



# Rocky Mountain Research Station New Publications

October to December 2012

Integrated Science Working for You



Air, Water,  
and Aquatic  
Environments



Fire, Fuel,  
and Smoke



Forest and  
Woodland  
Ecosystems



Grasslands,  
Shrublands,  
and Desert  
Ecosystems



Human  
Dimensions



Inventory,  
Monitoring,  
and Analysis



Science  
Application  
and Integration



Wildlife  
and Terrestrial  
Habitats

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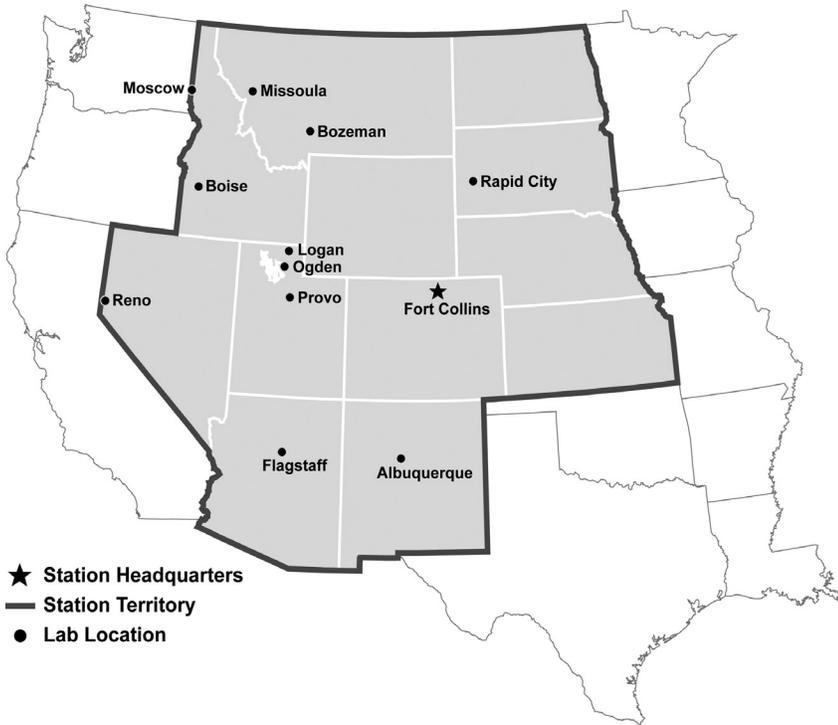
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<http://www.fs.fed.us/rm/publications>

# The Rocky Mountain Research Station



The Rocky Mountain Research Station is one of five regional units that make up the US Forest Service Research and Development organization—the most extensive natural resources research organization in the world. We maintain 14 research locations throughout a 12 state territory encompassing the Great Basin, Southwest, Rocky Mountains and parts of the Great Plains. The Station employs over 400 permanent full-time employees, including roughly 100 research scientists.

Scientists conduct research that spans an area containing 52% of the nation's National Forest System lands (54 National Forests and Grasslands). In the lower 48 states, our territory also includes 55% of the nation's BLM lands; 48% of the designated wildernesses; 37% of National Park Service lands; numerous other public and tribal lands; and 41% of the non-urban/rural private lands.

We administer and conduct ecological research on 14 experimental forests, ranges, and watersheds over the long-term, even centuries, enabling us to learn how forests change as climate and other factors change over time.

We also oversee activities on several hundred research natural areas, a network of ecosystems set aside to conserve biological diversity. The areas represent a wide 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.



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## New RMRS Series Publications

### Riparian ecosystem bibliography

Order 44

**Threats to western United States riparian ecosystems: A bibliography.** Poff, B.; Koestner, K.A.; Neary, D.G.; Merritt, D. 2012. Gen. Tech. Rep. RMRS-GTR-269. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

This bibliography is a compendium of state-of-knowledge publications about the threats affecting western U.S. riparian ecosystems and is a companion to the website: <http://www.rmrs.nau.edu/awa/riphreatbib/>. The bibliography is ordered al- phavbetically and the type of threats discussed in each publication is highlighted.

