibliographies, and guidebooks), easy-to-digest one-page fact sheets, links to useful information databases, and new and existing software tools. Potential users include fuels specialists, resource specialists, forest planners, ID teams, and others, including the public.

An important step is understanding the concerns of the Public, and engaging them in the planning process. The Social Considerations Team determined some of the important issues and needs, and synthesized information into fact sheets and reports.

Few planners have economists available to estimate the costs of proposed alternatives. The Economic Considerations Team developed My Fuel Treatment Planner, a decision support tool (in an Excel-based spreadsheet) that can be used to estimate cost, revenue, and economic impact.

One way the planner can estimate whether a proposed treatment will result in desired results is to consult the Fire Behavior Guidebook that uses the existing software model FVS/FFE (Forest Vegetation Simulator/First order Fire Effects) to provide examples of forest structural conditions and treatment results in various regions of the Interior West, and assistance to users in making their own custom runs of this model.

Managers must evaluate the consequences of any treatment to soil, air, water, plants, insects and disease, and wildlife habitat. The Environmental Consequences Toolkit has two parts: software and a clearinghouse of information resources. These resources include publications produced by the Environmental Consequences Team, an annotated bibliography of publications about fuel treatments, and links to other useful websites. The Team also developed new software tools or modified existing ones (for example, making them more user-friendly).



The most commonly applied fuel treatment is prescribed burning. Because smoke can decrease air quality in sensitive airsheds, the Smoke Impact Spreadsheet estimates local smoke production, emissions, and dispersion.

Erosion potential is often a concern. WEPP-FuMe is an enhanced variation of Disturbed-WEPP, an existing software tool that estimates the probability of sediment yield and flooding after disturbance (e.g., burning and logging).

Users get estimated effects of treatment on trees (density, size distributions, canopy cover, regeneration, and mortality) from custom FVS/FFE output or from the Fire Behavior Guidebook. Plants on the forest floor (understory) may be a concern—the planner may need to consider the potential effects of treatment on weed invasions or other plant species of interest (those important for forage, wildlife habitat, and threatened and endangered species). The Understory (Plant) Response Model (URM) provides a comparative evaluation of treatments on any non-woody vascular plant species in the Interior West.

Where potential exists for insect or disease infestation, the FVS/Insect & Disease (extension of FVS) estimates potential infestation from several important root diseases and bark beetles. The Armillaria Response Model (ARM) is an improved predictor of areas where Armillaria root rot could occur after treatment.

Finally, the Wildlife Habitat Response Model (WHRM) is new software that provides qualitative estimates about the consequences of proposed treatments (positive, negative, null effects) to most vertebrate animals in the interior West, both aquatic and terrestrial.

These products, useful to fuels and resource specialists, forest planners, and others, were evaluated by potential users and scientific peers, and their comments incorporated in the tools and publications. To view fact sheets, publications, software tools, and information clearinghouses visit: http://www.fs.fed.us/fire/tech_transfer/synthesis/synthesis_index.



The Fuels Planning: Science Synthesis and Integration Project makes the best science available to help plan fuels treatments.

Restoring Western Ranges and Wildlands

The Rocky Mountain Research Station has just published a new three volume set titled *Restoring Western Ranges and Wildlands* that is a “why, how to, and what” on rehabilitating and restoring wildlands in the Inland West of the United States. Volume 1 treats history, ecological principles, equipment, herbicides, seeding, and management; Volume 2 focuses on plant materials—grasses, forbs, and shrubs; and Volume 3 is devoted to seed biology and planting stock as well as appendixes of common and scientific names, an substantive index, and extensive reference section.

The 18 authors and compilers present wildland restoration principles, philosophy, and practices in a review and synthesis format documented by citation, discussion, and review of original research. Volume 1 includes the history of range and wildlife habitat restoration in the Intermountain West, a description of the geographical and ecological background, the climate and terrain, and soil factor considerations for the area of application. This volume also presents how to control plant competition, the use of herbicidal and mechanical control, prescribed burning, seedbed preparation, seeding practices, and the incorporation of wildlife habitat needs, including animal nutrition requirements, into restoration and management practices. There is also a disussion on plant diseases in relationship to restoration of disturbed wildlands. The authors conclude Volume 1 with guidelines for restoring and managing the principal plant communities (subalpine herblands and upper elevation aspen openings, wet and semiwet meadows,

inland saltgrass, riparian, aspen-conifer, mountain brush-ponderosa pine, juniper-pinyon, sagebrush, salt desert shrub, blackbrush, annual weedy grasses, and lowland annual weeds).

In Volume 2, the authors address the various classes of plant materials available for restoration and rehabilitation plantings. Separate chapters are presented for grasses and forbs and 4 categories of shrubs (chenopod family, composite family, rose family, and shrubs of other families). The grass chapter treats more than 50 species including

names, synonymy, germplasms and cultivars, availability, and appropriate attributes such as seed characteristics, seedling vigor, growth and establishment, longevity, forage production and palatability, grazing tolerance, contribution to soil stability, tolerance to shade and flooding, ecotypic variation, and adaptation to vegetation types and compatability with other vegetation. Many

of these same characteristics are provided for the 45 forbs and 150 shrubs that are included in the forb chapter and 4 shrubs chapters. Species in each of the grass and forb, as well as the 4 shrub chapters, are evaluated in terms of ecological relationships and distribution, plant culture, uses and management, and varieties and ecotypes. The shrub chapters include treatments of 21 species of chenopods, 29 species of composites, 34 species of the rose family, and 64 species of other families.

The authors in the concluding Volume 3 present information on how to collect, clean, store, germinate, and evaluate the quality of seed, including what equipment and facilities are needed. They also



Station scientists developed seed production fields of Eagle yarrow (left) and Appar blue flax for use in restoration and revegetation plantings.



present the seed testing requirements and regulatory laws for the sale and transport of seed. Alternative establishment of plants by seed, transplanting, and interseeding as well as the production and use of planting stock is also covered. The volume ends with a reciprocal alphabetical list of scientific/common and common/scientific names, a yeoman reference list of some 3,300 entries, and an index.

Restoring Western Ranges and Wildlands, General Technical Report RMRS-136, Vol. 1-3, is available from the Rocky Mountain Research Station and on the Internet at www.fs.fed.us/rm/publications/lists_rmrs/rmrs_gtr.pdf.

Public Perspectives on Wildfire and Fuels Management in the Southwest

Although fire is increasingly recommended as a vegetation management tool on both public and private lands, controversy often inhibits its use. A lack of communication and understanding between land managers and the public contributes to these difficulties. Often, managers lack information concerning the public's knowledge and beliefs regarding fire and fuels management, and have insufficient data on the socioeconomic consequences of differing fire management practices to adjacent communities. Also lacking is information on community and user group preferences for fire management and vegetation restoration techniques. An incomplete understanding of public desires, concerns, and attitudes toward risks associated with wildfire and managed fire can result in public unwillingness

to accept agency initiatives, hindering implementation.

A multi-year, National Fire Plan-funded project, based out of the Forestry Sciences Laboratory in Albuquerque, New Mexico, is designed to provide needed information to managers and researchers concerning public knowledge, desired outcomes, and attitudes toward the risks associated with wildfire and fuels management. The project is being carried out on forests and grasslands of the Agency's Southwestern Region (Arizona and New Mexico), and small portions of Texas and Oklahoma. Station scientists and cooperators from Integrated Resource Solutions designed and implemented a research strategy to gather the desired information using a variety of research techniques.

A series of focus groups and interviews with locally knowledgeable community members (over 238 interviews with members of the public and 38 with Forest Service personnel) were carried out on five selected forests and grasslands (Kiowa National Grassland and the Santa Fe, Lincoln, Kaibab, and Tonto National Forests) to provide qualitative background information and issue development topics for a region-wide quantitative survey. The questionnaire survey will be administered to a randomly selected regional sample. During the first phase of the project, reports from the initial interviews and focus groups on the five targeted forest areas were provided to all participants and forest staff and are available to the public at www.irsolutions.net/beta/.

A general report synthesizing this body of information for the public and the forests of the region is in preparation. Topics highlighted in the report include attitudes concerning Forest Service thinning and burning projects and homeowner attitudes and activities concerning wildfire risk perceptions and risk reduction activities related to their property.



Studies are underway to better understand the public's desires and concerns related to fire management.

In addition, a conference and an edited volume, *Wildfire and Fuels Management: Risk and Human Reaction*, are focusing on public perceptions of the risks associated with both wildfire and managed fire. At the conference, held in Santa Fe, NM in December 2004, participants presented papers encompassing community and individual perspectives on human reaction to risks associated with wildfire and fuels management strategies, as well as decision analytic and economic perspectives on the topic. The conference volume is being edited by cooperators from Integrated Resource Solutions and Station scientists from Albuquerque and Fort Collins.

This body of data is being used by Forest Service managers, as well as other land managers and researchers, to work with individuals and communities concerning both wildfire and prescribed fire as a vegetation management tool. Understanding public desires and concerns relating to fire management is crucial to successful project implementation.

Pinyon-juniper Woodland Expansion and Sagebrush Ecosystem Decline in the Great Basin

Pinyon and juniper dominated woodlands of the Great Basin have increased in distribution and density since European settlement. They now occupy three to four times their former area. On-going increases in tree densities and woody fuel loads are resulting in dramatic increases in fire frequency, severity and size, and in the loss of some of the most diverse and productive sagebrush ecosystems in the region. Landscape level studies are now developing a better understanding of the causes, patterns, rates, locations and plant communities associated with these changes. This includes measuring changes occurring in stand densities and fuel loads as well as in fire frequency, intensity and size that continue to accompany woodland expansion. It also includes evaluating the effects of fire on sagebrush communities, soil erosion, and water quality.

A close relationship exists between the patterns of woodland expansion and topography, soils, environmental conditions, and community composition, and the types and frequency of fire that occurred prior to settlement. Across the Great Basin, woodland expansion began around the 1880's. Expansion followed a reduction in the frequency, and a change in the extent and patterns of fire from the reduction of fine fuels by livestock grazing and other land use practices. The initial reduction in shrub and herbaceous vegetation that accompanied increasing tree dominance also contributed to early declines in fire frequency. However, the steady increase in dominance across increasingly more area is now driving an increase in both the amount of fuel present, and the continuity of that fuel across the landscape. Fuel loads contributed by the trees have



A mountainside in the Underdown Canyon Demonstration Area, Nevada, showing upslope woodland expansion where the majority of the sagebrush ecosystem has been lost and fuel loads have more than doubled in 30 years (1973-2005).



doubled over the last century and can be expected to double over the next 50 years. Scientists believe this has serious implications for the severity and extent of future fires in the Great Basin.

The loss of the sagebrush community species that results from the increasing tree dominance, combined with the intense crown fires that are now increasingly occurring, are helping to push many of these sites into dominance by exotic annuals. Once present, exotic annuals such as cheatgrass lead to widespread degradation of sagebrush ecosystems and pinyon-juniper woodlands. This is dramatically changing the successional patterns that follow fire, and can include the permanent loss of the sagebrush ecosystems that once existed, and the wildlife habitat and livestock forage they once provided. As areas become increasingly tree dominated, treatment to retain or restore the original sagebrush ecosystems becomes more difficult and expensive.

Scientists in Reno, Nevada, are developing a basic understanding of the causes and effects of tree expansion, increasing tree densities and cheatgrass invasion on pinyon-juniper woodlands and sagebrush ecosystems. They are devising techniques for restoring and maintaining sustainable sagebrush ecosystems and pinyon-juniper woodlands, including the use of prescribed fire as a restoration tool and seeding methods for restoring native communities. A collaborative, Joint Fire Sciences Program Demonstration Area has been established in central Nevada to illustrate the ecological response of watersheds dominated by trees to prescribed fire.

For more information on the Forestry Sciences Laboratory in Reno, Nevada, visit www.fs.fed.us/rm/main/labs/reno.html.

Where Our Water Originates

Water is a critical resource. As human populations increase, careful management of our water supplies becomes ever more important, both to satisfy human needs and to protect the environments of other species. Successful management relies on an accurate broad-scale characterization of the resource. A study by Station scientists in Fort Collins, Colorado, provides a key element of that characterization for water—spatially explicit estimates of the U.S. water supply as it originates on the watershed.

Our fresh water supply begins as precipitation falling on land and fresh waters. From there the water naturally has three destinations: the atmosphere via evapotranspiration, groundwater aquifers via infiltration, or the sea via streams and rivers. Water that evaporates or transpires is unavailable for use until it falls again elsewhere as precipitation. What remains is—until it reaches the sea—potentially accessible to humans and other species, and in a broad sense is our fresh water supply.

The approach taken was to estimate water supply at its source as precipitation minus evapotranspiration for each point in a fine-scale grid covering the contiguous 48 states (Alaska and Hawaii were excluded because of lack of comparable data). Overlaying land management boundaries or land cover delineations then allows estimation of the amount of water originating on distinct land units.

Because it is directly measurable using simple equipment, precipitation in the U.S. has been well mapped. However, evapotranspiration is much more difficult to measure; for large-scale studies it must be modeled as a function of more easily measured variables such as temperature, wind speed, humidity, and solar radiation. This study used two approaches, one of which required considerable refinement for nationwide application.

Results show that across the contiguous 48 states, 54% of the water supply originates on forested land (which covers only 29% of the surface area), 25% on agricultural land, and 8% on rangeland. Forest is the most important cover type in several sections of the U.S., contributing 66%, 56%, and 68% of the water supply in the West, South, and East, respectively. Agriculture is most important in the Great Plains and Midwest, contributing 44% and 57%, respectively.

