United States Department of Agriculture

Rocky Mountain Research Station

New Publications

July–September 2017

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The Rocky Mountain Research Station

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% 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 Bureau of Land Management 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. 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

Restoring whitebark pine ecosystems in the face of climate change

Contact Robert Keane, rkeane@fs.fed.us, for printed copies

Restoring whitebark pine ecosystems in the face of climate change. Keane, Robert E.; Holsinger, Lisa M.; Mahalovich, Mary F.; Tomback, Diana F. 2017. Gen. Tech. Rep. RMRS-GTR-361. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 123 p.

Whitebark pine (*Pinus albicaulis*) forests have been declining throughout their range in western North America from the combined effects of mountain pine beetle (*Dendroctonus ponderosae*) outbreaks, fire exclusion policies, and the exotic disease white pine blister rust (*Cronartium ribicola*). A rangewide whitebark pine restoration strategy (Keane et al. 2012b) was developed recently to inform restoration efforts for whitebark pine across Federal, State, and Provincial land management agencies. This strategy, however, did not address the effects of climate change on existing whitebark pine populations and restoration efforts. In this report, we present guidelines for restoring whitebark pine under future climates using the rangewide restoration strategy structure. The information to create the guidelines came from two sources: (1) a comprehensive review of the literature and (2) a modeling experiment that simulated various climate change, management, and fire exclusion scenarios.

https://www.fs.usda.gov/treesearch/pubs/54577.

How to generate and interpret fire characteristics charts for the U.S. fire danger rating system

Online only

How to generate and interpret fire characteristics charts for the U.S. fire danger rating system. Heinsch, Faith Ann; Andrews, Patricia L.; Tirmenstein, Deb. 2017. Gen. Tech. Rep. RMRS-GTR-363. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 58 p.

The fire characteristics chart is a graphical method of presenting U.S. National Fire Danger Rating System (NFDRS) indexes and components as well as primary surface or crown fire behavior characteristics. Computer software has been developed to produce fire characteristics charts for both fire danger and fire behavior in a format suitable for inclusion in reports and presentations. Scales, colors, labels, and legends can be modified as needed. The fire characteristics chart for fire behavior has been described previously (Andrews et al. 2011). This report describes the fire characteristics chart for fire danger, which displays the relationships among the Spread Component, Energy Release Component, and Burning Index by plotting the three values as a single point. Indices calculated by using FireFamilyPlus can be imported into the fire danger characteristics chart software. Example applications of this software for comparing fire seasons, weather stations, and fire danger rating fuel models are presented.

https://www.treesearch.fs.fed.us/pubs/54597

New RMRS Publication Series

Visualization of heterogeneous forest structures following treatment in the southern Rocky Mountains

Online only

Visualization of heterogeneous forest structures following treatment in the southern Rocky Mountains. Tinkham, Wade T.; Dickinson, Yvette; Hoffman, Chad M.; Battaglia, Mike A.; Ex, Seth; Underhill, Jeffrey. 2017. Gen. Tech. Rep. RMRS-GTR-365. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 72 p.

The central purpose of this tool is to link quantitative and visual descriptions of immediate post-treatment spatial forest structure to help communicate desired spatial structures at the stand level in dry forest types of the Rocky Mountains. This tool was developed by simulating four different treatments across four stands with varying productivity that had been identified as candidates for ecological restoration. The simulated treatments included a thin from below, random tree selection, moderate clumping, and high clumping prescriptions. Following the simulated treatments, we produced a visual representation of the spatial pattern of the residual trees and openings; calculated traditional stand-scale metrics; and described the fine-scale forest structure including individual trees, clumps of trees, and openings.

https://www.treesearch.fs.fed.us/pubs/54887

Assessment of aspen ecosystem vulnerability to climate change for the Uinta-Wasatch-Cache and Ashley National Forests, Utah

Online only

Assessment of aspen ecosystem vulnerability to climate change for the Uinta-Wasatch-Cache and Ashley National Forests, Utah. Rice, Janine; Bardsley, Tim; Gomben, Pete; Bambrough, Dustin; Weems, Stacey; Huber, Allen; Joyce, Linda A. 2017. Gen. Tech. Rep. RMRS-GTR-366. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 67 p.

