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New Publications

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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

Wildcat5 for Windows, a rainfall-runoff hydrograph model: User manual

Contact Dan Cenderelli, dcenderelli@fs.fed.us, for a printed copy

Wildcat5 for Windows, a rainfall-runoff hydrograph model: User manual and documentation. Hawkins, R.H.; Barreto-Munoz, A. 2016. Gen. Tech. Rep. RMRS-GTR-334. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 68 p.

Wildcat5 for Windows (Wildcat5) is an interactive Windows Excel®-based software package designed to assist watershed specialists in analyzing rainfall runoff events to predict peak flow and runoff volumes generated by single-event rainstorms for a variety of watershed soil and vegetation conditions. Model inputs are: (1) rainstorm characteristics, (2) parameters related to watershed soil and cover, (3) runoff timing parameters, and (4) unit hydrograph shape and scale selections. Many choices are available for each of the input categories and guidance is provided for their appropriate selection. The model is intended for small catchments responsive to conditions of upland soils and cover. Its peak flow estimation techniques are appropriate for projects such as gully control, culvert sizing and forest roads, environmental impact analyses, and post-wildfire hydrologic response.

http://www.fs.fed.us/rm/pubs/rmrs_gtr334.html

Forest root diseases across the United States

Contact Blakey Lockman, blockman@fs.fed.us, for a printed copy

Forest root diseases across the United States. Lockman, I. Blakey; Kearns, Holly S.J., eds. 2016. Gen. Tech. Rep. RMRS-GTR-342. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 55 p.

The increasing importance and impacts of root diseases on the forested ecosystems across the United States are documented in this report. Root diseases have long-term impacts on the ecosystems where they reside due to their persistence onsite. As a group of agents, they are a primary contributor to overall risk of growth loss and mortality of trees in the lower 48 States. Root diseases kill trees, decay wood, slow tree growth, predispose trees to other mortality agents, and cause trees to fail or fall over. In this manner, these diseases reduce timber volume, alter forest composition and structure, impair ecosystem function, and decrease carbon sequestration. Root diseases cause tree failures that can result in serious injury, damage, or death, and are thus important components in hazard tree management. Without adequate knowledge of root diseases and their roles in forested ecosystems, our ability to manage their negative impacts and build resilient forest landscapes is severely compromised.

http://www.fs.fed.us/rm/pubs/rmrs_gtr342.html

New RMRS Publication Series

Vulnerability of cattle production to climate change on U.S. rangelands

Online only

Vulnerability of cattle production to climate change on U.S. rangelands. Reeves, Matt C.; Bagne, Karen E. 2016. Gen. Tech. Rep. RMRS-GTR-343. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 39 p.

We examined multiple climate change effects on cattle production for U.S. rangelands to estimate relative change and identify sources of vulnerability among seven regions. Climate change effects to 2100 were projected from published models for four elements: forage quantity, vegetation type trajectory, heat stress, and forage variability. Departure of projections from a baseline (2001-2010) was used to estimate vulnerability. Projections show: (1) an increase in forage quantity in northerly regions, (2) a move toward grassier vegetation types overall but with considerable spatial heterogeneity, (3) a rapid increase in the number of heat-stress days across all regions, and (4) higher forage variability for most regions. Results are robust across multiple elements for declining production in southerly and western regions. In northern and interior regions, the benefits of increased net primary productivity or more grassy vegetation are mostly tempered by increases in heat stress and forage variability.

http://www.fs.fed.us/rm/pubs/rmrs_gtr343.html

Nevada photo-based inventory pilot (NPIP) resource estimates (2004–2005)

Contact Tracey Frescino, tfrescino@fs.fed.us, for a printed copy

Nevada Photo-Based Inventory Pilot (NPIP) resource estimates (2004-2005). Frescino, Tracey S.; Moisen, Gretchen G.; Patterson, Paul L.; Freeman, Elizabeth A.; Menlove, James. 2016. Gen. Tech. Rep. RMRS-GTR-344. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 59 p.

In 2004, a pilot study named the Nevada Photo-Based Inventory Pilot (NPIP) was initiated for Nevada using large-scale aerial photography to obtain ancillary information for inventory of forest land and lands not traditionally sampled by FIA, such as rangelands and riparian areas. Objectives of the pilot included development of photo-sampling protocol, statistical estimators, quality control procedures, and cost analyses. This report augments FIA's standard forest reporting by providing new estimates on both forest and nonforest components of Nevada's landscape to include area by cover type, prevalence of non-traditional elements such as disturbance and riparian, and an in-depth analysis of cover distributions. In addition, 250-m (820-ft) resolution maps of species' distributions, live tree cover, and vegetation condition type are also provided.

http://www.fs.fed.us/rm/pubs/rmrs_gtr344.html

New RMRS Publication Series

Risk terminology primer: Basic principles and a glossary for the wildland fire management community

Available online now. Printed copies will be available in August 2016

Risk terminology primer: Basic principles and a glossary for the wildland fire management community. Thompson, Matthew P.; Zimmerman, Tom; Mindar, Dan; Taber, Mary. 2016. Gen. Tech. Rep. RMRS-GTR-349. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 13 p.