Across the 48 states, 18% of the water supply originates on national forests and grasslands and another 6% originates on other federal lands. Federal lands are even more important in the 11 western contiguous states, where 50% of the water supply originates on national forests and grasslands (which cover only 21% of the surface area) and another 15% originates on all other federal lands.

Results will be useful in setting broad-scale watershed management policy, especially regarding management practices important to the protection of water supply, water quality, and avoidance of flooding.

Additional information can be found in: “The Complementary Relationship in the Estimation of

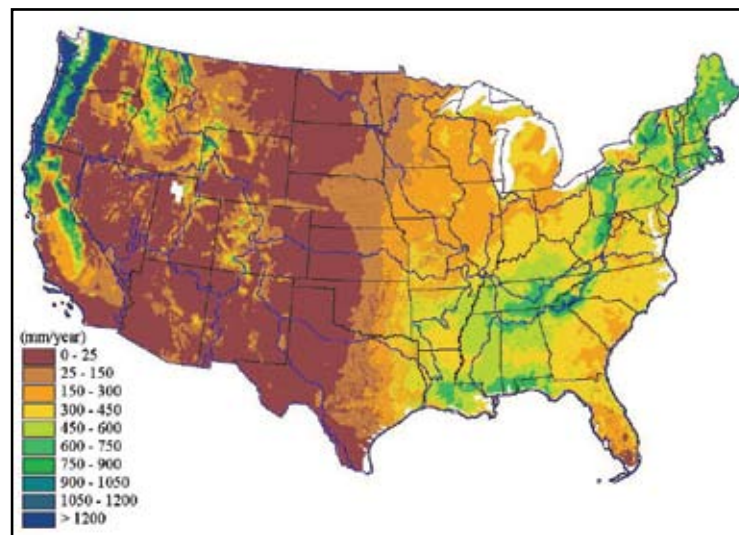
Regional Evapotranspiration: The Complementary Relationship Areal Evapotranspiration and Advection-Aridity Models.” *Water Resources Research* 37(5): 1367-1387.

“The Complementary Relationship in the Estimation of Regional Evapotranspiration: An Enhanced Advection-Aridity Model.” *Water Resources Research* 37(5): 1389-1403

“Trends in Pan Evaporation and Actual Evapotranspiration Across the Conterminous U.S.: Paradoxical or Complementary?” *Geophysical Research Letters* 31(13), L13503 (10.1029/2004GL019846, July 13, 2004).

“Observational Evidence of the Complementary Relationship in Regional Evapotranspiration Lends Strong Support for Bouchet’s Hypothesis.” *Geophysical Research Letters* 32(15), L15401 (10.1029/2005GL023549, August 5, 2005).

“The Source of Water Supply in the United States.” Discussion Paper DP-05-1, Rocky Mountain Research Station, U.S. Forest Service, Fort Collins, CO., available at www.fs.fed.us/rm/value/discpapers.html#source_water_supply.



Mean annual contribution to water supply (also shown are the state and water resource region boundaries).

Social and Institutional Influences on Fire Stewardship in the Northern Rockies

Social science research at the Rocky Mountain Research Station is helping guide the stewardship of fire as a natural process in Northern Rockies ecosystems. It was developed with the knowledge that wildland fire, as a natural disturbance process, can preserve ecological conditions inside and outside wilderness ecosystems and, at the same time, influence societal values across the interface between wilderness and non-wilderness lands.

Scientists at the Aldo Leopold Wilderness Research Institute in Missoula, Montana, serving as social science representatives of the Station's Bitterroot Ecosystem Management Research Project, are studying how social and institutional factors influence the way fire managers and the public evaluate trade-offs in the stewardship of fire as a natural process. They have been working to understand the meanings local residents associate with the Bitterroot Front and how these meanings interact with public attitudes toward fire and fuels management. Scientists have also been studying how the Forest Service involves the public in fire and fuels decision-making and how the public perceives the agency's ability to incorporate local values into land management.

The Northern Rocky Mountains are a unique and valuable laboratory for investigating social issues related to fire management across landscapes that

include federally protected wilderness. Recently, the planning phase of a landscape-level fuels treatment project on the Bitterroot National Forest provided the opportunity for scientists to conduct a baseline assessment of personal and community values attached to the Bitterroot landscape, which extends from the valley floor to the crest of the Selway-Bitterroot Wilderness. Using GIS technology, scientists mapped the spatial distribution of these values across the landscape, providing valuable social

data for modeling efforts designed to evaluate social and resource trade-offs among alternative fuels treatments. In addition, a baseline measure of trust across communities adjacent to the Bitterroot National Forest helped scientists and managers to understand the factors that influence the relationship between the public and local land managers regarding fire and fuels management.



On the Bitterroot National Forest, the wilderness/non-wilderness interface extends the length of the Bitterroot Valley.

Based upon this research, social scientists developed a simple monitoring tool to measure and monitor change in trust levels among participants in the Forest's collaborative planning process for fuels treatment. Scientists, managers, and the public are actively collaborating to incorporate results from these research efforts into management decisions.

The Bitterroot Valley has also served as a case study to provide insight into public perceptions of appropriate action to protect values at risk from wildfire. Following the Bitterroot fires of 2000, a diversity of valley residents assembled to develop a Community Wildfire Protection Plan articulating desired actions to reduce hazardous fuels and protect self-identified values at risk. Scientists conducted research in the Bitterroot Valley to examine how the development and implementation of the Bitterroot

Community Wildfire Protection Plan has addressed the interests of Bitterroot residents concerning potential wildfire risk to the Bitterroot National Forest and local rural communities.

This social science research program seeks to be responsive to national initiatives on fire and fuels management (e.g., the National Fire Plan and the Healthy Forests Initiative) as well as Station research priorities by providing land managers with the information needed to make decisions about fire and social regimes at the interface between wilderness and non-wilderness lands.

Details of this research can be found in: “Integrating Social Science Research with Wildland Fire Science: Assessing Values at Risk from the Bitterroot Community Wildfire Protection Plan.” Bitterroot Ecosystem Management Research Project Summary, on file with the Bitterroot Ecosystem Management Research Project, USDA Forest Service, Rocky Mountain Research Station.

“Mapping Place Meanings on the Bitterroot National Forest—A Landscape-level Assessment of Personal and Community Values as Input to Fuel Hazard Reduction Treatments.” Research Project Summary, on file with the Bitterroot Ecosystem Management Research Project, USDA Forest Service, Rocky Mountain Research Station.

“Monitoring Trust as an Evaluation of the Success of Collaborative Planning in a Landscape-level Fuel Hazard Reduction Treatment Project in the Bitterroot Valley, Montana.” Final 2005 report to the Joint Fire Science Program.

Seasonal Migration and Home Ranges of Female Elk in the Black Hills of South Dakota and Wyoming

Understanding the movement and dispersion patterns of elk (*Cervus elaphus*) on public lands will facilitate elk management and help resolve conflicts between management that benefit elk and other uses of land resources.

Scientists in Rapid City, South Dakota, studied seasonal movements and home ranges of female elk in two areas of the Black Hills of South Dakota, and examined underlying factors associated with each. Elk in the northern area did not demonstrate seasonal migration patterns. Rather, winter ranges in the northern area were mostly contained within the boundaries of the summer range. Elk in the southern



Researchers evaluated the seasonal movements and home ranges of female elk in the Black Hills of South Dakota.



area exhibited a north south migration pattern that coincided with seasonal patterns of snowfall. These elk migrated to winter range in late November and returned to summer range in late April. Home ranges of elk in the southern area were larger than home ranges in the northern area. Landscape characteristics that affected the size of elk home ranges included road density, the ratio of cover to forage, and steepness of the terrain. Elk home ranges were larger in landscapes with more roads, less cover, and flatter topography.

State wildlife managers are using this information to establish boundaries and timing of hunting seasons that will maintain elk populations within goals and that also reduce conflicts between and with other resources. Learn more about this and other studies at the Rapid City laboratory by visiting www.fs.fed.us/rm/rapidcity.

Microbial Impacts of Fire and Thinning

Wildfire, thinning, and prescribed fire cause variable impacts on belowground ecosystem processes and microbial communities. These fire effects, along with interactions of mycorrhizal fungi and herbaceous communities following wildfire, thinning and thinning/burning treatments, affect the long-term sustainability of ponderosa pine systems in the Southwest. The ability to link these ecosystem processes to actual changes in soil microbial communities will help predict the consequences of forest management compared to the effects from natural disturbances such as wildfire.

A fortuitous event, the Lake Fork Complex wildfire on the Santa Fe National Forest, New Mexico, in 2003, allowed Station scientists in Flagstaff, Arizona, and collaborators from Northern Arizona University, to examine sites that had previously been sampled as part the Fire/Fire Surrogate Project in the Southwest. The Lake Fork sites were part of a Fire and Fire-Surrogate study site sampled the previous year prior to any thinning or prescribed fire treatments. Few studies have been able to sample the exact same site pre- and post-wildfire.

Results showed increased soil microbial enzyme activity following the wildfire. In terms of organic matter utilization patterns, there was a simplification in organic matter utilization by bacteria while fungal use actually diversified. Laboratory estimates (but not on-site estimates) of net nitrogen transformation rates were higher in soils one-month after a high-severity burn. Scientists believe that wildfire may enhance net nitrogen transformation rates by reducing the availability of carbon to soil microorganisms. Wildfire resulted in a reduction in the size of the microbial biomass and a change in its functional composition. However, autotrophic nitrifiers (free-living, nitrogen-fixing bacteria) may increase dramatically in soils even after a high-severity burn. The results demonstrate an amazing resiliency of the belowground community to survive and function after a high-severity wildfire.

More information can be found in: “Effects of Fire on Belowground Sustainability: A Review and Synthesis.” *Forest Ecology and Management*. 122: 51-71.

“Long-term Interval Burning Alters Fine Root and Mycorrhizal Dynamics in a Ponderosa Pine Forest.” *Journal of Applied Ecology* 42: 752-761.



Studies evaluate the effects of fire on belowground ecosystem processes and microbial communities.

Reintroducing Fire into Southwestern Desert Grasslands

During the last 100 years, trees and shrubs have become a larger component of southwestern desert grasslands. As the number of woody plants increases, grass cover decreases and water infiltration is reduced, leading to an increase in soil erosion and runoff. A number of factors likely contribute to the expansion of woody species into historic grasslands. These include drought, increases in atmospheric CO₂ concentrations, climate change, and grazing practices. The complexity of these interactions poses significant challenges to grassland managers. Fire is a natural force that historically helped to shape and maintain desert grasslands, however, during this 100-year period, fire has been an infrequent event. Ecologists and managers have begun to use fire as a tool to restore and maintain these important communities. Research conducted by Station scientists in Albuquerque, New Mexico, and colleagues at the University of New Mexico, addresses the questions; (1) will fire reintroduction reduce existing woody plant cover and retard woody plant expansion, (2) how will desert grasses respond to more frequent fire, (3) how will fire affect soil movement and fertility, and (4) how do drought and fire interact in shaping desert grassland communities?

Study sites for this research are located on the Bernalillo watershed of the Cibola National Forest, the City of Albuquerque's west mesa watershed, and at the Sevilleta LTER (long-term ecological research) grassland site, located on the Sevilleta National

Wildlife Refuge in New Mexico. These sites all represent ecotones between desert grasslands and other more mesic grasslands where the role of fire is better understood.

Results from 9 years of data indicate that the use of fire in desert grasslands can successfully reduce woody plant and succulent cover while maintaining healthy stands of native grasses. Total recovery time, however, depends largely on pre- and post-fire precipitation patterns, which are highly variable in desert grasslands. Furthermore, individual grassland species differ in the amount of time needed to recover

from fire. According to Station scientists, managers must take these factors into consideration when planning fire return intervals. Results also indicate that subsequent fires may have different, less detrimental effects on the grassland community than does the initial reintroduction. Total perennial grass cover was significantly higher on previously burned plots than on once-burned plots. Similarly, soil fertility under grass

on twice-burned plots was higher than under shrubs one to two years following the second fire. This suggests that the well-documented pattern of greater soil fertility under shrub "islands" may represent communities removed from the influence of fire, and that repeat fire may increase soil fertility and stimulate below and above ground grass production. Other results emphasize the important role drought plays in determining plant cover, composition, and soil fertility of arid grasslands. Soil collections taken during drought periods had the highest levels of potentially mineralizable nitrogen recorded over a ten-year period. Thus, drought can increase



Collecting vegetation data on the Bernalillo Watershed, New Mexico.



soil fertility, which can alter additional ecosystem processes.

These findings will help resource managers of arid grasslands to (1) determine areas where fire might be used to meet management goals, (2) set realistic goals for woody plant management, and (3) determine proper fire return intervals.

More information can be found in “Regional-scale Drought Increases Potential Soil Fertility in Semiarid Grasslands.” *Biology and Fertility of Soils* 40: 73-78; “Soil Fertility Changes Following Repeat Fire for Shrub Control Within Urban-wildland Interface Semi-arid Grasslands.” Published abstract presented at the Ecological Society of America 89th Annual Meeting, Portland, OR, August 3, 2004; “Semiarid Grassland Response to Wildfire: A Comparison of Previously-burned and Unburned Plots.” Published abstract presented at the Ecological Society of America 89th Annual Meeting, Portland, OR, August 3, 2004; and “Response of Two Semiarid Grasslands to a Second Fire Application,” accepted for publication in *Rangeland Ecology and Management*.

