2008
Strategic Framework Update

Rocky Mountain Research Station

Contents

Rocky Mountain Research Station

http://www.fs.fed.us/rmrs/

| Executive Summary

The Rocky Mountain Research Station's 2008 Strategic Framework Update is an addendum to the 2003 RMRS Strategic Framework. It focuses on critical natural resources research topics over the next five to 10 years when we will see continued, if not accelerated, socioeconomic and environmental changes. These include the effects of **climate change** and **human connections** on three areas of research emphasis: **terrestrial ecosystems**, **wildland fire**, and **water supply and quality**.

Climate change for the Western United States includes shifts in temperature and precipitation patterns. These shifts may have profound effects on the three research emphasis areas above and the ability of terrestrial systems to provide the ecosystem services that society has come to expect.

Human connections to Interior West landscapes have increased dramatically. Growing and shifting populations result in exurban sprawl, potentially affecting all western terrestrial ecosystems, impacting wildlands, and contributing to the spread of invasive species. More people occupying a fixed amount of land reduces the availability of, and increases the demand for, the aesthetic and economic commodities they desire.

- **Terrestrial ecosystems** of the Interior West are composed of forests, woodlands, rangelands, grasslands, and deserts. We study the interacting components of these systems and the processes that control them. Climate change and invasive species are dramatically impacting some ecosystems that provide the goods and services that humans desire, ranging from timber, minerals, and grazing lands to hunting, wildlife viewing, and other recreational uses.
- **Fire** is a key process in landscapes of the Interior West. We must understand and assess its role and help ecosystems maintain their natural functions through designing treatments that increase ecosystem resilience. We have strong ongoing lines of research in fundamental fire physics, fire ecology, wildland fuel science, smoke emissions, and fire economics.
- **Water** is a precious resource in the dry Western United States and is critical to sustaining populations and ecosystems. Our mountains are the "water tower of the West." National Forests and Grasslands provide 33 percent of the West's water, mainly from winter snowpack. The rapidly increasing gap between water supply and demand creates management challenges and research opportunities.

Transferring technology and communicating knowledge are critical to helping our stakeholders apply our research on the ground. Our product is credible, clear scientific information that helps stakeholders make informed decisions.

This Update will be used to guide discretionary research funding decisions. It may also be considered when seeking new funding or filling research positions.

G. Sam Foster
Station Director

| Purpose

The Rocky Mountain Research Station (RMRS) is part of USDA Forest Service Research and Development (R&D). As one of seven Research Stations across the country, we conduct most of our research in the Interior West and help support national programs. The Forest Service Research and Development's mission is to provide knowledge and innovative technology to improve the nation's forests and rangelands, both public and private. To accomplish this, the RMRS must account for emerging drivers of change—primarily climate and human activities. The work we do, studies we conduct, and technologies we develop are a direct response to these and other drivers. The current changes resulting from this work will influence our mission well into the 21st Century, so we must focus on how to help human communities adjust and sustain natural systems. This 2008 Strategic Framework Update, which refreshes the 2003 RMRS Strategic Framework document, seeks to chart our direction for meeting these needs.

The research emphasis areas presented here explain what science we will do to address Forest Service direction and why this science is important. The Update does not offer excessive details: it is designed to provide a general overview and direction for our work. Important administrative considerations, such as business practices and workforce diversity, will be addressed elsewhere.

| Background

Within the Forest Service, the overarching responsibility of R&D is to improve the scientific basis and science applications for sustainable natural resources management. The USDA Forest Service Strategic Plan FY 2007-2012, Goal 7, calls for increased use of science-based applications and tools for sustainable natural resources management. The USDA Forest Service Research and Development Strategic Plan 2008-2012 lists six important driving forces for the next five to 25 years: urbanization, globalization, climate change and variability, alternative energy sources, rapid technological and information changes, and accountability. Climate change and shifting human populations represent known and potential impacts on our natural systems. Many relationships that RMRS has studied over the last century—those that form the basis for management decisions today—are affected by significant, accelerating changes in climate and human population. As a result, past knowledge alone may be inadequate to support future management decisions. The rules have changed.

Physical scientist monitors radiant heat flux and temperatures within Rapid Response research plots in Arizona. *Photo by Colin Hardy.*

Values

We are a *science first* organization.

Quality Science: objective, unbiased, credible, independent.

Quality science is the foundation of the Research Station's credibility, integrity, and reputation. We are a productive, effective, and multidisciplinary research organization, committed to staying at the forefront of science and safeguarding its integrity and objectivity. New knowledge is provided through a balance of basic and applied research and short- and long-term studies at various spatial scales. To assure public confidence, the Station utilizes statistical, technical, editorial, and peer reviews of our programs, study plans, and publications. Our scientists and their colleagues adhere to a Forest Service Research and Development Code of Scientific Ethics.

