

--- 2003 ---

RESEARCH ACCOMPLISHMENTS




Rocky Mountain Research Station

Front Cover Photo: This forest is under attack by the mountain pine beetle—a forest insect pest that is common throughout much of the western United States. Station scientists are studying this and other native and introduced insects and their relationships to healthy forest environments. Find out more in “Insects: the Silent Killers,” beginning on page 3. (photo by Dave Powell, USDA Forest Service)

Rocky Mountain Research Station

2003 Research Accomplishments



From the Director

Our nation's forests are some of our most valuable assets, providing water, recreation, wildlife habitat, wood products and, for many, a place of solitude and personal rejuvenation. However, these prized natural resources face many threats, including uncharacteristic wildfire, invasive species, loss of open space and unmanaged recreation.

Although fire plays an important ecological role in western forests, an estimated 190 million acres of federal forests and rangelands in the U.S. face high risk of catastrophic fire. Years of natural fuels buildup, coupled with drought conditions, insect infestation and disease, make many areas throughout the country vulnerable to intense and uncharacteristically destructive fires.

The globalization of trade and travel is spreading organisms from their natural habitats into new environments. Known as invasive species, they are disrupting native ecosystems and draining U.S. resources. Seventy million acres of forest are at serious risk of mortality from 26 different insects and diseases, and numerous invasive plants.

America is slowly losing its heritage of open space. More than 22 million acres of open space were lost to development during the last two decades – about 4,000 acres per day. Conversion of forest and rangeland to development can carry high ecological, social and economic costs.

Finally, recreational use of our national forests and grasslands has soared in recent decades. Americans make over 200 million visits to national forests and grasslands annually – 15 to 20 times more than in 1946. By 2100, the number of visitors is projected to double today's figure. Rising recreational use places increased pressure on our natural resources and, if not well managed, can damage wetlands and wildlife habitat, erode soils and spread invasive weeds.

The challenges facing today's public land managers are daunting and require the best science-based management plans to help maintain and improve the health of our Nation's forests and grasslands. The Rocky Mountain Research Station has a nearly 100-year record of long-term, multi-disciplinary research that is providing resource specialists with state-of-the-art information they need to meet those challenges.

I hope you find our 2003 Research Accomplishments Report useful and informative. I invite you to learn more about the Rocky Mountain Research Station by visiting our website at www.fs.fed.us/rm.

Marcia Patton-Mallory
Station Director



"Our mission is to develop and deliver scientific knowledge and technology that will help people sustain our forests, rangelands and grasslands."

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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 while maintaining 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 Staff

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: Operations, Computer Systems, Facilities Management, Financial Management, Library Services, Human Resources, Public Affairs, Publishing Services, Safety/Health/Environment, Civil Rights, Statistics, Budget, Grants and Agreements, Procurement and Purchasing.

"The Rocky Mountain Research Station encourages collaboration among managers and researchers, producing science that is relevant, timely and widely used by managers to get results on the ground."
(Deputy Chief, USDA Forest Service, Washington, D.C.)

Director's Office Staff

Station Director: Marcia Patton-Mallory

Deputy Station Director: John Toliver

Assistant Station Directors for Research:

Alison Hill

Janine Powell

Jim Saveland

Jack Waide

Assistant Station Director for Operations:

Galen Hall

Insects: the Silent Killers

By Rick Fletcher

The most abundant life forms in our national forests are insects. While some are important components of healthy ecosystems, the impacts can be devastating when the damaging ones reach epidemic proportions, affecting an estimated area 45 times that of fire, with an economic impact that is almost 5 times as great.

Rocky Mountain Research Station science is on the forefront of a multifaceted effort that focuses on both native and introduced insects and their relationships to healthy forest environments.

- For instance, researchers at our Logan, UT laboratory are studying the effects of climate change on insect populations. They are evaluating the potential disruption of the outbreak ecology for two native forest pests – the mountain pine beetle and spruce beetle, and one potential introduced pest, the gypsy moth. Study results point to a link between intensified outbreaks of mountain pine beetle and global warming. These predictions have important economic and ecological consequences, including the possibility of



To help assess the extent of spruce beetle populations, researchers built and installed traps baited with infested green tree bolts.



Mountain pine beetle

mountain pine beetle populations moving into previously beetle-free environments.

- Research on spruce beetle provides insights into the current massive tree mortality that occurred during the 1990's from Alaska to Utah. Findings show that the life cycle of the beetle is regulated by warm summer and fall temperatures. Warm temperatures accelerate development to the adult life stage the first year, which can increase the risk of beetle outbreaks or accelerate the rate of spruce mortality in an established outbreak. Forest entomologists and managers are using this information to develop treatment programs.
- The potential impact of gypsy moths on aspen is a major concern, as aspen is experiencing a serious decline in parts of the western U.S. While there is little likelihood of gypsy moths becoming established in aspen under current climate conditions, scientists project dramatic



changes if temperatures warm, with over 97 percent of the aspen in Utah predicted to have a high probability for successful gypsy moth establishment. These findings will help land managers and entomologists better plan for future forest management. Additional information on this research can be found at <http://www.usu.edu/beetle>.

- The Station's Interior West Resource, Monitoring and Evaluation Program, located in Ogden, UT, collects data in more than eight Interior West states to determine the status and trends of our forests. Using aerial and satellite imagery, along with field observations and existing data and computer models, scientists are developing maps and other tools that help resource managers analyze the risk and occurrence of insect outbreak. This information is being used to form and implement programs and policies to improve forest health throughout the Interior West.
- In Flagstaff, AZ, station scientists are investigating the abilities of Douglas-fir to resist attack by western spruce budworm, the most destructive insect pest of western coniferous forests. Research results point to genetic variation among trees as an important mechanism of resistance. Scientists also believe that the presence of ectomycorrhizae (a beneficial root fungus) may also be a contributing factor. This new understanding of the specific reasons why some trees are more resistant to damage from the budworm than others is being used in Douglas-fir tree improvement programs. It is also helping forest managers develop more effective management options to prevent widespread damage from outbreak populations and improve overall forest health.
- Work at Flagstaff also involves testing various sampling designs to measure the impacts of the budworm on timber resources. In addition, researchers reconstructed and evaluated the history of western spruce budworm outbreaks in mixed conifer forests of the southern Rockies. They found that outbreaks typically corresponded to increased moisture, while relatively little budworm activity occurred during drought. This research provides valuable new information about efficient sampling designs to accurately measure budworm impacts, and improve understanding of the role climate may play in deterring budworm outbreaks.



Mountain pine beetle damage in Colorado's Front Range

- Flagstaff scientists are focusing on the spruce aphid, a new invasive pest in the Southwest. This insect is causing extensive and severe damage on dormant Engelmann spruce and Colorado blue spruce. Work is underway using aerial photography, GIS analysis and field surveys to develop a hazard rating code for forests in this region. Recommendations based upon the results of the hazard rating are used to develop guidelines for managing forests at risk to the spruce aphid.
- At Station headquarters, in Fort Collins, CO, studies are looking at the role of natural disturbances, such as insect infestations, in maintaining healthy alpine and forest ecosystems. Scientists are evaluating the role bark beetles play in forest composition and structure to help increase our understanding of ecological factors that drive bark beetle populations. Studies on interactions between the Douglas-fir beetle and the tussock moth in Colorado's Front Range will help meet the needs of resource managers throughout the region.
- Fort Collins scientists are also working to develop statistical methods for adapting and enhancing available forest inventory and monitoring data that will detect "hot spots" of insect activity and infestation.
- The Black Hills National Forest in South Dakota recently asked Station scientists at our Fort Collins, CO headquarters to update a report on management and ecology of Black Hills ponderosa pine to help address multiple resource management challenges. The new report provides information on insects, including the mountain pine beetle, pine engraver, red turpentine beetle and pine tip moth. In a format useful for ecologists and managers, it addresses many of the insect management challenges facing resource specialists in South Dakota and Wyoming, and was used to develop the Black Hills Draft Environmental Impact Statement. The report is available at http://www.fs.fed.us/rm/pubs/rmrs_gtr097.html.

The fundamental understanding of insect ecology is being used throughout much of the Station's territory to help evaluate the relationships between climate, fire and insects in maintaining healthy forests.



National Fire Plan Research Update

Years of fuels buildup, coupled with drought conditions, insect infestation, and disease, have left forests and grasslands in many areas vulnerable to intense and uncharacteristically destructive fires.

The Forest Service is one of several federal, state and local agencies responding to this challenge through the National Fire Plan by addressing four strategic goals: firefighting capacity, rehabilitation and restoration, hazardous fuels reduction, and community assistance.

The Rocky Mountain Research Station, a world leader in wildland fire science, is supporting the National Fire Plan on several fronts:

Firefighting

National Fire Plan research in the area of Firefighting Capacity is producing new tools to improve firefighting preparedness through better risk assessment methodology, better tools for resource allocation, and improved fire weather and smoke dispersion modeling. Researchers are working in partnership with fire managers to apply these tools and make them widely available to firefighters.

- Station scientists at our Fire Sciences Laboratory in Missoula, MT are creating a nationwide fire monitoring system that uses satellite data to monitor factors such as active fires, fire severity, and smoke concentrations and dispersions, and allows reporting of data with only a 2-4 hour delay. This real-time fire information assists fire managers in developing fire attack strategies and making resource allocation decisions.
- Researchers are also developing mobile instruments that can do real-time measurements of particulate concentrations emitted by fires

over a large area. Such data enables managers and public officials to assess and predict effects on visibility and air quality, allowing for better preparation for these events. This is one of several projects targeted at understanding and predicting smoke movement under different environmental conditions.

- In cooperation with the US Geological Survey and other Forest Service units, scientists are developing and testing a package of data and software called LANDFIRE. LANDFIRE provides managers with tools that: identify the locations of hazardous fuels and values at risk; help prioritize fuel treatments; and develop fuels treatment prescriptions. It also provides



Photo by Kari Brown

Your Fire Sciences Lab is providing practical, on-the-ground applications that are making a difference in our operations and policy discussions. (Deputy Chief, USDA Forest Service, Washington, D.C.)

the ability to develop wildland fire suppression tactics and conduct long-range assessments of wildfire potential.

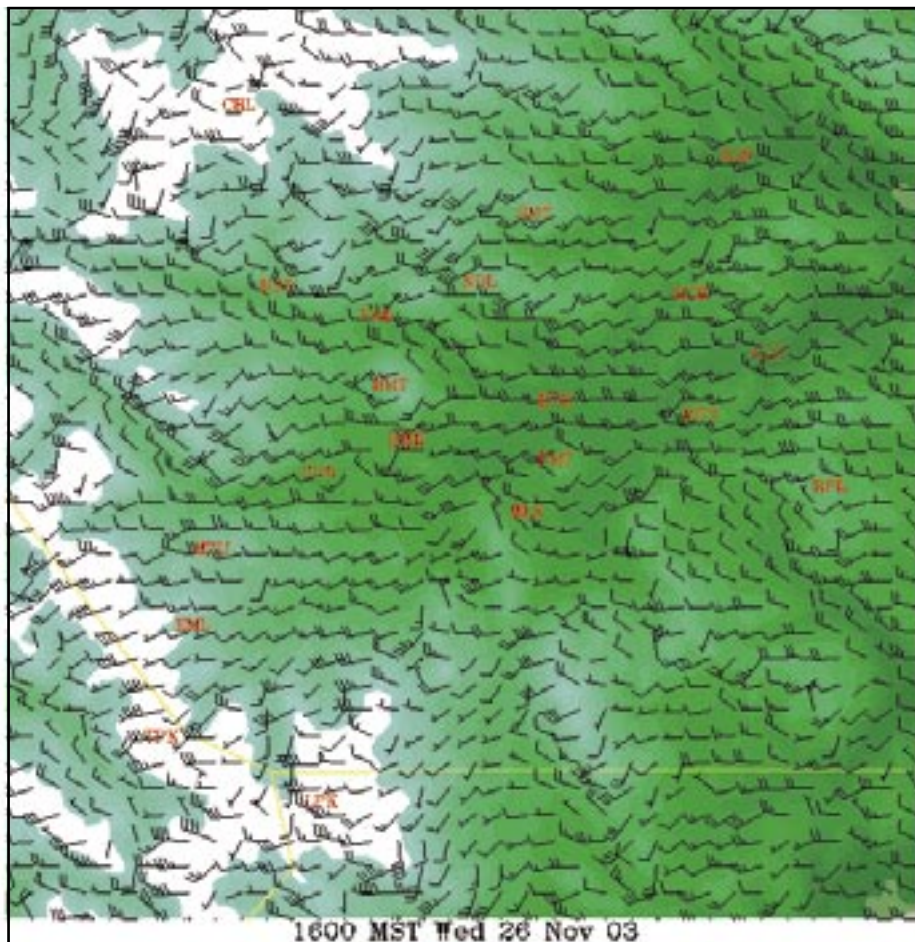
- The Station's Aldo Leopold Wilderness Research Institute in Missoula, MT recently published a general technical report titled *Linking Wilderness Research and Management, Vol. I*. This publication is helping managers access scientific information relevant to fire fighting and fire management in and near wilderness areas.
- Wildfire resource deployments and prescribed burn "go/no-go" decisions depend on detailed weather intelligence. In response, the Station created and supports the new Rocky Mountain Center, a computer modeling system that provides real-time, high-resolution weather

intelligence over the Interior West. Based in Fort Collins, CO, RMC assists in fire and smoke management through regional simulations of specific fire-weather phenomena, including fire danger, fire behavior and smoke dispersion. Information, tutorials and products are available at <http://fireweather.info>.

- Forests impacted by insects and diseases are more susceptible to wildfires. Fort Collins researchers are using satellite imagery to look at the impacts of these disturbances to determine the distribution of fire hazard and spread of wildfire. This information is being incorporated into an expert opinion decision analysis tool that will be used to help managers make operational decisions about management options. (Due to reductions in National Fire Plan funding for

research and development, this project will be terminated in Fiscal Year 2004.)

- Based on U.S. Clean Air Act and Regional Haze Rule requirements, researchers at the Fire Sciences Laboratory are developing a nationwide system, the Weather Research and Forecasting Smoke Dispersion Model, to forecast smoke dispersion and concentrations of pollutants downwind. Such information will be made available on the Internet and will help managers plan for and conduct prescribed burns while complying with air quality standards.



