

United States Department of Agriculture Forest Service



Rocky Mountain Research Station 2010 Research Accomplishments

On the cover: A Station technician uses radio telemetry equipment to track radio-tagged wolverines in Glacier National Park. This is part of a study to evaluate wolverine habitat and movement. Learn more about this research on page 36.

Rocky Mountain Research Station 2010 Research Accomplishments

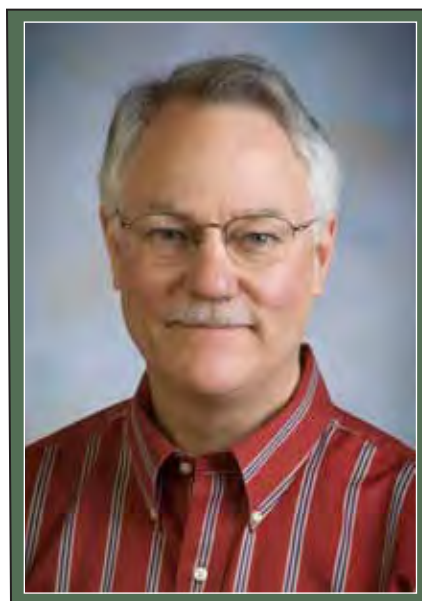


United States Department of Agriculture
Forest Service

Greetings!

It is with great pleasure that I bring you the Annual Report of the Rocky Mountain Research Station (RMRS) for Fiscal Year 2010. Our Station is guided by the motto of *Science First*, and focused on providing the best, most relevant science information to resource specialists and others throughout the world.

This past fiscal year marks the second full year since the RMRS organization restructured. This resulted in reduced complexity, combining over 30 Research Work Units into 7 Science Programs, and an increased ability to quickly and efficiently configure our science workforce to address the complex science issues that we face. There are no barriers to partnering to address these issues, either within our Station or externally with other Forest Service Research Stations or cooperators. We are driven to solve science problems and provide information and tools which are needed regionally, nationally, or internationally to address natural resource problems.



Station Director
G. Sam Foster

We strive to produce relevant information that managers, other scientists, and citizens need and can use. We work in a myriad of forums to understand the most important issues and use this to structure our annual plans of work. Our science workforce is well trained and continues to produce high quality science information, as you will see in this report. A hallmark of our work is the appropriate integration of science across a wide variety of issues including: climate change, fire, wildlife, fisheries, forestry, range, water, human dimensions, insects and diseases, and inventory and monitoring. The complex issues that society faces, from climate change to invasive species, dictates this integrated approach.

Creation of the Science Application and Integration staff was one of the unique benefits of our recent restructuring. **Jan Engert** joined us as the Assistant Station Director of this unit at the beginning of the fiscal year. Her staff is moving us toward newer, more effective science application and technology transfer techniques. For the Forest Service, application of new science is as important as knowledge discovery.

Nan Christianson joined us as our new Assistant Station Director for Communication in the spring. The Communication Staff includes our work in publications, oversight for the Forest Service Library, and public and legislative affairs; hence, it is a critical area for us.

Rounding out our Station management, **Cloetta Schroeder** came on-board last winter as Assistant Station Director for Operations. Without this support function, none of us get any work done, so this was a welcome addition.

In conclusion, 2010 was another great year and I hope that you will take the time to peruse this report and learn more about the Rocky Mountain Research Station and our continuing quest to provide the best science for wise resource management.

A handwritten signature in black ink that reads "G. Sam Foster". The signature is written in a cursive, flowing style.

Station Director

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A Look at RMRS

The Rocky Mountain Research Station is one of seven 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 12-state territory encompassing the Great Basin, Southwest, Rocky Mountains, and parts of the Great Plains. The Station employs a diverse workforce of approximately 400 permanent full-time employees, of which 91 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 273 research natural areas (<http://rna.nris.state.mt.us>).

Our research program serves the Forest Service as well as other Federal agencies, State agencies, international organizations, private groups, and individuals. Research results and products are made available through a variety of technical reports, journals, and other publications. In 2010, we published 59 Station technical reports, and mailed 89,000 publications while answering 18,000 publication requests. Research information is also available via web sites, seminars, symposia, demonstrations, exhibits, and personal consultations. These help resource managers and planners balance economic and environmental demands for forest and rangeland resources worldwide.



The Forest Service Research and Development mission of “develop and deliver knowledge and innovative technology to improve the health and use of the nation’s forests and rangelands” guides the work we do. Our priorities are to:

- Create credible, innovative, science-based solutions for resource management problems.
- Identify relevant needs and quickly and efficiently convert science gaps into findings and products for managers and citizens.
- Anticipate and respond to emerging issues.
- Enhance the ability of our customers and partners to more easily find, participate in, and use products of the RMRS research program

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 use it effectively. As we disseminate information, we solicit feedback on its relevance and usefulness, monitor the success of our communication efforts, and adapt strategies as needed.

A Look at RMRS

Support Staffs

The success of our research programs would not be possible without the critical team support provided by our professional, technical, and administrative employees. Professional and technical staffs include biologists, foresters, ecologists, technicians, and other specialists, who work with our scientists and help conduct field and laboratory studies. Administrative staffs include: Strategic Management, Civil Rights, Budget, Public and Legislative Affairs, Science Application and Integration, Acquisition Management, Facilities Management, Financial Management, Library Services, Publishing Services, Web Services, Safety and Health, and Statistics. The Station also receives Human Resources Management and budget and fiscal support from the Albuquerque Service Center.

Partnerships

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

National Forest Systems. Forest supervisors and managers comprise the Station's largest customer segment or stakeholder group. The Station supports several national missions, including the Fire Sciences Laboratory and the Aldo Leopold Wilderness Research Institute, both in Missoula, Montana. National Forest Systems rely heavily on Station staffs to provide scientific information and assistance in implementing the Endangered Species Act, Clean Water Act, Clean Air Act, and other environmental legislation.



The Station's largest customer base is comprised of managers of our Nation's National Forests.

In addition: the National Forest Service Library, based at Station headquarters in Fort Collins, CO, regularly serves Forest Service resource specialists; the Station has played a major role in developing the national Wildland Fire Decision Support System that assists fire managers and analysts in making strategic and tactical decisions for fire incidents; and the Station is helping the Forest Service develop safe systems for high-risk environments, such as fighting wildfires.

Other Federal Land Management Agencies. The Station serves managers of the largest public land holdings in the lower 48 states, including the Bureau of Land Management, National Park Service, Bureau of Reclamation, U.S. Fish and Wildlife Service, and Department of Defense.

Other Federal Non-land Management Agencies. We provide regular consultation to the Environmental Protection Agency, National Marine Fisheries Service, Natural Resources Conservation Service, and Bureau of Indian Affairs.

State, Local and Other Public Agencies. Our Inventory and Monitoring science program provides eight Western States with resource inventory and monitoring data for use by state, county and urban planners, State resource agencies, industry, and others. In separate work, the Station continues to partner with the State of Michigan on a bald eagle monitoring program to assess pollutants in the food webs of the Great Lakes region.

Industry. The forest products industry is an important customer for tree improvement, forest productivity, insect and disease, genetics, and engineering technology research. We collaborate 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 recreational 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 increasingly aware of, and are valuing, research information for their uses. Some of these groups include: The Wilderness Society, Northern Colorado Bark Beetle Cooperative, American Forest and Paper Association, Society of American Foresters, Malpai Borderlands Group, American Fisheries Society, the Front Range Fuels Treatment Partnership, and the Soil and Water Conservation Society of America.

Tribal Governments. The Station supports a number of working relationships with several Tribal governments in many parts of our territory. For example, the Station co-sponsored a workshop with the Confederated Salish and Kootenai Tribes of Montana, the Intertribal Timber Council, and the University of Washington to engage Native leadership and keepers of traditional knowledge in guiding research and education for environmental problem solving; and a Station scientist is the liaison for the Intertribal Nursery Council, a group that works to share information on improving plant nursery production and outplanting and restoration techniques.

International Cooperation. Station scientists often travel to other countries to cooperate with scientists, universities, institutions, and government agencies on a variety of natural resources projects and issues. In 2010, researchers visited 23 different countries. For instance, our scientists worked with Canadian colleagues on postfire erosion and treatment effectiveness studies. Results are providing new information on postfire erosion rates and changes with various mitigation treatments.

University and Non-university Cooperators. We maintain 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.



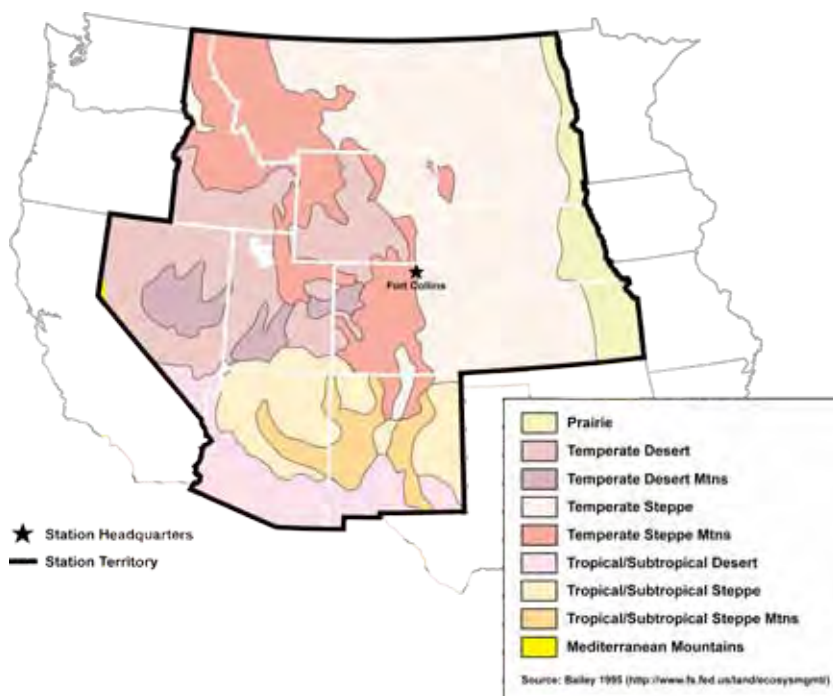
The Station is working with the state of Michigan on a bald eagle study.

A Look at RMRS

Within the Rocky Mountain Research Station Territory...