Quality Service: responsive, timely, relevant, customer-focused.

We focus our research and development activities on questions and issues that are relevant and of concern to our stakeholders. We provide integrated, scientific, cost effective, and legally defensible information for making wise decisions on sustaining ecosystems. We look for better ways to share state-of-the-art knowledge that stakeholders can understand and apply. We seek high levels of effectiveness and accountability.

Quality Relationships: trusting, dependable, conversational.

We recognize that discussions with our stakeholders result in quality relationships that help us meet the expectations of our stakeholders and the public at-large. We focus on providing a broad-based science and professional infrastructure through a high-quality, diverse workforce that builds strong, trusting working relationships and partnerships with people inside and outside our organization. User feedback assures that our work remains relevant and evolves appropriately for the future.

| Mission

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

| Vision

Our science and technology provide society with options on the sustainable management, use, and appreciation of forests and rangelands.

Who Are Our Stakeholders?

Our stakeholders have a voice in determining what research we conduct. Anyone potentially using our research products is a stakeholder, such as:

- The general public
- National Forest System, State & Private Forestry, International Forestry, and Research & Development
- Natural resource scientists, managers, and policymakers
- The international scientific community
- The Administration and Congress of the United States
- Tribal, state, county, and local governments
- Private landowners in forest, rangeland, agricultural, and urban settings
- Industry such as timber, mining, ranching, recreation, tourism, and farming
- Colleges, universities, and high schools
- Environmental and commodity non-government organizations
- Bureau of Land Management
- National Park Service
- U.S. Fish & Wildlife Service
- U.S. Geological Survey
- National Aeronautics and Space Administration
- Environmental Protection Agency
- Department of Energy
- Department of Defense
- Agricultural Research Service
- Natural Resources Conservation Service
- Cooperative States' Research, Education, and Extension Service
- National Laboratories
- National Oceanic & Atmospheric Administration
- Professional societies
- The media

| Overarching Issues

Two primary issues cut across all three research emphasis areas: climate change and human connections. These issues and the bases for our roles in addressing them are briefly described here.

Climate Change

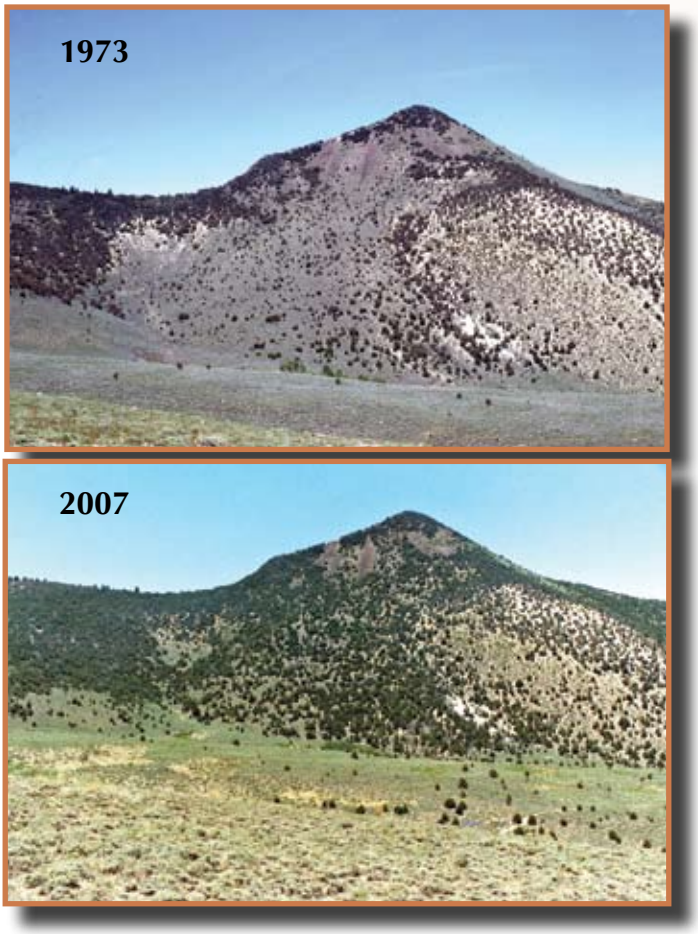
Terrestrial ecosystems of the Interior West provide water storage and flood prevention, biological carbon sequestration, recreational opportunities, food and fiber production, and many other commodities and amenities, commonly called "ecosystem services." Climate change shifts temperature and precipitation patterns, which may alter ecosystem function. As a result, the ability of terrestrial systems to provide the ecosystem services that society has come to expect from them will change.