This map of surface wind predictions near Estes Park, CO, is an example of tools delivered by the Rocky Mountain Center.



Rehabilitation and Restoration

Minimizing postfire erosion and flooding damage, and helping native vegetation recover in burned areas are critical National Fire Plan objectives.

- Scientists at our Fort Collins, CO headquarters are studying the regeneration of white pine forests following wildfire. These high elevation forests help reduce erosion and set the stage for development of ecologically significant forest types following fire. Researchers are characterizing the regeneration dynamics of these species after fire and identifying and selecting sources of white pine seeds that display hardiness and resistance to white pine blister rust to ensure economically and ecologically effective restoration of burned sites. (Due to reductions in National Fire Plan funding for research and development, this project will be terminated in Fiscal Year 2004.)
- In Provo, UT, work is underway to identify and characterize native plant species that can be used for postfire restoration, and develop practices for seed production and protocols for seed warehousing. This effort is helping ensure native seed supplies are available to land management agencies when needed.
- Information on the water flow patterns and geology of sites is critical for assessing risks of postfire erosion and flooding, and selecting postfire treatments that will mitigate these effects. At our Flagstaff, AZ laboratory, researchers are working to incorporate these factors into predictive models that will provide managers with better support for burned area emergency rehabilitation decisions. Studies were conducted during the past two summers on fires in New Mexico and Arizona.
- At the Forestry Sciences Laboratory in Boise, ID, studies focus on the effects of fires and fire-related management on aquatic systems. Scientists are measuring the influence of large fires, post-fire climatic events and post-fire management on watershed processes and the persistence of sensitive aquatic species, such as bull trout. Better understanding of when and where fire represents a threat to aquatic ecosystems will enable managers to characterize risk and prioritize fire and fuels management and post-fire rehabilitation efforts.
- Scientists from several disciplines, working on studies on the Tenderfoot Creek Experimental Forest in Montana, are exploring the ecological and biological effects of thinning and prescribed fire in lodgepole pine stands – the third most extensive forest type in the Rockies. Research results provide recommendations on silvicultural options, including fuel treatments for reducing fuel loading, improving stand health, maintaining regeneration potential, options for hydrologic and wildlife considerations, and prescriptions for improving residual tree growth. These recommendations are critical to National Forest planning efforts.
- Researchers at our Reno, NV, Bozeman, MT, Flagstaff, AZ, Albuquerque, NM and Boise, ID laboratories are studying the relationships and interactions between fire and exotic weeds and invasive plants. For instance, the cycle of wildfires and subsequent weed invasion has altered millions of acres of western shrublands and grasslands by reducing plant and animal diversity and increasing fire size and frequency. Results of this work will provide managers with new tools and plant resources for reestablishing and protecting biological diversity. (Due to reductions in National Fire Plan funding for research and development, portions of this project will be terminated in Fiscal Year 2004.)
- Researchers are examining what factors make Great Basin ecosystems particularly susceptible to invasion by fire-adapted plants such as cheatgrass.
- They are also looking at ways to utilize prescribed fire to restore and sustain native grasslands and reduce the incursion of woody

plants. Findings help managers identify effective practices that maintain grassland ecosystems.

- Wildfire, fuel reduction and thinning treatments create conditions that encourage weed invasions and possibly the susceptibility of trees to diseases. Interdisciplinary research is helping understand the ecological, economic and social consequences of wildfire and rehabilitation efforts on southwestern forest health, and is being used to develop guidelines for postfire vegetation management.

Hazardous Fuels Reduction

New investigations are underway to facilitate fire risk assessment, anticipate treatment impacts, and develop new uses and systems for harvesting forest undergrowth and small diameter trees. Modeling and mapping efforts are helping determine where the most dangerous fuel buildups currently occur and predict where they will occur in the future.



Photo by Tom Iraci

- Managers face an enormous task in deciding what areas of fuel buildup will receive treatments to reduce fire risks, in what priority, and with what consequences. Scientists at our Fire Sciences Laboratory in Missoula, MT are using two types of modeling systems to help managers schedule fuel treatments to meet management objectives, and quantify what tradeoffs are associated with choosing one type of treatment over another.
- Fort Collins researchers are gathering information on the types and methods of fuel reduction alternatives that are best suited for treating high elevation fire-dependent ecosystems in Colorado and the Black Hills of South Dakota. Results are used to restore a natural mix of ecological conditions and reintroduce fire as a management tool.
- Many stream ecosystems throughout the Rocky Mountains are undergoing vegetation changes due to the absence of fire. These changes reduce the potential for these sites to house a variety of threatened, endangered and state-listed species. Scientists in Albuquerque, NM are assessing differences in animal populations in burned and unburned riparian areas. Findings will supply guidance for restoring riparian zones to healthy conditions while achieving fuel reduction goals.

“RMRS scientists from the Fire Sciences Lab in Missoula have provided advice and information used to model vegetation dynamics and develop predictive models used in revisions of forest and resource management plans for the Boise, Payette, Sawtooth, Caribou, Uinta and Wasatch-Cache National Forests.” (Director, Planning, Appeals and Litigation, Intermountain Region, USDA Forest Service)



- Fuel management, forest growth and forest health all interact to affect fire behavior. Researchers in Moscow, ID are studying these interactions to examine the implications of forest vegetation structure on burn severity and succession after fire. Research results are integrated into existing fire modeling systems that managers use to develop fuel management treatments.
- Investigations on the effects of fuel management treatments such as thinning, salvage logging and prescribed fire on soil characteristics is also being studied in Moscow. Resulting information will be incorporated into computer models that can be used to assist in fuel management decisions.
- Finally, studies at the Southwest Forest Sciences Complex in Flagstaff, AZ center on the effects of wildfire and fuels treatments on breeding

and nonbreeding birds and small mammals in the Intermountain West and Rocky Mountain regions. Results will help land managers assess cumulative effects and evaluate ecological trade-offs when considering options for treating and managing fuels.

Community Assistance

Station researchers are working to provide managers with information they can use to help communities increase their wildfire preparedness. Other research is focused on understanding individuals' beliefs, attitudes and knowledge related to fire and fuels management treatments.

- Scientists in Albuquerque, NM and Fort Collins, CO are gathering information on the factors contributing to successful public involvement approaches for fire and fuel management planning. Results will help managers design and implement successful, socially-acceptable fire and fuels management policies and programs, and improve two-way communication between the public and fire management agencies.
- At the Fire Sciences Laboratory in Missoula, MT, work continues on what specific home design factors contribute to home ignition during wildfires. As part of the FIREWISE Program, researchers conduct workshops, and have produced a video that helps spread the word to homeowners and government agencies about protecting structures from wildfire.



Photo by Bryan Day

"Your scientists at the Fire Lab provided essential information to the Northern Rockies Multi-Agency Coordination Group during the historic 2003 fire season. Evacuation planning and resource allocation were based in part on their state-of-the-art fire spread modeling which was provided in a timely manner. These efforts made a positive difference during an extremely complex and chaotic time." (Director, Fire, Aviation and Air, Northern Rockies Multi-Agency Coordination Group)

Technical Assistance

In 2002, the Station assembled a team of scientists and professionals to conduct a case study analysis of that year's Hayman Fire in Colorado's Front Range. The Hayman Fire Case Study report is now available on the Internet at http://www.fs.fed.us/rm/hayman_fire/. The study revealed much about wildfires and their interactions with both the social and natural environments. As the largest fire in Colorado's recorded history, it had a profound impact both locally and nationally. The findings of this study will inform both private and public decisions on the management of natural resources, and how individuals, communities and organizations can prepare for wildfire events.

Joint Fire Sciences Program

In addition to supporting the National Fire Plan, Station scientists were awarded 21 projects in 2003 from the Forest Service/Bureau of Land Management co-funded Joint Fire Sciences Program.

The support for fire research has enabled the Forest Service R&D branch and its cooperators to accelerate research efforts and speed development and delivery of technology transfer products and tools to the field.

For more information on the Joint Fire Sciences Program, visit <http://jfsp.nifc.gov>.

"As Acting Bureau of Indian Affairs representative on the Multi-Agency Coordinating Group during the 2003 fire season, we received excellent state-of-the-art fire prediction services from your Fire Sciences Lab. This information, under various worst case scenarios, proved very valuable in decision making and setting priorities." (Fuels Management Specialist, Bureau of Indian Affairs, MT)



Accomplishments

During 2003, The Rocky Mountain Research Station:

- Produced 595 technical publications and journal articles (a partial listing is available on the Station's website at <http://www.fs.fed.us/rm/main/pubs.html>).
- Provided 158 tours to educational and professional groups.
- Presented 176 short courses and training sessions to educational and professional groups.
- Offered 212 invited presentations before scientific organizations.
- Presented 231 audiovisual presentations on research findings.
- Gave 194 presentations to lay audiences.

Examples of Other accomplishments include:

- Through the Consortium for Advancing the Monitoring of Ecosystem Sustainability in the Americas (CAMESA), the Station and Mexico developed a pilot study to investigate new cost-effective and scientifically credible approaches for monitoring ecosystem resources at multiple scales and resolution levels.
- The Station hosted faculty from the Northwest Sci-Tech University of Agriculture and Forestry in Yangling, China to assist them in developing erosion control technologies for their nation.
- Several Station scientists were members of the Hayman Fire Science Team that produced the *Hayman Fire Case Study Analysis*. It was a unique opportunity to study the many dimensions of a large wildfire, including how fire behavior is influenced by previous forest management practices. The Study Analysis led to the publication of General Technical Report RMRS-GTR-114, titled *Hayman Fire Case Study*. It, along with a summary report (RMRS-GTR-115), is available on the Internet at <http://www.fs.fed.us/rm/main/pubs/electronic.html>.
- A scientist with the Aldo Leopold Wilderness Research Institute in Missoula, MT traveled to South Africa to work with the Wilderness Foundation and the WILD Foundation on wilderness assessment and research prioritization in that country.
- A project leader at our Albuquerque, NM facility spent time in France working with scientists at the University of Paris and the National Scientific Research Center studying the human context of environmental degradation in the southern Rhone Valley.
- The keynote speaker at the first ever Green Cities, Sustainable Cities Congress in Africa, was a scientist at the National Agroforestry Center in Lincoln, NE. His talks and collaborative efforts promoted the use of agroforestry and other “green” technologies for conserving natural resources, improving local economies, and creating sustainable cities.
- The Station's Forest Inventory and Analysis Program helped create and served as a member of the Multi-Resolution Land Characteristics Consortium (www.mrlc.gov) – a group of federal agencies charged with creating a new Landsat database that will map the nation's vegetative land cover.
- Scientists at our Moscow, ID laboratory were instrumental in establishing an atmospheric deposition monitoring site that monitors trends in precipitation chemistry at the Priest River Experimental Forest (ID). It is part of the National Atmospheric Deposition Program and is one of more than 200 air quality monitoring stations in North America.

- The Station co-sponsored the Biennial Forest Service Geospatial Conference in Colorado Springs, CO. It brought together managers and policy makers that influence geospatial programs and activities throughout the Forest Service. Presentations are available at <http://fsweb.fsgeospatial.fs.fed.us>.
- The Station's Stream Systems Technology Center in Fort Collins, CO produced a video titled *Identifying Bankfull Stages in Forested Streams in the Eastern United States*. Made at the request of Forest Service regions in that part of the country, it demonstrates how to consistently identify bankfull stages for a variety of stream types. The Center also hosted the Streamside Vegetation-Hydrological Interactions workshop, held at the University of Arizona, Tucson.
- A scientist at the Aldo Leopold Wilderness Research Institute in Missoula, MT collaborated with the University of Arizona to organize a workshop on recreation travel simulation modeling. The event addressed progress in modeling the flow of recreational visitors through parks and wilderness areas.
- A project leader in Albuquerque, NM led the Southwestern Willow Flycatcher Team that helped produce a recovery plan for the endangered migratory bird, which is being studied by researchers at our Albuquerque facility. The plan (<http://arizonaes.fws.gov>) describes the status, current management, and recovery objectives and criteria, and recommends specific actions to shift the flycatcher from endangered to threatened, and to ultimately remove it from the list of threatened and endangered species.
- Researchers at our Boise, ID laboratory led a workshop for Forest Service and Bureau of Land Management resource specialists on applications of the Water Erosion Prediction Process (WEPP) model for forest conditions. Similar workshops were conducted by scientists at our Moscow, ID facility.
- A Lincoln, NE scientist served as the U.S. and Forest Service delegate at the United Nations Forum on Forestry Intersessional Experts Meeting: Maximizing the Role of Planted Forests in Sustainable Forest Management, held in New Zealand. Presented papers and the final report are available at <http://www.maf.govt.nz/mafnet/unff-planted-forestry-meeting/conference-papers/index.htm>.
- An Information Technology Specialist at our Missoula, MT laboratory hosted a training workshop on PLATA (Project Level Analysis of Treatment Alternatives). PLATA, is a tool for project-level economic analysis that was developed at the Station's Forestry Sciences Laboratory in Missoula. It is available at www.fs.fed.us/rm/missoula/4802/PLATA.
- The Stream Systems Technology Center (Fort Collins, CO) helped host a Geomorphology Workshop in Reno, NV. It provided Forest Service practitioners with tools to assess potential effects of dams on river morphology.
- *Supply Side Sustainability* is the title of a new book co-authored by a project leader in Albuquerque, NM. The book, published by Columbia University Press, is aimed at understanding historical cases of collapse, resilience and sustainability, and developing a general understanding of sustainability to apply to our contemporary resource and administrative institutions.
- A Flagstaff, AZ project leader was selected to serve a 2-year term as Subject Editor for the scientific journal *Environmental Entomology*, published by the Entomological Society of America. She has also served as Associate Subject Editor and Editor of the journal.
- The Program Manager for the National Agroforestry Center in Lincoln, NE traveled to Finland to work with the United Nation's



Convention on Biological Diversity's Ad Hoc Expert Working Group on Biodiversity and Climate Change. The effort focused on how climate change mitigation and adaptation projects, such as reforestation and afforestation activities, can be done in ways that benefit biodiversity. An executive summary and final report have been published by the U.N.