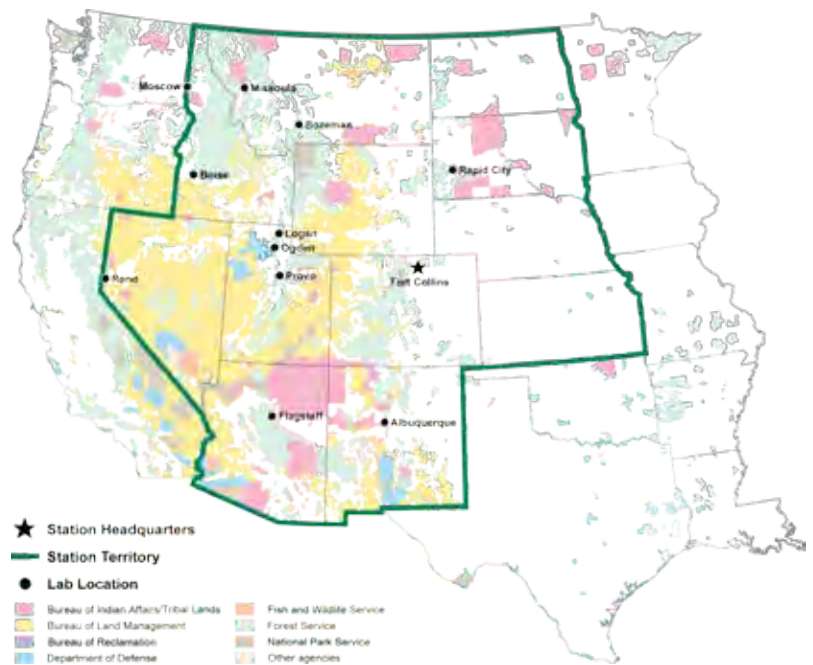


Watersheds



Ecoregions

Forest Service Regions and National Forests



Federal Lands

2010 Highlights

The Station filled all its leadership vacancies during 2010: Station scientist **Colin Hardy** was selected to serve as Manager of the Fire, Fuel and Smoke Science Program; **Deborah Finch** is the new Manager for the Grassland, Shrubland and Desert Ecosystems Science Program; **Nan Christianson** is the new Assistant Station Director for Communications; **Cloetta Schroeder** was named Assistant Station Director for Operations; **Nick Reyna** was selected as Assistant Station Director for Strategic Management and Accountability; and **Jan Engert** is the new Assistant Station Director for Science Application and Integration.



Research Ecologist **Michael Schwartz** (left) and Research Social Scientist **Alan Watson** each received the US Forest Service Chief's Wilderness Award; Schwartz for his leadership in the development and application of non-invasive genetic sampling; Watson for contributions to the Wilderness Program.



Quantitative Ecologist **Linda Joyce** was a co-recipient of this year's Forest Service Deputy Chief's Distinguished Science Award. Joyce was noted for her contributions to the Intergovernmental Panel on Climate Change reports and the IUFRO (International Union of Forestry Research Organizations) report "Adaptation of Forests and People to Climate Change: A Global Assessment."



Tom Zimmerman, Program Manager for the Wildland Fire Management Research Development and Application program, received the Chief's Honor Award for Science and Technology. He was recognized for providing outstanding science-based applications and tools for sustainable natural resources management.



Grassland, Shrubland and Desert Ecosystems Science Program Manager **Deborah Finch** was honored with the Forest Service's National Award for Outstanding Achievement in Rangeland Research and Development. She was noted for her efforts to advance the knowledge of grassland, shrubland and riparian ecosystems in the Southwestern United States.



Sharlene Sing, Research Entomologist, was the recipient of the Outstanding Paper Award from the *Journal of Invasive Plant Science and Management*. The award recognizes her paper titled "Hybridization Between Invasive Populations of Dalmatian Toadflax and Yellow Toadflax."

The Station presented its Outstanding Publication and Administration Awards for the year:

- Best Scientific Publication - Research Hydrologist **Charles Luce** for “Declining Annual Streamflow Distributions in the Pacific Northwest United States, 1948-2006”;
- Best Visionary Science Publication – Research Plant Physiologist **Robert Musselman** for “Significance of Pollutant Concentration Distribution in the Response of the Red Kidney Beans to Ozone,” and “Nocturnal Stomatal Conductance and Ambient Air Quality Standards for Ozone;”
- Best Technology Transfer Publication – Research Plant Physiologist **Kasten Dumroese** for “Nursery Manual for Native Plants – a Guide for Tribal Nurseries;”
- Outstanding Science Support – Hydrologist **Tom Black**;
- Outstanding Program Support – Administrative Operations Assistant **Patricia Lynam**;
- Outstanding Leadership Team Support – Program Coordinator **Karen Iverson**;
- Outstanding Customer Service – Administrative Operations Assistant **Virginia Wilson**;
- Outstanding Support, Open Category – Secretary **Vicki Berrett**;
- Outstanding Administrative Team – Business Managers **Paulette Benally**, **Susan Bradford**, **Keith Louks**, **Pat Ford**, and **Donna Marchwick**;
- Customer Appreciation Award – Assistant Station Director for Strategic Management and Accountability **Nick Reyna**; and
- Safety Award – Hydrologist **Tom Black**.

Research Foresters **Russ Graham** (left) and **Terrie Jain** received the College of Natural Resources Alumni Achievement Award from the University of Idaho for many contributions to the science and management of forest ecosystems of southern Idaho and the western United States, and for achievement in forest ecology and management, respectively.



One of the top five most cited articles in the journal *Forest Ecology and Management* over the past five years is coauthored by Research Entomologist **Jose Negron** and titled “The Effectiveness of Vegetation Management Practices for Prevention and Control of Bark Beetle Infestations in Coniferous Forests of the Western and Southern United States.”



Research Soil Scientist **Deborah Page-Dumorese** is author of one of the top ten most cited articles in the journal *Forest Ecology and Management*. Her paper is titled “The North American Long-Term Soil Productivity Experiment: Findings from the First Decade of Research.”



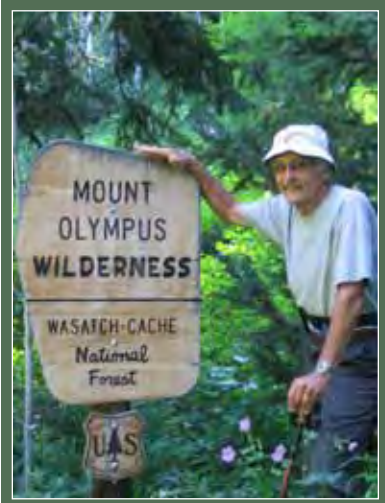
2010 Highlights



Research Ecologist **Mike Ryan** received the Distinguished Alumnus Award from Northern Arizona University's School of Forestry for a variety of research accomplishments.



Research Ecologist **Paulette Ford** was honored with the Forest Service National Grasslands Research and Technology Award. The award recognized her research efforts on the Kiowa National Grassland and her service as Research Representative on the National Grasslands Council.



The Walter F. Mueggler-Butler Fork Research Natural Area was dedicated and named after renowned and retired Station Aspen Ecologist **Walt Mueggler**. Located on the Wasatch-Cache National Forest in Utah, this area represents the potential of aspen communities throughout northern Utah and adjacent Rocky Mountain states.

New Forestry Sciences Laboratory Dedicated

The Station dedicated its new Forestry Sciences Laboratory in Fort Collins, Colorado during a ceremony that included USDA Secretary Tom Vilsack, Colorado Governor Bill Ritter, Jr., Forest Service Chief Tom Tidwell, Fort Collins Mayor Doug Hutchinson, and other dignitaries. Funded in part by the American Recovery and Reinvestment Act, the state-of-the-art facility houses laboratory and office space for researchers conducting studies throughout much of the Interior West.

The Station's new Forestry Sciences Laboratory in Fort Collins, Colorado, includes state-of-the-art laboratory and office space.



The ribbon cutting ceremony to dedicate the new Forestry Sciences Laboratory included (l to r): Fort Collins Mayor Doug Hutchinson, Colorado Governor Bill Ritter, Jr., USDA Secretary Tom Vilsack, Station Director Sam Foster, and US Forest Service Chief Tom Tidwell.

Fire Sciences Laboratory Celebrates 50th Anniversary

The Station's Fire Sciences Laboratory in Missoula, Montana, celebrated 50 years of operation in September, 2010. Approximately 300 attendees enjoyed an alumni breakfast, dignitaries' speeches, a "Feast of Fire Science," and laboratory demonstrations. The lab is recognized world-wide as a leader in cutting edge wildland fire research. Learn more at www.firelab.org.



Visitors were treated to laboratory demonstrations, such as this in the burn chamber, during the 50th anniversary celebration.

Long-Term Research at Experimental Forests, Ranges and Watersheds

A unique and valuable part of the infrastructure within which the Forest Service conducts research is a network of experimental forests, ranges, and watersheds. They are living laboratories where Forest Service scientists conduct studies and demonstrate research results for our stakeholders. Experimental sites are some of the few places left where ecological research can be maintained over the long term – often longer than an individual scientist’s career. Experimental areas are extremely varied and are located throughout the United States and Puerto Rico.

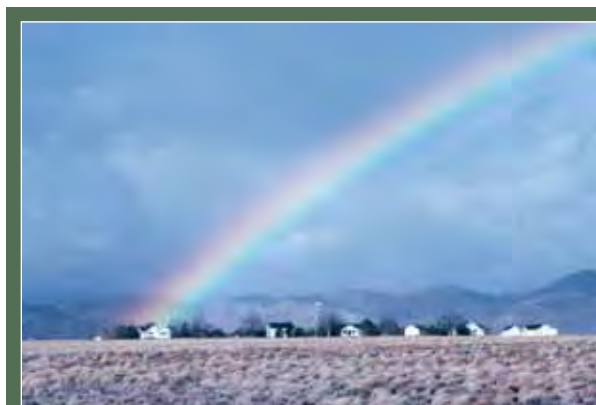


The Rocky Mountain Research Station administers and conducts research on 14 experimental forests, ranges, and watersheds (<http://www.fs.fed.us/rm/main/expfor.html>). The Fort Valley Experimental Forest, located near Flagstaff, Arizona, was established in 1908, and is the site of the first Forest Service research investigations in the Nation. Following is a sampling of current work at our experimental forests and ranges.

- Two million dollars were appropriated nationally in Fiscal Year 2010 for forest inventory and analysis (FIA) studies that will aid FIA modeling, address climate change mitigation and adaptation, and leverage other national monitoring networks such as the National Ecological Observatory Network (NEON), Long-term Ecological Research sites (LTERs), and Urban Long-term Research Areas (ULTRAs). The Station received \$360,000 to analyze the ecological representativeness of our experimental forests, ranges and watersheds, and to improve long-term metadata digitization to facilitate the networking of research.