Shifting ecological regimes may increase vulnerability to insects, diseases, and invasive species outbreaks. If climates shift, some Interior West forests may be unable to regenerate. In addition, more people may seek refuge in the cooler, higher elevation climates or where water is more abundant. As the snow melts earlier and animals migrate in different patterns, people may have to travel to different locations for recreation activities such as hunting and skiing. As climate change alters ecosystem services, we may see shifts in ecologic, social, economic, and demographic patterns in the Interior West.

The U.S. Forest Service Research and Development Strategic Framework (2006) has identified two main approaches for addressing climate change: (1) adaptation science and (2) mitigation science and technology.

Adaptation Science addresses how ecosystems will respond under different climate scenarios in various geographies and how land managers can prepare for an uncertain future influenced by changes in climate. This includes research on potential habitat shifts, what that might mean for vegetation, wildlife, and hydrologic regimes, and how technology can ameliorate the shifts.

Mitigation Science addresses ways that forests, woodlands, and grasslands can sequester carbon and how we calculate this carbon. It looks at minimizing carbon loss and providing renewable energy from woody biomass to offset fossil fuel consumption. It also identifies ways the Agency can reduce its environmental footprint (such as carbon, energy, and pollution) and lead by example by greening our practices.



These two photos of the same landscape show an expansion of growth in pinyon-juniper woodlands over a period of 34 years, perhaps due to a warmer climate and elevated CO_2 since the end of the Little Ice Age in the late 1800s. *Photos by Robin Tausch.*

Human Connections

Human populations and their use of Interior West landscapes are increasing dramatically. A growing population is leading to exurban sprawl, which threatens and fragments forests, woodlands, deserts, grasslands, and shrublands. More people occupying a fixed amount

Researchers are comparing the effectiveness of postfire treatments for reducing erosion and regenerating vegetation. The first step is digging a trench on a slope's contour after a wildfire and then installing a silt fence to capture sediment (Umatilla National Forest).

institutional arrangements for dealing with climate change effects.

RMRS is uniquely positioned to provide relevant interdisciplinary research on human dimensions because of our ability to conduct both basic and applied research on use, values, and attitudes across a large geographic area. Facilities for short-term and long-term research are in place on a variety of fire-prone landscapes, ecosystems, and watersheds. We work in urban, exurban, wild, and rural areas with the ability to gather information on uses, desired conditions, amenities, and products. The Station has the expertise to examine the impacts of this growing human use and interaction with the landscapes of the region.

of land reduces available habitat for wildlife, fish, and plants and introduces more invasive species. Increasing populations and their recreational use of western landscapes create a greater demand for both aesthetic and economic commodities. People care about preserving old growth forests, clean air and water, threatened, sensitive and endangered species, and scenic vistas. Wilderness and other protected areas are an important source of these amenity values. People also want commodities such as timber products, fuel wood, grazing lands, and recreational opportunities.

Sawtooth Wilderness, Idaho. *Photo by Aldo Leopold Wilderness Research Institute.*

Demographic changes, human desires, and human activities have profound interactions with fire, water systems, and terrestrial ecosystems in the Interior West. Our social scientist researchers and economists research how potential climate scenarios could impact demographics, communities, and economies. They also develop new ideas on

The Station's conservation education efforts help children explore invertebrates. *Photo by Michael Schwartz.*

Water within the Station's boundaries provides for a variety of human connections. *Photo by John Toliver.*

| Our Approach

Solutions to complex resource management problems require knowledge and multidisciplinary approaches spanning scientific disciplines and organizational units. Station scientists contribute individually to solving problems through basic and applied studies. As an organization, the Rocky Mountain Research Station brings diverse disciplines and science teams together using an integrated framework. Through this process, the Station can direct its unique knowledge and expertise to the most critical science questions, with the goal of finding answers to important problems. By understanding the linkages among research emphasis areas, we can provide managers and citizens with tools for managing whole systems—not just system parts.

Integrated Framework

Complex ecological and social systems can be viewed as interactions of change drivers, stressors/mitigators (disturbance agents and management activities), and values at risk (benefits derived from goods and services that flow from system processes). We apply this basic framework to the Interior West (Figure 1) by focusing on climate change and human demographic changes as key drivers influencing changes on the landscapes. These effects are further compounded by ecological stressors (for example, drought, bark beetles, diseases, or invasive species) and ameliorated by mitigators (management activities). As landscapes are modified, so are their capabilities to provide the goods and services. Water (including water-based recreation and water consumption) and human connections (traditional recreation, wildland experiences, and residence) are among the most important values at risk.