- The keynote address for the International Conference on Sustainable Development Indicators for the Minerals Industries, held in Milos, Greece, was presented by a Fort Collins Minerals Economist. She also coauthored the "Milos Statement," which covers the role minerals professionals can and should play in the transition to a sustainable future. It has been endorsed by professional societies in Australia, Canada, the European Union, South Africa and South America.
- Scientists in Missoula, MT discovered through DNA analysis the first scientific evidence of hybridization between the bobcat and Canada lynx in the wild. As a result, the Forest Service has conducted analyses of most of the lynx hair samples collected as part of the national lynx survey to help determine if hybridization has occurred elsewhere. Studies are underway to determine what implications these findings may have on lynx conservation.
- A Boise, ID scientist received a patent for his magnetostrictive precipitation gauge that

measures accumulated precipitation. The gauge is inexpensive to manufacture, does not require calibration and provides high quality data with only annual maintenance.

- A Research Fishery Biologist in Boise, ID hosted the annual Bull Trout Workshop in Atlanta, ID. The 80 attendees shared new information on the biology and management of bull trout, a federally listed species (www.fs.fed.us/rm/boise/teams/fisheries/new.htm).
- The Station's Aldo Leopold Wilderness Research Institute in Missoula, MT celebrated its 10th anniversary in 2003. It functions as an interagency center that addresses wilderness management research needs across the country. Researchers at the Institute have created a series of five publications to help land managers and others wade through the plethora of research on specific wilderness issues. The series addresses:
 - *Wilderness Fire Restoration and Management*
 - *Defining, Managing and Monitoring Wilderness Visitor Experiences*
 - *Recreation Fees in Wilderness and Other Public Lands*
 - *Understanding and Managing Invasive Plants in Wilderness and Other Natural Areas*
 - and a soon-to-be-published volume on *Backcountry Recreation – Impacts To Wildlife*.

The publications can be downloaded at <http://leopold.wilderness.net/resapp.htm>.

"The Fire Lab has done excellent work in aiding our efforts to manage the significant fires that we have had in the Northern Region. I have been extremely pleased with the quality of work and the timeliness that it was provided. Thanks again to your staff for outstanding support." (Regional Forester, Northern Region, USDA Forest Service)

Research Highlights

Indicators of Forest and Rangeland Health and Functionality in the Intermountain West

Many efforts are currently underway to address the health and sustainability of our nation's forests and rangelands using a "criteria and indicator" approach. One of these approaches, called the Properly Functioning Condition concept, is based on a regional scale and is used by the Forest Service's Intermountain Region. On a request from that Region, Station scientists with the Interior West Forest Inventory and Analysis program in Ogden, UT, conducted a pilot study on the Bridger-Teton National Forest in Wyoming to assess the status and health of the resources in relation to what is considered to be properly functioning.

The first paper to be published based on this study describes four rangeland health indicators that can be used to characterize rangeland health and functionality. The results of a comparison of data collected for four indicators (presence of noxious weeds, amount of bare ground, species composition, and shrub cover) with the guidelines of what is considered "properly functioning," showed that each of the vegetation types tested (aspen, alpine, mountain big sagebrush, and tall forb) might be at risk due to amount of bare ground and presence of noxious weeds. The paper recommends that these indicators can be used at many scales, from the site level for local planning, to state and national levels for strategic planning.

The indicators and methods summarized in *Indicators of Rangeland Health and Functionality in the Intermountain West* are being used by Forest Managers on the Bridger-Teton National Forest and other regional forests to get a better idea of how their vegetation cover types compare to established

guidelines. Managers and specialists are also taking the next steps to establish thresholds for risk assessment for the four criteria, especially ground cover. These results provide quantitative examples of some of the same indicators that are included in the recently published "Sustainable Rangelands Roundtable" report. These indicators are also being included in range habitat assessment classes at land grant universities. Additional analyses and reports are planned.

More information is available at www.fs.fed.us/rm/ogden. Suggested reading includes: *Indicators of Rangeland Health and Functionality in the Intermountain West*. General Technical Report RMRS-GTR-104. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 13 p.



Inventory crews assess species composition and presence of noxious weeds as indicators of rangeland health.



Linking Wilderness Research and Management

Whether you're a generalist interested in the breadth of factors that must be considered while addressing a wilderness management issue, a specialist striving to locate literature on a specific wilderness topic, or a reader familiar with concepts but searching for references to support or add depth to your understanding, a new series of annotated reading lists titled *Linking Wilderness Research and Management* was designed for you. Compiled by ecology and social science specialists at the Aldo Leopold Wilderness Research Institute in Missoula, MT, it is intended to help land managers and others wade through the plethora of potentially relevant research on specific wilderness issues. While each volume was developed to address wilderness issues, they also contain information that can be used to understand and manage issues on other public and private lands.

While many bibliographies are organized alphabetically or chronologically, this series organizes literature by topic. References have been categorized to draw attention to the relevance of each publication, and then organized to provide a logical framework for addressing the issue. Each volume begins with background references necessary to understand the overall issue, and then provides references useful for identifying management goals, understanding influences on those goals, and finally, for selecting and implementing management approaches. Within each section, articles are annotated to clarify their relevance to the section and to highlight their importance for wilderness management.

Rather than produce unwieldy comprehensive bibliographies, the authors included overviews, the most current examples of literature addressing pertinent concepts, and frequently cited classic publications. These lists can provide a starting point for readers interested in more detail to conduct their own literature reviews. All volumes include lists of related online resources.

Volume 1 - *Wilderness Fire Restoration and Management*, includes overviews on fire ecology and management, lists tools to access information on fire behavior and effects, discusses fire as a natural disturbance, and addresses how people have affected fire regimes. It specifically addresses the history, philosophy, and goals of wilderness fire management; approaches, options, and constraints to restoring wilderness fire; and provides information on seven current wilderness fire issues.

Volume 2 - *Defining, Managing, and Monitoring Wilderness Visitor Experiences*, offers sections on wilderness values; how to measure and describe wilderness experiences such as solitude, privacy, and spiritual dimensions; the role of wilderness for personal growth, therapy, and education; biophysical, crowding, and technological influences on visitor experiences; visitor satisfaction; visitor management techniques; management planning frameworks; and finally, approaches to identify indicators, set standards, and monitor visitor experiences.

Volume 3 - *Recreation Fees in Wilderness and Other Public Lands*, addresses the history of recreation fees; pros and cons; fee policy issues and research needs; pricing methods, issues, and concerns; willingness to pay, both as a tool to develop fee programs and to explore economic and personal meanings reflected by willingness to pay levels; attitudes toward fees; fee influences on visitation and use; as well as how to estimate and spend revenue.

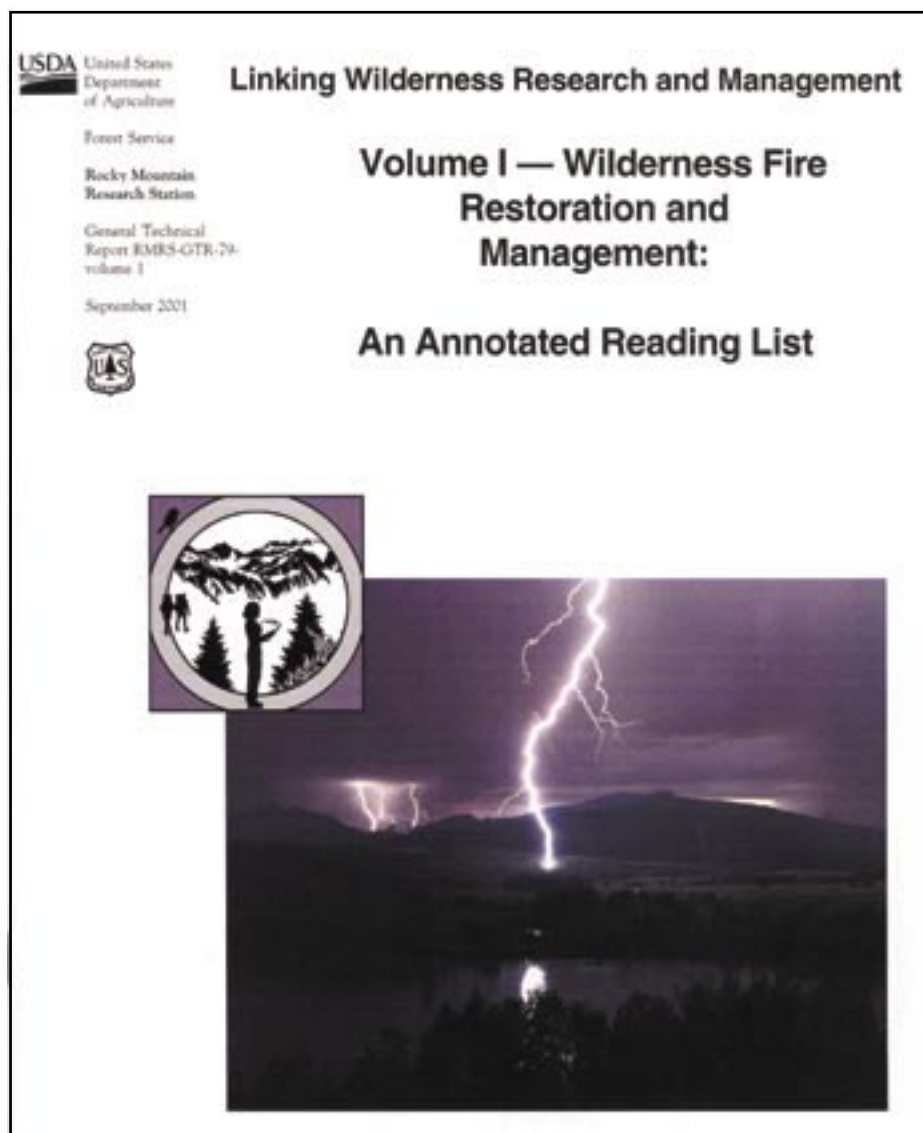
Volume 4 - *Understanding and Managing Invasive Plants in Wilderness and Other Natural Areas*, includes a section focused on invasive plants in wilderness and other natural areas, and then provides sections containing ecological overviews; the contribution of species, site, and dispersal characteristics to understanding plant invasions; effects of invasive plants on plant communities, ecosystem processes, and wildlife; management planning; preventing invasions; predicting invasive potential, spread, and distribution; finding, mapping, and monitoring invasive plants; control and eradication topics, including different control methods

and how to develop and prioritize control strategies; and restoration.

Volume 5 - *Backcountry Recreation Impacts to Wildlife* includes sections on the value of wilderness to wildlife conservation; value of wildlife to backcountry recreationists; overviews of general concepts; behavioral and physiological responses of individuals; wildlife community and population responses; specific examples of backcountry recreation impacts by taxonomic group; assessing

recreational impacts; planning frameworks and strategies; and management techniques, such as visitor education, use restrictions, and trail design.

Volumes can be ordered from the Rocky Mountain Research Station or downloaded from <http://leopold.wilderness.net/resapp.htm>. This web site also provides tools to improve access to scientific knowledge and information in support of wilderness management.



Helping Stream and Riparian Ecosystems Recover Following Wildfire

An important objective of watershed rehabilitation following fire is to stabilize burned areas to prevent soil erosion and storm water runoff. Longer-term goals include reestablishing native vegetation, fish and wildlife habitat and the function of the watershed. For rehabilitation efforts to be effective, interactions among post-fire physical and biological responses must be recognized and understood. Station scientists in Laramie, WY are in the midst of a multi-year evaluation of natural watershed recovery following wildfire, using a combination of historical pre-fire data and intensive post-fire monitoring of stream flow, sediment transport, distribution and movement of large woody debris, water quality, stream biology, and re-growth of streamside vegetation.

Study sites are located along Little Granite Creek in western Wyoming, where a wildfire in 2000 resulted in a 'natural experiment', i.e. one watershed burned while an adjacent watershed remained largely unburned. This combination presented a rare opportunity for evaluating local and downstream effects of fire-related sedimentation, while simultaneously monitoring post-fire recovery of streamside and aquatic habitat.

Results indicate that even in low flow years the amount of suspended sediment transported downstream of the burned area is frequently well above normal rates. The primary impact observed during the first post-fire year was elevated rates of suspended sediment transport associated with thunderstorms that generated shallow mudflows from burned areas. These events were short-lived, but resulted in clogging of the streambed with fine sediment, and movement of many pieces of large



Researchers collecting measurements in a burned study area.

wood as much as 200-500 meters. Subsequent changes in channel shape were associated with the movement of large wood, which caused the channel to scour, thus altering aquatic habitat. Re-growth of riparian vegetation increased substantially during the second year and appears to intercept shallow sediment flows from hillslopes in some locations. In general, physical and biotic processes within the burned watershed appear to undergo continual, dynamic adjustment in relation to hydrological events.

Results of this research is helping resource managers: (1) assess fire-related impacts; (2) design and implement effective post-fire rehabilitation projects, prescribed burns and fuel reduction treatments; and (3) manage burned areas for fish and wildlife habitat, livestock grazing, and recreation. Data on sedimentation, water yield, and rainfall intensities that trigger sedimentation events will be useful for validating models that predict changes in sediment yield following fire treatments.

More information on this study can be found in: “Fire and Riparian Ecosystems in Landscapes of the Western USA.” *Forest Ecology and Management* 178 (1-2): 61-74; and “Effects of Wildfire on Transport of Organic Matter and Sediment in Streams of the Little Granite Creek Watershed, Wyoming.” Published abstract presented at the North American Benthological Society 51st Annual Meeting, Athens, GA, May 30, 2003.



Toward a Better Understanding of Southwestern Riparian Areas

Streamside vegetation, referred to as riparian areas, occupy less than 2% of the Southwest but they are critical habitats for over 80% of the biota in the region. Understanding the interactions between hydrologic processes, physical attributes, and ecological relationships are important to meaningful management of these ecosystems and their sustainability.

Two recent synthesis documents, a result of six decades of research, have been completed by Station scientists in Flagstaff, AZ and university cooperators. The first is *Riparian Areas of the Southwestern United States: Hydrology, Ecology and Management*, published by Lewis Publishers. The second is a special issue of the *Journal of the Arizona-Nevada Academy of Science on Watershed Management in the Southwest*.