In related work, two comprehensive assessments, one on southwestern grassland ecosystems, and the other on grazing and wildlife relations, were conducted in collaboration with the Southwest Region of the U.S. Forest Service. Findings suggest that in southwestern grasslands, several species of birds, mammals, amphibians, reptiles, and invertebrates use or depend on prairie dogs and their colonies, including the black-footed ferret,

burrowing owl, ferruginous hawk, aplomado falcon, and swift fox, all of which are now classified as either sensitive, threatened or endangered. Because prairie dogs significantly influence ecosystem functions, they are often considered a grassland keystone species. In collaboration with New Mexico State University, researchers are examining the use of fire as a tool in Chihuahuan desert grassland for re-establishing black-tailed prairie dog colonies in protected areas. In addition, research is being conducted on the interaction of prairie dog populations, plague outbreaks, and weather conditions in collaboration with scientists from universities and the Center for Disease Control. This research, located on the Sevilleta National Wildlife Refuge and Valles Caldera National Preserve in New Mexico, is being used to create models that predict the cause and likelihood of population changes in the Gunnison’s prairie dog.

More information on wildlife in southwestern grasslands can be found in Volumes 1 and 2 of *Assessment of Grassland Ecosystem Conditions in the Southwestern United States*, General Technical Report RMRS-GTR-135, available from the Rocky Mountain Research Station and on the Internet at www.fs.fed.us/rm/publications/online/rmrs_gtr.html; and *Ecological Interactions of Ungulate Grazing and Native Species of the Southwest: Terrestrial Wildlife*, available soon from the Rocky Mountain Research Station or on the Station’s website at www.fs.fed.us/rm/publications/lists_rmrs.shtml.

Our Research Programs

Our research and development programs are regional, national and international in scope and application. This section covers our programs based on the State in which they are located.

Total FY2005 Station Appropriations: \$42,233,000

Total Outside Funding: \$15,232,293

Total National Fire Plan Funding: \$7,194,681

Total Number of Scientist Years: 98

(In addition to the outside funding shown above for our research work units, the Station's library and publications units were supported by \$255,500 in outside funding.)

Forest Service Research and Development in Arizona

The Rocky Mountain Research Station maintains four research work units in Arizona. They are located at the Southwest Forest Sciences Complex, a Federal/State partnership between the Rocky Mountain Research Station and Northern Arizona University's College of Ecosystem Science and Management.

Scientists conduct research on vegetation, watershed, wildlife and fisheries resources, and their associated Southwestern ecosystems. The Station's Fort Valley Experimental Forest is near Flagstaff on the Coconino National Forest. The Santa Rita Experimental Range near Tucson, formerly maintained by the Station, remains a site for important rangeland studies.



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Total FY2005 Appropriations: \$5,583,000

Total Outside Funding: \$1,063,761

Total National Fire Plan Funding: \$1,288,404

Total Number of Scientist Years: 12



Southwestern Forest Health Restoration and Wildland-Urban Interface Fuels Management

(RMRS-4156) Flagstaff, Arizona (<http://www.rmrs.nau.edu/lab/4156/>)

Mission: Contribute to the scientific basis for natural resource management activities in Southwestern forests and urban interface areas to restore forest health and manage forest fuels in a publicly supported manner.

Key Accomplishments, Products, and Publications

- To protect communities in the Southwest, efforts are underway to reduce the risk of catastrophic wildfires through forest fuels management in strategic locations. A series of investigations provide information about how uneven-aged selection thinning practices can mitigate future wildfire behavior as well as result in ecological sustainability in ponderosa pine forests.
- In collaboration with Los Alamos National Laboratory in New Mexico, scientists are developing and using a computationally intensive physics-based wildfire behavior model, FIRETEC, to examine potential ramifications of various silvicultural systems in mitigating wildfire behavior.
- Diffuse knapweed is an exotic invasive plant that is listed as a noxious weed in 14 western states and four Canadian provinces. Results from studies of areas impacted by severe wildfire and management to reduce forest fuels indicate that knapweed grows very well in conditions created by severe fires. Study results are helping managers reduce the spread of knapweed by checking for nearby knapweed populations and treating them before they spread into burned areas.
- Leafy spurge is an exotic invasive weed that causes significant environmental and economic damage in locations where it has become established. Studies show that two plant pathogens and an insect herbivore inhibit the reproductive ability of spurges and may have the potential to be used as native biocontrols.

FY2005 Appropriations:

\$2,344,000

Outside Funding: \$101,296

**National Fire Plan Funding:
\$741,930**

Scientist Years: 4

Number of Products: 109



This stand received thinning and prescribed burn treatments. Studies indicate this is the most effective treatment for meeting fuels reduction objectives in Southwest ponderosa pine forests.

Ecology and Conservation of Terrestrial Wildlife and Habitats in the Interior West

(RMRS-4251) Flagstaff, Arizona (www.rmrs.nau.edu/wildlife)

Mission: Acquire, develop, and provide reliable information on wildlife populations and habitats in terrestrial ecosystems to support science-based decisions for natural resource management.

FY2005 Appropriations:
\$1,815,000

Outside Funding: \$584,327

National Fire Plan Funding:
\$198,718

Scientist Years: 5

Number of Products: 138



Research is evaluating if wildfires are limiting the number of cavities that secondary cavity nesting birds can use for breeding habitat.

Key Accomplishments, Products, and Publications

- Scientists completed a special volume on “Fire and Avian Ecology in North America” that collectively reviews fire and avian ecology across 40 North American ecosystems. Topics include lessons in fire history, fire regimes, and the ensuing responses of bird communities by geographic regions of the continent.
- An effort to revise the Mexican Spotted Owl Recovery Plan and incorporate new information on owl ecology is underway. The Plan provides management guidance for this species throughout the southwestern U.S. Habitat and monitoring protocols developed by this unit have averted numerous lawsuits and appeals.
- Studies continue on the effects of forest management on the northern goshawk on Arizona’s Kaibab Plateau. Results helped develop management recommendations for the goshawk in much of the western U.S.
- Studies are evaluating the effects of various fuels reduction treatments on wildlife, both within and outside the urban-wildland interface.
- Scientists are conducting a comprehensive study in the Sacramento Mountains of New Mexico to better understand the effects of forest health restoration treatments within the urban-wildland interface on the Mexican spotted owl.
- Collaborative studies have resulted in pioneering practical research into the potential impacts of military helicopter, chainsaw, recreation birdwatcher, road construction equipment, and off road motorcycle noise on Mexican and northern spotted owls.

“I showed the edition of Fire and Avian Ecology to several of our staff biologists. This volume will be very helpful in writing fire and wildlife reports.” (Wildlife Biologist, Apache National Forest, Arizona)



Watersheds and Riparian Ecosystems Research

(RMRS-4302) Flagstaff, Arizona (www.rms.nau.edu/lab/4302)

Mission: Create, develop, and apply knowledge on stream, geology, water, soil, biologic and ecologic functions, processes, and dynamics. This information helps sustain watershed integrity and diverse, healthy and productive biotic populations within watersheds and riparian ecosystems of forests and woodlands in the semiarid interior western United States and Mexico.

Key Accomplishments, Products, and Publications

- Scientists provide comprehensive information on the management of watersheds in the Interior West through a cooperative website interface at <http://ag.arizona.edu/OALS/watershed/index.html>.
- The fourth volume in the series *Wildland Fire in Ecosystems* was published, providing a state-of-the-science assessment of the impacts of fire on water and soil resources. This volume provides useful information, overviews, and management implications on the soil and water effects of wildland fire for forest and rangeland managers, fire management specialists, ecologists, wildlife biologists, educators, students, and government and industry professionals.
- Historical changes in fish populations on large rivers in North America were evaluated in a recent American Fisheries Society publication, edited by a project scientist.
- Researchers are working with Native American Nations to restore culturally important springs after wildfires. Some of these springs are habitats for threatened and endangered species.
- Landscape degradation after wildfires is being assessed in the United States, Spain, and Israel to develop MODIS satellite-based tools to evaluate cover, vegetation type shifts, and erosion.

FY2005 Appropriations:

\$1,025,000

Outside Funding: \$42,851

National Fire Plan Funding:

\$347,756

Scientist Years: 2

Number of Products: 142



Project scientists measure riparian conditions of streams in conjunction with the White Mountain Apache Nation watershed management staff.

“We are so grateful to you for all of your efforts to help us – both with the razorback suckers we kept there and the salvaged fish from Sycamore Creek. None of this would have been possible without your assistance and willingness to share your facilities.” (U.S. Fish and Wildlife Service, Arizona)

Achieving Ecosystem Management in the Borderlands of the Southwestern United States through Research and Management Partnerships

(RMRS-4651) Flagstaff, Arizona (www.rmrs.nau.edu/lab/4651/)

Mission: Contribute to the scientific basis for developing and implementing a comprehensive ecosystem management plan to restore natural processes, improve the productivity and biological diversity of grasslands and woodlands, and sustain an open landscape with a viable rural economy and social structure in the Southwestern Borderlands area.

FY2005 Appropriations:
\$399,000

Outside Funding: \$335,287

Scientist Years: 1

Number of Products: 22



Prescribed burning treatments help develop techniques for restoring southwestern rangelands.

Key Accomplishments, Products, and Publications

- The unit was a key sponsor and organizer of the international conference “Connecting Mountain Islands and Desert Seas: Biodiversity and Management of the Madrean Archipelago II and 5th Conference on Research and Resource Management in the Southwestern Deserts,” held in Tucson, Arizona. The event focused on the future health of the Madrean Archipelago of the southwestern United States and northern Mexico as we enter the 21st Century.
- A major long-term, large-scale study developed to determine how climate and disturbance interact to structure desert grasslands is ongoing. Results indicate that abundance and diversity of vegetation and small mammals increase significantly on treatment areas, while remaining unchanged on control areas. Results support ecological theory that moderate levels of disturbance maintain biodiversity and contribute to understanding conditions under which grazing is an appropriate conservation strategy.
- Scientists collaborated with the Natural Resources Conservation Service, Coronado National Forest (AZ), and ranches in conducting a study to develop effective treatments to restore rangelands degraded by historic overgrazing and woody plant encroachment.
- Ongoing monitoring studies are aimed at calibrating watersheds prior to prescribed burning treatments to understand relationships of meteorological variability and effects on hydrologic response.

Forest Service Research and Development in Colorado

The Rocky Mountain Research Station maintains four research work units in Fort Collins, Colorado. Two of the units have national charters. They support the Forest Service and other Federal land management agencies on technology related to natural resource assessment, ecology, and management, and social and economic values in land management planning. Other units focus on regional issues related to fisheries and watersheds, climate change and air resources, biological diversity, and ecological processes and ecosystem health.

Station headquarters is in the Natural Resources Research Center in Fort Collins. This state-of-the-art facility is a Station-led partnership among eight Federal agencies and is near the Colorado State University campus.

The Station's Fraser Experimental Forest is on the Arapaho National Forest in central Colorado, and the Manitou Experimental Forest is on the Pike-San Isabel National Forest, northwest of Colorado Springs.



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Total FY2005 Appropriations: \$7,801,000

Total Outside Funding: \$1,471,886

Total National Fire Plan Funding: \$781,673

Total Number of Scientist Years: 24

Consequences of Land Management and Natural Disturbance to Water Quality and Quantity Across the Aquatic, Riparian, and Upland Continuum

(RMRS-4352) Fort Collins, Colorado (www.fs.fed.us/rm/rwu4352)

Mission: Quantify watershed processes and the impacts on watershed resources of management activities, disturbance and associated uncertainties across upland forests, riparian areas, and streams in the Central Rocky Mountains.

FY2005 Appropriations:
\$1,737,000

Outside Funding: \$116,440

Scientist Years: 6

Number of Products: 80



Models have been developed to help manage cutthroat trout in the western U.S.

Key Accomplishments, Products, and Publications

- Recent research on stream sedimentation in Colorado and Wyoming provides a better understanding of the mechanisms of sediment transport and the role of variation in sediment supply from different watershed sources. Findings indicate that significant changes in rates and timing of sediment input or flow, either from natural or human-caused influences, are likely to cause changes in channel form, including width, depth, velocity, and surface texture.
- Evaluation of the long-term runoff record at Fraser Experimental Forest, CO, shows that the previously predicted period of hydrological recovery following clear cuts in 1950 is shorter than the data previously suggested. Analysis of the five-decade record shows that flows from the subalpine Fool Creek watershed should return to predisturbance levels after slightly less than 60 years of revegetation. The three-decade flow record suggested a recovery time of 70 to 80 years.
- Assessing viability of stream populations of cutthroat trout and identifying streams suitable for establishing populations are priorities in the western U.S. Scientists have developed a model that could greatly reduce the uncertainty about projected population sizes when selecting streams for reintroductions or evaluating unsampled streams, and help streamline efforts to improve the status of cutthroat trout subspecies in the western U.S.



Sustaining Alpine and Forest Ecosystems Under Atmospheric and Terrestrial Disturbances

(RMRS-4451) Fort Collins, Colorado (www.fs.fed.us/rm/landscapes)

Mission: Apply interdisciplinary research approaches to develop increased understanding and management options for sustaining alpine and forest ecosystems in the Rocky Mountains.