The interactions in this framework present critical opportunities for science and tool development. Interacting stressors such as fire and invasive species become more influential under extreme conditions. The timing and potential severity of these interactions become critical factors in designing management interventions. Water is a limiting resource in the Interior West. It is pivotal in protecting native vegetation, wildlife habitat, and fish habitat and as a basis for recreation, aesthetic, spiritual, and economic development. Landscape and watershed condition profoundly affect water supply and influence human use and migration patterns.

The diagram here does not depict all possible relationships, and neither does this Update document. This document concentrates on three research emphasis areas: terrestrial ecosystems, fire, and water. For each area, we list examples of research questions that might address interactions with the overarching issues of climate change and human connections. The questions we pose are not all-inclusive. Actual research questions are integral to charters and study plans for the RMRS Research Programs. Our work involves developing mitigation and adaptation strategies to protect values at risk. The very large investment by RMRS in extensive long-term inventory and monitoring data should be recognized. This infrastructure is an important foundation resource that RMRS uses in research endeavors.

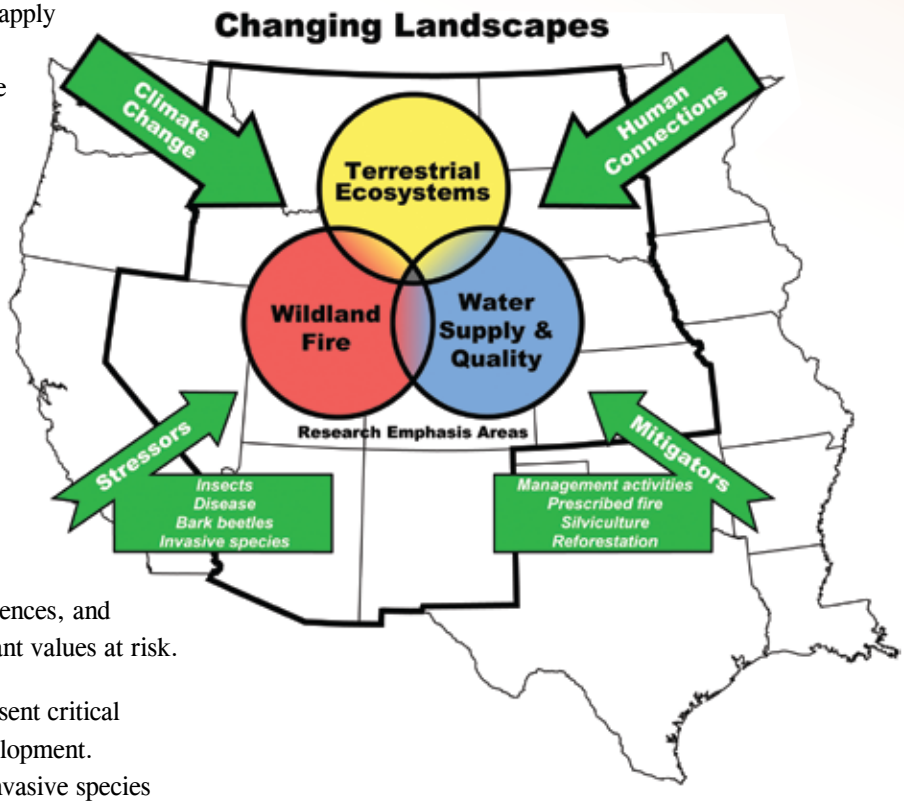


Figure 1. Future changes include the effects of climate change and human connections on terrestrial ecosystems, wildland fire, and water supply and quality in Interior West landscapes. These effects can be compounded by ecological stressors, or ameliorated by mitigators.

| Research Emphasis Areas

Here we describe the following research emphasis areas, as well as the questions that the Station will devote itself to in the next five to 10 years to address climate change and human connections:

- Terrestrial Ecosystems
- Wildland Fire
- Water Supply and Quality

Terrestrial Ecosystems

Terrestrial ecosystems are composed of forests, woodlands, rangelands, grasslands, and deserts. We study the interacting components of these systems and the processes that control them. Climate change and invasive species are dramatically impacting some ecosystems that provide the goods and services that humans desire, ranging from timber, minerals, and grazing lands to hunting, wildlife viewing, and recreational uses. In addition, the Interior West is seeing a continuous influx of people from other parts of the nation and the world, which often places traditional activities such as logging and ranching at odds with the aesthetic goals of many newcomers. Such land-use conflicts challenge land managers attempting to accomplish their mission of caring for the land and serving people. Our goal is to answer questions such as those seen below to help land managers and others sustain or restore terrestrial ecosystems and to understand the conditions we wish to restore.