Topics covered by these syntheses include the definitions and classifications of riparian areas, hydrology of riparian zones and the impacts of disturbances on hydrologic function, linkages between riparian corridors and surrounding watersheds, human alterations of riparian ecosystems, riparian flora, recreation, riparian ecosystem assessment, restoration, and livestock and native ungulate grazing impacts and implications. This comprehensive analysis will aid land managers and planners, hydrologists, engineers, biologists, nongovernmental organizations and policy makers in the ongoing attempt to find a balance among the competing demands of forestry, agriculture, recreation, conservation and development. The documents have potential use across a broad spectrum of society, from resource professionals to the general public, including students.

For more information, visit the websites: <http://www.rmrs.nau.edu/lab/4302/> and <http://www.ag.arizona.edu/OALS/watershed/index.html>.



White Mountain Apache Tribe children participating in riparian restoration activities in a wet meadow in the White Mountains of Arizona. Photo by Jonathan Long

The Effects of Habitat Loss and Fragmentation on Forest-Breeding Birds

As human populations and settlements grow, more and more native habitats are lost to agriculture, road construction and urbanization. Conversion of natural lands to human uses results in a loss of wildlife habitat, and blocks of habitat that are smaller and more isolated from each other. The latter is often referred to as habitat fragmentation. Loss of habitat and fragmentation are thought to be important factors causing widespread population declines of forest-nesting birds. But are these two factors equally important in explaining population declines? Are there characteristics of species that make them more or less susceptible to loss and fragmentation of habitats? Station scientists in Fort Collins, CO are seeking answers to these questions to better understand how to balance biodiversity conservation and human uses of natural resources.

Researchers have been collaborating with scientists at the University of Vermont and Carleton University on a series of studies designed to understand population dynamics of species that inhabit fragmented landscapes. These studies use both simulation modeling and statistical analyses relating bird populations to forest habitats.

One experiment revealed that the size of the population was largely determined by the amount of habitat on the landscape. However, when the amount of habitat was reduced to the point where populations were small, and the chance for extinction was high, how habitat was arranged (i.e., the degree of fragmentation) was key to maintaining viable populations. These results suggest that fragmentation effects were particularly important once a threshold in the amount of habitat was crossed. Under these conditions, if the habitat was arranged in many small patches that were

dispersed throughout the landscape, then there was a good chance that the populations would perish. If, however, there was at least one fairly large habitat patch that remained, then the virtual species tended to persist.

Follow-up studies using actual bird population data in landscapes with varying amounts of forest habitat, found two other factors that can affect the susceptibility of species to habitat fragmentation. First, where the birds chose to breed can affect range-wide population trends. Species where a high proportion breed in fragmented landscapes had lower population trends than species that tended to breed in more contiguously structured forest landscapes. Second, the species' reproductive potential affected its ability to occupy landscapes with low amounts of forest habitat. Species with high reproductive potentials required less amounts of habitat to maintain a 50 percent chance of landscape occupancy than species with low reproductive output.

These studies indicate that in order to understand how fragmentation affects species populations, three factors must be considered: 1) landscape context (how much habitat remains and how is it arranged); 2) habitat selection (do species preferentially breed in landscapes with habitat arranged in a contiguous fashion); and 3) reproductive potential. Scientists believe that it will not be possible to develop general management guidelines related to habitat fragmentation that can be applied universally to all species. A better strategy may be to identify those species that are most susceptible to habitat fragmentation, and manage landscapes in a way that will maintain at-risk species. These results are being used in the Agency's efforts to assess whether forest ecosystems are being managed in a sustainable manner.



Find out more about these studies in: “Patchy Reaction-diffusion and Population Abundance: The Relative Importance of Habitat Amount and Arrangement.” *American Naturalist* 159: 40-56; “Relationships Among North American Songbird Trends, Habitat Fragmentation, and Landscape

Occupancy.” *Ecological Applications* 12: 364-374, (also see <http://sciencenow.sciencemag.org/cgi/content/full/2002/429/1>); and “Relationship Between Minimum Habitat Requirements and Annual Reproductive Rates in Forest Breeding Birds.” *Ecology* 84.



Red-eyed vireo

Fire and Aquatic Ecosystems

Wildfire, forest health, and the declining status of many aquatic species, such as bull trout, frame an important discussion in land management in the western United States. Changes in climate, vegetation patterns, and associated fuels conditions have created larger, more intense fires in some forest types than were characteristic of the past. Management actions intended to mitigate, mimic, or replace the effects of fire have become important concerns for land managers, and major initiatives are in place to support massive fuels and fire management programs. Because some traditional land management activities have the potential to degrade aquatic habitats, concerns have been raised that more aggressive forest management poses threats to the integrity of aquatic ecosystems. Station research on fire and disturbance in aquatic ecosystems is providing a better understanding of when management is a threat and when it is likely to be a benefit.

Scientists at our Boise, ID laboratory are tracking changes in aquatic systems following large fires. The lab recently hosted a major workshop involving leading scientists and managers working with wildfire, fuels, and the physical and ecological processes of aquatic ecosystems, to synthesize existing information, and to identify key points for managers and central questions for research. Results of the workshop were published in 14 papers as a special issue of the journal *Forest Ecology and Management*.

Research results show that fires can have immediate negative effects on aquatic organisms. In many systems, however, disturbances such as fire may actually be critical to the long-term maintenance of productive habitats and populations because they represent a source of

materials necessary to create a complex mosaic of ecological conditions. The effects of fire depend very much on the ecological context. It is unlikely that large disturbances can be eliminated from the landscape and probably not advisable, even if possible. Prioritizing efforts based on the risks and opportunities represented by the mix of conditions is possible. Research efforts to integrate both terrestrial and aquatic issues may serve as a guide for solutions that consider short- and long-term risks.

Results of the workshop are available in “Fire and Aquatic Ecosystems of the Western USA: Current Knowledge and Key Questions,” *Forest Ecology and Management* 178 (1-2): 213-229. Publications and a bibliography relevant to fire and aquatic ecosystems can be found at <http://www.fs.fed.us/rm/boise/teams/fisheries/fire/firehome.htm>.



Dramatic reorganization of several tributaries to the North Fork Boise River occurred following a fire in 1994. This photo was taken in 2002. In spite of the dramatic changes to this stream, fish are still present, and in many streams the effects of fire have been positive. There are other streams, however, where important fish species have disappeared. Research will help understand what systems are most vulnerable to the effects of large fires to help prioritize fire and species conservation management.



Restoring Riparian Corridors Dominated by Sagebrush

Stream incision and overgrazing by livestock in the Great Basin often result in encroachment and dominance of sagebrush in streamside areas that formerly supported meadows. Restoring a mosaic of meadow and sagebrush ecosystems can improve watershed function, increase biodiversity and enhance other resources.

Scientists in Reno, NV, along with cooperators, conducted a study to determine the restoration potential of riparian corridors that are currently dominated by sagebrush. Because of the importance of water tables in determining vegetation composition in streamside areas, they hypothesized that the threshold for restoring grass and sedge meadows could be defined largely on the basis of water table depth. To evaluate this hypothesis, restoration treatments were applied to sites with relatively shallow, intermediate and deep water tables. Treatments included a fall prescribed burn to remove the sagebrush, and seeding with native grasses and forbs typical of streamside meadow complexes in the Great Basin.

Researchers found that sites with high and intermediate water tables had a greater abundance of perennial grasses, and that these species increased after the burn. In contrast, sites with low water tables were dominated by annual forbs after the burn. Site productivity increased progressively from 1997 to 1999 on burned areas, while adjacent unburned areas showed little change. The presence of individual sagebrush shrubs influenced the outcome, with former sagebrush locations exhibiting lower productivity until the third year after burning. Establishment of seeded species was low, and species composition was determined largely by pre-burn vegetation.

Results indicate that sagebrush dominated sites with high water tables represent an alternative state of naturally occurring dry meadows, while sites with low water tables have crossed a threshold governed by

water tables and can no longer be restored to meadow vegetation. Burning is an effective tool for restoring sites with relatively high water tables to dry meadows. Proper livestock grazing and, in some cases, repeated fire are necessary to maintain the dry meadow vegetation. Low water table sites require burning and seeding with species adapted to drier conditions.

This information is being used by resource managers and private landowners to assess the restoration potential of sagebrush dominated riparian corridors and to determine the most effective restoration methods that create a mosaic of sagebrush and dry meadow ecosystems that more closely resembles pre-disturbance conditions.

Find out more about this research in: “Restoring Sagebrush Dominated Riparian Corridors Using Alternative State and Threshold Concepts: Biomass and Species Response.” *Applied Vegetation Science* 5:237-246; and “Prescribed Burning of Central Nevada Degraded Riparian Ecosystems: Effects on Soil and Vegetation.” *Journal of Range Management* 56:387-395. Additional information can be found at www.ag.unr.edu/gbem.



Fire crews from the Humbolt-Toiyabe National Forest conduct a prescribed burn to remove sagebrush from a former meadow complex.

Fire Analysis Tools for Fuel Treatments and Wildland Fire Suppression

To help implement the National Fire Plan, the Station's Fire Sciences laboratory in Missoula, MT, initiated the LANDFIRE Project, a partnership between the Station, the US Geological Survey, and other Forest Service units. The Project integrates remote sensing capabilities, forest inventory analysis field data and modeling, and the Fire Lab's landscape ecosystem modeling capabilities. Together, they provide data and computer models that help managers predict the potential behavior and effects of fires. LANDFIRE provides tools that identify the locations of hazardous fuels and values at risk, prioritize fuel treatments, and develop treatment prescriptions. It also provides the ability to develop Wildland fire suppression tactics and conduct long-range assessments of wildfire potential.

Several LANDFIRE concepts and procedures were put to the test when lightning ignited hundreds of fires in Montana and Northern Idaho during the summer of 2003. The Multi-agency Area Command requested that the Fire Sciences Laboratory provide them with technical support for locating fires and

conducting a long-range assessment of potential fire behavior and effects given best, worst, and most likely case scenarios. Scientists used data from their Moderate Resolution Imaging Spectroradiometer satellite receiving station to locate fires, often through dense smoke that precluded visual detection. Airborne infrared sensors located and mapped fire perimeters, and because the staff, infrastructure, and many of the databases were in place, the LANDFIRE Team was able to provide fuels, weather, and terrain data. The Team also mapped communities and infrastructure at risk. The fuels, weather, predicted fire spread, and values at risk data were integrated into map products that allowed area commanders to develop emergency management plans and allocate suppression resources, thereby improving overall safety and effectiveness.

The fires were invaluable for demonstrating concepts, refining procedures, and building partnerships with fire managers, and they reinforced the need for a robust fuels treatment program and illustrated how real threats can be identified and used to prioritize treatment areas. Learn more about this and related research at <http://www.firelab.org/fep/fehhome.htm>.



Ecology and Management of Ponderosa Pine in the Black Hills

In 1974, the Station issued a research paper (RM-124) that summarized available knowledge about the silviculture and management of ponderosa pine in the Black Hills of western South Dakota and northeastern Wyoming. The paper, intended as a guide for professional foresters, described the environment and the characteristics of ponderosa pine in the Black Hills, discussed insects, diseases, and damaging agents affecting growth, and covered silviculture techniques that could be used to manage ponderosa pine for wood fiber production.

In 2003, the Black Hills National Forest asked Station scientists to update the 1974 publication to include current information available on management and ecology of Black Hills ponderosa pine. This information was seen as critical in addressing today's multiple resource management challenges.

The scope of the earlier report was expanded to include a broad-based synthesis of the general ecology of ponderosa pine in the Black Hills. Rather than emphasize management for wood production, as was the focus of the earlier paper, researchers broadened the discussion of silvicultural techniques to include management alternatives for wildlife habitat, esthetics, ecosystem restoration, and biodiversity. In keeping with current ecosystem-based management philosophy, they synthesized information and results of research on ponderosa pine from numerous sources both within and outside the Black Hills ecosystem. Both even- and uneven-aged silviculture systems are described, and management alternatives are presented that can be used to produce and maintain desired growth and stocking conditions for a variety of natural resource objectives.

General Technical Report RMRS-97, titled *Ecology, Management and Silviculture of Black Hills Ponderosa Pine*, provides information on insects including mountain pine beetle, pine engraver, red turpentine beetle and pine tip moth; diseases including

armillaria root disease; and other disturbances on the Black Hills such as fire, wind and snow. Coarse woody debris and snags are also described and management options reviewed. Major wildlife species such as elk, white-tailed deer and mule deer, Merriam's turkey, the northern goshawk, and non-game birds are also covered. The silviculture of ponderosa pine in the Black Hills is addressed, as is the management of associated tree species, and hydrology and the relationships between timber and water yield.

This publication is in a format useful to ecologists and managers, and addresses many of the ecological and management challenges currently facing managers of ponderosa pine in northwestern South Dakota and northeastern Wyoming. It has been used in the development of, and cited in, the Black Hills Draft Environmental Impact Statement.

The report is available on the Station's website at http://www.fs.fed.us/rm/pubs/rmrs_gtr097.html. Additional information on ponderosa pine management is located at <http://www.fs.fed.us/rm/landscapes>.



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Ecology, Silviculture, and Management of Black Hills Ponderosa Pine

Wayne D. Shepperd and Michael A. Battaglia



A Primer on Nonmarket Valuation

Most land management decisions involve making tradeoffs. Nonmarket valuation is the only technique available that provides monetary measures of the social value of the relevant tradeoffs associated with many management decisions. As most of the literature on nonmarket valuation is written for PhD level economists, a new book titled *A Primer on Nonmarket Valuation*, is unique in that it was written for a broader audience, including individuals working for government agencies, attorneys involved with natural resource damage assessments, graduate students and others new to nonmarket valuation. The chapters in this book, coauthored by Station scientists in Fort Collins, CO, are clearly written and provide detailed descriptions of the steps involved in implementing the most common nonmarket valuation techniques.

The first section of the book, containing three chapters, provides background for the methodology sections that follow. The opening chapter explains the policy context of nonmarket valuation. The next chapter develops the economic theory that is the basis of nonmarket values. And because value estimates are only as good as the data upon which they are based, the third chapter describes the process of collecting nonmarket valuation data.