Key Accomplishments, Products, and Publications

- Scientists brought together in a single Station report a synthesis of the new directions in forest pathology research, such as molecular biology and genetics, spatial statistics, and geographic information systems. Exciting opportunities exist to bridge understandings gained from molecular biology to the landscape scale as well as understanding how landscape dynamics influence molecular genetics at fine spatial scales.
- The potential ecological effects of chipping and mastication treatments used to reduce fuel loads was the focus of a workshop in Colorado. Scientists and managers shared current knowledge and practical experiences, and prioritized information needs.
- Frequently employed strategies to reduce fuels and fire risk include burning slash piles or lop and scatter. Scientists demonstrated that amount and geometrical arrangement of fuel loading impacts the prescribed fire intensity, duration, depth of the heat pulse into the soil, and magnitude of the soil temperatures caused by the fire. Findings assist land managers in the use of prescribed fire to benefit ecosystems.
- Researchers reported that the majority of Colorado high elevation lakes are sensitive to acidification. Study results show that while nitrogen concentrations in surface waters generally declined through the summer season, a large number of lakes exhibit high levels of nitrogen in late summer.
- Investigations show that successful ponderosa pine regeneration after fire is dependent upon canopy and ground conditions. This information improves understanding of how environmental heterogeneity within burned areas contributes to future forested landscapes.

FY2005 Appropriations:

\$1,994,000

Outside Funding: \$363,449

National Fire Plan Funding:

\$347,756

Scientist Years: 7

Number of Products: 171



Experimental prescribed burn of slash piles on the Manitou Experimental Forest in Colorado.

Social and Economic Values in Natural Resource Planning and Management

(RMRS-4851) Fort Collins, Colorado (www.fs.fed.us/rm/value)

Mission: Promote full consideration of social and economic values in natural resource decision making by conducting theoretical and empirical research on value measurement, changing and conflicting values, and processes by which values are incorporated into planning and decision-making.

FY2005 Appropriations:
\$1,044,000

Outside Funding: \$311,602

Scientist Years: 4

Number of Products: 54



Studies focus on how various stakeholders define unmanaged recreation and what tradeoffs they are willing to accept to deal with the issue.

Key Accomplishments, Products, and Publications

- A synthesis of existing research and a framework for evaluating the social impacts of large wildfires on communities were developed. This knowledge is used by fuel managers and community wildfire protection planners to help local residents and community service providers reduce impacts and mitigate losses from wildfires.
- Scientists reviewed and synthesized the growing research literature on place attachment and sense of place, focusing particularly on how place attachments influence public understanding of landscape change and disturbance. Research results help managers identify publicly acceptable fuel, vegetation, and other resource management strategies.
- Unmanaged recreation has captured the attention of the public as well as land management agencies. Studies focus on how various stakeholders define the unmanaged recreation issue and what tradeoffs they are willing to accept to deal with the issue.
- The shift from “Old West” to “New West” has been well documented, and is both complex and, at times, contentious. Research on how values related to natural resources have changed over time is helping understand how those values affect natural resource use and how they influence the options available to resource managers and local communities.
- Evidence from over 2,000 water market transactions was examined to learn who is selling to whom and for what purpose and what price. Data help determine the value of water flowing from national forests and other land areas.



Natural Resource Assessment, Ecology, and Management Science Research

(RMRS-4852) Fort Collins, Colorado (www.fs.fed.us/rm/analytics)

Mission: Provide improved technology and methods for quantitative resource management planning and analysis. Researchers incorporate the dimensions of human-caused and natural disturbances into analysis tools to support forest planning.

Key Accomplishments, Products, and Publications

- A recent survey of the American public provides land managers with information about people's objectives for the management of forests and grasslands, as well as their opinions about the role the Forest Service should take to achieve various objectives. The survey also provides information on which ecosystem services and forest-based economic benefits people consider important.
- Scientists produced a new publication, *Good Fire/Bad Fire*, that is a well-illustrated document intended for lay and professional audiences. The publication provides a concise, easy, and motivational read addressing fire issues of today.
- Researchers wrote an analysis of the status of ponderosa pine forests for the Colorado State Forest Service report on the Health of Colorado's Forests 2004. This analysis focused on the current ecological condition of ponderosa pine forests in relation to historical conditions, including the recent pattern of more severe, large crown fires than occurred prior to Euro-American settlement.
- Scientists compiled existing data on species distributions and more than 680,000 occurrence records for terrestrial vertebrates and butterflies for Arizona and New Mexico into a single digital database for general use in conducting broad-scale biodiversity assessments.
- A book published with an international collaborator on mineral indicators of sustainability and sustainable mineral resource management is helping land managers and the public understand how to ensure that mineral extraction is conducted in a socially and environmentally responsible manner.

FY2005 Appropriations:

\$1,921,000

Outside Funding: \$674,395

**National Fire Plan Funding:
\$433,917**

Scientist Years: 7

Number of Products: 347



The publication Good Fire/Bad Fire provides a concise, easy, and motivational read addressing fire issues of today.

"I received your new publication Good Fire, Bad Fire yesterday. I think it is the best written paper on land management and ecological processes that I have read in a long time. Very well done!" (Ecologist, Ozark-St. Francis National Forests, Arkansas)

Stream Systems Technology Center

(STREAM) Fort Collins, Colorado (www.stream.fs.fed.us)

Mission: The Stream Systems Technology Center is a national technical center chartered to improve knowledge of stream systems, develop operational tools and technology, provide training and technical support, and identify research needs for the purpose of coordinating development of needed technology to secure favorable conditions of water flows.

FY2005 Appropriations:
\$1,105,000

Outside Funding: \$6,000



Researchers conduct a preliminary site assessment of an aquatic organism passage barrier on the Deschutes National Forest in Oregon.

Key Accomplishments, Products, and Publications

- Scientists published a technical reference and software package titled *WinXSPRO, a Channel Cross Section Analyzer, User's Manual, Version 3.0* that is specifically designed for mountain streams.
- Work is underway with universities to develop a science synthesis publication on cumulative watershed effects of fuel treatments in the western United States.
- In cooperation with Colorado State University, scientists continue to develop simple and innovative bedload measurement technologies to support channel maintenance.
- Researchers conduct field work to support development of protocol guides for measuring the water needs of wet meadows, springs, and streams.
- Working with cooperators, scientists are studying the effects of invasive species on riparian vegetation and stream processes.
- Scientists studied several springs in Colorado to develop an understanding of the linkages between surface and ground water, and create recommendations for protecting plant and aquatic communities and other ecological functions of springs. The amount of water needed was a point of contention between the Forest Service and the State of Colorado. Research findings diffused the controversy and led to a resolution acceptable to both parties.



Forest Service Research and Development in Idaho

The Rocky Mountain Research Station maintains four research work units at two Forestry Sciences Laboratories in Idaho, one in Boise and one in Moscow.

Scientists at Boise conduct integrated research that relates land use activities to the quality of riparian and aquatic environments. Areas of focus include: the evaluation and management of sensitive aquatic species; watershed processes that constrain and influence the quality of the habitats for those species; and the interrelationships of riparian-stream ecosystems.

Research at our Moscow facility centers on biology and ecological genetics of Interior West forests, including biometric methods to quantify changes in forest composition and structure over time and across landscapes; root disease management practices and soil management techniques to sustain productivity of the cedar, hemlock, grand fir, and Douglas-fir ecosystems of the Inland Northwest; and cost-effective methods of predicting and avoiding or minimizing impacts of forest roads on soil and water resources on steep unstable lands.

The Station maintains three experimental sites in Idaho: the Boise Basin Experimental Forest on the Boise National Forest, and the Deception Creek and Priest River Experimental Forests on the Idaho Panhandle National Forests.



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Forestry Sciences Laboratory

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(In 2006, the Boise lab is scheduled to relocate to a new facility at 322 East Front St., Boise, ID 83702)

Total FY2005 Appropriations: \$5,398,000

Total Outside Funding: \$1,520,492

**Total National Fire Plan Funding:
\$1,338,084**

Total Number of Scientist Years: 14

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Effects of Environmental Variability and Forest Management on Ecosystem Processes that Regulate Forest Dynamics in the Interior West

(RMRS-4155) Moscow, Idaho (<http://forest.moscowfsl.wsu.edu/gems/>)

Mission: Develop new knowledge on selected ecological processes and forest dynamics at the plant, stand, ecosystem, and landscape levels. This mission specifically includes research that expands our understanding of Interior West forest biology and ecological genetics, and provides biometric methods to support forest science and management.

FY2005 Appropriations:
\$1,383,000

Outside Funding: \$487,559

National Fire Plan Funding:
\$394,174

Scientist Years: 3

Number of Products: 278

Key Accomplishments, Products, and Publications

- The Fuels Synthesis Project (www.fs.fed.us/fire/tech_transfer/synthesis/synthesis.index) provides easily accessible scientific information about treating fuels to reduce wildfire impacts in the western U.S. The information is organized around four science topics: forest structure and fire hazard; environmental consequences of fuel treatments; economic uses of material and costs of fuel treatments; and public understanding, beliefs, attitudes, and behaviors related to fuels management.
- Climate change will alter forest environments and the ability of plant species to survive. Guidelines are being developed to help managers establish populations physiologically attuned to future environments.
- Reforestation recommendations are now available for grand fir mosaic habitats that are difficult to regenerate because of pocket gophers and successional plant communities dominated by bracken fern and western coneflower. Studies show that partial cutting and planting is the best alternative if pocket gophers are not controlled, but clearcutting results in better conifer growth if gophers are controlled.



Mechanical mastication of woody biomass in a dry ponderosa pine forest, Boise Basin Experimental Forest, Idaho.



Shrubland Biology and Restoration Research

(RMRS-4253) Provo, Utah, and Boise, Idaho (www.fs.fed.us/rm/provo)

Mission: Develop knowledge, plant materials, and technology for successful long-term restoration of diverse shrubland plant communities to meet resource needs and values.

Key Accomplishments, Products, and Publications

- A major publication, *Restoring Western Ranges and Wildlands*, was published. It is a culmination of 25 years of research and synthesis, providing background on philosophy, processes, plant materials, selection, site preparation, and seed and seeding equipment for revegetating disturbed rangelands, emphasizing the use of native species. Guidelines for planning, conducting, and managing are given, as well as a compilation of rangeland research conducted over the last several decades to aid practitioners in reestablishing healthy communities and curbing the spread of invasive species.
- Studies continue on the biological control of cheatgrass by headsmut fungus. Results show that both cheatgrass and the headsmut fungus have multiple genotypes that interact with each other and the environment. The realization of a biological control for cheatgrass would be a huge boon to restoring western wildlands to more natural, ecologically functioning conditions.

FY2005 Appropriations:

\$1,214,000

Outside Funding: \$1,988,661

National Fire Plan Funding:

\$471,955

Scientist Years: 4

Number of Products: 130



Contrasting treatments in a post-fire native plant restoration study, five years after treatment. The treatments contrast rate and composition of seed application.

*“Your publication *Beginnings of Range Management* is excellent—a valuable contribution to our knowledge about land management. The authors have performed a valuable service and left an important legacy. The historical account should be read by all Regional employees to help them understand the roots of the Agency.” (Plant Ecologist, USDA Forest Service, Utah)*

Integrated Research on Watershed Processes and Aquatic Ecology to Guide Management of Aquatic Ecosystems and Water and Soil Resources

(RMRS-4353) Boise, Idaho (www.fs.fed.us/rm/boise)

Mission: Develop knowledge of the biophysical conditions and processes that influence water quality and quantity, aquatic habitat quality, and the distribution, diversity, and persistence of fish and other aquatic species. Apply this knowledge to develop guidance for water resource management and the conservation and restoration of fish populations and other aquatic species at scales that define functional aquatic ecosystems.

FY2005 Appropriations:
\$1,961,000

Outside Funding: \$502,151

National Fire Plan Funding:
\$278,205

Scientist Years: 4

Number of Products: 193



Researchers sample for fish to determine how quickly they recover from large disturbances such as floods.

Key Accomplishments, Products, and Publications

- Researchers addressed the limited understanding of large-scale and ecological processes that shape aquatic ecosystems by convening a major international symposium that synthesized the state-of-science and will influence large-scale collaborative research and land management charged with conservation of aquatic ecological diversity in rapidly changing environments.
- Scientists and staff continue development and transfer of new information on the effects of wildfire and fire related management on aquatic ecosystems. They hosted multiple workshops to help specialists understand and apply a rapidly changing knowledge of the role of fire in aquatic ecosystems. This work also provides a foundation for new decision support tools that will begin to integrate sometimes conflicting objectives of terrestrial and aquatic management.
- Scientists continue to develop new understanding of the large-scale distribution and structure of sensitive fish populations such as those of Chinook salmon. This work helps determine characteristics of critical habitat and provides new tools for more effective inventory of sensitive species and their habitats.
- Studies are tied closely to National Forests throughout the Interior West to apply current and emerging knowledge and aquatic ecological science. A framework for forest plan revision and implementation developed through the project has been used on many National Forests. Researchers also work with States, Tribes, other agencies, non-governmental organizations, and universities to address key questions in aquatic conservation, research, and management.



Microbial Processes that Affect Ecosystem Function

(RMRS-4552) Moscow, Idaho (<http://forest.moscowfsl.wsu.edu/smp>)

Mission: Conduct research and technology transfer on microbial processes that regulate forest ecosystem function in support of sustaining and enhancing productivity in the western United States.

Key Accomplishments, Products, and Publications

- Scientists have discovered three new host plant species for white pine blister rust (*Pedicularis racemosa*, *Castilleja miniata*, and *Castilleja rhexifolia*). Studies are underway on the prevalence and range of infection on these alternate hosts.
- Pre-fire forest stand structure and fire severity ratings are being used to determine stands at risk for a catastrophic fire. Research on fire severity effects provides new methods to help managers restore western ecosystems.
- Studies on belowground wood decay are used to determine forest management impacts on site sustainability. Decomposition rate changes over a wide range of sites also give an indication of climate change affects on soil productivity.
- Researchers produced the Armillaria Response Tool (ART). This interactive tool uses habitat type subseries and temperature and moisture regimes to determine Armillaria root disease distribution and activity.
- The North American Long-Term Soil Productivity site on the Payette National Forest, Idaho, is 10 years old. This site, combined with 35 other installations in North America, provides data for validating soil quality standards, assessing management impacts on soil productivity, and determining the importance of soil organic matter.