Long-Term Research at Experimental Forests

- **Black Hills Experimental Forest (South Dakota)** — Like many other places in the Interior West, ponderosa pine forests of the Black Hills in South Dakota and Wyoming are experiencing a serious mountain pine beetle infestation; the Black Hills Experimental Forest (BHEF) is also having similar patterns of mortality. The current forest structure within BHEF is not fire resilient and encourages insect activity; thus within a changing climate there are concerns for future health and resilience. A study on 700 hectares within the BHEF is designed to evaluate the effects of silviculture treatments on forest resilience, forest heterogeneity, fire resilience and other factors at multiple spatial and temporal scales that may influence the growth and development of these forests within the context of a changing climate. Much of the Black Hills National Forest and the BHEF is within the wildland urban interface. Station scientists and Forest staff are working together to develop a long-term burn plan that corresponds with forest thinning. In addition, a soil productivity study is being developed between Station and Forest staff to address the effects of harvesting on soil nutrition.
- **Boise Basin Experimental Forest (Idaho)** — Studies are underway to develop and evaluate silviculture treatments that will sustain or restore dry forest ecosystems within the context of climate change. These include: old-growth restoration; alternative fuel treatments that meet social and ecological objectives; design of silviculture systems for increasing landscape diversity; and forest thinning to increase the resilience of old ponderosa pine forests.
- **Desert and Great Basin Experimental Ranges (Utah)** — Researchers made significant progress in the conversion of long-term meteorological and vegetation data to electronic format for archiving.
- **Fraser Experimental Forest (Colorado)** — The experimental forest was selected as a National Ecological Observatory Network (NEON) site. In addition, new construction is underway on a combination dormitory/lounge/kitchen facility which will increase current capacity, and provide year-around lodging for winter research.



Desert Experimental Range.



Glacier Lakes Ecosystem Experiments Site.

- **Priest River Experimental Forest (Idaho)** — The Priest River Experimental Forest will celebrate its 100th anniversary in 2011. Located in northern Idaho, it was the site of early nursery, planting, and regeneration studies.
- **Glacier Lakes Ecosystem Experiments Site (GLEES) (Wyoming)** — Research continues to examine the effects of climate change and insect mortality on carbon fluxes and ecosystem dynamics.

Long-Term Research at Experimental Forests

- **Manitou, Glacier Lakes Ecosystem Experiment Site (GLEES), and Priest River Experimental Forest and Great Basin Experimental Range** have joined a United States Geological Survey Pilot Study for the Federal Pollinator Network, federal initiative to develop a monitoring scheme for insect pollinators. The geographic spread of these locations adds an important dimension to this study.

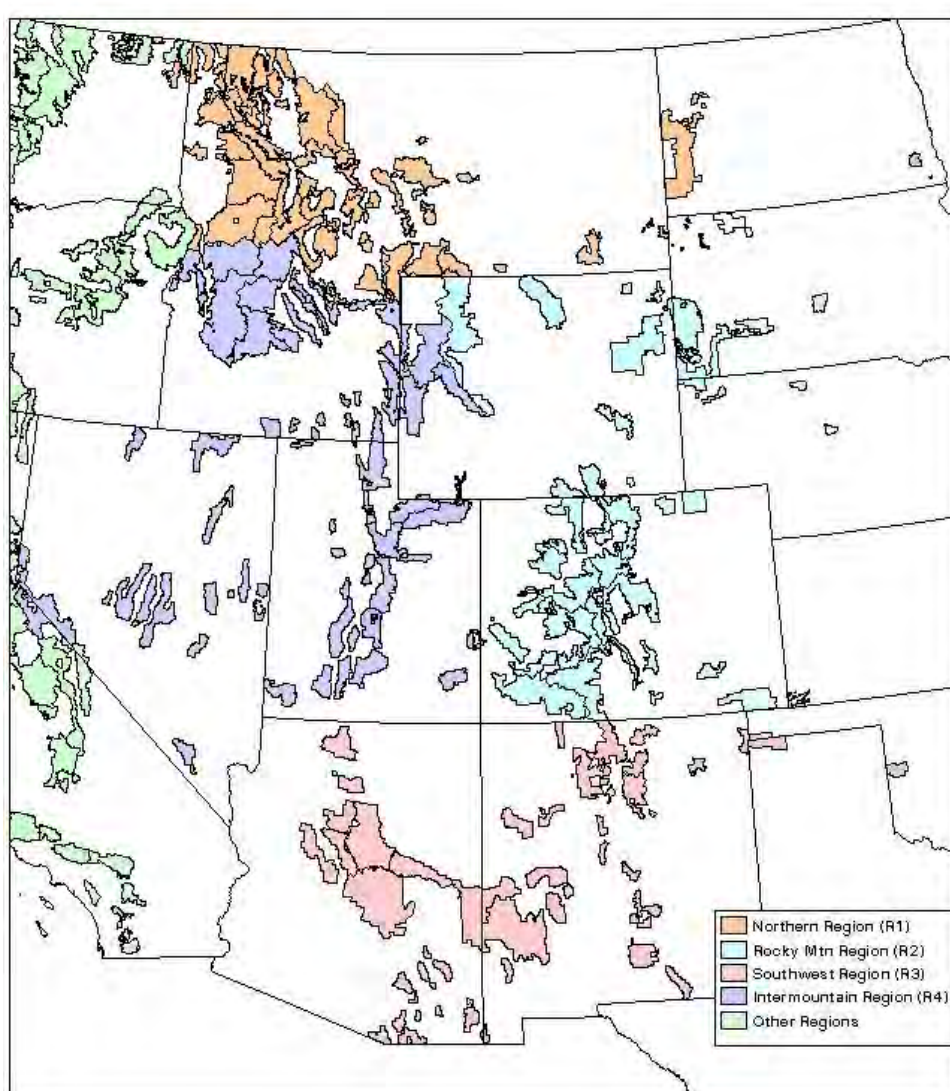


Manitou Experimental Forest in central Colorado.

- **Tenderfoot Creek, Fraser and Sierra Ancha Experimental Forests** received national funding for equipment to participate in the International Cooperative Programme Level II. They have installed the equipment and began taking measurements this year, covering the north/south gradient of the Interior West in Montana, Colorado, and Arizona, respectively. The program was originally launched in 1985 under the Convention on Long-range Transboundary Air Pollution of the United Nations Economic Commission for Europe (UNECE). Level II funding provides intensive monitoring to gain a better understanding of the cause-effect relationships between the condition of forest ecosystems and anthropogenic as well as natural stress factors (in particular air pollution) by means of intensive monitoring on a number of selected permanent observation plots. Twenty-one Experimental Forests and Ranges participate nationwide. There are over 800 plots in selected forest ecosystems in Europe. Currently 41 countries participate in the International Cooperative Programme.

Research Natural Areas: Conserving Biological Diversity

The Rocky Mountain Research Station (RMRS) oversees activities on 275 Research Natural Areas (RNA). These areas represent a variety of habitats and ecosystems from alpine ecosystems to lowlands, and from coniferous forests of the Northern Rockies to semiarid deserts of the Southwest and prairie ecosystems of the Great Plains.



Research Natural Areas within the Rocky Mountain Research Station territory.

The Research Natural Areas within our territory offer an unprecedented opportunity to investigate natural resources in an unspoiled and protected environment. They have been selected and managed in cooperation with the National Forest System Regions as the best possible representatives of major habitat types, or for unique ecological, botanical, geological, or hydrological features. The geographic extent ranges from the Gooding RNA 5 miles from the Mexican border to the Snowy Top RNA 100 feet from the Canadian border, and the Babbit Peak RNA on the Nevada-California state line to the Signal Hill RNA in the Sand Hills of Nebraska.

Research Natural Areas

The Forest Service Research Natural Areas (RNAs) System represents a valuable ecological resource for scientists, managers and educators. The Forest Service encourages scientific and educational use of Research Natural Areas. Scientists, land managers and educators who are interested in conducting science or using RNAs for education purposes are asked to submit a request to the Rocky Mountain Research Station. Additional information is available on our website at <http://rna.nris.state.mt.us/>.

Recent activities within the Station's Research Natural Areas (RNA) include:

- The 1,270-acre **Walter F. Mueggler-Butler Fork Research Natural Area**, named after our retired RMRS scientist, was established on the Wasatch-Cache National Forest in the central Wasatch Mountain Range of north-central Utah. The RNA highlights Dr. Mueggler's subject of expertise, quaking aspen, in a near pristine state, having not been subject to grazing for over 100 years.
- The **RMRS RNA web site** <http://www.fs.fed.us/rmrs/research-natural-areas/> has received a complete overhaul resulting in improved organization and clarity. Spatial locations and individual information can be explored on Google Earth for our 275 RNAs that we co-manage with the National Forest System.
- A study on aspen stand dynamics was conducted on the **Timbered Cinder Cone Research Natural Area** in the Dixie National Forest in southwestern Utah by Dr. Charles E. Kay at Utah State University. This study was designed to measure aspen-conifer stem dynamics as part of a larger study on the ongoing decline of aspen (*Populus tremuloides*) in southern Utah. Because the Timbered Cinder Cone Research Natural Area is surrounded by an extensive field of lava boulders which prevents access by both wildlife and livestock, the RNA has never been grazed and is, in essence, a large enclosure.
- Station Scientists are initiating a **research study on 19 Research Natural Areas** throughout the Station territory to measure climate effects on soils at high elevations. In addition, three experimental forests will be sampled, as well as three other national forest locations. These sites were selected in order to observe plant community changes based on elevation and aspect. The RNAs and other locations cover a wide range of geographic gradients (elevation, latitude, longitude) to provide a robust statistical design.

Conservation Education

When asked about our favorite memories of childhood, many of us would respond: “catching fireflies and frogs!” or “exploring little creeks and ponds!” or “building forts or tree houses!” But, childhood has changed. American kids now spend a big part of their time being entertained by electronic media! Less time is spent outside, and when it is, it is often spent participating in organized sports. The “make-it-up-as-go” play, especially in natural surroundings, is verging on becoming a thing of the past!

Station employees continue to work with youth and others in the community, to connect them with their natural environment and make a difference in the way they see their world. We’re showing them what caught our imaginations, what we loved about the outdoors and made us want to explore it. Some of the following were funded through the Station’s Conservation Education program; some were made possible through partnerships with not-for-profit organizations in the community, or through university collaborations; and some were done on an individual volunteer basis.

For example:

- Scientists at the Priest River Experimental Forest (ID) helped students design streams and create circumstances that affect the physical characteristics of a stream and the riparian zone with the use of a streamboard, a simple educational tool that demonstrates basic principles of hydrology.
- The Boise River (ID) became the outdoor classroom for exploration, where kids reconnected with their natural world, learned about the interconnectedness of watersheds and communities that ensures a healthy future for the river, and through hands-on activities, discovered some essential aquatic principles.
- Kids in Nevada participated in a Spring Mountains Safari to gain an understanding about how all elements of an ecosystem – insects, animals, plants, water, and soils – are interdependent.
- Scientists partnered with high school students in Pottach, Idaho, on a year-long research venture. The students will sample and process tree cores and soil samples to help answer the question, “How does the forest’s uptake of water affect recharge to groundwater?”
- Albuquerque (NM) homeless youth and their parents were invited to the Rio Grande Nature Center State Park and engaged in meaningful outdoor experiences that broadened their awareness and understanding of the natural world.
- Through hands-on data acquisition and analysis opportunities, students in Logan, Utah, were introduced to dendroecology and dendrochronology – finding that tree rings can tell us much more than just the age of a tree.
- Through various activities and games, kindergarten through 2nd grade students in Flagstaff, Arizona, were introduced to bird watching and sharpened their listening skills by identifying local bird calls.