Risk management is being increasingly promoted as an appropriate method for addressing wildland fire management challenges. However, a lack of a common understanding of risk concepts and terminology is hindering effective application. In response, this General Technical Report provides a set of clear, consistent, understandable, and usable definitions for terms associated with wildland fire risk management. The material presented herein is not brand-new or innovative per se, but rather synthesizes the extant science so that readers can readily make a crosswalk to the professional literature. The broad objectives of this effort are to provide context and information to support application of risk terminology across all levels of risk management, and to facilitate clear exchange of data, information, and ideas among fire management officers, staff, and scientists.

http://www.fs.fed.us/rm/pubs/rmrs_gtr349.html

Risk management: Core principles and practices, and their relevance to wildland fire

Available online now. Printed copies will be available in August 2016

Risk management: Core principles and practices, and their relevance to wildland fire. Thompson, Matthew P.; MacGregor, Donald G.; Calkin, David E. 2016. Gen. Tech. Rep. RMRS-GTR-350. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 29 p.

Risk management (RM) has long been put forth as an appropriate approach for addressing fire, and agency-wide adoption of RM principles and practices will be critical to bring about necessary change and improve future decisions. To facilitate more comprehensive adoption of formal RM frameworks, we designed this report as an introduction to RM. We repackaged and repurposed information from the extant RM literature to help readers develop a sound, science-based understanding of RM concepts. A primary intent of the report is to bring coherence and consistency to a topic that the Forest Service and the fire community have been discussing for years. We outline what adoption of RM would look like in practice, and recommend next steps as the Forest Service continues on its RM journey. Ultimately, we hope fostering an improved understanding of RM will lead to higher probabilities of achieving desired outcomes and conditions.

http://www.fs.fed.us/rm/pubs/rmrs_gtr350.html

New RMRS Publication Series

Utah's forest resources, 2003–2012

Contact Chuck Werstak, cewerstak@fs.fed.us, for a printed copy

Utah's forest resources, 2003-2012. Werstak, Charles E., Jr.; Shaw, John D.; Goeking, Sara A.; Witt, Chris; Menlove, Jim; Thompson, Michael T.; DeRose, R. Justin; Amacher, Michael C.; Jovan, Sarah; Morgan, Todd A.; Sorenson, Colin B.; Hayes, Steven W.; McIver, Chelsea P. 2016. Resour. Bull. RMRS-RB-20. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 159 p.

This report presents a summary of the most recent inventory of Utah's forests based on field data collected from 2003 through 2012. Results show that Utah's forest land area totals 18.3 million acres. Fifteen percent (2.8 million acres) of this forest land is privately owned, and another 35 percent (6.3 million acres) is administered by the United States Department of Agriculture (USDA) Forest Service. The pinyon/juniper forest-type group is the most predominant group covering more than 10.7 million acres and accounts for 59 percent of the forest land in Utah. The State's most predominant forest type is pinyon/juniper woodland covering nearly 8 million acres and accounts for 44 percent of the forest land in Utah. Gambel oak is the most abundant tree species by number of trees, and Utah juniper is the most abundant by volume or biomass.

http://www.fs.fed.us/rm/pubs/rmrs_rb020.html

The Four Corners timber harvest and forest products industry, 2012

Contact Steve Hayes, steve.hayes@business.umt.edu, for a printed copy

The Four Corners timber harvest and forest products industry, 2012. Sorenson, Colin B.; Hayes, Steven W.; Morgan, Todd A.; Simmons, Eric A.; Scudder, Micah G.; McIver, Chelsea P.; Thompson, Mike T. 2016. Resour. Bull. RMRS-RB-21. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 62 p.

This report traces the flow of timber harvested in the "Four Corners" States (Arizona, Colorado, New Mexico, and Utah) during calendar year 2012, describes the composition and operations of the region's primary forest products industry, and quantifies volumes and uses of wood fiber. Recent changes in the wood products industry are discussed, as well as trends in timber harvest, production, and sales of primary wood products.

http://www.fs.fed.us/rm/pubs/rmrs_rb021.html

New RMRS Publication Series

Shrub succession on eight mixed-severity wildfires in western Montana, northeastern Oregon, and northern Idaho

Online only

Shrub succession on eight mixed-severity wildfires in western Montana, northeastern Oregon, and northern Idaho. Ferguson, Dennis E.; Byrne, John C. 2016. Res. Pap. RMRS-RP-106. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 81 p.