Field assistants band nestling Lewis's woodpeckers in a recently burned forest. *Photo by Vicki Saab.*

Terrestrial ecosystems encompassed by RMRS stretch from Mexico to Canada and from near sea level to high mountain peaks. In the Interior West, wildlands are a critical component of the landscape. With all the associated flora and fauna in these systems, both broad and narrow studies will be needed to capture and understand the impacts of climate change and human connections.

Big Sagebrush ecosystem.

Climate change research questions:

- How will species and populations adapt to new climates or new locations for known climatic regimes? How will climate change alter the ecological role of species?
- Can management systems exploit genetic variation within native species to better adapt to climate change?
- What key species and populations should be targeted for management and conservation?
- What is climate's role (if any) in the major disturbances we are seeing now, specifically in sudden aspen decline, pinyon loss in pinyon-juniper ecosystems, and lodgepole pine mortality?
- How can carbon sequestration rates be increased in forested lands?
- How will climate change affect invasive species?
- What insights do our historic and paleoclimatic records of terrestrial ecosystem dynamics provide us about what the future holds?

Boreal toad ecology and detection research provides insight into climate change. *Photo by Michael Young.*

- What does climate change mean for "natural" ecosystems, such as wilderness areas protected for their natural values?
- How does climate change influence insect and disease (for example, bark beetles, white pine blister rust) dynamics, expansion, and adaptation? How do management responses and habitat fragmentation influence the genetic adaptation of such organisms?
- What are the cumulative effects of lodgepole pine mortality due to the mountain pine beetle epidemic?
- How should landscape models of vegetation and habitat link to wildlife models?
- How does climate change directly influence species such as lynx, wolverine, wolf, spotted owl, and grizzly bear?

Human connection research questions:

- What are the effects of recreation, urbanization, energy development, ATVs, and other human activities on wildlife, soils, and water?
- How can we identify desirable future conditions of terrestrial ecosystems that sustain our needs?
- What is the feasibility of various biomass energy technologies?
- How does landscape fragmentation influence ecosystem dynamics?
- How do wilderness and other wildlands contribute to society in an increasingly urbanized landscape?
- What methods for managing visitor use can be used to reduce recreation impacts?
- What methods can we use to assess the effectiveness of restoration options?
- What are the social and economic effects of reductions in traditional products (such as timber) in rural communities?
- What are the demographic and economic impacts of human migration and settlement patterns and their implications for natural resource management?

These questions will change and become more urgent as climate affects landscapes.

Wildland Fire

Fire is an important process on landscapes of the Interior West. We must understand the fundamentals of this process to project its future role and to help managers design treatments to increase ecosystem resilience. We have strong ongoing lines of research in fundamental fire physics, fire ecology, fire chemistry, wildland fuel science, smoke emissions, fire economics, and fuels treatment economics. We provide support to property owners, land managers, and policy makers through decision-support tools for predicting fire behavior, smoke emissions, air quality, and fire effects. We assist in developing fuel treatment alternatives and data products such as spatially explicit fuels maps, fire weather/danger forecasts, and real-time smoke emissions estimates.

Today, we manage more wildland fire than ever as fire seasons lengthen, fire behavior intensifies, and the wildland-urban interface expands. At the same time, due to limited resources, suppression strategies focus more on point protection than full perimeter control. In addition, more fires are being allowed to burn for their resource benefits. To effectively use fire as a tool to achieve land management objectives while protecting values-at-risk, managers need to understand the consequences of fire management decisions on a full suite of resource and societal values.

Burned aspen stands are inventoried by Forest Inventory & Analysis crews in Colorado as part of the North American Forest Dynamics project, which uses data for maps that help communicate the timing, area, and intensity of fires, harvests, and other disturbances.