Students participate in a field trip at the Station's Priest River Experimental Forest in Idaho.

Conservation Education

- Each spring and fall, our Flagstaff (AZ) lab helps host 6th grade students at the successful outdoor environment educational camp known as Camp Colton. This event is offered free to every 6th grade student in the Flagstaff Unified School District. Students learn about Forest Service research, including the study of birds and other wildlife species, and about fire and restoration efforts being done in the forest that surrounds many of their homes.
- The Priest River Experimental Forest (PREF) in Idaho hosted its 3rd Annual Forest Expo for 6th graders. Over 100 students participated in demonstrations of logging techniques, and nine educational stations that focused on forest management, fish and wildlife, recreation, forest products, paper making, PREF history, weather, plant identification and fire. The success of the event depended on many volunteers, participation of, and funding from, local businesses, and a partnership with the Priest Community Forestry Connection.
- The Fire Sciences lab in Missoula, Montana, hosted undergraduates from around the United States and Great Britain as part of the National Conference on Undergraduate Research, held at the University of Montana. Students learned about the mission and history of Fire Lab research. Technicians conducted lab demonstrations and students learned about dendrochronology by examining tree cores and fire-scarred wood.
- Quantitative Ecologist Linda Joyce gave a talk on climate change and forests at a “Project Learning Tree Forests of the World” educational program for high school and junior high school teachers who can now share the information with potentially hundreds of students.
- The Forest Service Fisheries and Aquatic Sciences shared technology transfer program, based at our Boise, Idaho, Aquatic Sciences Lab, unleashed a fantastic “Science for Kids” website geared toward providing educational materials on aquatic ecology. It features seasonal articles on things to do outside and lessons on watersheds. A big part of the website is devoted to the Class in the Creek Program, a hands-on river experience for youngsters.



“In the end, we will conserve only what we love, we will love only what we understand, and we will understand only what we are taught” (Environmentalist Baba Dioum, 1968).

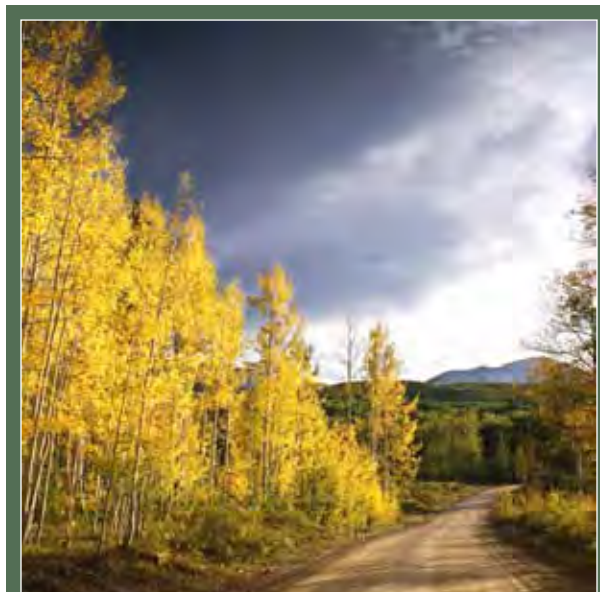
- Research Forester Gerald Gottfried was the Forest Service representative on the planning committee for the Phoenix, Arizona, Jewish Community’s 11th Annual Tu B’Shevat Festival, a holiday called the birthday of the trees, which honors nature in general and dates back to the 16th century in Israel. Nearly 2,000 people attended the event this year.
- Fisheries Biologist Dona Horan helped organize the Boise RiverSweep again this year. This is a collaborative effort, engaging Station employees and local citizens in cleaning up the Boise River in Idaho. More than 1,500 aluminum cans were among the trash that was collected during the annual clean-up effort.

Science and Wise Resource Management

Scientists and support personnel with the Rocky Mountain Research Station work to efficiently and effectively increase the understanding of Interior West ecosystems and management strategies, and provide the best service and tools possible to our customers. To help focus our strategy, formulate budgets, and enhance our collaboration with stakeholders, our research is organized under seven Science Programs and the Science Application and Integration unit.

1. Air, Water and Aquatic Environments
2. Fire, Fuel and Smoke
3. Forest and Woodland Ecosystems
4. Grassland, Shrubland and Desert Ecosystems
5. Human Dimensions
6. Inventory and Monitoring
7. Wildlife and Terrestrial Ecosystems

The following pages introduce each of our Science Program Areas, highlight just a few of the many studies underway throughout our 12-state territory, and showcase how our science is making a difference throughout the world. For a more comprehensive look at what we do at the Rocky Mountain Research Station, please visit our website at www.fs.fed.us/rmrs.



Kebler Pass, Colorado (photo by Lisa Parresol).

Science and Wise Resource Management



Air, Water, and Aquatic Environments



Bear Plat Lake, Montana.

Air quality, water quality and availability, and aquatic habitats are critical issues within the rapidly changing western United States. The Air, Water, and Aquatic Environments (AWAE) Science Program conducts research on the effects of natural processes and human activities on watershed resources, including interactions between aquatic and terrestrial ecosystems in the Interior West. Research results support effective watershed management in forests and grasslands, sustain biodiversity, and maintain and restore healthy watershed conditions

that provide for sustainable clean air and water quality and delivery. Additional information can be found at <http://www.fs.fed.us/rmrs/research/programs/air-water-aquatics>.

Climate Change Effects on Stream Temperature

Climate change affects stream temperature, which in turn affects fish and other aquatic organisms. A new temperature model, developed via collaboration between researchers at the Rocky Mountain Research Station's Aquatic Sciences Laboratory in Boise, Idaho, and the Australian Commonwealth Scientific and Research Organization, can accurately predict stream temperatures, rates of climate warming, and habitat loss for sensitive species across large river networks. The model integrates temperature information, commonly collected by the Forest Service and other agencies with GIS and remote-sensing technologies, to give decision-makers an expanded base of information to consider when making investment decisions for stream-restoration projects.

The model was first developed to estimate the effects of climate change on streams draining the Boise River Basin in central Idaho, and has recently been extended to provide historical and future temperature predictions for all streams on the Payette National Forest. The temperature model advances the water resources protection and enhancement goal that Agriculture Secretary Tom Vilsack and Forest Service Chief Tom Tidwell set forth in their shared vision for America's forests.



Bull trout in pristine central Idaho streams are a sensitive species likely to be effected by climate change.

Management of Western Water Resources in a Changing Climate _____

Hydrologists and water and resource managers from national forests and eight governmental and non-governmental organizations planned and participated in a three-day watershed and climate change workshop held in November 2009 in Colorado. Funding for the event was awarded competitively through the United States Global Change Research Program. The objective of the workshop was to bring together the management and research community to share knowledge and tools available to address water and climate change and identify additional tools that are needed to adequately address water and climate change issues.

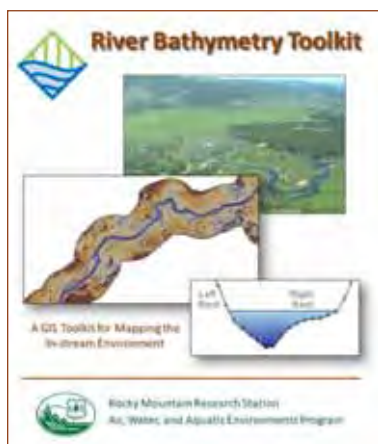
Attendees said they were amazed at the amount of information currently available to resource managers and they left with a better sense of how they might use this information to address climate change impacts on national forests. More than three-quarters of the attendees said they were likely to use climate change knowledge to inform resource management after having attended the workshop. As a result of this improved awareness, water managers will be able to make more cost-effective and efficient use of existing management tools, and they will be better equipped to manage watershed resilience for generations to come.



A recent workshop provided water managers with information to help make more cost-effective and efficient use of existing management tools.

New Toolkit Helps Interpret Digital Channel Maps _____

Station scientists are developing a computer application called the [River Bathymetry Toolkit](#) (RBT) that automatically extracts river channel shape information from digital maps. This research and development is funded by the Station, the National Oceanic and Atmospheric Administration and the Bonneville Power Administration, all of which recognized the Toolkit as an answer to the need for a safer, faster, and simpler way to describe channel structure and habitat.



The RBT can measure a channel at thousands of locations on a digital model in place of a researcher wading into the channel at several locations to take only a few samples. The technology can also be used to assess climate change impacts because it allows scientists to map and describe critical areas, such as off-channel habitat, in the current state as well as under different climate change scenarios. The Toolkit benefits watershed managers, fish biologists, and aquatic ecologists, allowing them to make better decisions. In combination with new remote sensing methods for mapping channels, this tool gives scientists a much more powerful way to describe aquatic habitat and the physical characteristics of a channel.

Science and Wise Resource Management

Determining the Cost of Biomass Removal

While removing accumulations of woody biomass from the forest reduces fire fuel and provides wood for power generation and ethanol production, the question remains - Is the value of the biomass high enough to cover the cost of removing it? Forest managers can now use a computer spreadsheet tool to find out. The Western Biomass Tool estimates the costs of harvesting, chipping and transporting biomass, and can also be used to calculate the cost of removal purely as a fuel-management measure. Both applications are valuable to managers who need to understand the economic viability of their proposed management activities. Funded through the Forest Service's National Fire Plan, development of the tool was a collaborative effort by Forest Service researchers and the University of Idaho.



Skidder and delimber operating on a fuel management research project in the Priest River Experimental Forest in Idaho.

Fire, Fuel, and Smoke



Rattlesnake Fire, Montana, 2007.

Scientists with this program conduct both fundamental and applied research relating to wildland fire processes, fire behavior, the effects of fire on ecosystems and the atmosphere, and how ecosystems adapt to fire. Their mission is to improve the safety and effectiveness of fire management by creating and disseminating basic fire science knowledge, tools, and applications for scientists and managers. Find out more about this program at

<http://www.fs.fed.us/rmrs/research/programs/fire-fuels-smoke> and www.firelab.org.