The valuation methods are presented in two sections, one section on stated preference methods and the other on revealed preference methods. Following a short introduction chapter, the section on stated preference methods includes three chapters—two covering widely used nonmarket valuation techniques (contingent valuation and attribute-based methods) and the other describing an emerging technique (the method of paired comparisons). The revealed preference section also includes an introduction chapter and three methods chapters. The methods chapters, which include the travel cost method, the hedonic method, and the defensive behavior and damage cost methods, each use “clues” from behaviors observed in markets to estimate nonmarket values. Readers will come away from these two

sections with a thorough understanding of how to design and implement a nonmarket valuation study. The chapters also describe how to analyze the data and estimate values.

The final section of the book takes stock of the usefulness of nonmarket valuation. The first chapter in this section describes techniques for transferring values from existing studies to new situations. The next chapter discusses interesting situations in which nonmarket values were used to help make important natural resource and environmental decisions. The final chapter provides thoughts on the history, validity, and future of nonmarket valuation. The book is published by Kluwer Academic Press, Boston.

As a companion to *A Primer on Nonmarket Valuation*, a website is available at <http://www.fs.fed.us/nonmarketprimerdata>, which includes downloadable datasets for each of the techniques described in the *Primer*, as well as links to published journal articles and reports based on the data. The website also provides an opportunity for students to estimate models using the data.

Aspects of Livestock Ranching on the Santa Fe and Carson National Forests, NM

An incomplete understanding of local sociocultural values and attitudes toward land use can contribute to controversy over the use of federal lands and the role of land management agencies.

To help address this issue, Station scientists in Albuquerque, NM are studying factors related to Forest Service lands used for grazing. Although Forest Service-grazing permittee relations have improved in recent years, problems still exist, as in northern New Mexico where distinctive custom, culture, and tradition contribute to misunderstanding and conflict. This pilot study is part of a long-term research program of gathering information on contemporary land management and use issues among ranchers with federal grazing permits.

Researchers are gathering information on both the economic and non-economic contributions of livestock ownership to local families and communities. The study explores the extent to which the use of public land for grazing and other purposes provides opportunities for community interaction and maintenance of traditional culture. It was undertaken using a personally administered questionnaire followed by in-depth interviews.

Findings show that livestock operations contribute to family and community by adding to household income, serving as a tie to ancestral lands and

heritage, supporting family goals and traditions, and maintaining community interaction. As examples, 58% of those surveyed use income from the ranch for basic living expenses, 48% for household and family emergencies, and 45% for special expenditures such as college tuition for the children. Responses to questions concerning goals for the livestock operations indicate that maintaining the family's quality of life through ranching and remaining in the livestock business were most important. Many described how they teach their children about their ancestral heritage by working with the land and livestock. In addition, ranching provides community members with considerable opportunities for interaction. Eighty-four percent herd their animals in cooperation with their relatives, while 81% herd them in cooperation with their neighbors or other community members. Although small livestock operations generally do not fully support their owners, they are critically important in terms of maintaining traditional culture and heritage, as well as in contributing to family economic security.

Research results are being used by Forest Service managers in northern New Mexico to develop greater understanding of local culture and traditions and to orient new employees, greatly reducing the potential for conflict between land managers, grazing permittees, and communities. Findings are also valuable as a public education tool since many residents of the state, especially those newly migrated to both urban and rural areas, are unfamiliar with the primarily Hispanic culture and traditions of northern New Mexico.

Find out more in: *Economic, Social, and Cultural*

Aspects of Livestock Ranching on the Española and Canjilon Ranger Districts of the Santa Fe and Carson National Forests: A Pilot Study.

General Technical Report RM-113. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 89 pp.



Ecology and Management of Bats in Pinyon-Juniper Woodlands

Recognizing that bats not only contribute to biodiversity, but also to ecological processes such as insect control and nutrient cycling, government agencies have become increasingly interested in managing bat habitat and protecting populations. Southwestern ecosystems are particularly deserving of such concern because of the high diversity of bats in this region. Although two-thirds of North American bat species occur in Arizona and New Mexico, few studies have been conducted on their ecology and management. Because pinyon-juniper woodlands are some of the most widely distributed vegetation types in the southwest, studies are underway to evaluate the degree to which these woodlands are used by bats, the types of trees used as roosts, and whether maternity colonies reuse their tree roosts.

Working on the Cibola National Forest in west-central New Mexico, researchers captured bats nightly in mesh nets set over water. They compared the number of bat species captured and capture rates in pinyon-juniper woodlands with those in ponderosa pine forests, an adjacent vegetation type. To locate maternity roosts, radio transmitters were attached to selected female bats. Each roost tree was evaluated, measured, and then monitored for several consecutive summers.

Findings show that pinyon-juniper woodlands support diverse and abundant bat communities and provide valuable summer roost habitat for female bats and their pups. Although capture rates were similar between ponderosa pine and pinyon-juniper habitats, a greater number of bat species were captured in pinyon-juniper woodlands and a greater proportion were reproductive females. Female bats and their pups roosted under the bark and in crevices and cavities of live or dead junipers, pinyons, and ponderosa pine trees. Interestingly, each of the three bat species studied, the long-eared myotis (*Myotis evotis*), the long-legged myotis (*M. volans*), and the fringed

myotis (*M. thysanodes*), had markedly different roost preferences.

This is the first study to document the use of trees in pinyon-juniper woodlands by female bats and their pups, and one of few studies documenting the use of small-stature trees by western bat species. Given the wide distribution of pinyon-juniper woodlands and the high diversity and abundance of bats that use them, scientists believe their value to bats has been underestimated. Careful management of this vegetation type is critical due to the low reproductive rates of bats and the importance of suitable foraging and roost habitat to reproductive success. Results from this research provide guidelines on the types, species, and characteristics of trees to conserve, and allow managers to predict and mitigate potentially negative effects of land management activities on bat populations in pinyon-juniper woodlands of the southwest.

Additional reading is available in: "Monitoring Long-term Reuse of Trees by Bats in Pinyon-juniper Woodlands of New Mexico." *Wildlife Society Bulletin* 31(1): 73-79; "Ecology and Management of Bats in Pinyon-juniper Woodlands of West-central New Mexico." Dissertation. University of New Mexico, Albuquerque. 113pp; and "Bats of the Piñon-juniper Woodlands of Southwestern Colorado." In *Ancient Piñon-juniper Woodlands: Natural History of Mesa Verde County*. University Press of Colorado. Boulder, Colorado, USA.



Captured bats are examined to determine species, sex, age and reproductive status

Research Supports Prescribed Fire in the Southwest

The Rocky Mountain Research Station, in collaboration with the Coronado National Forest in Arizona and other natural resource agencies and organizations, is developing a fire management program for the southern Peloncillo Mountains on the Arizona-New Mexico border that will restore degraded savanna grassland and higher elevation watersheds to a more productive condition. The goal is to use prescribed fire to reduce tree and brush cover and increase herbaceous plant cover in areas dominated by woody species, such as mesquite and junipers. Fire has been absent from many of these areas due to past heavy livestock grazing which resulted in the loss of continuous ground fuels that allowed natural fires to spread. More recently, aggressive fire suppression by land management agencies has contributed to lack of large fires more characteristic to the area.

Fire is an important management tool used to restore natural vegetation composition, structure, and processes in semi-arid grasslands and woodlands. The Peloncillo Mountains Programmatic Fire Plan is an example of landscape level planning and management in the central Southwestern Borderlands region.

Using science-based information, the Douglas Ranger District of the Coronado National Forest conducted the Baker II Burn mosaic in June 2003 that covered about 46,500 acres. The ability to use fire as a restoration tool on public and private lands at this scale is unprecedented. Initial monitoring has demonstrated a marked increase of herbaceous plants in the burned areas with normal summer monsoonal precipitation. To further contribute to adaptive management, the Station is supporting studies to: 1) refine remote sensing and GIS tools for analyzing fire effects, in collaboration with the University of Arizona; and 2) understand the effects of fire on potential habitat of the threatened New Mexico ridgenose rattlesnake, in collaboration with the University of Arizona and the University of Notre Dame.

The following are offered for additional reading: “Modeling Fire in Semi-desert Grassland/oak Woodland: The Spatial Implications.” *Ecological Modeling*. 153:229-245; “Fire Frequency Effects Fuel Loadings in the Pine-oak Forests of the Madrean Province.” Research Note RMRS-RN-10. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 6 p; and “Nutrient Dynamics and Fire History in Mesquite (*Prosopis* spp.) Dominated Desert Grasslands of the Southwestern United States.” Ph.D. Dissertation, Department of Soil and Water Science, University of Arizona, Tucson, AZ. 163 p.



A helicopter is used to ignite a prescribed fire in rugged terrain on the Coronado National Forest in Arizona

“For the past seven years, we have been collaborating with your scientists at the Southwest Forest Sciences Complex in Flagstaff, AZ on ecosystem management research in the Malpai Borderlands. The work of your staff has been a crucial ingredient in bringing scientific expertise to on-the-ground ecosystem management. As a result, we have shed new light on the relationships between nectar-feeding bats and agaves, the fire ecology of agaves, and gained a clearer picture of the historic role of fire in shaping and maintaining southwestern ecosystems.” (Program Director, Animas Foundation, NM)



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 FY2003 Station Appropriation: \$39,407,000

Total Outside Funding: \$20,553,247

Total National Fire Plan Funding: \$7,983,679

Total Number of Scientist Years: 113 (scientist year = one scientist working one full year)

(In addition to the outside funding shown above for the research work units, the Station's library and publications units are supported by \$395,250 in outside funding.)

"The support we get from the Rocky Mountain Research Station is great and makes timely and real world improvements in the natural resource work that we do on the Boise National Forest." (Forest Supervisor, Boise National Forest, ID)

Forest Service Research and Development in Arizona

The Rocky Mountain Research Station maintains five research work units in Arizona. These units are located at the Southwest Forest Science 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 Southwest ecosystems. The Station's Fort Valley Experimental Forest is located near Flagstaff on the Coconino National Forest.



USDA Forest Service

Rocky Mountain Research Station

Forestry Sciences Laboratory

Southwest Forest Sciences Complex

2500 S. Pine Knoll

Flagstaff, AZ 86001

(928) 556-2001

Fax: (928) 556-2130

(<http://www.fs.fed.us/rm/main/labs/flagstaff.html>)

(<http://www.rmrs.nau.edu/lab>)

Total FY2003 Appropriations: \$5,434,000

Total Outside Funding: \$1,464,777

Total National Fire Plan Funding: \$1,592,703

Total Number of Scientist Positions: 13

Research Work Units

- **Wildland-Urban Interface Fuels Management and Forest Health Restoration in the Southwest (RMRS-4156)**

FY2003 Appropriation: \$1,646,000

Outside Funding: \$0

National Fire Plan Funding: \$373,348

Number of Scientist Years: 1

Mission: Investigate ways to reduce the risk of catastrophic wildfires in wildland-urban interface areas and restore and sustain the health and productivity of southwestern forest ecosystems.

- **Ecology and Conservation of Terrestrial Wildlife and Habitats in the Interior West (RMRS-4251)**

FY2003 Appropriation: \$1,814,000

Outside Funding: \$767,905

National Fire Plan Funding: \$173,980

Number of Scientist Years: 5

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



Station scientists in Flagstaff, AZ, worked with the Lincoln National Forest, NM, to design and implement a program to evaluate the effects of forest thinning on the threatened Mexican spotted owl and other resources.

“Researchers in Flagstaff compiled a literature review on methods used to study causes of post-fire mortality of Douglas-fir and ponderosa pine after the fires of 2000. The report was very complete and will serve as an excellent resource for us in the future as we design more studies or are asked to develop marking guides.”
(Forest Staff, Nez Perce National Forest, ID)



- **Watersheds and Riparian Ecosystems of Forests and Woodlands in the Semi-arid West (RMRS-4302)**

FY2003 Appropriation: \$854,000

Outside Funding: \$154,763

National Fire Plan Funding: \$373,348

Number of Scientist Years: 3

Mission: Create, develop and apply knowledge on river, geologic, water, soil, and ecological functions, processes and dynamics needed to sustain watershed integrity and diverse, healthy and productive plant and animal populations. Work is underway to help determine, predict and manage the effects of prescribed fires, wildfires, grazing, vegetation management, and other activities on riparian ecosystems.

- **Ecological Roles of Insects and Pathogens in Coniferous Forests of the Interior West (RMRS-4152)**

FY2003 Appropriation: \$707,000

Outside Funding: \$40,000

National Fire Plan Funding: \$672,027

Number of Scientist Years: 3

Mission: Understand the roles of insects and pathogens as agents of disturbance and regulators of ecosystem processes in western coniferous forests. Scientists are also developing methods to assess and predict their effects for use in the decision support and planning processes used by forest managers, silviculturists, and forest health protection specialists.

Researchers in Flagstaff, AZ, are investigating the ecology of forest pathogens, such as dwarf mistletoes, on western conifers.



Post-fire flooding is being studied by researchers at our Flagstaff, AZ, laboratory. Results are providing land managers with a better understanding of flood events.

- **Achieving Ecosystem Management in Southwestern Borderlands (RMRS-4651)**

FY2003 Appropriation: \$413,000

Outside Funding: \$502,109

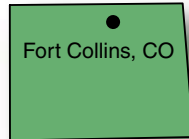
Number of Scientist Years: 1

Mission: Develop methods to restore natural processes and sustain the health and productivity of grassland and woodland ecosystems in the Borderlands area of the Southwestern United States and northern Mexico.

“The Station has been involved in a cooperative effort with the Malpai Borderlands Group in southeast Arizona and southwest New Mexico since 1994. They provide public and private land managers in the area with valuable information to use in making decisions. This research is a combination that is often heralded as an outstanding example of informed adaptive management of natural resources.” (Executive Director, Malpai Borderlands Group, Douglas, AZ)



Forest Service Research and Development in Colorado



The Rocky Mountain Research Station maintains six research work units and the Stream Systems Technology Center, all located at Station headquarters in Fort Collins, Colorado. Three of the units have national charters. They support the Forest Service and other federal land management agencies on technology related to natural resource inventory, monitoring, economics and land management planning. Other units focus on regional issues related to fisheries and watersheds, climate change and air resources, recreation benefits, biological diversity, and ecological processes and ecosystem health.