Online: [http://www.fs.fed.us/rm/pubs/rmrs\\_gtr269.html](http://www.fs.fed.us/rm/pubs/rmrs_gtr269.html).

### RPA Assessment: U.S. rangelands

Order 45

**A synoptic review of U.S. rangelands: A technical document supporting the Forest Service 2010 RPA Assessment.** Reeves, Matthew Clark; Mitchell, John E. 2012. Gen. Tech. Rep. RMRS-GTR-288. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 128 p.

This report focuses on quantifying extent, productivity, and health of U.S. rangelands. Since 1982, the area of U.S. rangelands has decreased at an average rate of 350,000 acres per year, owed mostly to conversion to agricultural and residential land uses. Nationally, rangeland productivity has been steady over the last decade, but the Rocky Mountain Assessment Region appears to have moderately increased productivity since 2000.

Online: [http://www.fs.fed.us/rm/pubs/rmrs\\_gtr288.html](http://www.fs.fed.us/rm/pubs/rmrs_gtr288.html).

### Climate change and fire: Effect on forests and fish communities

Order 46

**Climate change, forests, fire, water, and fish: Building resilient landscapes, streams, and managers.** Luce, Charles; Morgan, Penny; Dwire, Kathleen; Isaak, Daniel; Holden, Zachary; Rieman, Bruce. 2012. Gen. Tech. Rep. RMRS-GTR-290. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 207 p.

Fire will play an important role in shaping forest and stream ecosystems as the climate changes. Historic observations show increased dryness accompanying more widespread fire and forest die-off. This report comprises three primary chapters on physical processes, biological interactions, and management decisions, accompanied by a special section with separately authored papers addressing interactions of fish populations with wildfire. Together, they serve as a useful reference with varying levels of detail for land managers and resource specialists.

Online: [http://www.fs.fed.us/rm/pubs/rmrs\\_gtr290.html](http://www.fs.fed.us/rm/pubs/rmrs_gtr290.html).

### Upper Verde River research/monitoring

Order 47

**Synthesis of Upper Verde River research and monitoring 1993-2008.** Neary, Daniel G.; Medina, Alvin L.; Rinne, John N., eds. 2012. Gen. Tech. Rep. RMRS-GTR-291. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 296 p.

This volume is a state-of-knowledge synthesis of monitoring and research conducted on the Upper Verde River (UVR) of Arizona. It contains information on the history, hydrology, soils, geomorphology, vegetation, and fish fauna of the area that can help land managers and other scientists in successfully conducting ecosystem management and future monitoring and research in this important Southwest river ecosystem.

Online: [http://www.fs.fed.us/rm/pubs/rmrs\\_gtr291.html](http://www.fs.fed.us/rm/pubs/rmrs_gtr291.html).

### Fuels management guide for conifer forests

Order 48

**A comprehensive guide to fuel management practices for dry mixed conifer forests in the northwestern United States.** Jain, Theresa B.; Battaglia, Mike A.; Han, Han-Sup; Graham, Russell T.; Keyes, Christopher R.; Fried, Jeremy S.; Sandquist, Jonathan E. 2012. Gen. Tech. Rep. RMRS-GTR-292. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 331 p. NOTE: Paper copy will not be available until the end of February 2013.

This guide provides (1) summaries and links to supporting guides and literature on the mechanics of fuel treatments; (2) a decision tree to help managers select the best mechanical method for any situation in these regions; (3) how to apply prescribed fire to achieve diverse and specific objectives; (4) principles for developing an effective monitoring plan; (5) economic analysis of mechanical fuel treatments in each region; and (6) discussion on fuel treatment longevity.

Online: [http://www.fs.fed.us/rm/pubs/rmrs\\_gtr292.html](http://www.fs.fed.us/rm/pubs/rmrs_gtr292.html).

### RPA Assessment: Wildlife-associated recreation trends

Order 49

**Wildlife-associated recreation trends in the United States: A technical document supporting the Forest Service 2010 RPA Assessment.** Mockrin, Miranda H.; Aiken, Richard A.; Flather, Curtis H. 2012. Gen. Tech. Rep. RMRS-GTR-293. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 34 p.