To provide scientific information for land managers facing the challenge of helping aspen ecosystems adapt to climate change, we developed an aspen vulnerability assessment on the Uinta-Wasatch-Cache and Ashley National Forests. Literature-based information and expert elicitation are used to define (a) components of sensitivity and exposure to climate change and (b) the capacity of these ecosystems to adapt to expected changes. Aspen ecosystems benefit from fire and quickly reproduce. Yet, aspen trees are susceptible to drought and heat that is projected to become more frequent and intense in the future. Overall, vulnerability is defined as moderate because although persistence of aspen ecosystems is likely, a dynamic spatial and temporal response to climate change is expected.

https://www.treesearch.fs.fed.us/pubs/54651

New RMRS Publication Series

Developing a monitoring program for bird populations in the Chiricahua Mountains, Arizona, using citizen observers: Initial stages

Online only

Developing a monitoring program for bird populations in the Chiricahua Mountains, Arizona, using citizen observers: Initial stages. Ganey, Joseph L; Iniguez, Jose M.; Sanderlin, Jamie S.; Block, William M. 2017. Gen. Tech. Rep. RMRS-GTR-368. Fort Collins, CO: U.S, Department of Agriculture, Forest Service, Rocky Mountain Research Station. 30 p.

The Madrean Sky Island region is an ecologically important area harboring exceptional biodiversity, including a unique avifauna that supports a thriving ecotourism industry in southeastern Arizona. This area has been impacted by several large wildfires in recent decades. We studied occupancy and habitat associations of forest and woodland birds within five mountain ranges in southeastern Arizona from 1991 to 1995, before these fires occurred. Funding to accomplish the necessary postfire bird sampling has been limited. This report documents the early stages of an effort to sample bird populations in the Chiricahua Mountains, Arizona using citizen observers. It describes field methods, presents preliminary results, summarizes early lessons learned, and outlines future steps necessary to design and implement a rigorous monitoring program using citizen observers to sample bird populations in the Madrean Sky Islands.

https://www.fs.usda.gov/treesearch/pubs/54536

Journals and Other Publications

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Air, water and aquatic environments

Consistent loss of genetic diversity in isolated cutthroat trout populations independent of habitat size and quality. Carim, Kellie J.; Eby, Lisa A.; Barfoot, Craig A.; [et al.]. 2016. Conservation Genetics. 17: 1363–1376. https://www.fs.usda.gov/treesearch/pubs/54711.

Ecological segregation moderates a climactic conclusion to trout hybridization. Young, M.K.; McKelvey, K.S.; Horan, D.; Schwartz, M.K.; [et al.]. 2017. Global Change Biology. doi: 10.1111/gcb.13828. https://www.fs.usda.gov/treesearch/pubs/54920.

Effect of forest cover on water treatment costs. Warziniack, Travis; Sham, Chi Ho; Morgan, Robert; [et al.]. 2017. Water Economics and Policy. 3(4). https://www.fs.usda.gov/treesearch/pubs/55229..

Effects of climate change on cold-water fish in the Northern Rockies. Young, Michael K.; Isaak, Daniel J.; Groce, Matthew C.; Horan, Dona; Nagel, David E.; [et al.] 2018. In: Halofsky J.; Peterson D., eds. Climate change and Rocky Mountain ecosystems. Cham, Switzerland: Springer International. Advances in Global Change Research. 63: 37–58.

Effects of climate change on snowpack, glaciers, and water resources in the Northern Rockies. Luce, Charles H. 2018. In: Halofsky J.; Peterson D., eds. Climate change and Rocky Mountain ecosystems. Cham, Switzerland: Springer International. Advances in Global Change Research. 63: 25–36.

Evidence for gap flows in the Birch Creek Valley, Idaho. Finn, D.; Butler, B.; Wagenbrenner, N.; [et al.]. 2016. Journal of the Atmospheric Sciences. 73(12): 4873–4894. https://www.fs.usda.gov/treesearch/pubs/54956.

Historical and projected climate in the Northern Rockies Region. Joyce, Linda A.; Talbert, Marian; Sharp, Darrin; [et al.]. 2018. In: Halofsky J.; Peterson D., eds. Climate change and Rocky Mountain ecosystems. Cham, Switzerland: Springer International. Advances in Global Change Research. 63: 17–23.

Life history, population viability, and the potential for local adaptation in isolated trout populations. Carim, K.J.; Vindenes, Y.; Eby, L.A.; [et al.]. 2017. Global Ecology and Conservation. 10: 93–102. https://www.fs.usda.gov/treesearch/pubs/54712.

