

New Publications

January–March 2019

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Publications are also available at <https://www.fs.fed.us/rmrs/publications>.

The 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

Living with wildfire in Archuleta County, Colorado: 2015 data report

Online only

Living with wildfire in Archuleta County, Colorado: 2015 data report. Meldrum, James R.; Brenkert-Smith, Hannah; Wilson, Pamela; Champ, Patricia A.; Barth, Christopher M.; Boag, Angela. 2019. Living with wildfire in Archuleta County, Colorado: 2015 data report. Res. Note RMRS-RN-79. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 38 p.

Residents in the wildland-urban interface (WUI) can play an important role in reducing wildfire's negative effects by performing wildfire risk mitigation on their property. This report offers insight into the wildfire risk mitigation activities and related considerations, such as attitudes, experiences, and concern about wildfire, for people with homes in the Pagosa Fire Protection District of Archuleta County, Colorado. Data come from a social survey and parcel-level rapid wildfire risk assessments administered by FireWise of Southwest Colorado. Results are presented both in graphical form and as detailed summary statistics (in appendices). As we recognize that results from similar surveys and assessments in other communities may differ, these linked datasets contribute to a broader effort to understand decisions about wildfire risk mitigation on private property. Results can facilitate long-term monitoring, management, and educational practices concerning the mitigation of wildfire risk in WUI communities.

<https://www.fs.usda.gov/treesearch/pubs/57791>

Living with wildfire in La Plata County, Colorado: 2015 data report

Online only

Living with wildfire in La Plata County, Colorado: 2015 data report. Brenkert-Smith, Hannah; Meldrum, James R.; Wilson, Pamela; Champ, Patricia A.; Barth, Christopher M.; Boag, Angela. 2019. Living with wildfire in La Plata County, Colorado: 2015 data report. Res. Note RMRS-RN-80. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 36 p.

Residents in the wildland-urban interface (WUI) can play an important role in reducing wildfire's negative effects by performing wildfire risk mitigation on their property. This report offers insight into the wildfire risk mitigation activities and related considerations, such as attitudes, experiences, and concern about wildfire, for people with homes in select communities in La Plata County, Colorado. Data come from a social survey and parcel-level rapid wildfire risk assessments administered by FireWise of Southwest Colorado. Results are presented both in graphical form and as detailed summary statistics (in appendices). As we recognize that results from similar surveys and assessments in other communities might differ, these linked datasets contribute to a broader effort to understand decisions about wildfire risk mitigation on private property. Results can facilitate long-term monitoring, management, and educational practices concerning the mitigation of wildfire risk in WUI communities.

<https://www.fs.usda.gov/treesearch/pubs/57792>

New RMRS Publication Series

Living with Wildfire in Montezuma County, Colorado: 2015 Data Report

Online only

Living with Wildfire in Montezuma County, Colorado: 2015 data report. Brenkert-Smith, Hannah; Meldrum, James R.; Wilson, Pamela; Champ, Patricia A.; Barth, Christopher M.; Boag, Angela. 2019. Living with Wildfire in Montezuma County, Colorado: 2015 Data Report. Res. Note RMRS-RN-81. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 36 p.

Residents in the wildland-urban interface (WUI) can play an important role in reducing wildfire's negative effects by performing wildfire risk mitigation on their property. This report offers insight into the wildfire risk mitigation activities and related considerations, such as attitudes, experiences, and concern about wildfire, for people with homes in select communities in Montezuma County, Colorado. Data come from a social survey and parcel-level rapid wildfire risk assessments administered by FireWise of Southwest Colorado. Results are presented both in graphical form and as detailed summary statistics (in appendices). As we recognize that results from similar surveys and assessments in other communities may differ, these linked datasets contribute to a broader effort to understand decisions about wildfire risk mitigation on private property. Results can facilitate long-term monitoring, management, and educational practices concerning the mitigation of wildfire risk in WUI communities.

<https://www.fs.usda.gov/treearch/pubs/57793>

Modeling historical range of variability and alternative management scenarios in the upper Yuba River watershed, Tahoe National Forest, California

Online only

Modeling historical range of variability and alternative management scenarios in the upper Yuba River watershed, Tahoe National Forest, California. McGarigal, Kevin; Mallek, Maritza; Estes, Becky; Tierney, Marilyn; Walsh, Terri; Thane, Travis; Safford, Hugh; Cushman, Samuel A. 2018. Modeling historical range of variability and alternative management scenarios in the upper Yuba River watershed, Tahoe National Forest, California. Gen. Tech. Rep. RMRS-GTR-385. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Stations. 346 p.