FY2005 Appropriations:

\$1,003,000

Outside Funding: \$82,000

**National Fire Plan Funding:
\$191,266**

Scientist Years: 4

Number of Products: 45



Research focuses on a new alternate host (Castilleja rhexifolia) for the white pine blister rust fungus.

Soil and Water Engineering

(RMRS-4702) Moscow, Idaho (<http://forest.moscowfsl.wsu.edu/engr/>)

Mission: Provide scientific information, methods, and models related to wildland soil erosion and hydrologic processes associated with access, wildfire, and operations, to land management decision makers, researchers, and the public to sustain or improve watershed health.

FY2005 Appropriations:

\$1,051,000

Outside Funding: \$448,782

National Fire Plan Funding:

\$474,439

Scientist Years: 3

Number of Products: 64

Key Accomplishments, Products, and Publications

- Studies continue on the erosion impacts of all terrain vehicles, with focus on Arizona and Washington.
- An indoor rainfall simulation was carried out comparing the effectiveness of shredded woody biomass on reducing soil erosion. The study was sufficiently encouraging that additional field studies on closed roads are underway.
- Monitoring continues on several post wildfire mitigation watersheds in the western U.S. Findings continue to confirm that straw mulch is more effective than no treatment, hydromulch, or log erosion barriers in reducing soil erosion after wildfire.
- Ongoing studies on the impact of postfire salvage logging indicate that salvage logging does not generate more sediment than sites that were not logged.
- Research continues to determine the best remote sensing techniques to use to estimate wildfire impacts on soil erodibility properties.
- Work is underway on the impacts of fuel management on erosion and sediment delivery at the plot scale (about 30 square meters), and the small watershed scale (5-10 ha) on 21 sites in Idaho.



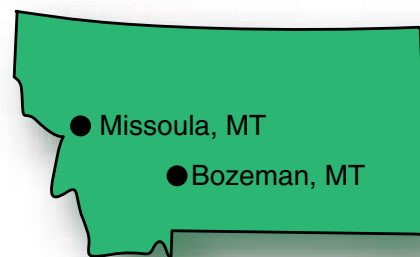
Soil erosion studies are being carried out at several locations throughout the western United States.



Forest Service Research and Development in Montana

The Rocky Mountain Research Station maintains four research facilities in Montana: Forestry Sciences Laboratories in Missoula and Bozeman, and the Aldo Leopold Wilderness Research Institute and the Fire Sciences Laboratory in Missoula.

Scientists also conduct studies on the Coram Experimental Forest on the Flathead National Forest, and the Tenderfoot Creek Experimental Forest on the Lewis and Clark National Forest.



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Total FY2005 Appropriations: \$ 7,619,000

Total Outside Funding: \$6,474,063

Total National Fire Plan Funding: \$2,767,577

Total Number of Scientist Years: 27

Ecology and Management of Northern Rocky Mountain Forests

(RMRS-4151) Missoula and Bozeman, Montana (www.fs.fed.us/rm/ecology)

Mission: Integrate knowledge about forest ecology and silvicultural practices into management guidelines needed to sustain ecosystem integrity, improve forest health, and enhance social values in landscapes of the Central and Northern Rocky Mountains.

FY2005 Appropriations:

\$1,232,000

Outside Funding: \$103,455

National Fire Plan Funding:

\$540,201

Scientist Years: 3

Number of Products: 140

Key Accomplishments, Products, and Publications

- A landscape dynamic simulation system called SIMPPLLE (www.fs.fed.us/rm/missoula/4151/SIMPPLLE) is being used as a landscape-level planning tool by federal land managers, private consulting firms, nonprofit organizations, and academic researchers. New components include a grasslands version developed for the Custer National Forest, South Dakota; a pinyon-juniper version used by the National Park Service in Colorado to evaluate the protection of archaeological resources at Mesa Verde National Park (CO); and an estimator of invasives occurrence and spread in the Northern Rockies and Colorado Plateau.
- To support the need of managers planning hazardous fuel treatments in the dry Interior West, a collaborative effort called the Fuels Planning: Science Synthesis and Integration Project brought together scientists and professionals with the common goal of making the best science relating to fuel treatments available to managers. Scientists helped develop an Environmental Consequences Toolkit that helps document the potential consequences of treatments on resources, and is being used to plan treatments (<http://forest.moscowfsl.wsu.edu/fuels>).
- Scientists are helping design a robust experiment evaluating the efficacy and effects of fuel treatments in forests at high risk for catastrophic fire. Sites have been chosen and sampling plots laid out.
- Work on invasive weed biocontrols includes working with cooperators in Eurasia to identify potential biocontrols on orange hawkweed in Montana; introducing a new biocontrol agent on rush skeletonweed in Idaho; and monitoring the efficacy of established biocontrols on tansy ragwort and leafy spurge in Montana.



State and federal land managers learn to monitor dalmatian toadflax and native vegetation after introduction of a new biocontrol insect.



Wildlife Ecology in Rocky Mountain Landscapes

(RMRS-4201) Missoula, Montana (<http://www.fs.fed.us/rm/wildlife/genetics>)

Mission: Develop wildlife habitat information at multiple spatial scales for use in managing and conserving wildlife in forest and rangeland ecosystems of the Rocky Mountains.

Key Accomplishments, Products, and Publications

- Scientists evaluated the impacts of roads on lynx, wolverine, and fisher in the Purcell, Cabinet, Clearwater, and Pioneer Ranges of Montana and Idaho. Lynx studies are the largest ever undertaken and utilize new methodologies such as GPS tracking. Collected data quantify movement patterns, habitat associations, and demographics.
- Researchers discovered a unique genetic strain of fisher in western Montana and central Idaho. This genetic signature likely indicates the presence of native fisher in this area. If so, this is the only known population of native fisher in the western United States outside of California.
- Habitat connectivity maps for black bear in northern Idaho were developed by relating minimum cost path algorithms to genetic patterns. This product is associated with a major Joint National Fire Sciences Project funded study in northern Idaho that will develop habitat relationships models in fuels treated landscapes.
- Scientists discovered critical links between hantavirus and imported biocontrols designed to control knapweed. Imported gallflies act as a food subsidy for deer mice, the primary carrier for hantavirus, a virus that cause Hantavirus Pulmonary Syndrome, a deadly disease affecting humans.

FY2005 Appropriations:

\$987,000

Outside Funding: \$978,577

Scientist Years: 4

Number of Products: 204



This adult female wolverine is part of an ongoing study in Glacier National Park on the impacts of roads on the species.

Fire Behavior Research

(RMRS-4401) Missoula, Montana (www.firelab.org)

Mission: Conduct research on wildland fire behavior to help land managers involved in prefire planning and management, fire suppression, and prescribed burning to better manage and protect the environment, firefighters, and communities. This unit conducts fundamental laboratory and field research on wildland fire behavior, develops physically based models, and synthesizes knowledge into models and tools useful to managers.

FY2005 Appropriations:
\$1,611,000

Outside Funding: \$843,937

National Fire Plan Funding:
\$357,692

Scientist Years: 5

Number of Products: 112



Thermal infrared sensors are installed at wildland fire incidents where areas within the actively burning plot containing remote instrument packages can be viewed.

Key Accomplishments, Products, and Publications

- An interdisciplinary study integrating three scales of remotely-sensed thermal infrared measurements has been successfully implemented on wildland fire incidents. The Rapid Response study evaluates the relative accuracy and efficacy of alternative remote sensing methods for characterizing fires, predicting fire effects, and supporting post-fire severity mapping efforts.
- A major update to the BehavePlus fire modeling system was released. New capabilities include crown fire modeling, new fuel models, and output tables designed for prescribed fire planning. BehavePlus is used for real-time fire behavior prediction, prescribed fire planning, and fuel hazard assessment.
- Work continues to support wildland fire management with high resolution surface wind simulations that predict wind direction and speed at the 100-200m scale in 1-2 hour time frames. The accuracy of this technology has been assessed using measurements of wind flow gathered from a grid of anemometers deployed in multiple geographical locations.
- The effect that solar insolation can have on fire behavior has been the focus of recent experiments directed toward a better understanding of the basic physics governing wildland fire ignition, spread and intensity. These experiments provide new understanding into the physics of wildland fire and assist in developing new and more accurate models of fire spread and intensity.



Fire Ecology and Fuels Research

(RMRS-4403) Missoula, Montana (www.firelab.org)

Mission: Determine the effects of fire on forests and rangelands through a program that involves site-, watershed-, and landscape-level field studies integrated with remote sensing and computer modeling. Research is conducted to restore and sustain healthy conditions, design and prioritize effective fuel treatments, and determine the effects of fire management on native plants and exotic/invasive weeds. Technology is transferred to managers through workshops, field demonstrations, and national and regional training courses.

Key Accomplishments, Products, and Publications

- A new fuel sampling procedure was developed and tested using systematically developed photographs of fuel loads.
- Relationships between optically sensed data and canopy bulk density were published in the *Canadian Journal of Forest Research*.
- Restoration studies were conducted in ponderosa pine, lodge pole pine, and whitebark pine forests. Findings are helping managers and planners restore burned forests to healthy ecosystems.
- Invasive species were monitored following prescribed fire and wildfire in Montana, Oregon, and Idaho.
- The historical role of fire in ponderosa pine and mixed conifer forests in Utah and Idaho was examined with dendrochronology studies.
- Landscape- and stand-level modeling work was conducted to examine the interactions of fuels, fire behavior, and stand and landscape structure.

FY2005 Appropriations:

\$1,218,000

Outside Funding: \$1,174,746

**National Fire Plan Funding:
\$382,532**

Scientist Years: 5

Number of Products: 335



Sampling a fire-scarred stump on the Boise National Forest, Idaho, to determine the historical role of fire in these forests.

Fire Chemistry Research

(RMRS-4404) Missoula, Montana (www.firelab.org)

Mission: Develop knowledge of spatial and temporal distribution of fires, combustion processes, emissions of trace gases and aerosols by fires, and long-range transport of atmospheric pollutants produced by fires using a variety of the most advanced technologies. Produce critical near real-time fire and smoke information to aid land managers in reducing the impact of fires on the environment.

FY2005 Appropriations:
\$910,000

Outside Funding: \$713,854

National Fire Plan Funding:
\$965,488

Scientist Years: 2

Number of Products: 30

Key Accomplishments, Products, and Publications

- The remote sensing team provides comprehensive daily, near real-time, high-resolution satellite images of fire locations, burned areas and smoke dispersion nationwide on the website www.firelab.org (click on “Remote Sensing”).
- Researchers conducted extensive ground and airborne experiments of smoke emissions during one of the worst fire seasons in Mexico in April and May, 2005. Researchers measured greenhouse gas emissions during flaming and smoldering combustion of fires in pine and mixed pine and oak forests, chaparral, and grassland in Chihuahua, Nuevo Leon, and Durango of Northern Mexico.
- Two experiments of smoke dispersion were carried out in New Mexico and Montana. Scientists monitored the dynamics of the three-dimensional distribution of smoke plumes and the backscattering from aerosols in the atmosphere, and created an automated system for defining spatial boundaries and monitoring the dynamics of smoke plumes in real-time.
- The components of the WRF/CHEM-Smoke Dispersion forecasting system have been rigorously tested and the system is in the final stages of integration. Testing included a detailed case study of the 2002 Hayman Fire (Colorado). The system will be fully tested and on-line in the Spring of 2006.



Studies are underway on the long-range transport of atmospheric pollutants produced by fires.



Bitterroot Ecosystem Management Research Project

(RMRS-4654) Missoula, Montana (www.fs.fed.us/rm/ecopartner)

Mission: Strengthen the scientific theory and practice of managing Rocky Mountain ecosystems at the landscape level in the context of social, economic, and ecological opportunities and constraints.

Key Accomplishments, Products, and Publications

- This project is a multidisciplinary partnership between the Rocky Mountain Research Station, Bitterroot National Forest (MT), the Northern Region of the USDA Forest Service, and the University of Montana that encourages exchanging information, communicating research results, and accomplishing relevant applied research to support ecosystem management.
- A survey of communities helps scientists and managers understand factors that influence the relationship between the public and local land managers regarding fire and fuels management.
- Research into the history of mixed conifer/lodgepole pine systems in headwater stream corridors and associated uplands indicates fire frequencies of 5 to 36 years, more frequent and less severe than generally supposed.
- Scientists tested an approach for integrating spatial landscape fire behavior, simulation, and treatment scheduling models to guide and evaluate treatment locations for the Trapper-Bunkhouse project on the Bitterroot National Forest
- Researchers measured the effects of weeds and biological control agents on migratory birds, insects, and native bunchgrasses and forbs.
- Studies show that thinning and underburning can improve the health and vigor in old-growth ponderosa pine and larch stands when undergrowth competition is severe.

FY2005 Appropriations:

\$406,000

Number of Products: 79



Banding chipping sparrows, a common inhabitant of native grasslands. Studies are evaluating how knapweed-infested sites have reduced abundance of the birds, as well as delayed breeding, reduced reproductive success, and reduced site fidelity.

Economic Aspects of Forest Management on Public Lands

(RMRS-4802) Missoula, Montana (www.fs.fed.us/rm/missoula/4802)

Mission: Develop information, methodology, and models needed to better integrate analyses of economic efficiency and economic effects into forest management decisions on public lands.