Does Raking Before Prescribed Burning Help Reduce Mortality? _____

Many western pine forests evolved with frequent surface fires that kept forest floor and woody fuel accumulations low. After nearly a century of fire suppression, land managers are now attempting to reintroduce fire to these forests. Managers are concerned that prescribed burning may kill large, old trees from basal girdling of cambium if deep forest floor accumulations of litter and duff smolder for hours at the base of a tree. Concern about protecting old trees with deep forest floor depths has led to the practice of removing accumulated pine needles and duff around the base of trees before prescribed burning. Yet, the practice is expensive and there is uncertainty if removal of the needle accumulations helps trees survive. Two studies addressed this problem by examining whether removing litter and duff from the base of large trees before prescribed burning is effective in reducing mortality.

These studies suggest that raking around old, high vigor ponderosa and Jeffrey pine trees before operational low intensity prescribed burning is likely not necessary to prevent tree mortality.

Forest floor removal does reduce basal cambium kill, and removal to 23 cm from the base of the tree is as effective in preventing cambial kill as removal to 1 m. In dry western pine forests where deep duff is still a concern around high value trees, basal accumulations can be removed without concern of reducing tree growth or causing mortality. Additional research is needed to better understand the interaction of duff depth and moisture on duff consumption, and how postfire weather and bark beetles may contribute to tree mortality. More information can be found in: <http://www.firelab.org/science-applications/fire-ecology/71-prescribed-burning>, and at http://www.firescience.gov/projects/04-2-1-112/project/04-2-1-112_final_report.pdf.



Studies suggest that raking around old pine trees before prescribed burns will not likely prevent tree mortality.

Science and Wise Resource Management

Whitebark Pine Management Guide Published

Don't expect the Clark's nutcracker, a jay-size bird named for the Lewis and Clark expedition's William Clark, to save the declining whitebark pine. That is the conclusion of Rocky Mountain Research Station scientists after they analyzed the results of experimental ecosystem restoration projects at five sites in Idaho and Montana. Experiments using silviculture and prescribed burning helped researchers create seed cone caching habitat for the nutcracker. But low cone crops led the bird to cache only small quantities of whitebark pine seed, and the nutcracker retrieved nearly all of the cache, leaving little for tree regeneration. Scientists who had studied the nutcracker in years when caching was plentiful found it did not claim about 40 percent of stored seed, which then became part of the whitebark pine regeneration seed bank.



Dead and dying whitebark pine in western Montana.

Decline of whitebark across its range in North America is attributed primarily to mountain pine beetle epidemics and white pine blister rust. The decline can negatively affect more than 110 animal species that eat seeds from the cones of whitebark pine. This research, spanning about 15 years, led to recent publication of an RMRS whitebark pine-focused management guide for ecosystem restoration titled *Management Guide to Ecosystem Restoration Treatments: Whitebark Pine Forests of the Northern Rocky Mountains, U.S.A.*, General Technical Report RMRS-GTR-232, available from the Rocky Mountain Research Station.

Forest and Woodland Ecosystems



Science helps resource managers sustain and restore the health and productivity of forest and woodland ecosystems in the West. Increasingly these areas are being impacted by human developments, uncharacteristically large and severe wildfires, insect and disease outbreaks, exotic species invasions, and severe droughts.

Scientists conduct basic and applied research to help understand the function, composition, and structure of these complex ecosystems. Research results help provide sources of energy, clean water, esthetic and recreation amenities, and critical wildlife habitat. Additional information is available at <http://www.fs.fed.us/rmrs/research/programs/forest-woodlands-ecosystem>.



This program addresses the basic ecology of aspen and other forest and woodland ecosystems.

Reducing Spruce Beetle-Caused Mortality in the Southern Rocky Mountains

Rocky Mountain Research Station scientists, in partnership with the Forest Service Forest Health Protection unit, have determined that partial forest cutting can, under typical bark beetle conditions, reduce spruce beetle-caused tree mortality. Among all surveyed forest stands, thinned stands had 7.3 percent mortality compared to 14.4 percent for unthinned stands. The study, published in the April 2010 issue of the *Western Journal of Applied Forestry*, was initiated to address entomologists' uncertainty about the success of partial cutting as a method to reduce bark beetle-caused tree mortality.



Partially cut Engelmann spruce stand, Routt National Forest, Colorado.

This is the first published study showing the effectiveness of partial cutting to reduce losses to spruce beetle. Study results are beneficial to entomologists, forest managers and the general public. Implementing partial cutting of forests over a geographic area could help mitigate spruce beetle outbreaks, which have been anecdotally linked to the changing climate throughout western North America. Improving the odds for residual spruce survival will lead to healthier forests for public recreation and ecosystem health.

Science and Wise Resource Management

Climate Change Impacts on Douglas-fir



Douglas-fir is a highly valued tree in the western United States.

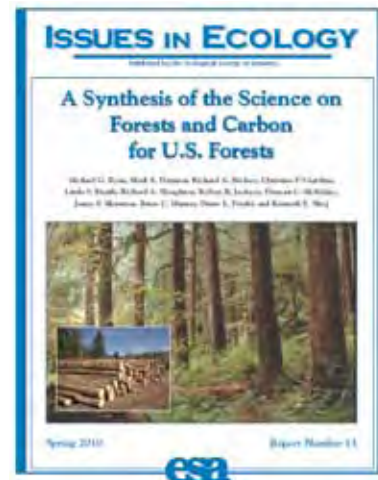
A collaborative effort led by the Rocky Mountain Research Station has produced a report outlining the impact of changing climate on forest distribution, particularly that of Douglas-fir. Douglas-fir is the top valued forest product tree in the West, and understanding its ecological and evolutionary potential is necessary to understand its future commercial value. This research was conducted in response to a recognized need to understand how climate change will affect the species' distribution, ability to migrate, and ability to adapt and survive where it is. The study is unprecedented in size, with thousands of samples collected from throughout the Intermountain West, from Canada to Mexico.

Study results are critical to land managers who must develop adaptation strategies and proactive management decisions and to the public who values forests for water resources, wildlife, and timber production. This research was made possible by successful collaboration with scientists from the Pacific Southwest and Pacific Northwest Research Stations, Forest Inventory and Analysis, Oregon State University, and the University of Washington Climate Impacts Group.

A Synthesis of the Science on U.S. Forests and Carbon

The Rocky Mountain Research Station was asked by the Ecological Society of America to lead the production of a synthesis of scientific findings relating to the role of forests in capturing carbon gases. Twelve scientists collaborated on this report, including six Forest Service scientists from across the nation. Research results were published in the Ecological Society of America's spring edition of *Issues in Ecology*. The report details strategies being implemented or proposed in the United States, and the risks, uncertainties, and trade-offs of each: avoiding deforestation, afforestation (planting trees), decreasing harvests, using wood for construction instead of concrete or steel, urban forestry, and fuel treatments.

All of the strategies analyzed have tradeoffs and potentially unintended consequences, and it is recognized that these strategies are not additive. For example, you cannot store more biomass in the forest while increasing consumption of woody biofuels. The findings relate not only to the issues of climate change and energy independence but also to the economic concerns that are currently facing America. According to the authors, the costs of implementing the strategies to sequester carbon are often far less than the cost of reducing the same amount of greenhouse gas emissions through conservation and efficiency gains in the transportation or electric power sectors. A technical report on carbon resulting from this effort is also being published in *Ecological Applications*.



Designing Fuel Treatments for the Wildland-Urban Interface

Studies in an area of vacation homes near Idaho's Warm Lake are helping resource managers design fuel treatments for the wildland-urban interface. In 2007, the Cascade Complex of fires burned upward of 500,000 acres in central Idaho. Burning went around and through 8,000 acres of fuel treatments (a combination of prescribed fire and mechanical treatments) intended to change fire behavior and thus provided a degree of fire protection for more than 70 vacation homes on leased national forest land.

At the request of the Boise National Forest, the Rocky Mountain Research Station studied effects of those treatments. Although they did not stop fires or slow their spread, the treatments did limit severity and made it possible for crews to put out spot fires as they approached homes. No dwellings burned. Researchers also found that treated areas tended to have more post-fire green vegetation than did areas not treated. In addition to this research's influence on treatment planning for the wildland-urban interface, it has also led to information useful in maintaining wildlife habitat, protecting soil productivity and speeding recovery of vegetation.

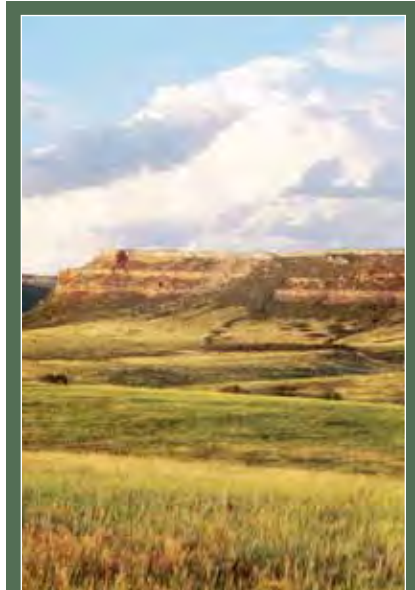


Fire moves through a fuels-treated area in central Idaho.



Grassland, Shrubland, and Desert Ecosystems

This program develops and delivers scientific knowledge, technology, and tools that help to understand, restore, and sustain grasslands, shrublands, and deserts under increasing threats from expanding human-related uses, invasive species, changing disturbance patterns, and climate changes. Studies focus on understanding the effects of natural and human-caused disturbances on grasslands, shrublands, deserts, and associated riparian ecosystems; developing tools, techniques, and plant materials to evaluate and manage the spread of invasive plants, and to restore disturbed uplands and riparian areas; developing knowledge and tools to manage and sustain ecosystems to provide ecosystem services and wildlife habitat; and creating a better understanding of how climate change affects grassland, shrubland, and desert flora and fauna. Learn more at www.fs.fed.us/rmrs/research/programs/grassland-shrubland-desert.



Studies focus on native grasslands and their ecosystems.

Examining the Eastern Edge of Greater Sage-Grouse Habitat

Efforts to aid greater sage-grouse survival, a candidate for Endangered Species Act protection, will be enhanced by a project coordinated at the Rocky Mountain Research Station's Rapid City, South Dakota laboratory. Researchers examined nesting ecology in the eastern edge of sage-grouse range, which includes North Dakota and South Dakota. Information about greater sage-grouse and its habitat affects decisions related to grazing and other public-land uses.



A sage grouse hen on her nest.

Researchers found that, while there is only a small amount of eastern habitat, it is of good quality and nest initiation rates and bird weights were higher than in other regions. Researchers also found that nests nearly always occur beneath sagebrush, and that hatch rates improve when tall grass surrounds the brush. Grass also supports insects that are a critical food source for sage-grouse in the first weeks of life. These research findings will be helpful in grassland management. The Station partnered with the U.S. Bureau of Land Management, the North Dakota Game and Fish Department and South Dakota State University to conduct these studies.