This report describes modeling of historical range of variability and alternative management scenarios in the upper Yuba River watershed, Tahoe National Forest, California. We simulated the dynamics in vegetation driven by wildfire during the historical reference period (ca. 1550-1850). We provide a synopsis of the major findings or "take-home" messages of this study and their management implications. For example, our scenario analysis demonstrates that active vegetation management involving a combination of mechanical and prescribed fire treatments has the potential to emulate many aspects of landscape structure that would occur under a natural disturbance regime, but it would require a much higher intensity of treatment than we are accustomed to - perhaps as much as 10 times the current treatment rate.

<https://www.fs.usda.gov/treearch/pubs/57622>

New RMRS Publication Series

Proactive limber pine conservation strategy for the Greater Rocky Mountain National Park Area

Online only

Proactive limber pine conservation strategy for the Greater Rocky Mountain National Park Area. Schoettle, Anna W.; Burns, Kelly S.; Cleaver, Christy M.; Connor, J. Jeff. 2019. Proactive limber pine conservation strategy for the Greater Rocky Mountain National Park Area. Gen. Tech. Rep. RMRS-GTR-379. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 81 p.

This proactive conservation strategy addresses the unique situation of limber pine in the Greater Rocky Mountain National Park Area (GRMNPA). The target area includes Rocky Mountain National Park and surrounding areas of northern Colorado and southern Wyoming. The GRMNPA is at the infection front for white pine blister rust (WPBR) where populations were also impacted by the recent mountain pine beetle epidemic and are threatened by climate change. This is the first proactive conservation strategy for a five-needle pine species in North America. The recommendations apply to the GRMNPA and possibly to all of the southern Rockies; the approach used can be applied further. The recommendations herein are expected to be relevant for at least 20 years.

<https://www.fs.usda.gov/treearch/pubs/57621>

Riparian ecosystems of the Manti-La Sal National Forest: An assessment of current conditions in relation to natural range of variability

Online only

Riparian ecosystems of the Manti-La Sal National Forest: An assessment of current conditions in relation to natural range of variability. Driscoll, K. P.; Smith, D. Max; Finch, Deborah M. 2019. Riparian ecosystems of the Manti-La Sal National Forest: An assessment of current conditions in relation to natural range of variability. Gen. Tech. Rep. RMRS-GTR-386. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 160 p.

We conducted this assessment to provide information on the current conditions of riparian and wetland ecosystems in reference to their natural range of variability on the Manti-La Sal National Forest during forest plan revision. We used peer-reviewed literature, data from the Forest and other partners, and site visits to evaluate the status of four key ecosystem characteristics: (1) distribution of riparian ecosystems, (2) groundwater and surface water fluctuations, (3) channel and bank stability, and (4) floodplain condition. We determined that riparian and wetland ecosystems of the National Forest have experienced many stressors that have influenced their current conditions, including livestock and wild ungulate grazing, altered flow and fire regimes, road construction, timber harvest, invasive and encroaching species, vegetation mortality due to insects and disease, and altered temperature and precipitation regimes.

<https://www.fs.usda.gov/treearch/pubs/57790>

Journals and Other Publications

Online links are provided if available. For the general public, some links may hit a pay wall. Please accept our apologies for any inconvenience.

Air, water and aquatic environments

Potential effects of climate change on riparian areas, wetlands, and groundwater-dependent ecosystems in the Blue Mountains, Oregon, USA. Dwire, Kathleen A.; Mellmann-Brown, Sabine; Gurrieri, Joseph T. 2018. Potential effects of climate change on riparian areas, wetlands, and groundwater-dependent ecosystems in the Blue Mountains, Oregon, USA. *Climate Services*. 10: 44-52. <https://www.fs.usda.gov/treearch/pubs/57868>