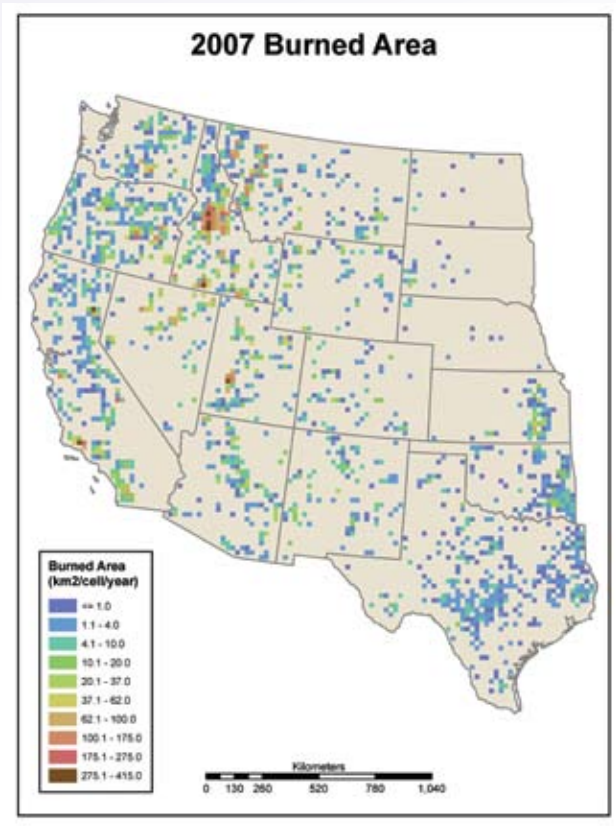
Stream temperatures in these riparian communities that burned in the same fire 10 years ago are very different today. The creek at top shows sparse revegetation because nutrients necessary for regrowth were swept away by a major debris flow shortly after the fire. *Photos by Jason Dunham.*

Climate change research questions:

- How will changing climate alter fire intensity, severity, and frequency?
- How does fire impact climate change mitigation strategies such as the use of vegetation management as a carbon sequestration tool?
- How will an increase in fire affect the quality, quantity, and distribution of aquatic and terrestrial habitat?
- Will an increase in burned area increase the need or desire for post-fire management activities?
- Could fire have synergistic effects with drought, climate change, insect outbreaks, disease, and nonnative plant invasions?
- Can restoring fire to landscapes reduce adverse impacts from climate change?
- What is the optimal amount and type of fuel treatment to apply to a landscape?

Human connections research questions:

- How do homeowners' risk-perceptions affect their willingness to take action in reducing fire hazards on their properties?
- What are the tradeoffs and costs of protecting important values at risk, such as old growth forests, endangered species, communities, and watersheds?
- How can human safety and public health be ensured through air quality protection and behavioral studies?
- What science information will managers need, particularly as they allow more fires to burn longer?
- How can our fire and land management organizations most effectively adjust to the changing decisionmaking environment?
- How do we best evaluate consequences of fire and fuels management decisions and assess tradeoffs among multiple resources and across multiple land ownerships? How are the current approaches to modeling fire behavior limiting our ability to plan, predict, or assess fire behavior?
- Can we build trust in our organization's decisions through more mindful application of high reliability organizing principles in collaborative planning for fire and fuel management activities?
- How do smoke emissions affect air quality?
- Do public perceptions of the benefits of wildland fire affect acceptance of smoke?
- Are wildland fire protection services distributed equitably across our society?
- Are there effective incentives (or disincentives) for managers to adequately consider costs and resource benefits in their fire management decisions?



Map shows burned area within the Station's boundaries and beyond in 2007. The Station validated a satellite-based fire detection and smoke forecasting system that closely matches observations reported at ground level.

Water Supply and Quality

Water is a precious resource in the dry Western United States and is critical to sustaining populations and ecosystems. Our mountains are the "water tower of the West." National Forests and Grasslands provide 33 percent of the West's water, flowing mainly from mountain snowpack. The rapidly increasing gap between water supply and demand creates numerous management challenges. Research is underway to understand watershed systems and the effects of use and management. Erosion calculation tools and water supply-and-demand maps are being developed. RMRS is committed not only to providing research on water, watersheds, and aquatic ecosystems but to reconnecting people to the landscape by helping them understand where their water comes from and providing them tools to manage it in a more sustainable manner.

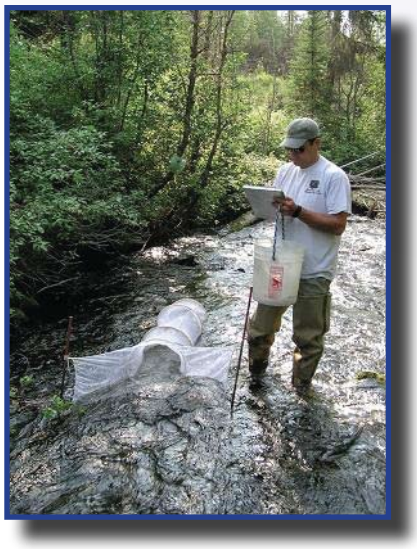
Climate change research questions:

- How will water supply be affected by changes in temporal and spatial distribution of precipitation and snowmelt runoff? What are the ancillary ecosystem effects?
- What are the effects of increased incidence of fire at higher elevations on erosion potential, siltation, and water quality?
- How is water supply affected by mountain pine beetle-caused lodgepole pine mortality?
- How can we design and monitor multi-scale management actions to protect, maintain, and restore stream-riparian habitats and understand the conditions we wish to restore? How will changes in timing and/or duration of runoff affect riparian vegetation?
- How will changing water systems affect the distribution, abundance, and quality of habitats for riparian-dependent species?
- How can fish species' habitat and survival requirements be improved to conserve, restore, and monitor populations?