How Removal of Invasive Trees Affects Riparian Nesting Birds

In central New Mexico's Middle Rio Grande corridor, birds such as the [black-chinned hummingbird](#) and the [endangered willow flycatcher](#) nest in invasive exotic tree species. This dependency on otherwise undesirable invasives raises concern about removing these exotic trees for wildfire control. Would nesting be harmed? Researchers investigated this question at the request of the U.S. Fish and Wildlife Service, the Middle Rio Grande Conservancy District and the City of Albuquerque.



Black-chinned hummingbird chicks in nest.

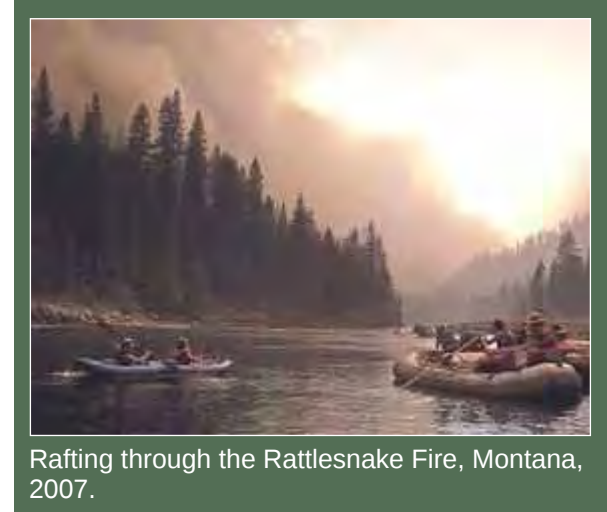
They studied nesting success in areas dominated by native tree species such as willows, areas dominated by invasive species such as tamarisk, sites that burned, those not burned, and those where invasive species had been removed. This ongoing research indicates that when invasive exotic tree species are removed, riparian-nesting birds move into native trees and nest survival rates show little change.

If these invasive species are not removed, the woodland may burn, which is a problem because these invasives respond positively to fire and may replace native habitat important to a broader multitude of species. Fires also result in loss of native tree species important for nesting by woodpeckers, hawks, and many other species. This research helps managers make better decisions regarding the management of invasive species. Additional research collaborators include the University of Oklahoma and the Gila National Forest.



Human Dimensions

This program provides social and economic science-based innovation to human societies as they develop a sustainable relationship with their environment. Major issues confronting societies across the globe, such as global climate change, energy, fire, and water, all have important social and economic dimensions that are explored and addressed by this Program. Scientists also work to improve firefighter and public safety, reduce large fire costs, and expand the treatment of hazardous fuels for watershed restoration that is strategic, cost-effective, and socially acceptable. Additional information is at <http://www.fs.fed.us/rmrs/research/programs/social-economics-decision>.



Rafting through the Rattlesnake Fire, Montana, 2007.

Aiding Visitation Management in the Boundary Waters Canoe Area Wilderness

The unique wilderness of the Boundary Waters Canoe Area, Minnesota, draws over 250,000 visitors annually, making it one of the most popular wilderness areas in the US. With this popularity comes the challenge of maintaining the desired pristine beauty, water quality and isolation of the area. Together with the Superior National Forest and university partners, Station scientists are monitoring and mapping visitor travel and camping patterns. This new knowledge will help inform and enhance the permitting system to reduce conflict due to competition for campsites, and limit threats to natural resources caused by crowding and overuse of certain sites.

The Boundary Waters Canoe Area Wilderness is large and receives high use, but contains very few trails, limits camping to established sites and limits the number of permits available at each entry point, all in order to assure wilderness experiences for all visitors.



Adapting to Climate Change in National Forests: A Workshop for Resource Managers

In April of 2010, scientists from the Rocky Mountain, Pacific Northwest, and Pacific Southwest Research Stations organized and conducted a workshop for resource managers on climate change and land management. The workshop, facilitated by the WestWide Climate Initiative, and funded by the Forest Service's Global Change Research Program, engaged 150 managers and scientists from more than 14 different academic, government, and non-government organizations. The workshop provided a scientific knowledge foundation and shared tools and real-life experiences in preparing adaptation strategies on national forests. Attendees said they gained a sense of empowerment from the workshop-facilitated discussions. They also felt that this knowledge, combined with past experiences, could better guide their management decisions. Participants took home specific approaches to making the adaptation process a success, including on-the-ground management options. Partners identified ways they could introduce adaptation and climate change into their agency and opportunities to work with National Forests to more successfully adapt to climate change.



Workshop participants question panel members about climate change adaptation strategies.

Improving the Assessment of Wildfire Risk



A new tool helps resource managers weigh investments and mitigation measures to reduce wildfire risk.

Human habitation, municipal watersheds, sensitive species, public infrastructure – these are just a few of the considerations when assessing wildfire risk and measures to mitigate it. A new risk analysis framework, developed in part by the Rocky Mountain Research Station, has been designed to help resource managers and policy-makers weigh investments and mitigation measures to reduce wildfire risk. This framework supports decision-making at multiple scales from local fuel treatment strategies to national programmatic funding. This spatially-explicit framework makes it easier to monitor trends in wildfire risk over time and to prioritize mitigation work. The Deschutes National Forest in Oregon has begun using the framework and the Beaverhead-Deerlodge National Forest in Montana is testing it. Other collaborators include the Pacific Northwest and Southern Research Stations.

Science and Wise Resource Management

Conserving Parks and Wilderness in the 21st Century

A Station scientist is coauthor of a new book that:

1. Increases awareness about the limitations of traditional protected area goals;
2. Advances alternative concepts that might be useful; and
3. Suggests some innovations to try.

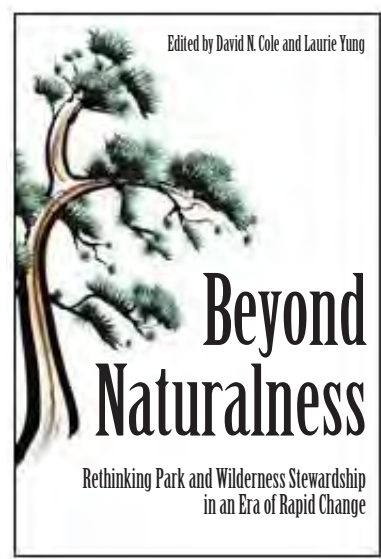
Chapters explore the concept of naturalness; the changes that compel us to rethink and better articulate the goals, purposes and strategies of protected area conservation; the implications of new ecological paradigms for protected area management; our understanding of future environmental change and biotic response to change; the evolution of park and wilderness values, practices and policies in response to changes in science and society; approaches to the conservation of parks and wilderness; a hands-off, non-intervention approach to stewardship; an approach that emphasizes preserving historical fidelity and connections with the past; and specific practical strategies for responding to changing conditions and stewardship dilemmas.

Later chapters in the book advance the concept of Wild Design, acknowledging the intentionality inherent in interventions but balancing it with reciprocity and ecosystem knowledge, and cover:

1. The importance to stewardship programs of setting realistic objectives and setting priorities;
2. Management responses to climate change, increasing resistance and resilience, mitigation, adaptation and realignment; and
3. The increased importance of planning for conservation at larger spatial scales, such as landscapes and systems of protected areas.

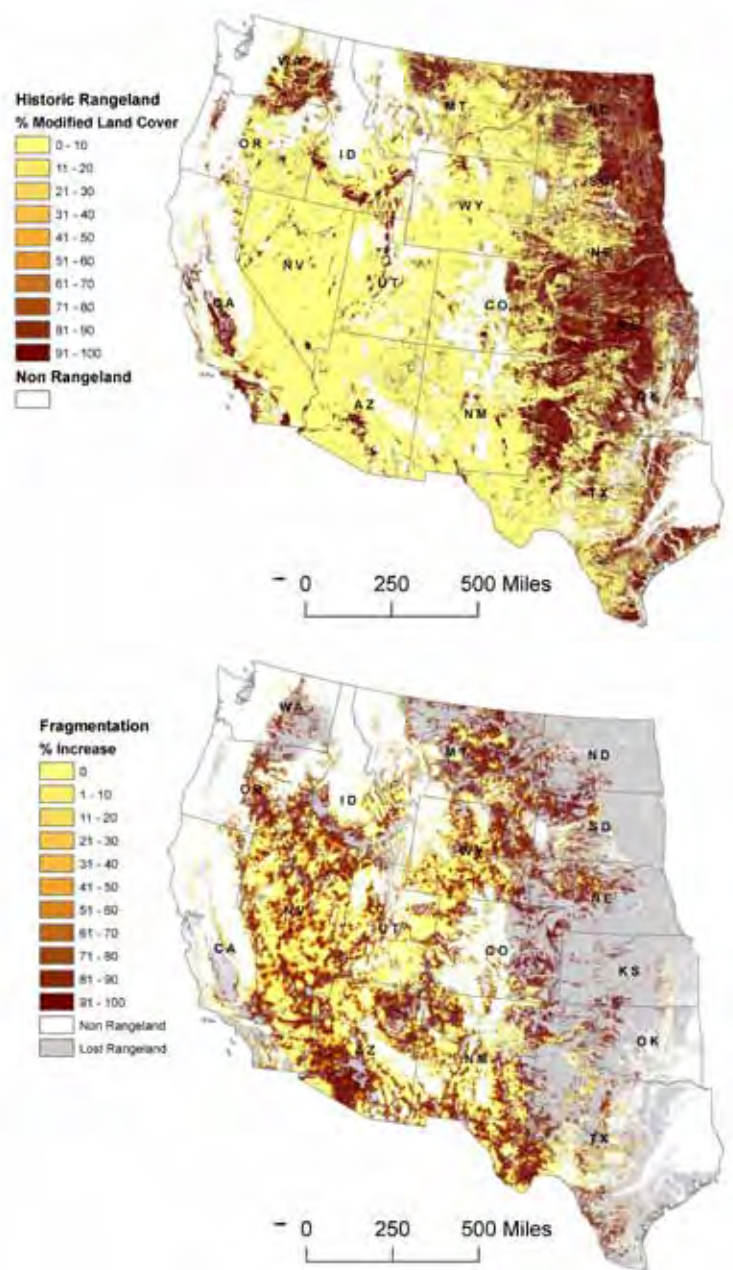
The book concludes with a chapter that synthesizes the material covered in the book and explores the path forward, with a specific focus on policy questions and options.

Beyond Naturalness: Rethinking Park and Wilderness Stewardship in an Era of Rapid Change is published by Island Press.