Station headquarters is located 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 located 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.

*USDA Forest Service
Rocky Mountain Research Station
2150 Centre Ave., Bldg. A
Fort Collins, CO 80526
(970) 295-5000
Fax: (970) 295-5959
(<http://www.fs.fed.us/rm/main/labs/ftcollins.html>)*

Total FY2003 Appropriation: \$6,924,500

Total Outside Funding: \$1,929,396

Total National Fire Plan Funding: \$945,321

Total Number of Scientist Years: 27

Research Work Units

- **Research to Sustain Fish and Watershed Components of Aquatic and Riparian Ecosystems in the Central Rocky Mountains and Northern Great Plains (RMRS-4352)**
(This unit is co-located in Fort Collins and Laramie, WY)

FY2003 Appropriation: \$1,214,500

Outside Funding: \$317,282

Number of Scientist Years: 4

Mission: To further our understanding of sustainable aquatic and riparian ecosystems involving the interaction between hydrological and biogeochemical responses, nutrient allocation, channel morphology, and aquatic habitat and selected fisheries, and how this association is impacted or influenced by land and water management practices.



As part of the Cold Land Processes Experiment, snow density measurements are taken to get total snowpack water equivalent

- **Sustaining Alpine and Forest Ecosystems Under Atmospheric and Terrestrial Disturbances (RMRS-4451)**

FY2003 Appropriation: \$1,848,000

Outside Funding: \$94,678

National Fire Plan Funding: \$597,357

Number of Scientist Years: 7

Mission: Develop and refine the knowledge and technology needed to understand, model and manage vegetation and ecosystem processes that help sustain alpine, forest, and woodland ecosystems.

- **Research on Sustaining Social, Biological and Physical Components of Colorado Front Range Ecosystems (RMRS-4653)**

FY2003 Appropriation: \$103,000

Outside Funding: \$1,147,259

National Fire Plan Funding: \$217,291

Number of Scientist Years: 2

Mission: Devise strategies to manage public lands along the Colorado Front Range in ways that will sustain ecosystems while addressing the needs and desires of society.

“For the past year, your scientists have been collaborating with us to summarize, for the Environmental Protection Agency, the current state of knowledge concerning the use of vegetation effects-based air quality exposure- and dose-response indices to predict vegetation effects associated with ozone. Results have been published in a Criteria Document that the EPA distributes for public comment. Your contributions are very important for assessing whether modification to the current ozone standard to protect vegetation is necessary.”
(A.S.L. and Associates, Helena, MT)



Several large-scale forest management programs have begun along Colorado's Front Range, based directly on Station research on historical ponderosa pine landscapes. This forest was thinned following the Schoonover and Hayman fires, removing most surface fuels.



- **Forest Inventory and Monitoring Environmetrics (RMRS-4804)**

FY2003 Appropriation: \$670,000

Outside Funding: \$0

Number of Scientist Years: 3

Mission: Develop, validate, and transfer scientifically credible methods of mathematical statistics for the Forest Inventory and Analysis programs across the United States to assist in more timely and useful inventory and monitoring of forest lands.

- **Identification and Valuation of Wildland Resource Benefits (RMRS-4851)**

FY2003 Appropriation: \$1,009,000

Outside Funding: \$70,000

Number of Scientist Years: 5

Mission: Develop new methods and test the validity and reliability of current methods used to measure people's values for natural resources, including environmental amenities. Research emphasizes the relationships of human values and experiences to attributes of the environment and economic transactions. Scientists also assist resource managers in applying state-of-the-art economic and social science analyses.

- **Natural Resource Assessment, Ecology, and Management Science Research (RMRS-4852)**

FY2003 Appropriation: \$975,000

Outside Funding: \$298,600

National Fire Plan Funding: \$130,673

Number of Scientist Years: 6

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.



Scientists in Fort Collins, CO, are part of an effort addressing the critical need for standardized monitoring and reporting of ecological, economic and social elements of rangeland sustainability.

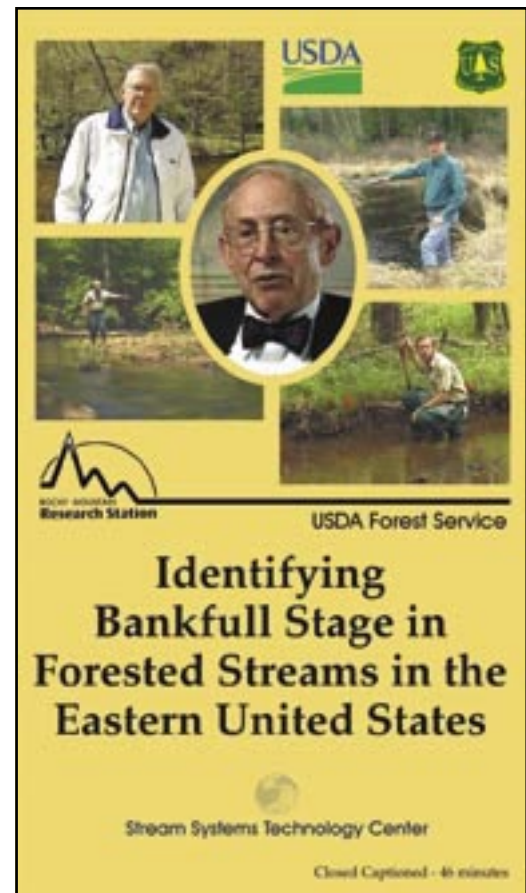
"In working with and leading Roundtable partnerships in the development and application of common criteria and indicator measures of sustainability, the Station continues to do cutting edge work foundational for not only monitoring the vital signs of sustainability, but also for enabling people to better work together using science based information. Keep up the good work!" (National Coordinator for Sustainable Development, USDA Forest Service, Washington, D.C.)

- **Stream Systems Technology Center**

FY2003 Appropriation: \$1,105,000

Outside Funding: \$1,577

Mission: The National Stream Systems Technology Center (STREAM) is a national technical service center sponsored and supported by National Forest Systems and Research and Development. STREAM provides science-based technical support to Forest Service field units and policy makers about physical stream processes, general instream flow technology, and hydrologic processes. The Center's emphasis is on stream flows, channel maintenance, streamside vegetation and watershed conditions. STREAM provides a link between research, field specialists and management, and acts as a catalyst to identify research needs and improve knowledge of stream systems and related watershed processes. Through this collaborative structure, STREAM develops operational tools and provides training and technical support to field specialists and other forest officers.



Scientists in Fort Collins have produced a video that helps land managers identify bankfull stage, which is largely responsible for maintaining the size of streams and rivers.

“We continue to work closely with Station scientists in many areas of water resource management. In particular, the assistance of the Stream Team in facilitating research by Station scientists to address issues related to stream flow, water quality and water needs in riparian areas, continues to be very valuable.”

(Water Program Manager, Rocky Mountain Region, USDA Forest Service)



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 the 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.

USDA Forest Service
Rocky Mountain Research
Station
Forestry Sciences Laboratory
316 East Myrtle Street
Boise, ID 83702
(208) 373-4340
Fax: (208) 373-4391
(<http://www.fs.fed.us/rm/boise>)

USDA Forest Service
Rocky Mountain Research
Station
Forestry Sciences Laboratory
1221 South Main Street
Moscow, ID 83843-2321
(208) 883-2321
Fax: (208) 883-2318
(<http://www.fs.fed.us/rm/main/labs/moscow.html>)
(<http://forest.moscowfs.lwsu.edu>)



Total FY2003 Appropriations: \$5,460,000

Total Outside Funding: \$2,517,918

Total National Fire Plan Funding: \$1,296,264

Total Number of Scientist Years: 17

Research Work Units

• Watershed and Aquatic Ecosystem Research (Boise) (RMRS-4353)

FY2003 Appropriations: \$1,928,000

Outside Funding: \$425,253

National Fire Plan Funding: \$260,597

Number of Scientist Years: 5

Mission: Conduct research on aquatic and terrestrial processes and the effects of disturbance to assist managers in conserving diverse, resilient and productive aquatic ecosystems. Findings will help managers prioritize limited resources and focus conservation and restoration efforts while addressing other management goals.

“The Station has continued to provide the US Fish and Wildlife Service with high quality, timely data and analysis on conservation needs and population dynamics of native fish. In addition, scientists have provided expertise for peer review of listing, recovery and related actions. Finally, these researchers have been very accessible to our biologists seeking clarification or additional information.” (Fisheries Staff, US Fish and Wildlife Service)

Studies at the Aquatic Sciences Laboratory in Boise, ID, are developing improved protocols for fish population surveys that are receiving widespread use among biologists. These Station fisheries biologists are training U.S. Fish and Wildlife Service biologists to sample stream fishes by snorkeling.



- **Forest Ecosystem Development and Management (Moscow) (RMRS-4155)**

FY2003 Appropriations: \$1,433,000

Outside Funding: \$140,783

National Fire Plan Funding: \$373,348

Number of Scientist Years: 4

Mission: Conduct research on ecological processes and forest dynamics that expands our understanding of Interior West forest biology and ecological genetics in support of forest science and management.

Station scientists and cooperators developed a case study of the 2002 Hayman Fire in Colorado. Findings, which shed light on wildfire interactions with both social and natural environments, are being used by land managers and others to help prepare for wildfire events.



- **Microbial Processes (Moscow) (RMRS-4552)**

FY2003 Appropriation: \$1,039,000

Outside Funding: \$255,021

National Fire Plan Funding: \$186,674

Number of Scientist Years: 5

Mission: Conduct research on the role of microbes as they regulate the growth, development and/or restoration of western conifer ecosystems; evaluate how microbes are affected by forest management; and develop methods for preserving or modifying key processes to enhance long-term forest sustainability, productivity, health and vigor.



Studies at our Moscow, ID, facility are helping develop methods of gauging changes in soil productivity caused by management practices.

- **Soil and Water Engineering (Moscow) (RMRS-4702)**

FY2003 Appropriation: \$1,043,000

Outside Funding: \$1,696,861

National Fire Plan Funding: \$475,645

Number of Scientist Years: 3

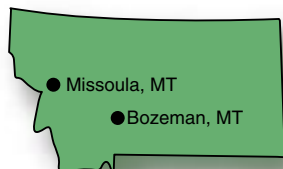
Mission: Gain an increased understanding of forest soil erosion processes in order to develop management tools and practices to reduce on-site soil erosion and off-site sedimentation resulting from forest disturbances, including roads, forest operations and fires.



How streams respond to and recover from forest road closings are being evaluated by scientists at our Moscow laboratory.

“Scientists at the Boise Lab have been instrumental in assisting the development and use of predictive models to identify landslide prone areas. The Payette National Forest and the Station have been working together inventorying landslides and debris torrents to further our knowledge of what influences landsliding processes. Research at the Station is helping to understand the ecological context of landsliding events and associated effects on hydrologic systems.” (Civil Engineer, Payette National Forest, ID)

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.

*USDA Forest Service
Rocky Mountain Research
Station
Forestry Sciences
Laboratory
800 East Beckwith
PO Box 8089
Missoula, MT 59807
(406) 542-4150
Fax: (406) 543-2663
(<http://www.fs.fed.us/rm/main/labs/missoula.html>)*

*Aldo Leopold Wilderness
Research Institute
790 East Beckwith
PO Box 80895775
Missoula, MT 59807
(406) 542-4190
Fax: (406) 542-4196
(<http://www.wilderness.net/leopold>)*

*USDA Forest Service
Rocky Mountain Research
Station
Forestry Sciences
Laboratory
1648 South 7th Avenue
MSU Campus, Bldg. 278
Bozeman, MT 59717-0278
(406) 994-4852
Fax: (406) 994-5916
(<http://www.fs.fed.us/rm/main/labs/bozeman.html>)*

*Intermountain Fire
Sciences Laboratory
PO Box 8089
West Highway 10
Missoula, MT 59802
(406) 329-4848
Fax: (406) 329-4825
(http://www.fs.fed.us/rm/main/labs/miss_fire.html)*

Total FY2003 Appropriations: \$7,758,000

Total Outside Funding: \$7,588,582

Total National Fire Plan Funding: \$2,924,062

Total Number of Scientist Years: 28

Research Work Units

- **Forest Ecology and Management (unit is co-located in Bozeman and Missoula) (RMRS-4151)**

FY2003 Appropriation: \$1,202,000

Outside Funding: \$635,669

National Fire Plan Funding: \$672,027

Number of Scientist Years: 5

Mission: Provide knowledge and guidelines to sustain ecosystem integrity, improve forest health, and enhance social values in the Central and Northern Rocky Mountains, including Montana, east-central Idaho, northwest Wyoming, and northern Utah.



At our Missoula, MT, Forestry Sciences Laboratory, researchers are developing monitoring protocols to help managers evaluate new invasive weed biological controls.

“During our annual silvicultural field workshop, your researchers not only brought to us the 20-year results of forest development at the Newman Ridge site, but also a wealth of knowledge from their outstanding careers as plant ecologists and silviculturists. This is yet another example of your station’s contribution to knowledge transfer assisting us with managing the national forests.” (Forest Supervisor, Lolo National Forest, MT)



- **Wildlife Ecology in Rocky Mountain Landscapes (RMRS-4201)**

FY2003 Appropriation: \$1,023,000

Outside Funding: \$1,508,425

Number of Scientist Years: 4

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



Researchers at the Station's wildlife genetics laboratory in Missoula, MT, are using DNA and molecular genetics to help estimate population size, determine movement rates, identify ranges, inventory and monitor, and confirm the presence or absence of species of concern.

- **Economic Aspects of Forest Management on Public Lands (Missoula) (RMRS-4802)**

FY2003 Appropriation: \$364,000

Outside Funding: \$252,500

National Fire Plan Funding: \$168,006

Number of Scientist Years: 1.5

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

- **Bitterroot Ecosystem Research Program (Missoula) (RMRS-4654)**

FY2003 Appropriation: \$421,000

Outside Funding: \$0

Number of Scientist Years: 0.5

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.