Marine mammal subspecies in the age of genetics: Introductory remarks from the Associate Editor and Editor-in-Chief of Marine Mammal Science. Schwartz, Michael K.; Boness, Daryl J. 2017. Marine Mammal Science. 33(Special Issue): 7–11. https://www.fs.usda.gov/treesearch/pubs/54512.

Post-disturbance sediment recovery: Implications for watershed resilience. Rathburn, Sara L.; Shahverdian, Scott M.; Ryan, Sandra E. 2017. Geomorphology. https://www.fs.usda.gov/treesearch/pubs/55035.

A review of surface energy balance models for estimating actual evapotranspiration with remote sensing at high spatiotemporal resolution over large extents. McShane, Ryan R.; Driscoll, Katelyn P.; Sando, Roy. 2017. Scientific Investigations Report 2017-5087. Washington, DC: U.S. Department of the Interior, U.S. Geological Survey. 19 p.

Twenty-first-century climate in CMIP5 simulations: Implications for snow and water yield across the contiguous United States. Mahat, Vinod; Ramírez, Jorge A.; Brown, Thomas C. 2017. Journal of Hydrometeorology. 18: 2079–2099.

Fire, fuel and smoke

Adapting to wildfire: Moving beyond homeowner risk perceptions to taking action. Champ, Patricia. 2017. In: A century of wildland fire research: Contributions to long-term approaches for wildland fire management: Proceedings of a Workshop. Washington, DC: National Academies of Sciences, Engineering, and Medicine, The National Academies Press: 67–72. https://www.fs.usda.gov/treesearch/pubs/55047.

Journals and Other Publications

Online links are provided if available, but some are available only to Forest Service Personnel because of open access privilege. For the general public, some links may hit a pay wall. Please accept our apologies for any inconvenience.

Analog-based fire regime and vegetation shifts in mountainous regions of the western US. Parks, Sean A.; Holsinger, Lisa M.; Miller, Carol; [et al.]. 2017. Ecography. 40: 001–011. https://www.fs.usda.gov/treesearch/pubs/55029.

Anticipating surprise: Using agent-based alternative futures simulation modeling to identify and map surprising fires in the Willamette Valley, Oregon USA. Hulse, David; Branscomb, Allan; Enright, Chris; [et al.]. 2016. Landscape and Urban Planning. 56: 26–43. https://www.fs.usda.gov/treesearch/pubs/54960.

Assessing climate change impacts on wildfire exposure in Mediterranean areas. Lozano, Olga M.; Salis, Michele; Ager, Alan A.; [et al.]. 2016. Risk Analysis. doi: 10.1111/risa.12739. https://www.fs.usda.gov/treesearch/pubs/54961.

Assessing wildland fire risk transmission to communities in northern Spain. Alcasena, Fermín J.; Salis, Michele; Ager, Alan A.; [et al.]. 2017. Forest. 8: Article 30. https://www.fs.usda.gov/treesearch/pubs/54924.

Bridging the divide between fire safety research and fighting fire safely: How do we convey research innovation to contribute more effectively to wildland firefighter safety? Adams, Theodore Ted; Butler, Bret W.; Brown, Sara; Wright, Vita; Black, Anne. 2017. International Journal of Wildland Fire. 26: 107–112. https://www.fs.usda.gov/treesearch/pubs/53675.

Characterising resource use and potential inefficiencies during large-fire suppression in the western US. Katuwal, Hari; Dunn, Christopher J.; Calkin, David E. 2017. International Journal of Wildland Fire. 26: 604–614. https://www.fs.usda.gov/treesearch/pubs/54857.

Effect of particle aging on chemical characteristics, smoldering, and fire behavior in mixed-conifer masticated fuel. Sikkink, Pamela G.; Jain, Theresa B.; Heinsch, Faith Ann; Keane, Robert E.; Butler, Bret; [et al.]. 2017. Forest Ecology and Management. 405: 150–165. https://www.fs.usda.gov/treesearch/pubs/55027.

Effects of climate oscillations on wildland fire potential in the continental United States. Mason, Shelby A.; Hamlington, Peter E.; Jolly, W. Matt; [et al.]. 2017. Geophysical Research Letters. 44. doi: 10.1002/ 2017GL074111. https://www.fs.usda.gov/treesearch/pubs/54903.