The response of 28 shrub species to wildfire burn severity was assessed for 8 wildfires on 6 national forests in the northern Rocky Mountains, USA. Stratified random sampling was used to choose 224 stands based on burn severity, habitat type series, slope steepness, stand height, and stand density, which resulted in 896 plots measured at approximately 2-year intervals from 1 to 11 years after the fire. For each species, mathematical models were developed to predict the probability of occurrence on 1/300-acre plots, cover on the plot, and average height. The association between burn severity and the probability of occurrence was generally negative. For most species, occurrence increased with increasing time since the wildfire. Cover decreased with increasing burn severity, except for some species that are dependent on seed for establishment. The longer it took the species to become established on the plot, the less cover could be expected. The best variable to predict shrub height was the cover of that species on the plot.

http://www.fs.fed.us/rm/pubs/rmrs_rp106.html

Journals and Other Publications

Air, water, and aquatic environments

Climate adaption [adaptation] and post-fire restoration of a foundational perennial in cold desert: Insights from intraspecific variation in response to weather. Brabec, M.M.; Germino, M.J.; Richardson, B.A. 2016. Journal of Applied Ecology. 10 p. doi: 10.1111/1365-2664.12679. http://www.treesearch.fs.fed.us/pubs/52208.

The effects of climate change and extreme wildfire events on runoff erosion over a mountain watershed. Gould, Gregory K.; Liu, Mingliang; Barber, Michael E.; Cherkauer, Keith A.; Robichaud, Peter R.; Adam, Jennifer C. 2016. Journal of Hydrology. 536: 74–91. http://www.treesearch.fs.fed.us/pubs/52116.

Evaluation of methods for delineating riparian zones in a semi-arid montane watershed. Salo, Jessica A.; Theobald, David M.; Brown, Thomas C. 2016. Journal of the American Water Resources Association. 52(3): 632-647. http://www.treesearch.fs.fed.us/pubs/52081.

Fire, fuel, and smoke

Assessing impacts of fire and post-fire mitigation on runoff and erosion from rangelands. Pierson, Frederick

Journals and Other Publications

B.; Williams, C. Jason; Robichaud, Peter R. 2015. Great Basin Factsheet Series. Number 11. 6 p. http://www.treesearch.fs.fed.us/pubs/52114.

Avian relationships with wildfire at two dry forest locations with different historical fire regimes. Latif, Q.S.; Sanderlin, J.S.; Saab, V.A.; Block, W.M.; Dudley, J.G. 2016. Ecosphere. 7(5): e01346. http://www.treesearch.fs.fed.us/pubs/50963.

Fighting fire in the heat of the day: An analysis of operational and environmental conditions of use for large airtankers in United States fire suppression. Stonesifer, Crystal S.; Calkin, David E.; Thompson, Matthew P.; Stockmann, Keith D.2016. International Journal of Wildland Fire. 25: 520–533. http://www.treesearch.fs.fed.us/pubs/50972.

Fire and drought. Littell, Jeremy S.; Peterson, David L.; Riley, Karin L.; Liu, Yongqiang; Luce, Charles H. 2016. In: Vose, James M.; Clark, James S.; Luce, Charles H.; Patel-Weynard, Toral, eds. Effects of drought on forests and rangelands in the United States: A comprehensive science synthesis. Gen. Tech. Rep. WO-93b. Washington, DC: U.S. Department of Agriculture, Forest Service, Washington Office: 135–154. http://www.treesearch.fs.fed.us/pubs/50971.

Forest fuels and potential fire behavior 12 years after variable-retention harvest in lodgepole pine. Crotteau, Justin S.; Keyes, Christopher R.; Sutherland, Elaine K.; Wright, David K.; Egan, Joel M. 2016. International Journal of Wildland Fire. http://dx.doi.org/10.1071/WF14223. http://www.treesearch.fs.fed.us/pubs/52085.

Fuel loads and simulated fire behavior in 'old-stage' beetle-infested ponderosa pine of the Colorado Plateau. Hansen, E.M.; Johnson, M.C.; Bentz, B.J.; Vandygrif, J.C.; Munson, A.S. 2015. Forest Science 61: 644–664. http://www.treesearch.fs.fed.us/pubs/52199.

How will climate change affect wildland fire severity in the western US? Parks, Sean A.; Miller, Carol; Abatzoglou, John T.; Holsinger, Lisa M.; Parisien, Marc-Andre; Dobrowski, Solomon Z. 2016. Environmental Research Letters. 11: 035002. http://www.treesearch.fs.fed.us/pubs/50582.