Rangelands On The Edge

City and county planners across the United States will have a new toolkit to better manage development encroachment into rangelands. The soon-to-be-published “Rangelands on the Edge” project, paid for by the Forest Service, led by the Rocky Mountain Research Station, and conducted in partnership with Colorado State University, shows how historic rangeland extent has been altered and modified by human use, and predicts future trends in rangeland fragmentation and loss (see maps below). The report shows the current loss of rangeland in the western U.S. due to expanded development is 40,000 acres per year. Municipalities can use this information to enhance decisions about where to best place development and invest in open space conservation. This information will also serve as the base for the rangeland section of the next Resources Planning Act report.



Science and Wise Resource Management

Retrospective Analysis of Fire Behavior

The suppression of lightning ignited wildfires removes one of the most important natural processes from fire dependent ecosystems, and yet resource specialists currently have no way of measuring or monitoring the effects of these management actions.



New research findings are helping improve the prioritization and planning of fuels management activities.

Station researchers have developed methods to measure the cumulative consequences of fire suppression and thus explicitly describe the opportunities we forego when fires are suppressed. Fire behavior modeling technology, GIS, and local expertise were used to investigate where lightning-caused fires that were suppressed in the past might have spread. This retrospective modeling approach is a method that managers can use to better understand, measure and track the cumulative effects of their decisions from year to year. Both economic and non-economic consequences of fire management strategies are quantified, including the foregone opportunities to create fuel breaks, reduce fire regime departures and decrease future extreme fire behavior by modifying fuels.

Results from this research help improve the prioritization and planning of fuels management activities, and allow managers to frame future decisions and cost-benefit analyses in the context of past experiences, track the cumulative effects of suppression, and communicate tradeoffs to the public and other governmental entities.

Inventory and Monitoring



Station researchers conduct forest inventory throughout the Western United States.

Scientists provide the data, analyses, and tools needed to identify and evaluate the current status and trends in the condition of forests and rangelands throughout the Interior West. Results help identify changes in use, management options and impacts, and threats and impacts of climate change, fire, insects, disease, and other natural processes. The Forest Inventory and Analysis Program is a central component of this Science Program. Details are available at <http://www.fs.fed.us/rmrs/research/programs/inventory-monitoring-analysis>.

Using Timber-Survey Data to Assess Habitat of the Threatened Mexican Spotted Owl

The Mexican spotted owl's southwestern roosting habitat has increased significantly on public land, is almost disappearing on private land, but has been maintained overall since its Recovery Plan was implemented. That and other findings improve and expand information available for a pending update of the federal Mexican spotted owl recovery plan. The bird has been listed as a threatened species since 1993.

Researchers drew on timber-survey data from 1995-99 and 2001-07 to assess roosting habitats from central Arizona to west-central New Mexico. In addition to supporting the recovery plan update, this work also exemplifies how to do a trend analysis on a large-scale landscape and how to apply timber-oriented metrics to wildlife habitat.

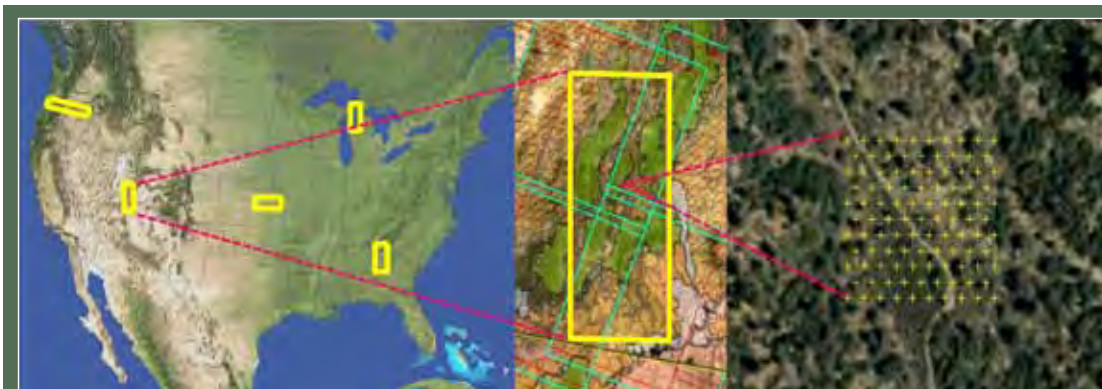


Researchers are gathering data on Mexican spotted owl habitat.

Science and Wise Resource Management

National Land Cover Database Tree Canopy Product

Forest Inventory and Analysis Program scientists throughout the country are collaborating with the Forest Service's Remote Sensing Applications Center in Salt Lake City, Utah, to develop modeling and mapping procedures for the 2011 Tree Canopy Cover product of the National Land Cover Database (NLCD). The NLCD provides nationally complete, current, and consistent public information on the Nation's land use and land cover. The Tree Canopy Cover data provides foundational information for many broadscale analyses for U.S. forests and for informing management decisions, modeling efforts, and sampling strategies for a wide variety of applications such as carbon, wildlife, and wildland fire. Pilot tests are underway now in five ecologically diverse areas and prototype mapping should begin early fall, 2010.



Data about tree canopy cover were collected on an intensive sample of photo plots in five pilot areas in the US. Analyses are underway to merge photo and FIA field data with Landsat data and other ancillary information to inform modeling strategies to be used in producing the NLCD 2011 Tree Canopy Cover product.

Aspen Forest Trends in the Interior West



Aspen is valued for wildlife habitat, wood product potential and it has golden leaves that in the autumn draw masses of forest visitors to enjoy their scenic beauty. The rate of aspen deaths in parts of the Interior West, including Colorado and Utah, have been alarming in recent years. While loss of aspen in localized areas is a serious concern, a Rocky Mountain Research Station monitoring project has found that the tree is not in a broad population crisis. In fact, current research is investigating how bark beetles might actually enhance the iconic trees overall presence and survival. The Station continues its investigations into aspen decline and ways to enhance aspen forests throughout the West.

Young aspen stands are more resistant to drought and other stressors than older stands

Wildlife and Terrestrial Ecosystems



The Wildlife and Terrestrial Ecosystems science program focuses on six components:

1. Understanding the ecological tradeoffs of vegetation management on wildlife populations, communities and habitats;
2. Understanding the underlying causes and consequences of species invasions over time and space and emergence of zoonotic (animals to people) diseases to better manage and mitigate these threats to native biodiversity, ecosystem services, and human populations;
3. Applying genetic tools for monitoring populations, assessing threats to populations, defining populations or species, understanding the degree of connectivity/isolation of a population, and measuring how populations respond to environmental changes over time and space;
4. Providing high-quality information on species and habitats at risk that helps to develop effective management strategies;
5. Assessing human/wildlife interactions; and
6. Developing monitoring methods that can be applied in a cost-effective manner for many species and across landscapes ranging from National Forest to regional. Learn more at <http://www.rmrs.nau.edu/wildlife/>.

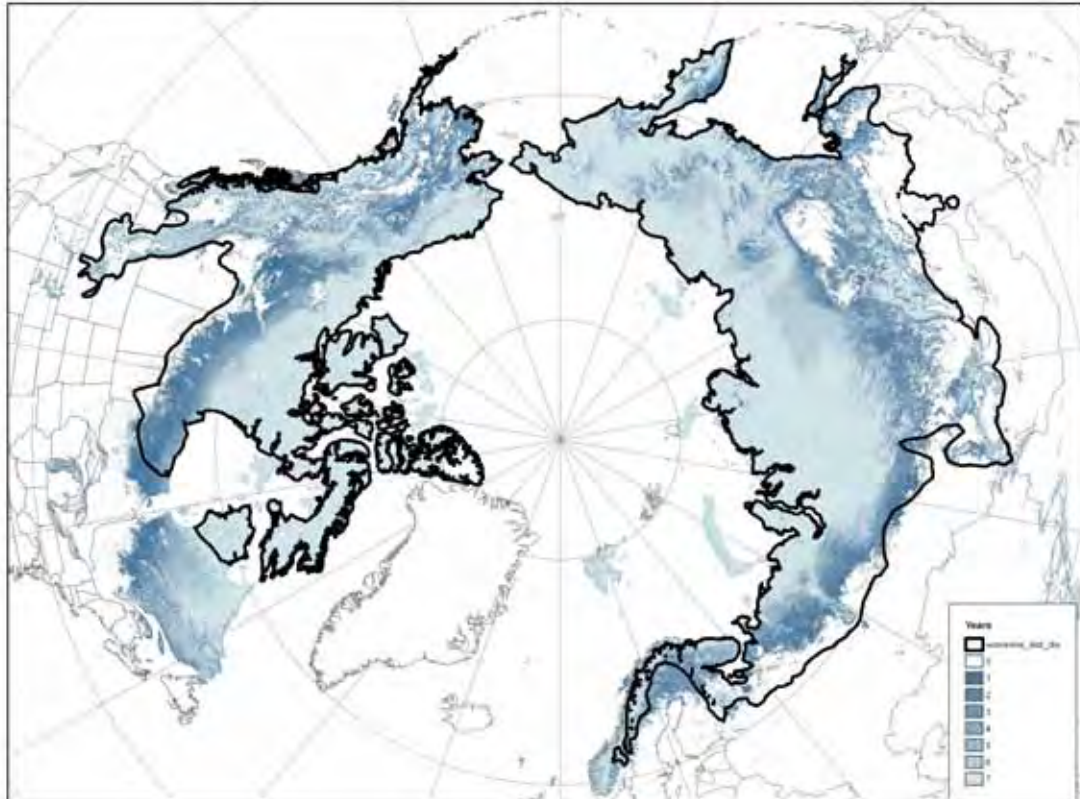


Fisher.

Science and Wise Resource Management

Wolverine Futures in a Changing Climate

Rocky Mountain Research Station researchers have demonstrated that wolverines are dependent on persistent spring snow for denning—a factor critical to determining the future extent and survival of wolverine populations. To build on this understanding, funding was provided by National Forest and U.S. Fish and Wildlife Service partners for the Station to work with the University of Washington Climate Impacts Group to predict where suitable snow might exist for this species in the future. These research results are being used for wolverine reintroduction.



Wolverine range, May snow cover. Wolverines require snow to den in the spring.

Colorado and California, places where wolverines were eliminated completely in the last century, are now seen as suitable sites for reintroductions based on this research on predicted climate futures and wolverine needs. Getting reintroduction efforts right the first time is important because there are few wolverine populations to draw from and the reintroduction process is very expensive.

The Station has found ways to use models derived from current genetic patterns and apply them to future landscapes, to inform land management decisions on current and likely future corridors locations. The Station has also partnered with multiple state and private agencies to provide maps which identify corridor locations which optimize wolverine population connectivity. While current efforts are focused on wolverines, these newly developed tools can be applied to a variety of organisms to inform their potential future in a changing climate.