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An empirical machine learning method for predicting potential fire control locations for pre-fire planning and operational fire management. O'Connor, Christopher D.; Calkin, David E.; Thompson, Matthew P. 2017. International Journal of Wildland Fire. 26: 587–597. https://www.fs.usda.gov/treesearch/pubs/54858.

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A framework for developing safe and effective large-fire response in a new fire management paradigm. Dunn, C.J.; Thompson, M.P.; Calkin, D.E. 2017. Forest Ecology and Management. 404: 184–196. https://www.fs.usda/gov/treesearch/pubs/55034.

Impacts of changing fire weather conditions on reconstructed trends in U.S. wildland fire activity from 1979 to 2014. Freeborn, Patrick H.; Jolly, W. Matt; Cochrane, Mark A.

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2016. Journal of Geophysical Research: Biogeosciences. 121: 2856–2876. https://www.fs.usda.gov/treesearch/pubs/54959.

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A large source of dust missing in particulate matter emission inventories? Wind erosion of post-fire landscapes. Wagenbrenner, N.S.; Chung, S.H.; Lamb, B.K. 2017. Elementa: Science of the Anthropocene. 5: Article 2. https://www.fs.usda.gov/treesearch/pubs/54930.

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Predicting post-fire tree mortality for 12 western US conifers using the First-Order Fire Effects Model (FOFEM). Hood, Sharon; Lutes, Duncan. 2017. Fire Ecology. 13(2): 66–84. https://www.fs.usda.gov/treesearch/pubs/55050.

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Qualitative flow visualization of flame attachment on slopes. Grumstrup, Torben P.; McAllister, Sara S.; Finney, Mark A. 2017. Presented at the 10th U. S. National Combustion Meeting; 2017 April 23–26; College Park, MD. Pittsburgh, PA: The Combustion Institute. 6 p. https://www.fs.usda.gov/treesearch/pubs/54927.

Returning fire to the land: Celebrating traditional knowledge and fire. Lake, Frank K.; Wright, Vita; Morgan, Penelope; [et al.]. 2017. Journal of Forestry. 115(5): 343–353. https://www.fs.usda.gov/treesearch/pubs/54392.

A review of challenges to determining and demonstrating efficiency of large fire management. Thompson, Matthew

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P.; Calkin, David E.; Hand, Michael S. [et al.]. 2017. International Journal of Wildland Fire. 26: 562–573. https://www.fs.usda.gov/treesearch/pubs/54860.

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A simulation and optimisation procedure to model daily suppression resource transfers during a fire season in Colorado. Wei, Yu; Thompson, Matthew P.; Calkin, Dave E.; Stonesifer, Crystal S. [et al.]. 2016. International Journal of Wildland Fire. doi: http://dx.doi.org/10.1071/WF16073. https://www.fs.usda.gov/treesearch/pubs/53455.

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Systems thinking and wildland fire management. Thompson, M.P.; Dunn, C.J.; Calkin, D.E. 2017. In: Proceedings of the 60th annual meeting of the International Society for Systems Sciences; 2016 July 23–30; Boulder, CO. International Society for the Systems Sciences. 17 p. https://www.fs.usda.gov/treesearch/pubs/55036.

Temporal optimisation of fuel treatment design in blue gum (*Eucalyptus globulus*) plantations. Martin, Ana; Botequim, Brigite; Oliveira, Tiago M.; [et al.]. 2016. Forest Systems. 25(2): eRC09. https://www.fs.usda.gov/treesearch/pubs/54962.

Towards enhanced risk management: Planning, decision making and monitoring of US wildfire response. Dunn, Christopher J.; Calkin, David E.; Thompson, Matthew P. 2017. International Journal of Wildland Fire. 26(7): 551–556. https://ww.vs.usda.gov/treesearch/pubs/54854.

Towards improving wildland firefighter situational awareness through daily fire behaviour risk assessments in the US Northern Rockies and Northern Great Basin. Jolly, W. Matt; Freeborn, Patrick H. 2017. International Journal of Wildland Fire. 26: 574–586. https://www.fs.usda.gov/treesearch/pubs/54856.

Using an agent-based model to examine forest management outcomes in a fire-prone landscape in Oregon, USA. Spies, Thomas A.; White, Eric; Ager, Alan; [et al.]. 2017. Ecology and Society. 22(1): Article 25. https://www.fs.usda.gov/treesearch/pubs/54928.