FY2005 Appropriations:
\$380,000

Outside Funding: \$384,702

National Fire Plan Funding:
\$173,908

Scientist Years: 2

Number of Products: 88



Researchers develop tools to forecast wildland fire suppression expenditures and measure the public and private values protected by wildfire suppression activities.

Key Accomplishments, Products, and Publications

- Scientists are developing tools to evaluate the public and private values protected by wildfire suppression activities. This research has application during large fire events to improve strategic suppression decision making, and after the fire season as a performance measure to evaluate whether suppression expenditures on a given fire were economically justified. Related research, funded by the Joint Fire Sciences Project, is exploring opportunities to improve estimation of values at risk required from Burned Area Emergency Response teams.
- Researchers, in collaboration with scientists at the Southern Research Station and the Scripps Institution of Oceanography, developed models to forecast fire suppression expenditures early in the fire season. These models are the starting point for a system to allocate Forest Service suppression funds.
- Interviews with command and general staff of Type I and Type II Incident Management teams were completed and provide information on the factors influencing suppression expenditures, barriers to effective cost management, and possible cost-saving strategies.
- Scientists have developed MAGIS, a decision support system for scheduling and analyzing trade-offs of fuel and forest health restoration treatment options at landscape scales. MAGIS incorporates vegetation treatments, economics and biomass, road access, sediment prediction, and information from fire behavior models (FARSITE) and vegetation disturbance simulation models (SIMPPLLE).

Aldo Leopold Wilderness Research Institute

(RMRS-4901) Missoula, Montana (<http://leopold.wilderness.net>)

Mission: Provide scientific leadership in developing and using the knowledge needed to sustain wilderness ecosystems and values.

Key Accomplishments, Products, and Publications

- Researchers compiled a soon-to-be-published Station technical report on computer simulation modeling of recreation use.
- Field work was completed for nine interrelated studies on visitor experiences in very popular wildernesses close to urban areas in the Pacific Northwest region.
- Studies are helping develop methods for measuring and monitoring public trust in planning for and managing fire and fuels.
- Researchers applied the decision support modeling tool BurnPro to two Forest Service wildernesses and three national parks to assess the feasibility of wildland fire use as a strategy for restoring historical fire regimes.
- Methods were developed for GIS mapping of the meanings that people place on areas being considered for fuel treatments. Resulting maps help managers plan treatments that simultaneously meet ecological and social objectives.
- Research was completed in Denali National Park and Preserve to define visitor experiences in visiting remote, non-wilderness glaciers.
- Scientists cooperated with Parks Canada to develop and evaluate a process for identifying and adopting indicators useful in establishing management objectives in remote northern wildlands.
- An annotated bibliography of social science literature relate to firefighter safety was developed for use in training to improve organizational culture and practices related to firefighter safety.

FY2005 Appropriations:
\$875,000

Outside Funding: \$623,295

National Fire Plan Funding:
\$347,756

Scientist Years: 4

Number of Products: 192



Scientists are studying spotted knapweed which aggressively invades following wildfire.

"I just returned from an annual briefing for House and Senate appropriations staffers on fire research. We used materials developed by you on the Fire Effects Planning Framework. I want to express how proud I am to be a part of this organization and to have the chance to represent the excellent work that is taking place in your unit. That I was able to find what I needed on the Web speaks to your commitment to having your work accessible. Good work!" (National Program Leader for Fire Systems Research, USDA Forest Service, Washington, D.C.)

LANDFIRE

Missoula, Montana (www.landfire.gov)

Mission: The LANDFIRE project is a multi-agency, interdisciplinary research and development project designed to develop maps and computer models needed by land and fire managers to prioritize, evaluate, plan, complete, and monitor fuel treatment and restoration projects essential to achieving the goals targeted in the National Fire Plan and the Healthy Forests Restoration Act of 2003.

FY2005 Appropriations:
\$8,000,000

Outside Funding: \$4,986,381
Scientist Years: 2

Key Accomplishments, Products and Publications

- Researchers accumulated and processed data from over 400,000 field reference plots from state and federal agencies, thereby creating a master database of vegetation condition. These data are used, along with ecological models, to develop supervised classifications of vegetation and fuels across the Nation.
- LANDFIRE creates maps that characterize fuel conditions based on fire behavior, fire effects, and fire danger research, and develops models that will be used to evaluate ecosystem status, fire hazard, and fire potential status.
- During a recent summer of severe wildfires in Montana and Idaho, LANDFIRE concepts and procedures provided fire specialists with technical support for locating fires and conducting a long-range assessment of potential fire behavior and effects. The fires demonstrated LANDFIRE concepts, and aided in refining procedures and building partnerships with fire managers.
- A recent Congressional General Accountability Office report describes LANDFIRE as “the only proposed research project so far that appears capable of producing consistent national inventory data for improving the prioritization of fuel projects and communities.”



LANDFIRE maps fuels and vegetation, enabling managers to assess the risks to communities and infrastructure.



Forest Service Research and Development in Nebraska

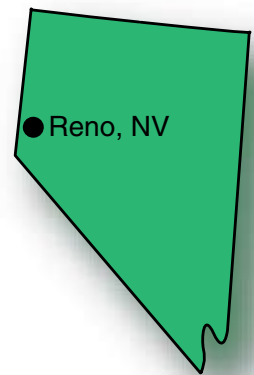


The Station currently maintains no research units in Nebraska. The USDA National Agroforestry Center, Lincoln, was transferred to the Forest Service's Southern Research Station in 2004. The Rocky Mountain Research Station continues to conduct studies throughout much of the Great Plains that benefits the residents of Nebraska, with much of the work based at the Center for Great Plains Ecosystem Research in Rapid City, South Dakota. The Station maintains cooperative working relationships with researchers and other resource specialists throughout Nebraska.

Forest Service Research and Development in Nevada

The Rocky Mountain Research Station maintains one research unit and the Great Basin Interdisciplinary Ecosystem Management Program in Reno, Nevada. Researchers examine the response of both upland communities, especially those associated with pinyon-juniper woodlands, and riparian ecosystems to past and present climate change and human disturbance in the Great Basin.

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Total FY2005 Appropriations: \$792,000

Total Outside Funding: \$223,654

Total National Fire Plan Funding: \$114,263

Total Number of Scientist Years: 2



Ecology, Paleoecology and Restoration of Great Basin Watersheds

(RMRS-4252) Reno, Nevada (<http://www.fs.fed.us/rm/main/labs/reno/rmrs4252.html>)

Mission: Increase understanding of the effects of both long-term climate change processes and more recent natural and human-caused disturbances on Great Basin ecosystems and watersheds, and use this understanding to devise meaningful scenarios for their restoration and management.

Key Accomplishments, Products, and Publications

- Studies provide a better understanding of the causes, timing, patterns, rates, and affected sagebrush ecosystems experiencing expansion of pinyon/juniper woodlands. Ecosystems affected are some of the most productive in the Great Basin. Findings shed light on the patterns of change in community composition as tree dominance, fuel loads, and associated wildfire risk increases.
- Scientists examined the susceptibility of Great Basin vegetation communities altered by woodland expansion and climate change to exotic annual plants such as cheatgrass. Studies focus on the most susceptible topographic, soils, and environmental and plant community conditions facilitating the expansion in range and dominance of cheatgrass and related species. How these changes are facilitated by disturbances is being studied.
- Plant fossil data from woodrat middens (nests) help determine how long-term trends drive environmental and vegetation changes and how these patterns and rates are being altered by human impacts. Geomorphic and community outcomes of extreme climate events from as long as 2,000 years ago still have significant influence on the distribution of current communities. How human impacts are changing these communities and their distribution provides insight into potential future changes.

FY2005 Appropriations:
\$459,000

National Fire Plan Funding:
\$114,263

Scientist Years: 2

Number of Products: 2



Researchers are investigating the ongoing upslope expansion of pinyon/juniper woodlands in the Shoshone Mountains study area in central Nevada.

Great Basin Interdisciplinary Research and Management Project

(RMRS-4655) Reno, Nevada (www.ag.unr.edu/gbem)

Mission: Achieve a better understanding of the structure and functioning of riparian ecosystems and watersheds within central Nevada, and develop management guidelines for maintaining or restoring their integrity.

FY2005 Appropriations:
\$333,000

Outside Funding: \$223,654

Number of Products: 29

Key Accomplishments, Products, and Publications

- This interdisciplinary research project is providing process-based information for restoring and managing Great Basin watersheds and riparian areas. Linked studies on climate history, geomorphology, hydrology, and ecology are providing both a basic understanding of complex riparian meadow ecosystems and the necessary information for maintaining their integrity.
- A demonstration area on ecosystem response to watershed-scale burns in pinyon-juniper woodlands has been developed in collaboration with the Joint Fire Sciences Program that is helping guide fuels and fire management efforts in the Great Basin.
- Landscape-scale evaluations of the response of wildlife species to ecosystem change are providing valuable information on using species such as birds and butterflies as environmental indicators.



The Great Basin Ecosystem Management Research Project is developing methods for restoring degraded riparian areas.



Forest Service Research and Development in New Mexico

The Rocky Mountain Research Station maintains two research units at the Forestry Sciences Laboratory in Albuquerque, New Mexico. The lab is co-located with the Forest Service's Southwestern Region headquarters.

USDA Forest Service

Rocky Mountain Research Station

Forestry Sciences Laboratory

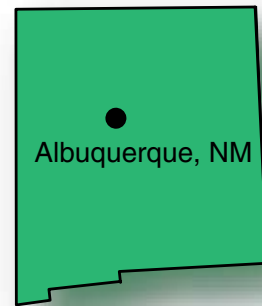
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Total FY2005 Appropriations: \$1,600,000

Total Outside Funding: \$875,361

Total National Fire Plan Funding: \$368,125

Total Number of Scientist Years: 7

Ecology, Recovery and Sustainability of Southwestern Grasslands and Associated Riparian Ecosystems and Wildlife

(RMRS-4351) Albuquerque, New Mexico (www.fs.fed.us/rm/albuq/rwud4351.htm)

Mission: Develop, synthesize and apply new methods and knowledge of processes, interactions, and human uses of grassland and riparian ecosystems to restore damaged lands, recover sensitive species, and sustain intact, productive, and diverse plant and wildlife communities and associated abiotic systems in the Southwest.

FY2005 Appropriations:
\$737,000

Outside Funding: \$549,961

National Fire Plan Funding:
\$368,125

Scientist Years: 5

Number of Products: 217

Key Accomplishments, Products, and Publications

- Long-term research on the role of fire and climate change on creosote shrub community expansion provides information for fire management decisions in southwestern blue- and black-grama grasslands.
- The effectiveness of an integrated weed management plan for invasive yellow starthistle was assessed by combining prescribed fire with seeded perennial grass and weed suppression treatments. This study describes approaches and outcomes of a community-based collaborative group focused on voluntary yellow starthistle control in New Mexico.
- In cooperation with Montana State University, researchers are conducting a study to assess linkages among fire, depth to water, and riparian vegetative recovery in New Mexico and Montana.
- To determine successional responses of exotic-invaded riparian habitats to fire, scientists measured micro- and macro-habitat components, fuel loads, avian populations, and bird nesting success at 7 burns, finding over 200 nests in 2005. Managers are using findings in restoration efforts.
- A project scientist conducted a tour of a Long Term Ecological Research (LTER) Site at the Sevilleta National Wildlife Refuge for the New Mexico Section of the Society for Range Management. Sevilleta LTER research focuses on understanding how abiotic drivers and constraints affect dynamics and stability in arid ecosystems.



Scientists led a tour of the Sevilleta Long Term Ecological Research Site for the New Mexico Section of the Society for Range Management.



Ecology, Diversity, and Sustainability of Soil, Plant, Animal, and Human Resources of the Rio Grande Basin

(RMRS-4652) Albuquerque, New Mexico (www.fs.fed.us/rm/albuq/rwu4652.htm)

Mission: Develop, synthesize, and apply new knowledge on processes, interactions, and sociocultural uses of upland and riparian ecological systems for sustaining diverse, productive, and healthy plant, animal, and human populations and associated natural resources in the Rio Grande Basin.

Key Accomplishments, Products and Publications

- Research on the importance of traditional economic pursuits, such as ranching, in maintaining rural cultures and lifestyles is facilitating communication between land managers, public land users, and the general public.
- Scientists are examining the sociocultural and economic roles of livestock ranching in maintaining rural Hispanic culture and traditions among grazing permittees on the Santa Fe and Carson National Forests, New Mexico.
- New studies are underway in the Middle Rio Grande Basin to determine the impact of drought and bark beetle attacks on pinyon-juniper woodlands. Results will clarify the effects on dynamics, stability, and productivity of upland ecosystems in relation to watershed capability.
- Research determined that pinyon-juniper woodlands support abundant and diverse bat communities and provide important summer habitat to reproductive female bats. Results were published in the journal *Forest Ecology and Management*.
- To guide management efforts in controlling invasive plants, reducing fire risk, and restoring native habitats, scientists have identified patterns of species composition and habitat use by plant, herpetofaunal, bat, and bird communities in riparian cottonwood forests of the Middle Rio Grande Basin.
- Studies on the values, objectives, beliefs, attitudes, and behaviors of forest and grassland stakeholders are helping land managers understand public interests.

FY2005 Appropriations:
\$399,000

Number of Products: 169



A field technician checks a funnel trap for lizards in a study of the effects of fuels removal on wildlife.