Integrative taxonomy refutes a species hypothesis: The asymmetric hybrid origin of *Arsapnia arapahoe* (Plecoptera, Capniidae) Young, Michael K.; Smith, Rebecca J.; Pilgrim, Kristine L.; Fairchild, Matthew P.; Schwartz, Michael K. 2019. *Ecology and Evolution*. 9: 1364-1377. <https://www.fs.usda.gov/treearch/pubs/57608>

The phylogeography of westslope cutthroat trout. Young, M.K.; McKelvey, K.S.; Pilgrim, K.L.; Schwartz, M.K.; [et al.]. 2018. In: Trotter, P.; Bisson, P.; Schultz, L.; [et al.], eds. *Cutthroat trout: Evolutionary biology and taxonomy*. Special Publication 36. Bethesda, MD: American Fisheries Society: 261–301. <https://www.fs.usda.gov/treearch/pubs/57473>

Fire, fuel and smoke

Analyzing fine-scale spatiotemporal drivers of wildfire in a forest landscape model. Ager, Alan A.; Barros, Ana M. G.; Day, Michelle A.; Preisler, Haiganoush K.; Spies, Thomas A.; Bolte, John. 2018. *Ecological Modelling*. 384: 87-102. <https://www.fs.usda.gov/treearch/pubs/57896>

Tradeoffs between US national forest harvest targets and fuel management to reduce wildfire transmission to the wildland urban interface. Ager, Alan A.; Houtman, Rachel M.; Day, Michelle A.; Ringo, Chris; Palaiologou, Palaiologos. 2019. *Forest Ecology and Management*. 434: 99-109. <https://www.fs.usda.gov/treearch/pubs/57897>

Wildfires and climate change push low-elevation forests across a critical climate threshold for tree regeneration. Davis, Kimberley T.; Dobrowski, Solomon Z.; Higuera, Philip E.; Holden, Zachary A.; Veblen, Thomas T.; Rother, Monica T.; Parks, Sean A.; Sala, Anna; Maneta, Marco P. 2019. *PNAS Latest Articles*. doi: 10.1073/pnas.1815107116. <https://www.fs.usda.gov/treearch/pubs/57778>

Inferring energy incident on sensors in low-intensity surface fires from remotely sensed radiation and using it to predict tree stem injury. Dickinson, Matthew B.; Butler, Bret W.; Hudak, Andrew T.; Bright, Benjamin C.; Kremens, Robert L.; Klauberg, Carine. 2019. *International Journal of Wildland Fire*. 28: 230-236. <https://www.fs.usda.gov/treearch/pubs/57892>

Archetypes of community wildfire exposure from national forests of the western US. Evers, Cody R.; Ager, Alan A.; Nielsen-Pincus, Max; Palaiologou, Palaiologos; Bunzel, Ken. 2019. *Landscape and Urban Planning*. 182: 55-66.

A multi-century history of fire regimes along a transect of mixed-conifer forests in central Oregon, U.S.A. Heyerdahl, Emily K.; Loehman, Rachel A.; Falk, Donald A. 2019. *Canadian Journal of Forest Research*. 49: 76–86. <https://www.fs.usda.gov/treearch/pubs/57470>

Living on the edge: Trailing edge forests at risk of fire-facilitated conversion to non-forest. Parks, Sean A.; Dobrowski, Solomon Z.; Shaw, John D.; Miller, Carol. 2019. *Ecosphere*. 10(3): Article e02651. <https://www.fs.usda.gov/treearch/pubs/57779>

Contiguous United States wildland fire emission estimates during 2003–2015. Urbanski, Shawn P.; Reeves, Matt C.; Corley, Rachel E.; Silverstein, Robin P.; Hao, Wei Min. 2018. *Earth System Science Data*. 10: 2241–2274. <https://www.fs.usda.gov/treearch/pubs/57485>

A VIIRS direct broadcast algorithm for rapid response mapping of wildfire burned area in the western United States. Urbanski, Shawn; Nordgren, Bryce; Hao, Wei Min; [et al.]. 2018. *Remote Sensing of Environment*. 219: 271–283. <https://www.fs.usda.gov/treearch/pubs/57486>

Recent and projected future wildfire trends across the ranges of three spotted owl subspecies under climate change. Wan, Ho Yi; Cushman, Samuel A.; Ganey, Joseph L. 2019. *Frontiers in Ecology and Evolution*. 7: 37. <https://www.fs.usda.gov/treearch/pubs/57881>

Forest and woodland ecosystems

Identifying old trees to inform ecological restoration in montane forests of the central Rocky Mountains, USA. Brown, Peter M.;

Journals and Other Publications

Online links are provided if available. For the general public, some links may hit a pay wall. Please accept our apologies for any inconvenience.