"We appreciate the help your scientists are giving us in the administrative study we are engaged in to look at snowshoe hare densities in different stand ages and types, and also how snowshoe hares use the habitat on a year round basis. The information is very helpful as we evaluate lynx habitat on the forest and try to determine where precommercial thinning is appropriate." (Forest Supervisor, Targhee National Forest, ID)

- **Aldo Leopold Wilderness Research Institute (Missoula)**

FY2003 Appropriation: \$876,000

Outside Funding: \$402,132

National Fire Plan Funding: \$373,348

Number of Scientist Years: 4

Mission: Develop knowledge needed to improve management of wilderness and other natural areas to assure high-quality experiences while maintaining ecosystem integrity. The Institute, which is the nation's only federal research facility dedicated to this task, provides a national center for scientists from different disciplines and land management agencies to address wilderness research needs.

At the Aldo Leopold Wilderness Research Institute in Missoula, MT, researchers are studying the value of wilderness experience to people, and how to protect those values.



Surface mulch is applied as part of a study on restoring vegetation and soils on damaged wilderness campsites.



The Fire Sciences Laboratory in Missoula is the world's leading facility for research on wildland fire. The following three research work units work together to provide the science and technology needed by managers to understand fire and smoke behavior and fire effects to better manage the forests and rangelands of the U.S. and around the world.

Research Work Units

• Fire Behavior (RMRS-4401)

FY2003 Appropriation: \$1,668,000

Outside Funding: \$1,237,114

National Fire Plan Funding: \$373,348

Number of Scientist Years: 5

Mission: Conduct research on wildland fire behavior to help land managers in prefire planning and management, fire suppression, and prescribed burning to better manage and protect the environment, firefighters, property and communities.

• Fire Effects (RMRS-4403)

FY2003 Appropriation: \$1,261,000

Outside Funding: \$3,552,287

National Fire Plan Funding: \$373,348

Number of Scientist Years: 6

Mission: Determine the effects of fire on forests and rangelands through a program of research and development 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 impacts 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.

• Fire Chemistry (RMRS-4404)

FY2003 Appropriation: \$943,000

Outside Funding: \$455

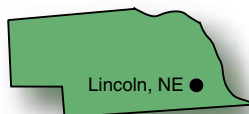
National Fire Plan Funding: \$963,985

Number of Scientist Years: 2

Mission: Characterize fire locations, burned areas, fire radiative energy, combustion processes, and smoke emissions and dispersion from wildfires and prescribed burning in tropical, temperate and boreal ecosystems. Research results provide critical information on the spatial and temporal extent of biomass burning and smoke emissions that can be applied to improve firefighting strategies, smoke management, regional air quality, and global atmospheric chemistry and climate models.

"In my discussions over the last two years with scientists at your Fire Sciences Lab in Missoula, I have increased my knowledge in critical concepts of fire ecology, specifically in terms of physical and biological effects of fire in surface soils and tree root systems. I have applied this knowledge in numerous silvicultural and ecological prescriptions and recommend that the research be continued, enhanced and applied more extensively." (Silviculturist, Fishlake National Forest, UT)

Forest Service Research and Development in Nebraska



The USDA National Agroforestry Center, located in Lincoln, Nebraska, pioneers the development of agroforestry, a science and practice that integrates agriculture and forestry land uses. The partnership combines resources of the USDA Forest Service and Natural Resources Conservation Service to develop and apply agroforestry technologies in appropriate conservation and/or production systems for farms, ranches, and communities. The Center oversees a Technology Transfer and Applications Program that works with a national network of cooperators to develop and distribute agroforestry technical information.

*USDA Forest Service
Rocky Mountain Research Station
National Agroforestry Center
University of Nebraska - East Campus
Lincoln, NE 68583-0822
(402) 437-5178
Fax: (402) 437-5712
(<http://www.fs.fed.us/rm/main/lab/lincoln.html>)
(<http://www.unl.edu/uac>)*

Total FY2003 Appropriations: \$1,843,000
Total Outside Funding: \$238,319
Total State and Private Funding: \$465,000
**Total Forest Service Research and
Development Funding:** \$619,000
**Total Natural Resource Conservation
Service:** \$702,000
Total Number of Scientist Years: 2

"During 2003, several new and innovative initiatives grew from the City of Topeka's continued partnership with the National Agroforestry Center in Lincoln, NE. We also partnered during the annual 1890's University Conference and provided case studies and technology transfers to the attending professors." (Superintendent, Water Pollution Control, City of Topeka, KS)



A multi-year field study, based out of Lincoln, NE, is providing information on the effectiveness of different riparian buffer designs to mitigate nonpoint source pollution.



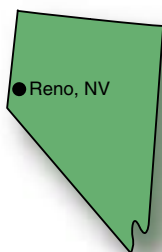
Research Work Units

- **Tree-based Buffer Technologies for Sustainable Land Use in the Central U.S. (RMRS-4551)**

Mission: Understand the functions and processes of riparian and upland tree-based buffer technologies and utilize this information to design plantings that integrate trees into land use systems to restore ecological functions and provide environmental services and economic opportunities.

“The National Agroforestry Center has provided significant guidance to the University of Florida Center for Subtropical Agroforestry (CSTAF) and the 1st World Congress on Agroforestry. Your staff have co-authored research articles and collaborated with CSTAF in preparing a successful agroforestry education proposal. CSTAF personnel have profited from attending agroforestry training sessions organized by the National Agroforestry Center and from the technical backstopping the staff continuously provides.” (Director, Center for Subtropical Agroforestry, University of Florida)

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 are examining 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.

USDA Forest Service

Rocky Mountain Research Station

Forestry Sciences Laboratory

University of Nevada

920 Valley Road

Reno, NV 89512

(775)784-5329 Fax: (775) 784-4583 (<http://www.fs.fed.us/rm/main/labs/reno.html>)

Total FY2003 Appropriations: \$508,000

Total Outside Funding: \$129,945

Total National Fire Plan Funding: \$112,005

Total Number of Scientist Years: 2

Research Work Unit

- **Ecology, Paleoecology, and Restoration of Great Basin Watersheds (RMRS-4252)**

FY2003 Appropriation: \$297,000

Outside Funding: \$12,500

National Fire Plan Funding: \$112,005

Number of Scientist Years: 1

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

- **Great Basin Interdisciplinary Ecosystem Management Project (RMRS-4655)**

FY2003 Appropriation: \$211,000

Outside Funding: \$117,445

Number of Scientist Years: 1

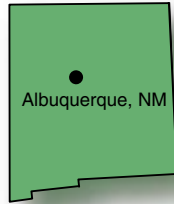
Mission: Achieve a better understanding of the structure and functioning of riparian ecosystems and watersheds within the Great Basin, and develop management guidelines for maintaining or restoring their integrity.



Scientists in Reno, NV, are evaluating changes in pinyon-juniper woodlands and associated sagebrush ecosystems in the Great Basin, and how these changes affect the intensity, frequency and extent of wildfires.



Forest Service Research and Development in New Mexico



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

*USDA Forest Service
Rocky Mountain Research Station
Forestry Sciences Laboratory
333 Broadway S.E., #115
Albuquerque, NM 87102-3497
(505) 724-3660
Fax: (505) 724-3688
(<http://www.fs.fed.us/rm/main/labs/albuq.html>)*

Total FY2003 Appropriations: \$1,598,000
Total Outside Funding: \$224,331
Total National Fire Plan Funding: \$665,306
Total Number of Scientist Years: 9

Research Work Units

- **Ecology, Recovery, and Sustainability of Grassland and Riparian Ecosystems and Wildlife in the Southwest (RMRS-4351)**

FY2003 Appropriation: \$734,000

Outside Funding: \$224,331

National Fire Plan Funding: \$358,414

Number of Scientist Years: 5

Mission: Develop new methods and knowledge needed to restore damaged ecosystems and recover sensitive and endangered species resulting from disturbances and degradation of southwestern and southern-plains grasslands and riparian areas.

"We at Turner Enterprises continue to welcome and appreciate the research your scientists are conducting on the Armendaris Ranch. We look forward to continued collaboration, see substantial practical benefits of such work, and believe your findings will be useful to other land owners and managers as well." (Senior Biologist, Turner Endangered Species Fund)



Station scientists are part of the National Riparian Roads Team that is developing and promoting technologies that protect and enhance riparian areas that intersect with roads on Forest Service lands.

- **Ecology, Diversity, and Sustainability of Soil, Plant, Animal, and Human Resources of the Rio Grande Basin (RMRS-4652)**

FY2003 Appropriation: \$413,000

Outside Funding: \$0

Number of Scientist Years: 1

Mission: Provide new information on the Rio Grande Basin ecosystem, with primary focus on the central basin in New Mexico. Studies focus on the influence of watersheds and management activities on riparian systems, biological diversity of riparian areas, and socioeconomic and historic responses to changes in land use.

- **Cultural Heritage Research (RMRS-4853)**

FY2003 Appropriation: \$451,000

Outside Funding: \$0

National Fire Plan Funding: \$306,892

Number of Scientist Years: 3

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.

Forest Service Research and Development in North Dakota



Although there are no Station research work units currently located in North Dakota, the Station conducts research throughout the Great Plains that benefits the residents of North Dakota. For instance, the research work unit located in Rapid City, South Dakota is working to protect and restore grassland ecosystems while providing benefits and maintaining commodity outputs. Scientists are also investigating ways to maintain viable populations of such animal and plant species as the black-footed ferret, swift fox, ferruginous hawk, mountain plover, burrowing owl, the prairie fringed orchid, milkvetch, and Dakota buckwheat. Finally, work is underway 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, the Center for Great Plains Ecosystem Research, in Rapid City.

*USDA Forest Service
Rocky Mountain Research Station
Forestry Sciences Laboratory
1730 Samco Road
Rapid City, SD 57702
(605) 394-1960
Fax: (605) 394- 6627
(<http://www.fs.fed.us/rm/main/labs/rapidcity.html>)*

Total FY2003 Appropriations: \$799,000

Total Outside Funding: \$124,698

Total Number of Scientist Years: 3

Research Work Units

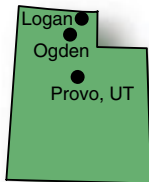
- **Management for Sustainable Ecological Systems on the Northern and Central Great Plains (RMRS-4254)**

Mission: Increase knowledge and develop technology to manage for sustainability the grassland and forested ecological systems of the Great Plains. Scientists are studying the mechanisms and processes that affect populations of both plants and animals, including threatened, endangered and sensitive species, and invasive weeds. Work is underway on the ecological community relationships between and among plants, animals and livestock in the prairies and forests of the Great Plains. Understanding these relationships and applying these principles is crucial for landscape management and monitoring. Scientists are also investigating how ecological stresses influence the sustainability and viability of landscapes.



Studies on the Dakota Prairie National Grassland are providing valuable information on the effects of drought on grazing resources.

Forest Service Research and Development in Utah



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

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

USDA Forest Service
Rocky Mountain Research
Station
Forestry Sciences Laboratory
860 North 12th
Logan, UT 84321
(435) 755-3590
Fax: (435) 755-3560
(<http://www.fs.fed.us/rm/main/labs/logan.html>)

Forest Service
Rocky Mountain Research
Station
Forestry Sciences Laboratory
East 507 25th Street
Ogden, UT 84401
(801) 625-5388
Fax: (801) 625-5723
(<http://www.fs.fed.us/rm/main/labs/ogden.html>)
(<http://www.fs.fed.us/rm/ogden>)

USDA Forest Service
Rocky Mountain Research Station
Shrub Sciences Laboratory
735 North 500 East
Provo, UT 84606
(801) 356-5100
Fax: (801) 375-6968
(<http://www.fs.fed.us/rm/main/labs/provo.html>)

Total FY2003 Appropriations: \$8,562,000

Total Outside Funding: \$5,616,158

Total National Fire Plan Funding: \$448,018

Total Number of Scientist Years: 10

In Logan, UT, work is underway on the spruce beetle and the effects of temperature on its life cycle and outbreaks. This photo shows spruce beetle mortality on the Dixie National Forest, UT.

Research Work Units

• Restoration of Disturbed Ecosystems (Logan) (RMRS-4301)

FY2003 Appropriation: \$253,000

Outside Funding: \$445,000

Number of Scientist Years: 2

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.

• Bark Beetle Disturbance Ecology (Logan) (RMRS-4501)

FY2003 Appropriation: \$615,000

Outside Funding: \$73,304

Number of Scientist Years: 2

Mission: Develop a scientifically credible knowledge base of ecological disturbances associated with bark beetles in coniferous forests. Apply this information in effective management options designed to maintain or restore these forests into productive, sustainable ecosystems at stand, landscape, and regional levels.



- **Interior West Forest Inventory and Analysis (Ogden) (RMRS-4801)**

FY2003 Appropriation: \$6,532,000

Outside Funding: \$3,935,454

Number of Scientist Years: 1

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 land of the Interior West on a continuous and annual basis.

- **Shrubland Biology and Restoration (Provo) (RMRS-4253)**

FY2003 Appropriation: \$1,162,000

Outside Funding: \$162,400

National Fire Plan Funding: \$448,018

Number of Scientist Years: 5

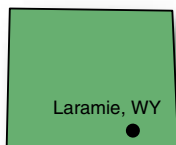
Mission: Develop knowledge, plant materials, and technology for successful long-term restoration of diverse shrubland plant communities to meet resource needs and values.

The biology of wildflowers is being studied at the Station's Provo, UT, laboratory. It's part of an effort to develop native plants for restoring degraded wildlands.



"Proceedings published by the Station in recent years provide useful and much needed insight for management of shrublands and other vegetation types – issues that have grown intense in recent years." (Range Staff, Ashley National Forest, UT)

Forest Service Research and Development in Wyoming



The Rocky Mountain Research Station maintains one research work unit at the Forestry Sciences Laboratory in Laramie, WY. The project is co-located at Station headquarters in Fort Collins, CO. 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.

*USDA Forest Service
Rocky Mountain Research Station
Forestry Sciences Laboratory
222 South 22nd Street
Laramie, WY 82070
(307) 742-6621
Fax: (307) 745-2397
(<http://www.fs.fed.us/rm/main/labs/laramie.html>)*

Total FY2003 Appropriations: \$520,500

Total Outside Funding: \$719,123

Total Number of Scientist Years: 2

Research Work Units

- **Research on Sustaining Fish and Watershed Components of Aquatic and Riparian Ecosystems in the Central Rocky Mountains and Northern Great Plains (RMRS-4352) (project is co-located at Station headquarters in Fort Collins, CO)**

FY2003 Appropriation: \$520,500

Outside Funding: \$719,123

Number of Scientist Years: 2

Mission: Further our understanding of sustainable aquatic and riparian ecosystems involving the interaction between hydrological and biogeochemical responses, nutrient allocation, channel morphology, and aquatic habitat and selected fisheries, and how this association is impacted or influenced by land and water management practices.