This report documents recent and historical trends in hunting and wildlife watching to fulfill RPA requirements. We present historical trends back to 1955 as well as recent changes from the past 10 to 20 years to evaluate changes in recreation since the 2000 RPA Assessment. Documenting and understanding these changes in wildlife-associated recreation is essential to ensure the continued successful management of wildlife resources.

Online: [http://www.fs.fed.us/rm/pubs/rmrs\\_gtr293.html](http://www.fs.fed.us/rm/pubs/rmrs_gtr293.html).

### Montana ecosystem restoration treatments

Order 50

**Management guide to ecosystem restoration treatments: Two-aged lodgepole pine forests of central Montana, USA.** Hood, Sharon M.; Smith, Helen Y.; Wright, David K.; Glasgow, Lance S. 2012. Gen. Tech. Rep. RMRS-GTR-294. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 126 p.

This management guide summarizes the effects of thinning and prescribed burning treatments in lodgepole pine in an effort to restore two-aged lodgepole pine stands on the Tenderfoot Creek Experimental Forest, Montana. We report changes in tree density and fuel loading following thinning and prescribed burning. Results are organized by unit to help users best match a study unit stand condition and treatment to his/her own stand and proposed treatment to estimate potential treatment effects.

Online: [http://www.fs.fed.us/rm/pubs/rmrs\\_gtr294.html](http://www.fs.fed.us/rm/pubs/rmrs_gtr294.html).

### RPA Assessment: U.S. water supply shortage

Order 51

**Vulnerability of U.S. water supply to shortage: a technical document supporting the Forest Service 2010 RPA Assessment.** Foti, Romano; Ramirez, Jorge A.; Brown, Thomas C. 2012. Gen. Tech. Rep. RMRS-GTR-295. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 147 p.

Climate change can increase water demand and decrease water supply to the extent that, barring major adaptation efforts, substantial future water shortages are likely, especially in the larger Southwest. Because further global temperature increases are probably unavoidable, adaptation will be essential in the areas of greatest increase in projected probability of shortage.

Online: [http://www.fs.fed.us/rm/pubs/rmrs\\_gtr295.html](http://www.fs.fed.us/rm/pubs/rmrs_gtr295.html).

### Aviation personnel exposure to wildfire risk

Online only

**Preliminary results from a survey of U.S. Forest Service wildfire managers' attitudes toward aviation personnel exposure and risk.** Wibbenmeyer, Matthew; Hand, Michael; Calkin, David. 2012. Res. Note RMRS-RN-50WWW. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 38 p.

The U.S. Department of Agriculture, Forest Service (USFS) has, in recent years, increasingly emphasized the importance of safety to its employees, but wildfire management remains a risky endeavor. A recent survey of wildfire managers conducted by the USFS Rocky Mountain Research Station and the National Fire Decision Support Center used a fire management lottery experiment to elicit manager attitudes toward aviation personnel exposure and several dimensions of risk. Preliminary results suggest that wildfire managers have assimilated the USFS' recent emphasis on personnel safety, though their degree of sensitivity to potential personnel risk depends on how relevant information is presented.

Online: [http://www.fs.fed.us/rm/pubs/rmrs\\_rn050.html](http://www.fs.fed.us/rm/pubs/rmrs_rn050.html).

### Wildland fuel characteristics in northern RM ecosystems

Order 52

**Spatial variability of wildland fuel characteristics in northern Rocky Mountain ecosystems.** Keane, Robert E.; Gray, Kathy; Bacciu, Valentina. 2012. Res. Pap. RMRS-RP-98. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 56 p.

We investigated the spatial variability of a number of wildland fuel characteristics for the major fuel components found in six common northern Rocky Mountain ecosystems. Surface fuel characteristics of loading, particle density, bulk density, and mineral content were measured for eight fuel components—four downed dead woody fuel size classes (1, 10, 100, 1000 hr), duff, litter, shrub, and herb—on nested plots located within sampling grids to describe their variability across spatial scales. We also sampled canopy bulk density, biomass, and cover for each plot in the grid. Findings and data from this study can be used to sample, describe, and map fuel characteristics, such as loading, at the appropriate spatial scales to accommodate the next generation of fire behavior prediction models.