- Gannon, Benjamin; Battaglia, Mike A.; Fornwalt, Paula J.; Huckaby, Laurie S.; Cheng, Antony S.; Baggett, L. Scott. 2019. *Tree-Ring Research*. 75(1): 34-48. <https://www.fs.usda.gov/treearch/pubs/57872>
- A national approach to leverage the benefits of tree planting on public lands.** Dumroese, R. Kasten; Balloffet, Nicole; Crockett, John W.; Stanturf, John A.; Nave, Lucas E. 2019. *New Forests*. 50: 1-9. <https://www.fs.usda.gov/treearch/pubs/57828>
- Transferability of lidar-derived basal area and stem density models within a northern Idaho ecoregion.** Fekety, Patrick A.; Hudak, Andrew T.; Jain, Theresa B.; [et al.] 2018. *Canadian Journal of Remote Sensing*. 44(2): 131–143. <https://www.fs.usda.gov/treearch/pubs/57466>
- Trajectory from beech and oak forests to eastern broadleaf forests in Indiana, USA.** Hanberry, Brice B. 2019. *Ecological Processes*. 8: 3. <https://www.fs.usda.gov/treearch/pubs/57870>
- Open forest management for early successional birds.** Hanberry, Brice B.; Thompson, Frank R., III. 2019. *Wildlife Society Bulletin*. doi: 10.1002/wsb.957. <https://www.fs.usda.gov/treearch/pubs/57830>
- Visualizing current and future climate boundaries of the conterminous United States: Implications for forests.** Hanberry, Brice B.; Fraser, Jacob S. 2019. *Forests*. 10(3): 280. <https://www.fs.usda.gov/treearch/pubs/57831>
- Beer, brains, and brawn as tools to describe terrestrial gastropod species richness on a montane landscape.** Lucid, Michael K.; Ehlers, Shannon; Robinson, Lacy; Cushman, Samuel A. 2018. *Ecosphere*. 9(12): e02535. <https://www.fs.usda.gov/treearch/pubs/57618>
- Post-spruce beetle timber salvage drives short-term surface fuel increases and understory vegetation shifts.** Mattson, Lucas R.; Coop, Jonathan D.; Battaglia, Mike A.; Cheng, Antony S.; Sibold, Jason S.; Viner, Sara. 2019. *Forest Ecology and Management*. 437: 348-359. <https://www.fs.usda.gov/treearch/pubs/57616>
- The Fire and Smoke Model Evaluation Experiment—A Plan for Integrated, Large Fire–Atmosphere Field Campaigns.** Prichard, Susan; Larkin, N.; Ottmar, Roger; French, Nancy; Baker, Kirk; Brown, Tim; Clements, Craig; Dickinson, Matt; Hudak, Andrew; Kochanski, Adam; Linn, Rod; Liu, Yongqiang; Potter, Brian; Mell, William; Tanzer, Danielle; Urbanski, Shawn; Watts, Adam. 2019. 10(2): 66-. <https://doi.org/10.3390/atmos10020066>. <https://www.fs.usda.gov/treearch/pubs/57718>
- Soil greenhouse gas, carbon content, and tree growth response to biochar amendment in western United States forests.** Sarauer, Jessica L.; Page-Dumroese, Deborah S.; Coleman, Mark D. 2018. *GCB Bioenergy*. doi: 10.1111/gcbb.12595. <https://www.fs.usda.gov/treearch/pubs/57617>
- Improving habitat and connectivity model predictions with multi-scale resource selection functions from two geographic areas.** Wan, Ho Yi; Cushman, Samuel A.; Ganey, Joseph L. 2019. *Landscape Ecology*. 34: 503-519. <https://www.fs.usda.gov/treearch/pubs/57882>
- ## Grasslands, shrublands and desert ecosystems
- Climate variability affects the germination strategies exhibited by arid land plants.** Barga, Sarah; Dilts, Thomas E.; Leger, Elizabeth A. 2017. *Oecologia*. 185: 437-452. <https://www.fs.usda.gov/treearch/pubs/57873>
- Contrasting climate niches among co-occurring subdominant forbs of the sagebrush steppe.** Barga, Sarah C.; Dilts, Thomas E.; Leger, Elizabeth A. 2018. *Diversity and Distributions*. 24: 1291-1307. <https://www.fs.usda.gov/treearch/pubs/57874>
- Climate-based seed transfer of a widespread shrub: Population shifts, restoration strategies, and the trailing edge.** Richardson, Bryce A.; Chaney, Lindsay. 2018. *Ecological Applications*. 28(8): 2165-2174. <https://www.fs.usda.gov/treearch/pubs/57484>
- Successfully storing milkweed taproots for habitat restoration.** Topping, Melissa L.; Dumroese, R. Kasten; Pinto, Jeremiah R. 2019. *Native Plants Journal*. 20: 48-58. <https://www.fs.usda.gov/treearch/pubs/57829>
- Seedling native species increases resistance to annual grass invasion following prescribed burning of semiarid woodlands.** Urza, Alexandra K.; Weisberg, Peter J.; Chambers, Jeanne C.; Board, David; Flake, Samuel W. 2019. *Biological Invasions*. doi: 10.1007/s10530-