Human connections research questions:

- What is the potential for water supply to limit demographic changes in the future?
- What are the effects of water diversions for urban uses on downstream riparian vegetation, species, and channel morphology?
- Will wildfire and/or atmospheric deposition significantly impact potable water?
- How will terrestrial and aquatic ecosystems respond to atmospheric deposition including nitrogen, sulfur, ozone, and heavy metals such as mercury?
- As recreation increases, what will be the effect on water quality?
- As water becomes more scarce, what are the tradeoffs of alternative uses?

Researchers study the effectiveness of streamside buffers and water quality. *Photo by Jim McKean.*



A researcher monitors declining vertebrate species in key habitat. *Photo by Michael Young.*

| Science Applications and Communication

Technology transfer and communicating research findings are critical to keeping partners, cooperators, and the public, as well as our co-workers, informed about how our products can be applied to make a difference on the ground. Credible scientific information that helps our stakeholders make informed decisions is our product. As we disseminate information, we will solicit feedback on its relevance and adapt as needed (Figure 2).

We will tailor practical information products to a range of audiences. RMRS will provide a scientific foundation for making decisions through knowledge application, integration, and delivery; and through effective communication.

Knowledge application:

- Measurement methodology for ecosystem status, dynamics, and monitoring;
- Techniques for adaptive management, resource monitoring, inventory, and analysis;
- Predictive models for disturbances such as fire and insect/disease outbreaks; and
- Quantitative tools and technologies that address the consequences of alternative management strategies.

Knowledge integration:

- Criteria and indicators of sustainability;
- Assessments for national, regional, and state strategic planning;
- Assessments at the watershed and landscape level;
- Risk and trade-off analyses; and
- Methods to assist the National Forest and Rangeland planning process.

Knowledge delivery:

- Peer-reviewed publications and reports;
- Reports for managers that synthesize information we acquire;
- Participation at meetings to connect researchers with resource managers;
- Diverse ways to reach new audiences who can benefit from our research; and
- Refined communication and technology transfer tools.

Our communication strategy will:

- Ensure public confidence in the quality of our products through statistical, technical, editorial, and peer reviews of our study plans and manuscripts;
- Package, promote, and deliver scientific information so that our stakeholders can understand it and use it effectively;

Figure 2. We will use a variety of media to cummunicate our research findings.

Station scientists transfer knowledge through various gatherings, such as this training session with NFS soil scientists on how to use the Forest Soil Disturbance Monitoring Protocol. *Photo by Debbie Page-Dumroese.*

The Station uses various media such as Station series publications, journals, DVDs, and the internet to communicate with stakeholders.

- Make our products easy to find and readily obtainable by all stakeholders and, in particular, our Forest Service manager counterparts;
- Disseminate our research through a host of opportunities including websites, newsletters, media, alliances, online forums, professional contacts, scientific panel discussions, collaboration and more;
- Promote awareness of what the Station is doing and how it benefits society;
- Produce more ecosystem-based state-of-knowledge summaries and syntheses of research findings to facilitate integrating science into natural resource management and policy;
- Build linkages between researchers and natural resource managers to ensure the implementation of science findings;
- Use strategic partnerships with the National Service Centers (such as Forest Management Service Center in Fort Collins, Missoula Technology and Development Center, and Remote Sensing Applications Center in Salt Lake City) for technology transfer; and
- Maintain the independence and credibility of each scientist as a neutral and objective source of scientific information providing facts, options, and consequences, rather than advocating positions or recommending specific management actions.

STRATEGIC GUIDELINES

Through many group discussions at various locations, Station employees and stakeholders provide input for developing our research. They help us shape our approaches to achieve our research goals and appraise new opportunities. The following guidelines will help us reach success.