Online: [http://www.fs.fed.us/rm/pubs/rmrs\\_rp098.html](http://www.fs.fed.us/rm/pubs/rmrs_rp098.html).

### Campsite restoration

Order 53

**Restoration of plant cover on campsites in subalpine forests: Sawtooth Wilderness, Idaho.** Cole, David N.; Dean, Liese; Taylor, Debarah; Hall, Troy E. 2012. Res. Pap. RMRS-RP-99. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 32 p.

This study assessed the effectiveness of restoration treatments in enhancing the growth of *Vaccinium scoparium* transplants and plants established from seed on six closed campsites in subalpine forests in the Sawtooth Wilderness, Idaho. In the primary experiment, the soil on all plots was scarified and amended with organic matter; plots varied regarding the type and amount of organic matter in the amendments, whether or not they were fertilized, and whether or not they were covered with a mulch blanket. In the second experiment, plots varied regarding whether or not they were scarified, amended with organic matter, or received supplemental water. Our results suggest that native vegetation can be restored on highly disturbed campsites in these forests. They also reinforce the importance of avoiding impact in the first place given the lengthy recovery periods required in these ecosystems and the intensive restoration efforts needed to speed recovery.

Online: [http://www.fs.fed.us/rm/pubs/rmrs\\_rp099.html](http://www.fs.fed.us/rm/pubs/rmrs_rp099.html).

## Experimental Forests and climate change

Order 54

**Experimental Forests and climate change: Views of long-term employees on ecological change and the role of Experimental Forests and Ranges in understanding and adapting to climate change.** Yung, Laurie; Bradbury, Mason; Williams, Daniel R. 2012. Res. Pap. RMRS-RP-100. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 56 p.

In this project, we examined the views of 21 long-term employees on climate change in 14 Rocky Mountain Research Station Experimental Forests and Ranges (EFRs). EFRs were described by employees as uniquely positioned to advance knowledge of climate change impacts and adaptation strategies due to the research integrity they provide for long-term studies, the ability to host experimental treatments on the efficacy of adaptation actions, and the opportunity for long-term field observations to inform and improve research. Institutional commitment and capacity was identified by participants as critical to realizing the potential of EFRs to contribute to climate change research.

Online: [http://www.fs.fed.us/rm/pubs/rmrs\\_rp100.html](http://www.fs.fed.us/rm/pubs/rmrs_rp100.html).

## Transplanted aspen on reclaimed surface coal mine

Order 55

**Response of transplanted aspen to irrigation and weeding on a Colorado reclaimed surface coal mine.** Musselman, Robert C.; Shepperd, Wayne D.; Smith, Frederick W.; Asherin, Lance A.; Gee, Brian W. 2012. Res. Pap. RMRS-RP-101. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 20 p.

This study identified factors that limit the survival and growth of aspen on reclaimed surface-mined lands by examining planted aspen saplings with supplemental irrigation and removal of competing vegetation in a fenced plot. The aspen saplings were grown on reclaimed roto-tilled, fresh-hauled soil or on dozer-cleared stored soils. Separate observations were made on survival and growth of nearby plots of natural aspen sprouts (fenced or unfenced) and on potted aspen seedlings.

Online: [http://www.fs.fed.us/rm/pubs/rmrs\\_rp101.html](http://www.fs.fed.us/rm/pubs/rmrs_rp101.html).

## Journals and Other Publications

Obtain the following publications through university libraries, the publisher, or other outlets. Forest Service employees may request these items from the National Forest Service Library at [FSLibrary-DocsFC@fs.fed.us](mailto:FSLibrary-DocsFC@fs.fed.us) or telephone: (970) 498-1205. We have also provided links to electronic copies when available.

### Air, water, and aquatic environments

**Degradation and damages from utilizing ecosystem services in a river basin.** Warziniack, Travis W. 2012. In: Proceedings of the American Water Resources Association 2012 summer specialty conference; riparian ecosystems IV: Advancing science, economics and policy; June 27-29, 2012; Denver, CO. Online: <http://www.treesearch.fs.fed.us/pubs/41871>.

**The fundamental equation of eddy covariance and its application in flux measurements.** Gu, Lianhong; Massman, William J.; Leuning, Ray; Pallardy, Stephen G.; Meyers, Tilden; Hanson, Paul J.; Riggs, Jeffery S.; Hosman, Kevin P.; Yang, Bai. 2012.