Weather, fuels, fire behavior, plumes, and smoke—The nexus of fire meteorology. Goodrick, Scott L.; Brown, Timothy J.; Jolly, W. Matt. 2017. Fire Management Today. 75(1): 33–38. https://www.fs.usda.gov/treesearch/pubs/54902.

Forest and woodland ecosystems

3-Methylcyclohex-2-en-1-one for area and individual tree protection against spruce beetle (Coleoptera: Curculionidae: Scolytinae) attack in the southern Rocky Mountains. Hansen, E. Matthew; Munson, A. Steven; Blackford, Darren C.; [et al.]. 2017. Journal of Economic Entomology. doi: 10.1093/jee/tox208. https://www.fs.usda.gov/treesearch/pubs/54911.

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Can aspen persist in conifer dominated forests? Page, Douglas H.; Shaw, John D. 2016. Tremblings Newsletter & Bulletin Board. 7(3): 2–4. https://www.fs.usda.gov/treesearch/pubs/54975.

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Climate-related genetic variation in a threatened tree species, *Pinus albicaulis*. Warwell, Marcus V.; Shaw, Ruth G. 2017. American Journal of Botany. 104(8): 1205–1218. https://www.fs.usda.gov/treesearch/pubs/54913.

Comparison of heat transfer and soil impacts of air curtain burner burning and slash pile burning. Jang, Woongsoon; Page-Dumroese, Deborah S.; Han, Han-Sup. 2017. Forests. 8: Article 297. 15 p. https://www.fs.usda.gov/treesearch/pubs/54699.

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Conserving threatened riparian ecosystems in the American West: Precipitation gradients and river networks drive genetic connectivity and diversity in a foundation riparian tree (*Populus angustifolia*). Bothwell, Helen M.; Cushman, Samuel A.; Woolbright, Scott A.; [et al.]. 2017. Molecular Ecology. 2017: 1–19. https://www.fs.usda.gov/treesearch/pubs/54910.

The current status of the distribution range of the western pine beetle, *Dendroctonus brevicomis* (Curculionidae: Solytinae) in northern Mexico. Valerio-Mendoza, O.; Armendáriz-Toledano, F.; Negrón, José J.; [et al.]. 2017. Journal of Insect Science. 17(5): 1–7. https://www.fs.usda.gov/treesearch/pubs/55037.

Draft genome sequence of the fungus associated with oak-wilt mortality in South Korea, *Raffaelea quercus-mongolicae* KACC44405. Jeon, Jongbum; Kim, Ki-Tae; Klopfenstein, Ned B.; [et al.]. 2017. Genome Announcements. 5: e00797-17. https://www.fs.usda.gov/treesearch/pubs/55031.

Effects of climate change on ecological disturbance in the Northern Rockies. Loehman, Rachel A.; Bentz, Barbara J.; Keane, Robert E.; Pearson, Dean E.; [et al.]. 2018. In: Halofsky J.; Peterson D., eds. Climate change and Rocky Mountain ecosystems. Cham, Swtzerland: Springer International. Advances in Global Change Research. 63: 115–141.

Effects of climate change on forest vegetation in the Northern Rockies. Keane, Robert E.; Jain, Terrie B.; Holsinger, Lisa M.; [et al.]. 2018. In: Halofsky J.; Peterson D., eds. Climate change and Rocky Mountain ecosystems. Cham, Switzerland: Springer International. Advances in Global Change Research. 63: 59–95. https://www.fs.usda.gov/treesearch/pubs/55073.

Estimating aboveground tree biomass for beetle-killed lodgepole pine in the Rocky Mountains of northern Colorado. Chung, Woodam; Evangelista, Paul; Anderson, Nathaniel; [et al.]. 2017. Forest Science. 63(4): 413–419. https://www.fs.usda.gov/treesearch/pubs/55043.

Eucalypt powdery mildew caused by *Podosphaera pannosa* in Brazil. Fonseca, Natalia R.; Guimaraes, Lucio M. S.; Klopfenstein, Ned B.; [et al.]. 2017. Topical Plant Pathology. 42: 261-271. https://www.fs.usda.gov/treesearch/pubs/55030.

Evaluating future success of whitebark pine ecosystem restoration under climate change using simulation modeling. Keane, Robert E.; Holsinger, Lisa M.; Mahalovich, Mary F.; [et al.]. 2017. Restoration Ecology. 25(2): 220–233. https://www.fs.usda.gov/treesearch/pubs/54591.

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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 William Block, Program Manager, for more information: 928-556-2161.

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