



# Rocky Mountain Research Station

# New Publications

January–March 2020

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# Rocky Mountain Research Station

The Rocky Mountain Research Station is one of seven regional units that make up the U.S. Forest Service Research and Development organization.



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 more than 400 permanent full-time employees, including about 100 research scientists.

Scientists conduct research that spans an area containing 52 percent of the nation’s National Forest System lands (54 national forests and grasslands). In the lower 48 States, our territory also includes 55 percent of the nation’s Bureau of Land Management lands; 48 percent of the designated wildernesses; 37 percent of National Park Service lands; numerous other public and tribal lands; and 41 percent 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. These 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 Publication Series

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### Protocol for Social Vulnerability Assessment to Support National Forest Planning and Management: A Technical Manual for Engaging the Public to Understand Ecosystem Service Tradeoffs and Drivers of Change

**Protocol for social vulnerability assessment to support national forest planning and management: A technical manual for engaging the public to understand ecosystem service tradeoffs and drivers of change.** Armatas, Christopher A.; Borrie, William T.; Watson, Alan E. 2019. Gen. Tech. Rep. RMRS-GTR-396. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 52 p.

Despite the generally accepted need for understanding social vulnerability within the context of USDA Forest Service planning and management, there is a lack of structured approaches available to practitioners to gain such an understanding. This social vulnerability protocol provides a step-by-step manual for engaging the public about ecosystem service tradeoffs and the drivers of change considered influential to the continued provision of important ecosystem services. This protocol provides a rigorous social science approach for implementation alongside common public engagement practices such as listening sessions, open houses, and focus groups. The approach includes a fun, thought-provoking exercise to be completed during the public engagement process, and we suggest that the approach can be implemented within the context of already busy work schedules and without outside expertise. This protocol, which is based on the social science method known as Q-methodology, includes guidance from the initial step of describing the decisionmaking context to the final steps of analysis and interpretation. The final results include multiple perspectives held by the public, and the perspectives are conveyed through engaging and understandable illustrations. The knowledge created through implementation of this protocol can inform both natural resource decisionmaking and public relations.

<https://www.fs.usda.gov/treesearch/pubs/59038>

### Aldo and Leonardo: A Wilderness Science and Art Collaboration

**Aldo and Leonardo: A wilderness science and art collaboration.** Pound, Grant (comp.). 2019. Aldo and Leonardo: A wilderness science and art collaboration. Gen. Tech. Rep. RMRS-GTR-397. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 126 p.

Aldo & Leonardo, a partnership between Colorado Art Ranch and the Aldo Leopold Wilderness Research Institute, was a project to celebrate the 50th anniversary of the Wilderness Act. The project was inspired by the scientific wisdom of Aldo Leopold and the artistic genius of Leonardo da Vinci. Our endeavor was an interdisciplinary collaboration of artists and scientists designed to celebrate the lands, resources and opportunities protected by the Wilderness Act. In 2013, we hosted one-month residencies in six diverse wilderness areas. Artists worked alongside wildland research scientists and gained firsthand knowledge of the wonders, complexities and challenges of our nation's wildest places. The result is this body of work that creatively illustrates the value of wild areas and honors the scientific efforts to preserve wilderness for the next fifty years.

English: <https://www.fs.usda.gov/treesearch/pubs/59140>

Spanish: <https://www.fs.usda.gov/treesearch/pubs/59141>

## The Ecology, History, Ecohydrology, and Management of Pinyon and Juniper Woodlands in the Great Basin and Northern Colorado Plateau of the Western United States

**The ecology, history, ecohydrology, and management of pinyon and juniper woodlands in the Great Basin and Northern Colorado Plateau of the western United States.** Miller, Richard F.; Chambers, Jeanne C.; Evers, Louisa; Williams, C. Jason; Snyder, Keirith A.; Roundy, Bruce A.; Pierson, Fred B. 2019. Gen. Tech. Rep. RMRS-GTR-403. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 284 p.