Agricultural and Forest Meteorology. 152: 135-148. Online: <http://www.treesearch.fs.fed.us/pubs/42118>.

**How well can we measure the vertical wind speed? Implications for fluxes of energy and mass.** Kochendorfer, John; Meyers, Tilden P.; Frank, John; Massman, William J.; Heuer, Mark W. 2012. Boundary-Layer Meteorology. 145: 383-398. Online: <http://www.treesearch.fs.fed.us/pubs/42116>.

**The past as prelude to the future for understanding 21st-century climate effects on Rocky Mountain trout.** Isaak, Daniel J.; Muhlfeld, Clint C.; Todd, Andrew S.; Al-Chokhachy, Robert; Roberts, James; Kershner, Jeffrey L.; Fausch, Kurt D.;

Hostetler, Steven W. 2012. *Fisheries*. 37(12): 542-556. Online: <http://www.treesearch.fs.fed.us/pubs/42330>.

**Persistent wind-induced enhancement of diffusive CO transport in a mountain forest snowpack.** Bowling, D. R.; Massman, W.J. 2011. *Journal Geophysical Research*. 116: G04006. Online: <http://www.treesearch.fs.fed.us/pubs/42121>.

**Riparian forest restoration: Conflicting goals, trade-offs, and measures of success.** Bateman, Heather L.; Merritt, David M.; Johnson, J. Bradley. 2012. *Sustainability*. 4: 2334-2347. Online: <http://www.treesearch.fs.fed.us/pubs/42122>.

**Stream isotherm shifts from climate change and implications for distributions of ectothermic organisms.** Isaak, Daniel J.; Rieman, Bruce E. 2012. *Global Change Biology*. doi:10.1111/gcb.12073.

**Water resources (Chapter 12).** Brown, Thomas C.; Foti, Romano; Ramirez, Jorge. 2012. In: *Future of America's forest and range- lands: Forest Service 2010 Resources Planning Act Assessment*. Gen. Tech. Rep. WO-87. Washington, DC: U.S. Department of Agriculture, Forest Service: 109-121. Online: <http://www.treesearch.fs.fed.us/pubs/41812>.

**Wildfire extent and severity correlated with annual stream-flow distribution and timing in the Pacific Northwest, USA (1984-2005).** Holden, Zachary A.; Luce, Charles H.; Crimmins, Michael A.; Morgan, Penelope. 2011. *Ecohydrology*. 5(5): 677-684. Online: <http://www.treesearch.fs.fed.us/pubs/42161>.

**Woodland expansion's influence on belowground carbon and nitrogen in the Great Basin U.S.** Rau, Benjamin M.; Johnson, Dale W.; Blank, Robert R.; Tausch, Robin J.; Roundy, Bruce A.; Miller, Richard F.; Caldwell, Todd G.; Lucchesi, Annmarie. 2011. *Journal of Arid Environments*. 75: 827-835. Online: <http://www.treesearch.fs.fed.us/pubs/42421>.

## Fire, fuel, and smoke

**Coal Canyon Fire: Serious accident investigation report.** Myers, Charles L.; Draeger, Randy; Dixon, Antoine; Dahl, Cliff; Saveland, Jim; Mayhew, Brad; Brown, Gary; Petrilli, Tony; Murphy, Ben; Newman, Erin; Mora, Karen; Foley, Tim. 2012. Custer, SD: U.S. Department of Agriculture, Forest Service, Black Hills National Forest, Hell Canyon Ranger District. 26 p. Online: <http://www.treesearch.fs.fed.us/pubs/41947>.

**The communicative construction of safety in wildland firefighting.** Jahn, Jody; Putnam, Linda L.; Black, Anne E. 2012. Final Report, JFSP Project Number: 10-3-01-4. Boise, ID: Joint Fire Science Program. 27 p. Online: <http://www.treesearch.fs.fed.us/pubs/41950>.