Pioneering Genetics Research Aids in Fisher Survival

Station scientists and collaborators have pioneered a mitochondrial genome sequencing technique that can be used to answer questions about the connectivity and genetic health of endangered species populations. The **fisher**, a forest carnivore, can be found in various places across the US, in part due to successful reintroduction efforts. Station researchers have found the previously held view that humans exterminated fishers from the central part of California is not true. They discovered instead that the northern and southern Sierra fishers naturally split up thousands of years ago. The implication of this finding is that the small southern population is likely more vulnerable as it has been historically more isolated. This might suggest that the southern population warrants additional protection.

Another interesting finding shows that the Rocky Mountain fisher population, once thought completely extinct, actually survives. Scientists now know that there are different lineages of fishers in the Rocky Mountains: those that were native and those that were reintroduced. This research is helping to inform Fish and Wildlife Service Threatened and Endangered Species listing decisions and management prescriptions that enable managers to allocate scarce conservation dollars towards the population needing a higher level of protection.



An subadult male fisher in the Rocky Mountains.

Science and Wise Resource Management

A New Approach to Large-scale Fish Monitoring

Imagine the ability to determine the status of wild animal populations without having to laboriously count them. The old paradigm of “how many are out there” is being replaced by a new method prototyped by the Rocky Mountain Research Station, which is easier to use and provides more comprehensive results than older methods.



Large bull trout, currently Threatened under the Endangered Species Act, use small headwaters streams to spawn.

Linking newly developed modeling approaches with genetic patterns provides both a reliable measure of the spatial extent of populations and insights into how those populations function. This approach is being prototyped for salmonids, and initial results are promising. The method is being applied to understand what characteristics might impede the undesirable spread of exotic brook trout in Rocky Mountain streams, and to validate an existing map of the distribution of native bull trout.

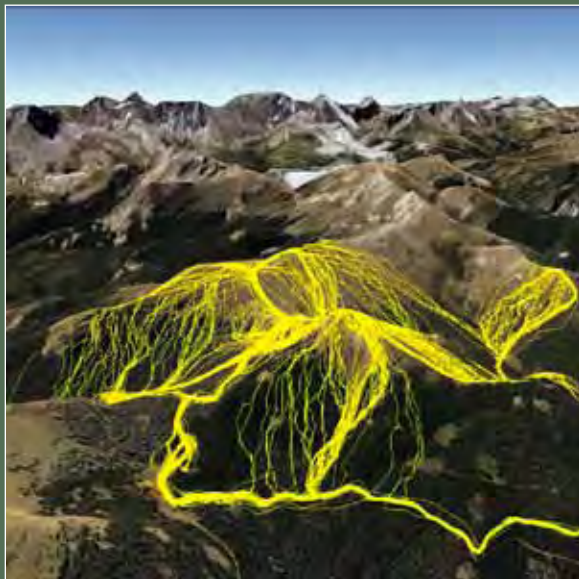
In addition, the Rocky Mountain Research Station is relating data on species' distributions and genetic patterns to stream conditions and habitat to determine which

stream characteristics are the best predictors of robust and genetically intact fish populations. This work has involved unique partnerships with the Columbia River Intertribal Fish Commission, National Forest managers, and the states of Montana and Idaho.

Monitoring Recreation Impacts on Wildlife

Surprising successes have been achieved in the first year of a pilot project examining how humans, lynx and wolverine use winter recreation areas. In 2010, hundreds of winter

recreationists in Colorado and Idaho agreed to carry Rocky Mountain Research Station supplied and monitored GPS (Global Positioning System) units to track their movements. These movements were mapped along with GPS coordinates taken from collars worn by lynx and wolverines, creating a unique set of spatial and temporal data that will help tell the story of how lynx and wolverine respond to people recreating in their habitat.



Winter recreationists carrying GPS units were tracked as they traveled in the backcountry.

As studies progress, researchers hope to find whether these animals avoid recreation areas all together, or maybe during certain times of day when use is the highest, or if they shift their habitat use to avoid humans. This project uniquely collects the same data across the same geographic scale and uses the same technology for both humans and animals on the same landscape. With this information, winter recreation specialists and wildlife biologists will be able to inform land management actions that can benefit both wildlife and recreationists.

Southwestern Ponderosa Pine Fire Findings Published

In 2010, the Rocky Mountain Research Station published ground-breaking findings on fire behavior in southwestern ponderosa pine forests. Using tree-ring data, researchers were able to reconstruct forest fire regimes back to 1495. This historical perspective shows that certain ponderosa pine/oak forests had both surface fires and stand-replacing fires. Stand-replacing fires, occurring on steep slopes, were found to often fragment the continuity of flammable fuels and subsequently lead to longer fire intervals of up to 50 years longer between fires.

This new information gives land managers greater understanding of how and when to introduce prescribed fire and manage lightning-ignited fires. This will have implications for restoration efforts and management decision-making. Perry Grissom, Fire Ecologist for Saguaro National Park, where much of this research was located, offered the following perspective:

“This information has been very valuable to us in this section of the Park. The research shows that we should expect and should allow for some intense fire there. It is also important to have this scientific data to inform our decisions as we look to manage fire and park resources, including the threatened Mexican spotted owl.”

Fire scarred pine snags within oak patches suggest a historical fire regime that included both surface and stand replacing fires. Tree-ring analyses show that this and other pine trees in this area were killed by a fire in 1867.



Science and Wise Resource Management

Science Application and Integration

The **Science Application and Integration (SA&I)** program is a cross-cutting staff that works with scientists, technology transfer specialists, National Forest System managers, State and Private Forestry, and other partners and stakeholders to develop and deliver scientific knowledge and technology that will help sustain forests and grasslands across the Interior West. The staff brings together several key applied science efforts under a Station-wide program including two focused research development and application programs (RD&A's): the Human Factors and Risk Management and the Wildland Fire Management RD&A programs.

Key Accomplishments include:



Field trips are just one method used to deliver scientific findings to users.

► **Science Application and Integration Program Charter.** The SA&I charter, approved in 2010, formalizes the SA&I mission and program, demonstrates program leadership, and creates congruence between the Station's seven science programs and key headquarters staffs in science application and delivery. The charter will be used as a foundation for working with the National Forest System, State and Private Forestry, external partners in the West, other research stations and national Research and Development staffs to reinforce goals of providing science-based application and tools for sustainable natural resource management.

- **National Fire Plan Technology Transfer Projects:** SA&I provides resources and oversight to:
1. Improve the Burned Area Emergency Response (BAER) web site (http://www.nifc.gov/BAER/Page/NIFC_BAER.html), and create mini-CDs Toolkits for BAER Teams and a workshop about BAER Tools;
 2. Edit and electronically publish the SIMPPLLE Landscape Modeling Decision Support System User Guide;
 3. Develop a training video to inform fire fighters of the considerable safety hazard of fire whirls; and
 4. Develop a web site and training materials on OptFuels fuel treatment optimization end user application.
- **Interior West Climate Change Initiative:** In 2010, the Rocky Mountain Research Station joined with the Forest Service's four Interior West Regions to coordinate and collaborate on responding to climate change impacts in the Interior West. A Working Group was formed that includes climate change coordinators from each Region, and Station scientists and program managers. A coordinated program of work is being developed, as well as active participation in working with national and inter-regional teams.

- **Joint Fire Science Knowledge Exchange Consortia:** The Station is a partner in three regional science application and delivery consortia, funded through the Joint Fire Sciences Program. These consortia organize, coordinate and share information on fire science results and findings within focused geographic areas, as well as engage managers in shared learning activities and efforts. The Consortia funded include the Great Basin, the Southern Rockies and the Southwest.

The **Human Factors and Risk Management RD&A** (Research Development & Application) program is helping the Agency develop ultra-safe systems in high-risk environments. The challenge is to develop a safety culture in the Forest Service that is highly reliable, resilient and takes a proactive and systematic approach to managing risk. Since 2007, researchers have provided ongoing support for serious accident investigations and reviews of escaped prescribed fires. They have also helped design and conduct experimental processes to further organizational learning in the wildland fire environment.

In 2010, the Human Factors and Risk Management RD&A developed:

- **Safety Learning Journeys:** Forest Service leadership has embarked on safety learning journeys to see how other leading organizations have developed an effective safety culture. Members of the Human Factors & Risk Management (HFRM) RD&A program have worked with the Dialogos, LLC consulting firm in the design and process implementation. These learning journeys gave members of leadership a sense of the possibilities for designing a world-class health & safety management system, as well as ideas for guiding cultural change for sustained high performance, which is by definition ultra-safe.
- **Human Performance Analyses:** The human performance analyses synthesize multiple lines of very active research in the psychological and organizational sciences. Though these analyses vary with each investigation, they continue to make important contributions to understanding the complexity of performance, safety, risk management and high-risk situations.
- **Influences to the Success of Fire Science Delivery:** Studies on how fire /fuels science is used helps evaluate fire/fuels specialists' and decision makers' perspectives about research, within the context of their positions. This study represents the first comprehensive attempt to use social science theory and methods to understand and improve fire science application.
- **The Web-based Key Decision Log (KDL):** Safer, more effective and efficient outcomes in fire management begin with understanding where we are today – where attention is focused during a wildland fire incident, and with what outcome. The KDL succinctly captures context, content and expected impact of decisions made by wildland fire managers. Designed in collaboration with the inter-agency wildland fire community, the KDL reveals for the first time, an empirically-based and organization-wide picture of where operations are smooth and consistent, and where there is confusion and stress.

Science and Wise Resource Management

The **Wildland Fire Management (WFM) RD&A** program helps develop and apply wildland fire science, decision support tools, and science integration service to the national interagency wildland fire community. The RD&A serves as a primary point of contact for communication between scientists and participating field managers, and as an advisor to program administrators at local, regional, and national levels.

In 2010, the Wildland Fire Management RD&A program developed or supported the following applications:

- **Wildland Fire Decision Support System (WFDSS)**: Ongoing integration of emerging science and technology into the Wildland Fire Decision Support System. In 2010, WFDSS was utilized in over 10,600 fire incidents nationwide. The system incorporates access and use of numerous weather analyses, fire behavior prediction tools, economic assessment tools, and landscape data acquisition and analysis processes to provide new ways to inform the decision-making process. It provides the ability to quickly acquire data, analyze those data, and use analysis information to inform decisions.
- **2009 Implementation Guidance to the 1995 Federal Wildland Fire Management Policy**: Smoke and air quality information has an important role in wildland fire decision making and is reinforced in the 2009 Implementation Guidance to the 1995 Federal Wildland Fire Management Policy. The RD&A program collaborated with the AirFire Program at the Forest Service's Pacific Northwest Research Station to develop a WFDSS Air Quality Portal that enables managers to obtain rapid information pertaining to smoke dispersal and potential smoke impacts.



The Wildland Fire Management RD&A serves as a point of contact between scientists and resource managers.

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