Journals and Other Publications

Online links are provided if available. For the general public, some links may hit a pay wall. Please accept our apologies for any inconvenience.

019-01951-9. <https://www.fs.usda.gov/treearch/pubs/57832>

Human dimensions

What drives at-risk species richness? Environmental factors are more influential than anthropogenic factors or biological traits.

Howard, Christine; Flather, Curtis H.; Stephens, Philip A. 2018. *Conservation Letters*. 2018: e12624. <https://www.fs.usda.gov/treearch/pubs/57481>

Should I stay or should I go now? Or should I wait and see? Influences on wildfire evacuation decisions. McCaffrey, Sarah; Wilson, Robyn; Konar, Avishek. 2018. *Risk Analysis*. 38(7): 1390–1404. <https://www.fs.usda.gov/treearch/pubs/55590>

Social dynamics of wildland fire in California [Chapter 27]. McCaffrey, Sarah M.; Duffner, Guy L.; Decker, Lynn M. 2018. In: van Wagendonk, Jan W.; Sugihara, Neil G.; Stephens, Scott L.; [et al.], eds. *Fire in California's ecosystems*. Oakland, CA: University of California Press: 507–516. <https://www.fs.usda.gov/treearch/pubs/57471>

Engaging the fire before it starts: A case study from the 2017 Pinal Fire (Arizona). O'Connor, Christopher D.; Calkin, David E. 2019. *Wildfire*. 28(1): 14-18. <https://www.fs.usda.gov/treearch/pubs/57587>

Will landscape fire increase in the future? A systems approach to climate, fire, fuel, and human drivers. Riley, Karin L.; Williams, A. Park; Urbanski, Shawn P.; Calkin, David E.; Short, Karen C.; O'Connor, Christopher D. 2019. *Current Pollution Reports*. doi: 10.1007/s40726-019-0103-6. <https://www.fs.usda.gov/treearch/pubs/57586>

Historical perspectives and a new U.S. Forest Service strategy for fish and aquatic stewardship. Shively, Dan; Rothlisberger, John D.; Gillespie, Nathaniel; Dombek, Mike; Moore, Virgil; Roghair, Craig; Demario, Devin; McCormick, Frank; Weldon, Leslie. 2018. *Fisheries*. 43(9): 386-395. <https://www.fs.usda.gov/treearch/pubs/57625>

Defining extreme wildfire events: Difficulties, challenges, and impacts. Tedim, Fantina; Leone, Vittorio; McCaffrey, Sarah; [et al.]. 2018. *Fire*. 1: 9. <https://www.fs.usda.gov/treearch/pubs/57472>

Inventory and monitoring

Effects of stand structure, browsing, and biophysical conditions on regeneration following mountain pine beetle in mixed lodgepole pine and aspen forests of the southern Rockies. Pelz, Kristen A.; Smith, Frederick W. 2018. *Forests*. 9: 525. <https://www.fs.usda.gov/treearch/pubs/57482>

How we sample trees influences our assessment of climate change impacts on forests. *Nature: Ecology and Evolution*. <https://www.fs.usda.gov/treearch/pubs/57609>