**Diamond Fire: Serious accident investigation report.** Waconda, John; Pupilidy, Ivan; Diaz, Leonard; Broyles, Robin; Junge, Roberta; Saveland, James. 2012. Whiteriver, AZ: White Mountain Apache Tribal Council, Fort Apache Agency. 30 p. Online: <http://www.treesearch.fs.fed.us/pubs/41945>.

**The effect of sampling rate on interpretation of the temporal characteristics of radiative and convective heating in wildland flames.** Frankman, David; Webb, Brent W.; Butler,

Bret W.; Jimenez, Daniel; Harrington, Michael. 2012. *International Journal of Wildland Fire*. doi: <http://dx.doi.org/10.1071/WF12034>. Online: <http://www.treesearch.fs.fed.us/pubs/42186>. Effect of suppression strategies on federal wildland fire expenditures. Gebert, Krista M.; Black, Anne E. 2012. *Journal of Forestry*. 110(2): 65-73. Online: <http://www.treesearch.fs.fed.us/pubs/41937>.

**Index for characterizing post-fire soil environments in temperate coniferous forests.** Jain, Theresa B.; Pilliod, David S.; Graham, Russell T.; Lentile, Leigh B.; Sandquist, Jonathan E. 2012. *Forests*. 3(3): 445-466. Online: <http://www.treesearch.fs.fed.us/pubs/41967>.

**Long-term (13-year) effects of repeated prescribed fires on stand structure and tree regeneration in mixed-oak forests.** Hutchinson, Todd F.; Yaussy, Daniel A.; Long, Robert P.; Rebeck, Joanne; Sutherland, Elaine Kennedy. 2012. *Forest Ecology and Management*. 286: 87-100. Online: <http://www.treesearch.fs.fed.us/pubs/42167>.

**Measurements of convective and radiative heating in wildland fires.** Frankman, David; Webb, Brent W.; Butler, Bret W.; Jimenez, Daniel; Forthofer, Jason M.; Sopko, Paul; Shannon, Kyle S.; Hiers, J. Kevin; Ottmar, Roger D. 2012. *International Journal of Wildland Fire*. doi: <http://dx.doi.org/10.1071/WF11097>. Online: <http://www.treesearch.fs.fed.us/pubs/42185>.

**Reconstructing fire history in central Mongolia from tree rings.** Hessler, Amy E.; Ariya, Uyanga; Brown, Peter; Byambasuren, Oyunsanna; Green, Tim; Jacoby, Gordon; Sutherland, Elaine Kennedy; Nachin, Baatarbileg; Maxwell, R. Stockton; Pederson, Neil; De Grandpre, Louis; Saladyga, Thomas; Tardif, Jacques C. 2012. *International Journal of Wildland Fire*. 21(1): 86-92. Online: <http://www.treesearch.fs.fed.us/pubs/40386>.

**Repeated prescribed fires alter gap-phase regeneration in mixed-oak forests.** Hutchinson, Todd F.; Long, Robert P.; Rebeck, Joanne; Sutherland, Elaine Kennedy; Yaussy, Daniel A. 2012. *Canadian Journal of Forest Research*. 42: 303-314. Online: <http://www.treesearch.fs.fed.us/pubs/40071>.

**Using escaped prescribed fire reviews to improve organizational learning.** Black, Anne E.; Saveland, James; Thomas, Dave; Ziegler, Jennifer. 2012. Final Report, JFSP Project Number: 10-2-05-1. Boise, ID: Joint Fire Science Program. 31 p. Online: <http://www.treesearch.fs.fed.us/pubs/41938>.

## Forest and woodland ecosystems

**Association of *Pinus banksiana* Lamb. and *Populus tremuloides* Michx. seedling fine roots with *Sistotrema brinkmannii* (Bres.) J. Erikss. (Basidiomycotina).** Potvin, Lynette R.; Richter, Dana L.; Jurgensen, Martin F.; Dumroese, R. Kasten. 2012. *Mycorrhiza*. 22: 631-638. Online: <http://www.treesearch.fs.fed.us/pubs/42196>.