To help evaluate the effects of logging on aquatic resources, researchers in Laramie, WY, have attached a transmitter to the back of this boreal toad to study its movements and habitat use.



Honors and Awards

- Rangeland Research Scientist *John Mitchell*, Fort Collins, CO, was honored by the Society for Range Management with its Sustained Lifetime Achievement Award for providing information and direction that foster sustainability of rangeland resources throughout the western U.S.
- *John Rinne*, Research Fisheries Biologist at our Flagstaff, AZ laboratory, received the Professional of the Year Award from the Arizona-New Mexico Chapter of the American Fisheries Society. He was recognized for outstanding contributions to fisheries management and conservation, and selfless dedication to the advancement and improvement of fisheries science in the professional and public interests in 2002 and beyond.
- Scientist *David Merritt*, Fort Collins, CO, was co-recipient of the G.K. Gilbert Award, presented by the Geomorphology Specialty Group of the Association of America Geographers for significant contributions to published research literature in geomorphology.
- *David Cole*, Research Scientist at the Aldo Leopold Wilderness Research Institute in Missoula, MT, was awarded the National Park Service's Intermountain Regional Director's Award for Natural Resources Researcher of the Year. He was recognized for his long career of producing useful research products to help wilderness managers.
- Support Services Specialist *Andrea Kern*, Rapid City, SD, received the Good Neighbor Award from the American Red Cross for soliciting donations of quality of life items and coordinating their shipment to American troops serving in combat in Iraq.
- Research Social Scientist *Alan Watson* in Missoula, MT, was honored with his second Fulbright Scholar Grant. He traveled to Brazil as a Protected Area Scholar, lecturing, assessing research and academic programs and making site visits to consult on protected areas issues.



John Mitchell



John Rinne



David Merritt



David Cole



Andrea Kern



Alan Watson

- Fisheries Research Scientist *Bruce Rieman*, Boise, ID, received the Forest Service's New Century of Service Chief's Award for his contributions to regional fisheries issues, his high personal integrity, intelligent leadership, modest attitude, unique approaches to research and management issues, and his ability to communicate and interact with land managers.
- *Ray Shearer*, a Research Forester with the Forestry Sciences Laboratory in Missoula, MT, had an interpretive trail on the Flathead National Forest named after him in honor of his research accomplishments.
- Minerals Research Economist *Deborah Shields*, Fort Collins, CO, received the Forest Service Chief's Global Stewardship Award for promoting sustainable natural resource management and contributing to the achievement of U.S. foreign policy objectives.
- *Krista Gebert*, Economist at our Missoula Forestry Sciences Laboratory, was recipient of the Forest Service Chief's Excellence in Budget and Financial Accountability Award. She was noted for developing an innovative method for predicting fire suppression costs.
- Personnel Management Specialist *Paul Poplett*, Fort Collins, CO, was honored with the Forest Service Chief's Excellence in Providing Business Operations Support Award. He was recognized for developing a national system of producing personnel action forms that improves customer service and reduces costs. This effort is saving the Forest Service over \$4 million annually.
- Forester *Cele Aguirre Bravo*, along with Mathematical Statisticians *Hans Schreuder* and *Mike Williams*, Fort Collins, CO, were part of an international team that received a USDA Secretary's Honor Award for developing an inexpensive, effective and easy-to-use system for monitoring natural resources and land use in Mexico.
- *Gretchen Moisen*, Research Forester in Ogden, UT, received the Environmental Distinguished Achievement Award from the American Statistical Association. She was noted for her publications in natural resources sampling and spatial modeling, and for improving the methodological aspects of the Forest Inventory and Analysis Program.



Bruce Rieman



Ray Shearer



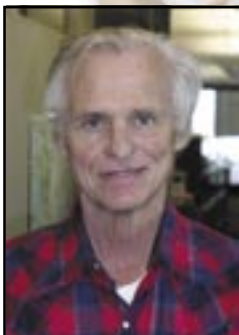
Deborah Shields



Krista Gebert



Mike Williams



Hans Schreuder



Paul Poplett



Cele Aguirre Bravo



Gretchen Moisen



The Station presented its 2003 Outstanding Publications and Administration and Research Support Awards:

- The Technology Transfer Publication Award went to Research Hydrologist *Roy Jemison* and Research Social Scientist *Carol Raish*, Albuquerque, NM. They co-edited the book *Livestock Management in the American Southwest: Ecology, Society and Economics*, published by Elsevier Science. The book makes a significant contribution in its integration of information concerning a wide range of southwestern ecosystems, animal management systems, and human use patterns. The broad-spectrum coverage makes the book useful to a wide range of resource management professionals, students, lay persons and researchers. It provides much-needed management recommendations and is already being employed heavily by the Forest Service in the southwestern U.S.
- Research Entomologist *Jesse Logan*, Logan, UT, was honored with the Visionary Science Publication Award for co-authoring "Ghost Forests, Global Warming and the Mountain Pine Beetle," published

in the Fall 2001 issue of *American Entomologist*. The paper provides a synthesis of previous work in both modeling mountain pine beetle response to the thermal environment, and general modeling approaches. The management implications of the findings in this paper are both important and far-reaching. It is making significant impact in the general scientific community and represents collaborative research at its most productive.

- Research Foresters *John Hof* and *Michael Bevers*, Fort Collins, CO, received the Eminent Science Publication Award for their books *Spatial Optimization in Ecological Applications*, and *Spatial Optimization for Managed Ecosystems*, published by Columbia University Press. These books synthesize approximately 20 journal articles in leading natural resource, landscape ecology and operations research journals.
- *Aaron Alexander*, Computer Specialist in Fort Collins, CO, was selected to receive the Outstanding Early Career Award. He was noted for consistently demonstrating a professional, courteous and helpful attitude when assisting staffs.



Roy Jemison



Carol Raish



Jesse Logan



Aaron Alexander



John Hof



Michael Bevers

- The Outstanding Administrative Team Award went to the Logan, UT Support Services unit. *Michele Bills, Julie Rowberry, Richard Spencer, Tom Donahue, Sharyl Ware* and *Deanna Vinson* were recognized for being a cohesive unit, excellent performance, retaining their esprit de corps, and handling a large workload.
- Financial Specialist *Jan Schoo*, Fort Collins, CO, received the Outstanding Customer Service Award for providing outstanding customer support to the Washington, D.C. Air Program and the more than 50 field units across the Agency served by the Program.
- The Outstanding Lab/Project Support/Secretary Award was presented to *Andrea Kern*, Rapid City, SD. She was noted for overall superior administrative support to Forest Service units.
- *Dona Horan*, Fisheries Biologist in Boise, ID, received the Outstanding Science Support Award. She was recognized for excellent technical skills and contributions to the expansion of expertise within her unit, and going above and beyond to represent the Station and aquatic sciences in general to our publics.
- The Open Category Award went to *Karen Charlton*, Ogden, UT. She played a large role in the preparation for, and success of, numerous critical meetings, and provided overall excellent administrative support.



Jan Schoo



Andrea Kern



Dona Horan



Logan Lab Support Services



Karen Charlton



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. The Station supports several national missions, including: the National Agroforestry Center; Fire Sciences Laboratory; Aldo Leopold Wilderness Research Institute; and the Forest Inventory and Monitoring Environmetrics, Nonmarket Valuation, Natural Resource Assessment and Ecology and Management, Cultural Heritage, and Stream Systems Technology units. 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.
- **Other Federal Land Management Agencies.** The Station serves managers of the largest public land holdings in the lower 48 states. These include 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, our scientists are working with NASA to develop methods for imaging snowpacks via airborne and ground-based campaigns. Results will be help resource managers in arid regions forecast water supplies.

To help estimate smoke and other pollutant emissions from fires, the Station teamed with NASA to develop and test new methods for monitoring burned areas with satellite imagery. An antenna on top of the Station's Fire Sciences Laboratory in Missoula, MT receives frequent satellite data that helps scientists estimate burned areas in considerably less time than previous methods.

The Station also 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 <http://fireweather.info>.

- **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.

"The Station's Library has been very timely on providing documents needed to support the SW Idaho Forest Plan Revision project record. RMRS researchers also continue to support our efforts on water and fish related issues and have been a tremendous support group." (Forest Environmental Coordinator, Boise National Forest, ID)

- **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 took 128 trips to other countries in 2003 to cooperate with scientists, universities, institutions and government agencies on a variety of natural resources projects and issues. For instance, through the Consortium for Advancing the Monitoring of Ecosystem Sustainability in the Americas, the Station and Mexico developed a pilot study to investigate new cost-effective and scientifically credible approaches for monitoring ecosystem resources at multiple scales and resolution fields. In addition, scientists at our Aldo Leopold Wilderness Research Institute traveled to South Africa to work with the Wilderness Foundation and the WILD Foundation on wilderness assessment and research prioritization in that country.

“The Station continues to provide us with cutting edge research results and analyses useful in fulfilling our mandate for national reporting on the status, condition and trend of the conservation treatment of nonfederal lands. Your scientists fulfill an important niche in providing information that is otherwise unavailable to us.” (NRCS Natural Resources Inventory and Analysis Institute, Fort Collins, CO)



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 2003, we conducted \$11.9 million in cooperative research with 46 universities and 31 non-university cooperators. Cooperative research is an important component of accomplishing our research mission.

“Washington State University Extension Specialists utilized the expertise of scientists and technology transfer personnel at the National Agroforestry Center in the complete re-writing of an extension bulletin titled Trees Against the Wind. Updating would not have been possible without the knowledge and cooperation of NAC personnel.” (Extension Forester, Washington State University, Seattle, WA)

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:



Station scientists often work with students at science fairs, in the classroom and at other venues to share their expertise.

- The FireWorks educational program, developed by researchers at the Fire Sciences Laboratory in Missoula, MT was used to develop and broadcast programs over the Dakota Digital Network to public schools in South Dakota, educating middle school students about wildfire.
- Our Laramie, WY laboratory hosted a tour for students from the University of Wyoming Child Development Center. The event was part of an outreach effort to inform the community about on-going forest and hydrologic research at the Station.
- One of our researchers in Flagstaff, AZ helped plan and organize the 4th Annual Tu B'Shevat Festival in Scottsdale, AZ. The event highlights the close cooperation, including technical exchanges, research and education, between the Forest Service and the Jewish National Fund, which is responsible for forestry in Israel.
- Scientists at our Missoula, MT Fire Sciences Laboratory instructed environmental educators and teachers in a master class in the FireWorks educational trunk and curriculum. Students in grades 1-10 learned about fire behavior, effects and management. In addition, the C.K. McClatchy High School in Sacramento, CA has integrated FireWorks into its Fire Science Academy – a 4-year program for students interested in occupations in fire science.
- Researchers at our Moscow, ID lab served as judges and coordinators at a local elementary school science fair. They discussed student projects, presented information on the scientific method, and offered suggestions and ideas.



- National Agroforestry Center (Lincoln, NE) scientists participated in the Earth Wellness Festival, where over 5,000 students and teachers attended sessions on air, water, soil and natural resource sciences. Employees presented hands-on experiments on how windbreaks protect crops, animals and homesteads. The annual event is a partnership between the Forest Service and the Natural Resources Conservation Service.
- A station editor in Fort Collins served as the technical writing judge at the 48th Annual Colorado Science and Engineering Fair at Colorado State University. He also served as judge at local and regional elementary schools, offering encouragement and communication tips, and helped Colorado State University professors conduct career-readiness interviews for graduating seniors in the Department of Technical Communication.
- Researchers in Lincoln, NE worked with the Lincoln Family Service's School's-Out Program to instruct students on habitat requirements for fish using their Fish Habit-At module. The presentation was also given to the York, Nebraska Elementary Science Club.
- Researchers at the National Agroforestry Center in Lincoln, NE presented the Working Trees for Wildlife program at the city's Folsom Zoo "Care-for-Bears Days." They helped educate the public on how trees can enhance wildlife habitat by providing critical travel corridors.
- Scientists with the Bitterroot Ecosystem Management Research Project sponsored a tour of the Sawmill Research Natural Area and the privately owned Burnt Fork Ranch in Montana. Tour participants viewed 6,000 acres of grassland and forest restoration treatments. Project scientists also conducted a tour of the Lick Creek Demonstration/Research Forest in Montana. They showcased the effects of thinning and use of understory fire to restore ponderosa pine forests.

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 Hispanic Camp is held annually at the Fraser Experimental Forest in Colorado.

- 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 vegetation studies at the AIMS Camp.

Natural Resources Conservation Education Program

The Forest Service's Natural Resources Conservation Education Program provides funding to the Station every year that 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:

- Scientists at our Flagstaff laboratory participated in the annual Flagstaff Festival of Science, now in its 14th 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,



Students and instructors at Camp Colton.



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.
- To find out how the Forest Service can improve on getting messages out to the public to promote good land stewardship, Station scientists, along with cooperators, devised a study to find out how conservation education and environmental education programs operate and communicate to their publics. Research results are being used to develop and improve educational efforts that help inform citizenry and engage them in natural resource management issues.

“The Fishlake National Forest benefits from wonderful working relationships with Station scientists and research staffs from at least five research work units in Ogden, Logan and Provo, UT; Missoula, MT; and Fort Collins, CO. We value this interaction because their research, technology transfer and publications lend credibility to the programs that we plan and carry out on the forest. This collaboration results in synergistic ideas to apply information that otherwise would not have been available.” (Fishlake National Forest staff, UT)

To find out more about the Rocky Mountain Research Station:

Visit our Internet website at <http://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

You can visit, write, phone or fax us at:

Rocky Mountain Research Station
Public Affairs Office
2150 Centre Avenue, Bldg. A
Fort Collins, CO 80526
(970) 295-5920
Fax: (970) 295-5927

Rocky Mountain Research Station
Public Affairs Office
324 25th Street
Ogden, UT 84401
(801) 625-5434
Fax: (801) 625-5129





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