“What a great meeting you organized. It was very worthwhile and I appreciate participating with such a diverse collaborative group. I look forward to following the direction of Rocky Mountain Research Station studies for the Middle Rio Grande Basin.” (Range Management staff, Cibola National Forest, New Mexico)

Cultural Heritage Research

(RMRS-4853) Albuquerque, New Mexico (<http://www.fs.fed.us/rm/albuq/>)

(Note: This unit ceased operations in 2005. Social science and cultural heritage research will continue under RMRS-4351.)

Mission: Support efficient and effective land management by improving understanding of sustainable relationships between communities and their environments, diversity in communities of land users, and human communities modifying landscapes through time.

FY2005 Appropriations:

\$464,000

National Fire Plan Funding:

\$325,400

Scientist Years: 2

Number of Products: 46



Studies evaluate the economic, social, and cultural aspects of livestock ranching on national forests of the Southwest.

Key Accomplishments, Products, and Publications

- Scientists helped organize a workshop on “Wildfire and Fuels Management: Risk and Human Reaction,” in Santa Fe, New Mexico. Invited papers will be published by the Rocky Mountain Research Station.
- Two “Interim Reports on Phase One of Public Input Concerning Fire and Fuels Management in Region Three” (www.irsolutions.net/beta) were completed and sent to Forest Service personnel and community members involved in interviews.
- Presentations were offered on the publication *Economic, Social, and Cultural Aspects of Livestock Ranching on the Espanola and Canjilon Ranger Districts of the Santa Fe and Carson National Forests: A Pilot Study* to groups of livestock permittees at their annual allotment meetings.

Forest Service Research and Development in North Dakota



Although there are no Station research units currently in North Dakota, the Station conducts research throughout the Great Plains that benefits the residents of North Dakota. For instance, the research unit located in Rapid City, South Dakota, works to protect and restore grassland ecosystems while providing benefits and maintaining commodity outputs. Scientists also investigate ways to maintain viable populations of such animal and plant species as the black-footed ferret, swift fox, ferruginous hawk, mountain plover, burrowing owl, prairie fringed orchid, milkvetch, and Dakota buckwheat. Other work focuses on the effects of fire, climate change, and grazing on the prairie landscapes of the northern and central Great Plains, as well as on the interactions of gamebirds and big game species with livestock. The Station maintains cooperative working relationships with researchers and other resource specialists throughout North Dakota.

Forest Service Research and Development in South Dakota

The Rocky Mountain Research Station maintains one research work unit in South Dakota - the Center for Great Plains Ecosystem Research, in Rapid City. The Black Hills Experimental Forest is located on the Black Hills National Forest.



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Total FY2005 Appropriations: \$862,000

Total Outside Funding: \$64,600

Total Number of Scientist Years: 3

"The Assistant Attorney General from the Department of Justice has recognized you for your outstanding assistance in the litigation concerning the Black Hills National Forest. Your scientists prepared expert reports, were deposed and provided invaluable assistance in preparing for the depositions of the plaintiff's experts. The team provided valuable input into the briefs that were filed and their assistance allowed the United States to present its best possible case to the court and led to the ultimate settlement of the matter just prior to trial." (Senior Attorney, Department of Justice)



Management for Sustainable Ecological Systems on the Northern and Central Great Plains

(RMRS-4254) Rapid City, South Dakota (www.fs.fed.us/rm/rapidcity)

Mission: Increase knowledge and develop technology to manage for sustainability in grassland and forested ecological systems of the Great Plains.

Key Accomplishments, Products, and Publications

- Scientists are developing simple, cost-effective techniques to accurately estimate forage production, utilization, and ecological trends in relation to management needs.
- Long-term monitoring of chemical and biological control of leafy spurge (an invasive weed) provides managers with information on the efficacy of control methods, potential nontarget impacts, and recovery patterns following control.
- Researchers are examining the influence of an introduced cool-season grass species (*Bromus inermis*) on internal nitrogen cycling in warm-season dominated range sites on northern mixed-grass prairie. Comparisons are focused on soil nitrogen mineralization as affected by substrate quality and plant nitrogen uptake and use.
- Studies are underway on understory-overstory relationships in ponderosa pine forests as a possible mechanism for predicting invasive plant infestations following management for fuels reduction.
- Research results are providing land managers with information on movement and dispersion patterns of elk in relation to seasonal disturbances to help resolve management conflicts on public lands.
- Scientists are studying habitat relations of black-backed woodpeckers to mountain pine beetle infestations, and Merriam's turkeys to land use patterns.

FY2005 Appropriations:
\$862,000

Outside Funding: \$64,600

Scientist Years: 3

Number of Products: 41



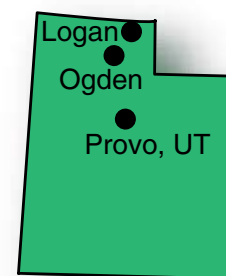
Scientists are evaluating the invasion of non-native plants following fuels reduction treatments.

"Your knowledge, professional interest, and experiences in working with the Forest on various studies, workshops, and silvicultural communication are reflected in the quality and usefulness of the disturbance ecology portion of the Science Consistency Consultation document. Thank you for your past and present much-appreciated contributions to the Forest." (Acting Forest Supervisor, Black Hills National Forest, South Dakota)

Forest Service Research and Development in Utah

The Rocky Mountain Research Station maintains four research units in Utah: two in Logan, one in Ogden, and one in Provo. An administrative service center is also in Ogden.

The Desert Experimental Range is in southeastern Utah, and the Great Basin Experimental Range is located on the Manti-La Sal National Forest.



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Total FY2005 Appropriations: \$12,762,000

Total Outside Funding: \$3,538,476

Total National Fire Plan Funding: \$471,955

Total Number of Scientist Years: 9



Restoration of Disturbed Ecosystems

(RMRS-4301) Logan, Utah (www.fs.fed.us/rm/logan/4301)

Mission: Find ways to better understand and manage lands and streams disturbed by human activities and natural events such as mining, floods, and landslides, and investigate aspen dynamics and ways to restore aspen stands at the landscape level.

Key Accomplishments, Products, and Publications

- Work is underway to develop and transfer science information and tools to help remediate selenium-contaminated watersheds in southeast Idaho.
- Scientists are documenting water quality trends and conditions in central Nevada watersheds.
- Researchers address concerns about the decline of aspen in the western United States by advising land managers, via technical transfer, on how best to restore this species and evaluate their restoration efforts.

FY2005 Appropriations:

\$347,000

Outside Funding: \$227,928

Scientist Years: 2

Number of Products: 19



Aspen/conifer forests on the Dixie National Forest, Utah, are burned to help restore aspen.

Biology, Ecology and Management of Western Bark Beetles

(RMRS-4501) Logan, Utah (<http://www.usu.edu/beetle/>)

Mission: Develop a scientifically credible knowledge base focused on insect population dynamics, in particular bark beetles, and their associated ecological effects in coniferous forests of western North America. Using this knowledge, develop tools to facilitate effective management strategies designed to maintain or restore these forests into productive, sustainable ecosystems at stand, landscape, and regional levels.

FY2005 Appropriations:
\$663,000

Outside Funding: \$167,567

Scientist Years: 2

Number of Products: 22



Researchers record data from a passive flight trap. These traps provide an unbiased measure of mountain pine beetle flight periods.

Key Accomplishments, Products, and Publications

- Results from a long-term project on the population dynamics of mountain pine beetle in whitebark pine indicate: 1) whitebark pine is an improved food resource as compared to the more traditional lodgepole pine host; 2) it appears to be less well chemically defended than lodgepole pine; and 3) comparably smaller whitebark pine are attacked and capable of producing brood. This information helps resource specialists manage ecosystems where recent mountain pine beetle infestations have resulted in extensive mortality.
- Entomologists are assessing a new delivery device for the chemical verbenone in an effort to protect whitebark pine. If proven effective, this product can be applied, using aircraft, to environmentally important remote stands.
- A study of mountain pine beetle populations across the range of the species is in progress. Results indicate that migration northward into British Columbia, Canada has occurred relatively recently. Scientists believe that recent warming trends will cause beetle populations to continue to expand northward.
- A model is being developed to predict those trees that will be most affected by bark beetles following wildfire. Associated brood data is being used to predict categories of fire-injured trees that may contribute to future beetle outbreaks.

“We greatly appreciate the time you spent with us. The information you presented was most interesting and applicable to what we are doing here on the Sawtooth National Forest. The members of our Leadership Team really valued the information you shared.” (Forest Supervisor, Sawtooth National Forest, Idaho)



Interior West Forest Inventory and Analysis Program

(RMRS-4801) Ogden, Utah (www.fs.fed.us/rm/ogden)

Mission: Improve the understanding and management of our Nation's forests by measuring, assessing, and reporting on the extent, condition and health of the forest lands of the Interior West on an annual basis.

Key Accomplishments, Products and Publications

- Crews collected, compiled, and made available to the public forest resource information on six states of the Interior West: Arizona, Colorado, Idaho, Montana, Nevada and Utah.
- Analysis staff reported on data from the latest periodic forest inventory of Wyoming and the Santa Fe (NM) and Tonto (AZ) National Forests. Several papers on forest related issues were also published. These reports provide land managers and policy makers with reliable baseline data about forest health, use, and potential.
- Researchers are working with partners to link forest inventory data with the MODIS satellite-based fire detection system to enable users to rapidly quantify forest resources affected by wildfire.
- New field protocols were tested for a down woody material (DWM) procedure and a non-forest plot procedure. The primary goal of the DWM study is to obtain data to estimate biomass of down dead material, fuel loading, and wildlife habitat information. The purpose of the non-forest pilot study is to collect data about the vegetation on previously unsampled grid points to be used for a variety of planning purposes.
- Project scientists and the Forest Service's Remote Sensing Application Center (RSAC) are involved in a study to test the efficiency of integrating large-scale aerial photography into an all-vegetation inventory of Nevada.
- Researchers and collaborators are developing analytical approaches for coupling forest inventory data and photos with historic imagery to evaluate past trends in U.S. forests.

FY 2005 Appropriations:

\$10,538,000

Outside Funding: \$1,154,320

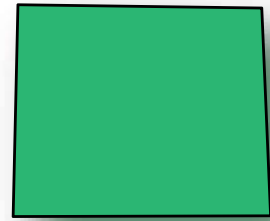
Scientist Years: 1



Researchers measure the condition and health of forest lands of the Interior West on an annual basis.

Forest Service Research and Development in Wyoming

The Station's Laramie, Wyoming laboratory was closed in 2005. The project was co-located in Fort Collins, Colorado, where operations continue. Scientists study watershed processes, wildlife and fisheries, and their associated habitats. Other Station projects, located in Fort Collins, conduct research at the Glacier Lakes Ecosystem Experiments Site on the Medicine Bow National Forest in southern Wyoming. The Station maintains cooperative working relationships with researchers and other resource specialists throughout Wyoming. Additional research is conducted in Wyoming by Station employees in Montana, Utah, South Dakota, Idaho, and Colorado.



Honors and Awards

- The Station presented its annual Outstanding Publications and Administration and Research Awards for 2005. Recipients included:

Nancy Shaw and **Durant McArthur**, Best Technology Transfer Publication Award, for *Restoring Western Ranges and Wildlands*, General Technical Report RMRS-GTR-136.



Nancy Shaw



Durant McArthur

Yvette Ortega, Best Early Career Publication Award for "Effects of Biological Control Agents and Exotic Plant Invasion on Deer Mouse Populations," *Ecological Applications*, Vol. 14, No. 1.



Yvette Ortega

Jeanne Chambers, Best Scientific Publication Award, for *Great Basin Riparian Ecosystems: Ecology, Management, and Restoration*, Island Press.

Sara Senn, Outstanding Customer Service Award, for demonstrating calm and professional competence and support during sensitive human resource issues.

Jonalea Tonn, Outstanding Science Support Award, for support in the area of plant identification in the Inland Northwest, and for general expertise.



Jonalea Tonn

Brian Dudding, Outstanding Lab Support Award, for improving the efficiency of lab operations and being instrumental in the design, construction, and moving efforts for a new office/lab at the Idaho Water Center.



Brian Dudding

The Station's **Financial Management Group**, Outstanding Administrative Team Award, for sustained outstanding work ethics and professionalism through many changes due to centralization of the organization (Group members include: Cathleen Arguello, Rebecca Bedan, Lynda Costellano, Victoria Dixon, Menn Pollworth, Margie Dodds, Dave McCluskey, and Tracey Parrish).



Financial Management Group members (L to R): Dave McCluskey, Margie Dodds, and Tracey Parrish (not pictured: Cathleen Arguello, Rebecca Bedan, Lynda Costellano, Victoria Dixon, and Menn Pollworth)

Michael Wilson, Outstanding Customer Appreciation Award, for coordination with various groups to assist in complex situations.

- Boise, Idaho scientist **Charlie Luce** was named recipient of the Editor's Citation for Excellence in Referring in an issue of EOS, Transactions of the American Geophysical Union. He was also awarded a U.S. Patent for "Method for Sensing Evaporation of a Liquid," which improves on the temperature sensitivity, precision, and cost of existing methods for measuring losses from evaporation pans.
- Retired Station scientist **Jack Lyon** received the Olaus Murie Award from the Rocky Mountain Elk Foundation for achievements related to conservation of North American elk.
- The Federal Laboratory Consortium presented the Station with a technology transfer award in recognition of support toward development of FIRETEC, a fire behavior model that was developed at the Los Alamos National Laboratory in Los Alamos, New Mexico. The Station provided the study area for testing FIRETEC and support for modeling through an interagency agreement.
- Scientist **Durant McArthur**, Provo, Utah, was honored by the Society of Range Management with the Range Manager of the Year Award for sustained scientific productivity and support.
- Project Leader **Dan Neary**, Flagstaff, Arizona, was selected as a Fellow by the American Society of Agronomy. He was one of 28 Fellows chosen in 2005 for their professional achievements and meritorious service.
- The Station was co-recipient of the 2004 Research Award from the New Mexico Riparian Council. The award recognizes research efforts on the Middle Rio Grande Fuels Reduction Study, designed to evaluate hydrological, vegetation, and wildlife responses to removal of riparian fuel loads.