Integrated Research
The Station encourages an integrated research approach whenever the scope of a problem requires interdisciplinary collaboration of scientists. Integrated research can begin with a unified, coordinated approach, or it can focus, synthesize, and/or combine disciplinary studies to achieve or reveal synergy in complex problem solving. A unified approach is often best done in the project-planning phase. Interdisciplinary research can be supported by funding coordinated and collaborative projects, reducing institutional barriers, and demonstrating the strategic agility to adapt to the needs of complex research problems.

Long-Term Research at Various Spatial Scales
Long-term studies are often the key to addressing natural resource issues. They are a unique strength within U.S. Forest Service Research and Development. We will strengthen our commitment to specific long-term research by using and maintaining selected Experimental Forests and Ranges, watersheds, experimental sites, Research Natural Areas, and data sets collected from them. We will build and maintain the necessary infrastructure and data management systems for relevant long-term studies on National Forests and Grasslands. The scale of a research effort depends on the organism or process being studied. Large scale, long-term studies may require a significant and/or long-term investment and collaboration. As such, the Station will maintain flexibility to conduct research at appropriate spatial scales.

Collaboration
We work collaboratively to accomplish our research. Collaboration across Research Programs and with universities, agencies, other research stations, National Forest Systems Regions, and non-traditional stakeholders is often cited as an area of opportunity. Collaboration is a mutually beneficial and well-defined relationship entered into by two or more organizations or individuals to achieve common goals. Major research projects cannot be accomplished in isolation. Expertise and funding from several sources is often required to accomplish common goals.

Through collaboration, the following opportunities will contribute to our success:

- Access to expertise, equipment, and land.
- Integrated approaches to research problems across Research Programs and scientists at universities and other institutions.

Researcher in the Missoula genetics lab uses DNA to study forest carnivore ecology. *Photo by Michael Schwartz.*

- Additional research capacity through use of graduate students on priority projects.
- Sharing of Experimental Forests, Ranges, Research Natural Areas, and other sites with other researchers.
- Engaging in research and administrative studies with our National Forest System counterparts.
- Engaging in research activities with tribal land managers.
- Collaboration with other units within the Forest Service, such as the Inventory & Monitoring Institute and the Forest Health Technology Enterprise Team.
- Interagency leadership from the Aldo Leopold Wilderness Research Institute in Missoula, MT.
- Engaging in research with state organizations and other federal agencies such as the Bureau of Land Management (BLM), National Park Service (NPS), U.S. Geological Survey (USGS), and U.S. Fish and Wildlife Service (USFWS).
- Strategic alliances with organizations that have skills needed to address our mission. Examples include, but are not limited to: Sandia National Lab, NM; Los Alamos National Lab, NM; Idaho National Engineering Lab, ID; Lawrence Livermore National Lab, CA; Earth Resources Observation System Data Center, SD; National Aeronautics & Space Administration, MD; and National Oceanic & Atmospheric Administration, CO.
- Cooperative Ecosystem Study Units (CESUs). This network of inter-university and inter-agency cooperative units provides collaborative opportunities that no unit alone can address. CESU partners share several science-based goals in the 21st century: high-quality science, usable knowledge for resource managers, responsive technical assistance, continuing education, and cost-effective research programs. A network of CESUs has been established to achieve these goals. RMRS is a member of five CESUs:
  - ◊ Rocky Mountain (hosted by University of Montana)
  - ◊ Great Plains (hosted by University of Nebraska)
  - ◊ Desert Southwest (hosted by University of Arizona)
  - ◊ Colorado Plateau (hosted by Northern Arizona University)
  - ◊ Great Basin (hosted by University of Nevada–Reno)
- RMRS also supports inter-agency cooperative efforts on:
  - ◊ Fire Sciences (Joint Fire Science Plan and National Fire Plan)
  - ◊ Forest Inventory and Analysis, and Forest Health Monitoring
  - ◊ Global Climate Change
  - ◊ Wilderness Stewardship Research
- Collaborative research with international groups is also essential to address critical research issues, such as invasive species and climate change.

Rocky Mountain Bighorn sheep. *Photo by Lane Eskew.*

| SUMMARY

This 2008 Strategic Framework Update, which refreshes the 2003 RMRS Strategic Framework document, discusses RMRS research priorities and research directions for the coming five to 10 years. Focusing on the effects of currently emerging change drivers, primarily climate and human activities, this Update presents our research emphasis areas. These are terrestrial ecosystems, wildland fire, and water supply and quality. Our research informs natural resource managers, the research community, and the public. Using integrated approaches, long-term studies, specialized studies, and collaboration among scientists across programs, agencies, and universities, RMRS will accomplish its mission of providing knowledge and innovative technology to improve the nation's forests and rangelands, both public and private.

United States Department of Agriculture

Forest Service
Rocky Mountain Research Station

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