Sampling bias overestimates climate change impacts on forest growth in the southwestern United States. Klesse, Stefan; DeRose, R. Justin; Guiterman, Christopher H.; Lynch, Ann M.; O'Connor, Christopher D.; Shaw, John D.; Evans, Margaret E. K. 2018. *Nature Communications*. 9: 5336. <https://www.fs.usda.gov/treearch/pubs/57610>

Science application and communication

Fishers and martens and lynx, oh my! Multiregional, goal efficient monitoring of mesocarnivores. Golding, Jessie. 2019. *Science You Can Use* (in 5 minutes). Fort Collins, CO: Rocky Mountain Research Station. 2 p. <https://www.fs.usda.gov/treearch/pubs/57588>

Wildlife and terrestrial ecosystems

Northern Arizona, USA, post-wildfire avian data: Western bluebird detection/non-detection and banding data. Block, William M.; Strohmeyer, Brenda E.; Sanderlin, Jamie S. 2018. Fort Collins, CO: Forest Service Research Data Archive. <https://doi.org/10.2737/RDS-2018-0040> <https://www.fs.usda.gov/rds/archive/Product/RDS-2018-0040>

Red fox ancestry and connectivity assessments reveal minimal fur farm introgression in Greater Yellowstone Ecosystem. Cross, Patrick R.; Sacks, Benjamin N.; Luikart, Gordon; Schwartz, Michael K.; Van Etten, Keith W.; Crabtree, Robert L. 2018. *Journal of Fish and Wildlife Management*. 9(2): 519-530. <https://www.fs.usda.gov/treearch/pubs/57893>

Wolverines in winter: Indirect habitat loss and functional responses

Science Program Areas

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. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/air-water-and-aquatic-environments>. Contact Frank McCormick, Program Manager, for more information: 970-498-1175.

Aldo Leopold Wilderness Research Institute

The Aldo Leopold Wilderness Research Institute aims to provide scientific leadership by bringing diverse groups of scientists and managers together to develop and use the knowledge needed to assure wilderness ecosystems and values endure for generations to come. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/aldo-leopold-wilderness-research-institute>. Contact Susan Fox, Program Director, for more information: 406-542-4193.

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. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/fire-fuel-and-smoke>. 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. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/forest-and-woodland-ecosystems>. Contact Alison Hill, Program Manager, for more information: 928-556-2105.

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. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/grassland-shrubland-and-desert-ecosystems>. 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. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/human-dimensions>. Contact David Chapman, Program Manager, for more information: 970-498-1378.

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. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/inventory-and-monitoring>. Contact Michael Wilson, Program Manager, for more information: 801-625-5407.

Science Application and Communication

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. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/science-application-and-communication>. Contact Jan Engert, Assistant Station Director, for more information: 970-498-1377.

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. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/wildlife-and-terrestrial-ecosystems>. Contact Michael Schwartz, Program Manager, for more information: 406-542-4161.

Science Program Areas

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. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/air-water-and-aquatic-environments>. Contact Frank McCormick, Program Manager, for more information: 970-498-1175.

Aldo Leopold Wilderness Research Institute

The Aldo Leopold Wilderness Research Institute aims to provide scientific leadership by bringing diverse groups of scientists and managers together to develop and use the knowledge needed to assure wilderness ecosystems and values endure for generations to come. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/aldo-leopold-wilderness-research-institute>. Contact Susan Fox, Program Director, for more information: 406-542-4193.

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. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/fire-fuel-and-smoke>. 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. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/forest-and-woodland-ecosystems>. Contact Alison Hill, Program Manager, for more information: 928-556-2105.

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. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/grassland-shrubland-and-desert-ecosystems>. 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. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/human-dimensions>. Contact David Chapman, Program Manager, for more information: 970-498-1378.

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. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/inventory-and-monitoring>. Contact Michael Wilson, Program Manager, for more information: 801-625-5407.

Science Application and Communication

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. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/science-application-and-communication>. Contact Jan Engert, Assistant Station Director, for more information: 970-498-1377.

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. Webpage: <https://www.fs.fed.us/rmrs/science-program-areas/wildlife-and-terrestrial-ecosystems>. Contact Michael Schwartz, Program Manager, for more information: 406-542-4161.

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