This synthesis reviews current knowledge of pinyon and juniper ecosystems, in both persistent and newly expanded woodlands, for managers, researchers, and the interested public. We draw from a large volume of research papers to centralize information on these semiarid woodlands. The first section includes a general description of both the Great Basin and northern Colorado Plateau. The ecology section covers woodland and species life histories, biology, and ecology and includes a detailed discussion of climate and the potential consequences of climate change specific to the Great Basin and Colorado Plateau. The history section discusses 20,000 years of woodland dynamics and geographic differences among woodland disturbance regimes and resilience. The ecohydrology section discusses hydrologic processes in woodlands that influence soil conservation and loss; water capture, storage, and release; and the effect that woodland structure and composition have on these processes. The final section, restoration and management, covers the history of woodland management, the different methods used, the advantages and disadvantages of different vegetation treatments, and posttreatment vegetation responses. We also discuss successes and failures and key components that determine project outcomes important for consideration when restoring ecosystem function, integrity, and resilience.

<https://www.fs.usda.gov/treesearch/pubs/59333>

## Managing for Large Wood and Beaver Dams in Stream Corridors

**Managing for large wood and beaver dams in stream corridors.** Wohl, Ellen; Scott, Daniel N.; Yochum, Steven E. 2019. Gen. Tech. Rep. RMRS-GTR-404. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 137 p.

Large wood and beaver dams are fundamental components of forested stream ecosystems but can also create hazards. We present guidelines for identifying stream segments that maximize environmental benefits while minimizing hazards. We focus on lesser gradient stream segments, although wood can be ecologically beneficial anywhere in a river network. Stream segments can be targeted for field-based evaluation using checklists for scenarios of either retention or reintroduction for logjams or beaver dams. We also present the Wood Jam Dynamics Database and Assessment Model, which incorporates a machine-learning-based statistical analysis to predict wood jam dynamics and provides a standardized survey protocol for wood jams.

<https://www.fs.usda.gov/treesearch/pubs/59331>

## Rangeland Water Developments at Springs: Best Practices for Design, Rehabilitation, and Restoration

**Rangeland water developments at springs: best practices for design, rehabilitation, and restoration.** Gen. Tech. Rep. RMRS-GTR-405. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 21 p.

Springs serve an ecologically important role as perennial water sources, essential habitat for native species, and support for stream flow. Spring developments on rangelands provide water to livestock and wildlife. Thoughtful design of sustainable developments will supply water to livestock and wildlife while maintaining the intrinsic ecological functions and values of springs. This guide addresses spring development project planning as well as long-term sustainable management of springs. The objectives of spring development design are (1) to retain hydrologic conditions in the developed spring habitat that are similar to undeveloped reference habitats and (2) to create a system that is easy to install and maintain. We present two gravity-flow development designs that incorporate flow-splitting devices to regulate environmental flows and levels and to work in a wide range of hydrologic conditions.

<https://www.fs.usda.gov/treesearch/pubs/59403>

## Ponderosa Pine Mortality in the Bob Marshall Wilderness After Successive Fires Over 14 Years

**Ponderosa pine mortality in the Bob Marshall Wilderness after successive fires over 14 years.** Flanary, Sarah J.; Keane, Robert E. 2020. Research Note. RMRS-RN-85. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 13 p.

Fire exclusion since the 1930s across western U.S. landscapes has greatly altered fire regimes and fuel conditions. After a lightning-caused fire swept through the center of the Bob Marshall Wilderness Area in 2003, researchers initiated a comprehensive study along the South Fork of the Flathead River. This study assessed the post-fire survival of over 600 iconic, relict ponderosa pine trees. These trees are of great interest as they are ancient (>400 years old), and some have Native American bark-peeling scars and fire scars. This area had not seen fire since 1910, if not earlier, despite having frequent fire (20-30 year fire return interval) prior to European settlement. Some of the trees sampled in 2003 experienced another fire in 2011 (Hammer Creek Fire). In 2017, these trees were remeasured for post-fire mortality by size class for the fifth time since the 2003 Little Salmon Complex fires. We found that mortality rates were quite low (<8%) for the larger trees (>20 inches diameter) despite the heavy pre-suppression fuel buildup and recent insect outbreaks. Ponderosa pine mortality rates remained somewhat low (<24%) throughout the sample period (2003-2017) with the larger trees having the least mortality (<18%) and the smaller trees having approximately 24% mortality. These surviving large relict ponderosa pine trees continue to thrive in the sampled areas despite a second Hammer Creek wildfire in 2011 that burned in the high fuel loading conditions created by the 2003 Little Salmon Fire.