**Changes in transpiration and foliage growth in lodgepole pine trees following mountain pine beetle attack and mechanical girdling.** Hubbard, Robert M.; Rhoades, Charles C.; Elder,

- Kelly; Negron, Jose. 2013. *Forest Ecology and Management*. 289: 312–317.
- De novo assembly and transcriptome characterization of an *Armillaria solidipes* mycelial fan.** Ross-Davis, Amy L.; Stewart, Jane E.; Hanna, John W.; Kim, Mee-Sook; Cronn, Rich C.; Rai, Hardeep S.; Richardson, Bryce A.; McDonald, G. I.; Klopfenstein, Ned B. 2012. In: Zeglen, S.; Palacios, P., comps. Proceedings of 59th annual western international forest disease work conference; 2011 October 11-14; Leavenworth, WA. Portland, OR: U.S. Department of Agriculture, Forest Service, Forest Health Protection, Region 5:165-168. Online: <http://www.treeseearch.fs.fed.us/pubs/42235>.
- Development and application of a soil organic matter-based soil quality index in mineralized terrane of the Western US.** Blecker, S. W.; Stillings, L. L.; Amacher, M. C.; Ippolito, J. A.; DeCrappeo, N. M. 2012. *Environmental Earth Sciences*. doi: 10.1007/s12665-012-1876-8. Online: <http://www.treeseearch.fs.fed.us/pubs/42160>.
- Discovery of cryptic *Armillaria solidipes* genotypes within the Colorado Plateau.** Hanna, J. W.; Klopfenstein, N. B.; Kim, M. -S.; Ashiglar, S. M.; Ross-Davis, A. L.; McDonald, G. I. 2012. In: Zeglen, S.; Palacios, P., comps. Proceedings of 59th annual western international forest disease work conference; 2011 October 11-14; Leavenworth, WA. Portland, OR: U.S. Department of Agriculture, Forest Service, Forest Health Protection, Region 5: 145-148. Online: <http://www.treeseearch.fs.fed.us/pubs/42239>.
- DNA-based identification of *Armillaria* isolates from peach orchards in Mexico State.** Roman, Ruben Damian Elias; Klopfenstein, Ned B.; Rosales, Dionicio Alvarado; Kim, Mee-Sook; Case, Anna E.; Ashiglar, Sara M.; Hanna, John W.; Ross-Davis, Amy L.; Guzman Plazola, Remigio A. 2012. In: Zeglen, S.; Palacios, P., comps. Proceedings of 59th annual western international forest disease work conference; 2011 October 11-14; Leavenworth, WA. Portland, OR: U.S. Department of Agriculture, Forest Service, Forest Health Protection, Region 5: 159-160. Online: <http://www.treeseearch.fs.fed.us/pubs/42236>.
- Duff mound consumption and cambium injury for centuries-old western larch from prescribed burning in western Montana.** Harrington, Michael G. 2012. *International Journal of Wildland Fire*. doi:10.1071/WF12038.
- Ecohydrological consequences of drought- and infestation-triggered tree die-off: Insights and hypotheses.** Adams, Henry D.; Luce, Charles H.; Breshears, David D.; [and others]. 2012. *Ecohydrology*. 5: 145-159. Online: <http://www.treeseearch.fs.fed.us/pubs/39186>.
- Effect of fall-applied nitrogen on growth, nitrogen storage, and frost hardiness of bareroot *Larix olgensis* seedlings.** Li, Guolei; Liu, Yong; Zhu, Yan; Li, Qingmei; Dumroese, R. Kasten. 2012. *Silva Fennica*. 46(3): 345-354. Online: <http://www.treeseearch.fs.fed.us/pubs/41816>.
- Examining soil parent material influence over Douglas-fir stem growth response to fertilization: Taking advantage of information from spatiotemporally distributed experiments.** White, Kevin P.; Coleman, Mark; Page-Dumroese, Deborah S.; Gessler, Paul E.; Kimsey, Mark; Shaw, Terry. 2012. *Forest Ecology and Management*. 286: 101-107. Online: <http://www.treeseearch.fs.fed.us/pubs/42157>.
- Fire-injured ponderosa pine provide a pulsed resource for bark beetles.** Davis, Ryan S.; Hood, Sharon; Bentz, Barbara J. 2012. *Canadian Journal of Forest Research*. 42: 2022–2036.
- Fusarium oxysporum* protects Douglas-fir (*Pseudotsuga menziesii*) seedlings from root disease caused by *Fusarium commune*.** Dumroese, R. Kasten; Kim, Mee-Sook; James, Robert L. 2012. *Plant Pathology Journal*. 28(3): 311-316. Online: <http://www.treeseearch.fs.fed.us/pubs/41817>.
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## Science Program Areas

The Rocky Mountain Research Station is evolving from a Station with 30 research work units (including ecosystem management units and national programs) to a comprehensive programmatic structure consisting of eight Science Program areas and several Research, Development and Applications programs. Descriptions of the Science Program areas follow below.