Charlie Luce



Dan Neary

- The Station's Boise, Idaho laboratory received the Southwestern Idaho Combined Federal Campaign Presidential Award. The honor is based on percent participation, contribution per capita, and total giving.
- Missoula, Montana scientist **Carol Miller** received the National Fire Plan Award for Excellence in Research. The award recognizes her success in creating an interdisciplinary research program that proactively addresses high priority fire and fuels management needs.
- A paper co-authored by researchers **Russ Thurow** and **John Guzevich**, Boise, Idaho, won the Best Paper Award at the Idaho Chapter of the American Fisheries Society annual meeting. The paper was titled "Utility of Snorkeling for Censusing Salmonids."
- Scientist **Dan Uresk**, Rapid City, South Dakota, was presented with the Lifetime Achievement Award at the annual meeting of National Grasslands Managers. The award cites his 28 years of service and 130 published articles.
- Scientist **Michael Schwartz**, Missoula, Montana, was honored with a 2004 Presidential Early Career Award for Scientists and Engineers. He was recognized for his exemplary professionalism in the field of wildlife genetics and ecology, and



Carol Miller



Russ Thurow



Dan Uresk



Michael Schwartz



for his leadership in international collaborations to use novel statistical methods to analyze genetic data, all of which contribute to the development of sound natural resource management policies. Schwartz provided the first scientific evidence of bobcat-lynx hybrids in the wild using tests he designed and implemented.

- Project Leader **Bruce Rieman**, Boise, Idaho, received the American Fisheries Society 2005 President's Fishery Conservation Award for long-term contributions that advance aquatic resource conservation at a regional level. Rieman worked to advance understandings of fishes and fisheries management in the Columbia River Basin, and to bring this information to bear on improving forest and fishery management. He was also honored with the American Fisheries Society "President's Fishery Conservation Award" for advancing the understanding of fishes and fisheries management in the Columbia River Basin.



Bruce Rieman

Community Involvement

Station employees regularly leave their laboratories and offices to take science to people in the community. They give presentations to landowners, school, church, and civic groups; lead field trips for the public; help with education programs in the classroom; and contribute their expertise in museums, visitor centers, and other public forums. For example:

- Each year, the Station proudly sponsors the Flagstaff Festival of Science, held in Flagstaff, Arizona. This year, scientists participated in the Festival's "Science in the Park," an event that gives families a chance to see what the science organizations in the community are working on. As part of the Festival, the Station hosted an open house at the Fort Valley Experimental Forest. Scientists were also part of the "In School Presentations Program," visiting local schools and talking about Forest Service research.
- The Station was a primary sponsor and organizer of the 5th Annual Tu B'Shevat Festival in Scottsdale, Arizona. Tu B'Shevat is the "Birthday of the Trees" in Israel. The event reflects 18 years of cooperation between the Forest Service and the Jewish National Fund, which is responsible for forestry and land development in Israel.
- Staff at the Aldo Leopold Wilderness Research Institute participated in River Fest 2004, in honor of the 40th anniversary of the Wilderness Act. Activities included speakers, performers, display booths, and demonstrations of science and its value to wilderness stewardship.
- Several members of the Station's Acquisition Management staff participated in "Make a Difference Day" by providing yard maintenance for people who were unable to do it themselves.
- Several Flagstaff, Arizona researchers helped judge entries for the Flagstaff Community Science Fair.
- Flagstaff biologists worked as volunteers at the national "Becoming an Outdoors Woman" workshop in Northern Arizona. The 3-day event taught concepts and skills in native wildlife and habitat, hunting and fishing, and environmental ethics to adult urban women.
- Ten scientists and technicians from the Station's Moscow, Idaho laboratory participated as evaluators for the Moscow Public Schools Science Fair.
- Scientist Steve Overby, Flagstaff, Arizona, provided technical assistance to the Singua High School Advance Placement Environmental Sciences class in evaluating water chemistry, aquatic macroinvertebrates, the fish community, and riparian mammals.
- Employees at the Aldo Leopold Wilderness Research Institute in Missoula, Montana, participated in a walk for the National Multiple Sclerosis Society, raising over \$1,200.
- Station employees give regularly and freely of their time and talents within their communities. Some of the many contributions in 2004 included: high-school class mentoring; participation in the Big Brother-Big Sister program; working with food co-ops; serving on local committees, boards and associations; preparing meals for the Meals-On-Wheels program; serving in local church functions; members of Lions Club and other service organizations; and serving as volunteers for local fund-raisers and charity groups.



Outreach to Under Represented Segments of Society

The Station annually hosts, co-hosts or participates in a variety of camps, conferences and other events aimed at introducing students and minority youth to Forest Service programs.

These include:

- The Hispanic Natural Resources Career Camp is held each October at the Station's Fraser Experimental Forest in central Colorado. Since 1993, researchers have sponsored the weekend camp for Hispanic high school students throughout northern Colorado and southern Wyoming. They are introduced to natural resource subjects such as hydrology, forestry, wildlife, entomology, climate, and forest surveying. For more information, visit <http://lamar.colostate.edu/~mhmartin>.
- The American Indian Math and Science (AIMS) Camp is hosted annually in Polson, Montana, by the Station, the Salish-Kootenai College, and the Flathead Reservation. Fifth and sixth graders from Tribal schools participate in a variety of events, including natural resource management activities, career opportunities, education requirements for natural resource disciplines, leadership, communications, problem-solving skills, tribal cultures, and environmental awareness.
- The Nature High Summer Camp, held at the Great Basin Experimental Education Center in Ephraim, Utah, introduces high school students from the State to natural resources, careers in resource management, the real life work of professionals, and the latest techniques and technology being used by today's resource specialists.



Students participate in group activities at the AIMS Camp.

Natural Resources Conservation Education Program

The Forest Service's Natural Resources Conservation Education Program annual funding is used as seed money to encourage the growth of education partnerships among the Station, States, and local educators. In addition to the Hispanic Natural Resources Career Camp, the Nature High Camp and the AIMS Camp, activities also include:

- The Station helped sponsor the Northern Arizona University Centennial Forest's Junior Forester Academy, and provided two full scholarship programs through Conservation Education funding. This provided an opportunity for two underserved youth to attend the academy that would not have had the opportunity to do so without a scholarship. The Station also provided equipment and supplies to the Senior Forester Academy.

- Scientists at our Flagstaff laboratory participated in the annual Flagstaff Festival of Science, now in its 15th year. The week-long event provides opportunities for the Forest Service to share natural resources research through in-school and after-school presentations.
- Flagstaff personnel also support and participate in Camp Colton, held annually on the slopes of the San Francisco Peaks in northern Arizona. Here, Project LIFE (Life In the Flagstaff Environment) is presented to students in the Flagstaff Unified School District. About 1,000 6th graders take part each year in the 5-day camp, consisting of a series of outdoor-related classes. The students learn how to live in a wilderness setting, appreciate the natural environment, understand their involvement in the environment, and gain a sense of responsibility to preserve nature and its beauty and wonder for future generations.
- The FireWorks Educational Trunk and Curriculum is a self-contained “trunk” of creative, interactive teaching materials for grades 1-9 that describes how fire affects forests. Created by scientists at the Fire Sciences Laboratory in Missoula, Montana, it is available on loan through the Montana Natural History Center (406-327-0405).
- The “Living with Fire” interactive touch screen computer program teaches visitors to the Fire Visitor Center at the Aerial Fire Depot in Missoula, Montana, about wildfire, the role fire plays in nature, and how wildfires are suppressed. It is also available on the Internet at: http://www.fs.fed.us/rm/fire_game.

Grants and Agreements

Universities and Cooperative Research

The Station participates in five Cooperative Ecosystems Studies Units, established as collaborative efforts between universities and Federal agencies to provide technical assistance and education to Federal land management, environmental and research agencies and their partners. The Station maintains an active cooperative research program with universities and other partners in order to share expertise and facilities to assist Forest Service research and development projects. In fiscal year 2005, we conducted \$12.9 million in cooperative research with 49 universities and 35 non-university cooperators. Cooperative research is an important component of accomplishing our research mission.

RMRS Partnerships

To help advance solutions to natural resource problems, the Rocky Mountain Research Station maintains key partnerships with:

- **National Forest Systems.** Forest supervisors and managers compose the Station’s largest customer segment or stakeholder group. National Forest Systems rely heavily on Station staffs to provide scientific information and assistance in implementing the Endangered Species Act, Clean Water Act, Clean Air Act, and other environmental legislation. The Station supports several national missions, including: the Fire Sciences Laboratory; Aldo Leopold Wilderness Research Institute; and the Natural Resource Assessment and Ecology and Management, Cultural Heritage, and Stream Systems Technology units.



- **Other Federal Land Management Agencies.** The Station serves managers of the largest public land holdings in the lower 48 states, including the Bureau of Land Management, National Park Service, Bureau of Reclamation, and Department of Defense.
- **Other Federal Non-land Management Agencies.** The Rocky Mountain Research Station provides regular consultation to the Environmental Protection Agency, National Marine Fisheries Service, U.S. Fish and Wildlife Service, Natural Resources Conservation Service and Bureau of Indian Affairs in non-land management functions. For instance, the Station created and supports the Rocky Mountain Center, a computer modeling system that provides real-time, high-resolution weather intelligence that assists in fire and smoke management in the Interior West. Partners include the National Oceanic and Atmospheric Administration, National Weather Service, Environmental Protection Agency, state agencies, universities, and others. Information is available at www.fs.fed.us/rmc.
- **State, Local and Other Public Agencies.** Our Interior West Resource Inventory unit is the Station's largest unit and provides eight Western States with resource inventory and monitoring data for use by State, County and urban planners, State resource agencies, industry, and others.
- **Industry.** The forest products industry is primarily concentrated in the northwestern part of our territory in Idaho and Montana. It has traditionally been an important customer for tree improvement, forest productivity, mensuration, insect and disease, and engineering technology research at our Moscow, Idaho, and other labs. The Station collaborates with the Forest Products Laboratory in Madison, Wisconsin, to link utilization researchers with forest products research opportunities. Summer recreation and winter ski area development and expansion make these industries major customers for Station research programs.
- **Non-government Organizations (NGOs).** Citizens representing themselves and special interest groups in land management planning efforts are a significant group requesting research information, and special interest groups are becoming increasingly aware of, and are valuing, research information for their uses.
- **Tribal Governments.** The Station supports a number of working relationships with several Tribal governments, including fuels reduction/ exotic plant removal studies with the Navajo Cochiti Pueblo (NM), fire effects consultation with the Navajo Tribe (AZ), and conservation education programs with the Salish-Kootenai Tribe (MT).
- **International Cooperation.** Station scientists regularly travel to other countries to cooperate with other scientists, universities, institutions, and government agencies on a variety of natural resources projects and issues. For instance, a Fort Collins, Colorado scientist traveled to Lillehammer, Norway to work with colleagues at the Norwegian Institute for Nature Research on a project examining the social and ecological impacts of second home development in Norway.

To find out more about the Rocky Mountain Research Station:

Visit our Internet Web site at www.fs.fed.us/rm. You'll find information on:

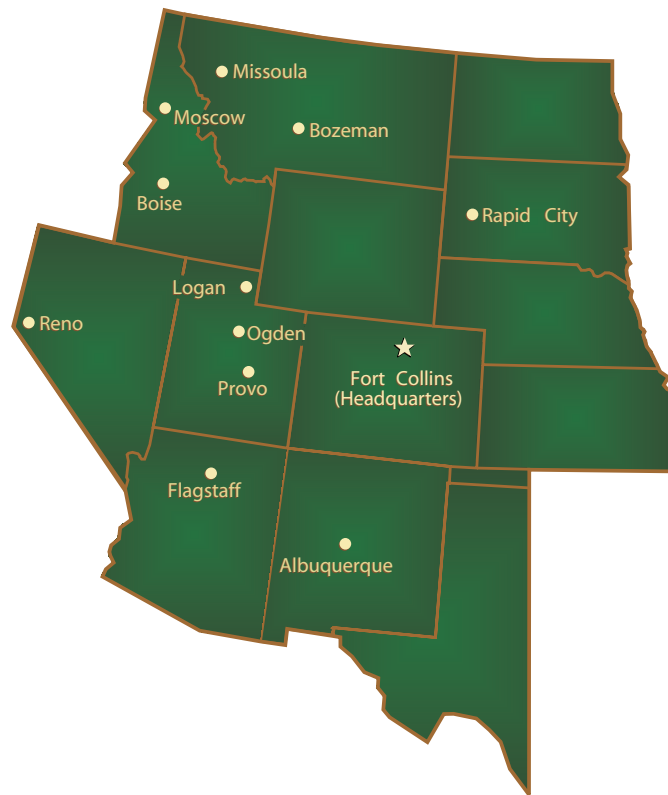
- Our research program, including our mission, research themes and highlights, strategic planning, and a map of our Station territory
- Our laboratories, research work units, and experimental forests
- An updated section on fire research and fire-related issues
- A listing of Station personnel
- Available Station publications, including electronic Web site publications and ordering information
- Links to other Forest Service and natural resources-related sites

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