<https://www.fs.usda.gov/treesearch/pubs/59332>

## Symposium Proceedings on Piñon-Juniper Habitats: Status and Management for Wildlife–2016

**Symposium Proceedings on Piñon-Juniper Habitats: Status and Management for Wildlife–2016.** Malcolm, Karl; Dykstra, Brian; Johnson, Kristine; Lightfoot, David; Muldavin, Esteban; Ramsey, Marikay. 2020. Proceedings RMRS-P-77. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 128 p.

Piñon-juniper vegetation types, including juniper woodland and savannah, piñon-juniper, and piñon woodland, cover approximately 40 million ha in the western United States, where they provide ecosystem services, wildlife habitat, and cultural and aesthetic value (Romme et al. 2009). These ecosystems are also the sites of oil and gas activities, grazing, and urban development and are impacted by changing climate and wildfire. The realization that piñon-juniper ecosystems are being lost and degraded by human activities and changing climate (Cole et al. 2008, Williams et al. 2010, Clifford et al. 2011, McDowell et al. 2016) has stimulated interest in management of these habitats for wildlife. The goal of the 2016 symposium, Piñon-juniper Habitats: Status and Management for Wildlife, was to bring together information on the management of piñon-juniper ecosystems for the wildlife that depend on them.

<https://www.fs.usda.gov/treearch/pubs/59393>

## Journals and Other Publications

External publications written by our scientists and cooperators and grouped by our Science Program Areas. For more information on our Science Program Areas, please visit our web site: [www.fs.usda.gov/rmrs/science-program-areas/](http://www.fs.usda.gov/rmrs/science-program-areas/).

### Air, Water and Aquatic Environments

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Robichaud, Peter R.; Lewis, Sarah A.; Wagenbrenner, Joseph W.; Brown, Robert E.; Pierson, Fredrick B. 2020. **Quantifying long-term post-fire sediment delivery and erosion mitigation effectiveness**. *Earth Surface Processes and Landforms*. 45: 771-782.

### Fire, Fuel and Smoke

**Legacy Title:** Albin, Frank A.; Brown, James K.; Reinhardt, Elizabeth D.; Ottmar, Roger D. 1995. **Calibration of a large fuel burnout model**. *International Journal of Wildland Fire*. 5(3): 173-192.

Wagenbrenner, Natalie S.; Forthofer, Jason M.; Page, Wesley G.; Butler, Bret W. 2019. **Development and evaluation of a Reynolds-Averaged Navier-Stokes solver in WindNinja for operational wildland fire applications**. *Atmosphere*. 10: 672.

### Forest and Woodland Ecosystems

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Moser, W. Keith; Butler-Leopold, Patricia; Hausman, Constance; Iverson, Louise; Ontl, Todd; Brand, Leslie; Matthews, Stephen; Peters, Matthew; Prasad, Anantha. 2020. **The impact**

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Caballero, Jorge R. Ibarra; Ata, Jessa P.; Leddy, K. A.; Glenn, Travis C.; Kieran, Troy J.; Klopfenstein, Ned B.; Kim, Mee-Sook; Stewart, Jane E. 2020. **Genome comparison and transcriptome analysis of the invasive brown root rot pathogen, *Phellinus noxius*, from different geographic regions reveals potential enzymes associated with degradation of different wood substrates**. *Fungal Biology*. 124: 144-154.

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## Human Dimensions

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## Wildlife and Terrestrial Ecosystems

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