### Air, Water and Aquatic Environments

Air quality, water availability, water quality, and aquatic habitats are critical issues within the rapidly changing Western United States. The Air, Water and Aquatic Environments program is committed to the development of knowledge and science applications related to air and water quality, as well as the habitat quality, distribution, diversity, and persistence of fish and other aquatic species. Website: [http://www.fs.fed.us/rm/boise/awae\\_home.shtml](http://www.fs.fed.us/rm/boise/awae_home.shtml). Contact Frank McCormick, Program Manager, for more information: 208-373-4351.

### Fire, Fuel and Smoke

The Fire, Fuel and Smoke program works to improve the safety and effectiveness of fire management through the creation and dissemination of basic fire science knowledge. The program investigates the impacts of fires on the environment by means of fundamental and applied research for understanding and predicting fire behavior, its effects on ecosystems, and its emissions into the atmosphere. Website: <http://www.firelab.org>. Contact Colin Hardy, Program Manager, for more information: 406-329-4978.

### Forest and Woodland Ecosystems

Forests and woodlands are increasingly being impacted by large scale urbanization and human developments, uncharacteristically large and severe wildfires, insect and disease outbreaks, exotic species invasions, and drought, and interactions of multiple stressors at local, landscape, and regional scales. The Forest and Woodland Ecosystems program acquires, develops, and delivers the scientific knowledge for sustaining and restoring forests and woodlands landscape health, biodiversity, productivity, and ecosystem processes. Website: <http://www.fs.fed.us/rmrs/research/programs/forest-woodlands-ecosystem/>. Contact Tom Crow, Program Manager, for more information: 970-498-1378.

### Grassland, Shrubland and Desert Ecosystems

Disruptions by large-scale clearing for agriculture, water diversions, extensive grazing, changes in the native fauna, the advent of alien weeds, altered fire regimes, and increases in human-caused insect and disease epidemics have contributed to produce areas that are in unsuitable condition. The Grassland, Shrubland and Desert Ecosystems program addresses the biology, use, management, and restoration of these grass and shrublands. Website: <http://www.fs.fed.us/rmrs/research/programs/grassland-shrubland-desert/>. Contact Debbie Finch, Program Manager, for more information: 505-724-3671.

### Human Dimensions

The Human Dimensions 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, water, and ecosystem services all have important social-economic dimensions that will be explored and addressed by this program. Website: <http://www.fs.fed.us/rmrs/research/programs/social-economics-decision/>. Contact Cindy Swanson, Program Manager for more information: 406-329-3388.

### Inventory, Monitoring and Analysis

The Inventory, Monitoring and Analysis program provides the resource data, analysis, and tools needed to effectively identify current status and trends, management options and impacts, and threats and impacts of fire, insects, disease, and other natural processes. Website: <http://www.fs.fed.us/rm/ogden/>. Contact Michael Wilson for more information: 801-625-5407.

### Science Application and Integration

The Science Application and Integration program is a knowledge transfer unit that provides leadership for the integration and use of scientific information in natural resource planning and management across the Interior West.

### Wildlife and Terrestrial Ecosystems

The Wildlife and Terrestrial Ecosystems program is engaged in sustaining species and ecosystems of concern through studies of ecological interactions within and between plant, aquatic, and terrestrial animal communities; understanding public use effects through studies elucidating social and economic values associated with consumptive and non-consumptive uses of fish and wildlife; managing terrestrial and aquatic habitats; and evaluating outcomes of land and water uses and natural disturbances. Website: <http://www.rmrs.nau.edu/wildlife/>. Contact William Block, Program Manager, for more information: 928-556-2161.

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