Infiltration and interrill erosion rates after a wildfire in western Montana, USA. Robichaud, Peter R.; Wagenbrenner, Joseph W.; Pierson, Fredrick B.; Spaeth, Kenneth E.; Ashmun, Louise E.; Moffet, Corey A. 2016. Catena. 142: 77–88. http://www.treesearch.fs.fed.us/pubs/52117.

Influences of prior wildfires on vegetation response to subsequent fire in a reburned Southwestern landscape. Coop, Jonathan D.; Parks, Sean A.; McClernan, Sarah R.; Holsinger, Lisa M. 2016. Ecological Applications. 26(2): 346–354. http://www.treesearch.fs.fed.us/pubs/52205.

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Reburns and their Impact on carbon pools, site productivity, and recovery. Page-Dumroese, Deborah S.; Jain, Theresa B.; Sandquist, Jonathan E.; Tirocke, Joanne M.; Errecart, John; Jurgensen, Martin F. 2015. In: Potter, Kevin M.; Conkling, Barbara L., eds. Forest Health Monitoring: National status, trends, and analysis 2014. Gen. Tech. Rep. SRS-209. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. p. 143–149. http://www.treesearch.fs.fed.us/pubs/52093.

A review of the relationships between drought and forest fire in the United States. Littell, Jeremy S.; Peterson, David L.; Riley, Karin L.; Liu, Yongquiang; Luce, Charlie H. 2016. Global Change Biology. doi: 10.1111/gcb.13275. http://www.treesearch.fs.fed.us/pubs/50970.

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Toward a more ecologically informed view of severe forest fires. Hutto, Richard L.; Keane, Robert E.; Sherriff, Rosemary L.; Rota, Christopher T.; Eby, Lisa A.; Saab, Victoria A. 2016. Ecosphere. 7(2): e01255. http://www.treesearch.fs.fed.us/pubs/50804.

Forest and woodland ecosystems

Bioclimatic modeling predicts potential distribution of *Armillaria solidipes* and *Pseudotsuga menziesii* (Douglas-fir) under contemporary and changing climates in the interior western USA. Hanna, J.W.; Warwelz, M.V.; Maffei, H.; Fairweather, M.L.; Blodgett, J.T.; Zambino, P. J.; Worralz, J.; Burns, K.S.; Jacobs, J. J.; Ashiglar, S.M .; Lundquist, J.E.; Kim, M.-S.; Ross-Davis, A.L.; Hoffman, C.; Mathiasen, R.; Hofstetter, R.; Shaw, J.D.; Pitman, E.W.I.; Nelson, E.V.; McDonald, G.I.; Cleary, M.R.; Brar, S.; Richardson, B. A.; Klopfenstein, N.B. 2015. In: Ramsey, Amy; Palacios, Patsy, comps. Proceedings of the 63rd annual western international forest disease work conference; September 21-25, 2015; Newport, OR. Olympia, WA: Washington Department of Natural Resources; Logan, UT: Utah State University, Quinney College of Natural Resources: 117–123. http://www.treesearch.fs.fed.us/pubs/52098.

Can metagenetic studies of soil microbial communities provide insights toward developing novel management approaches for Armillaria root disease? Kim, Mee-Sook; Ross-Davis, Amy L.; Stewart, Jane E .; Hanna, John W.; Warwell, Marcus V.; Zambino, Paul J.; Cleaver, Christy; McDonald, Geral I.; Page-Dumroese, Debbie S.; Moltzan, Bruce; Klopf enstein, Ned B. 2015. In: Ramsey, Amy; Palacios, Patsy, comps. Proceedings of the 63rd annual western international forest disease work conference; September 21-25, 2015; Newport, OR. Olympia, WA: Washington Department of Natural Resources; Logan, UT: Utah State University, Quinney College of Natural Resources: : 129–131. http://www.treesearch.fs.fed.us/pubs/52100.

Climate drivers of seed production in *Picea engelmannii* and response to warming temperatures in the southern Rocky Mountains. Buechling, Arne; Martin, Patrick H.; Canham, Charles D.; Sheppherd, Wayne D.; Battaglia, Mike A. 2016. Journal of Ecology. 104: 1051–1062. http://www.treesearch.fs.fed.us/pubs/52129.

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Fine-scale variability of forest soil fungal communities in two contrasting habitat series in northern Idaho, USA identified with microbial metagenomics. Ross-Davis, Amy; Stewart, Jane E.; Settles, Matt; Hanna, John W.; Shaw, John D.; Hudak, Andrew T.; Page-Dumroese, Deborah S.; Klopfenstein, Ned B. 2016. In: Ramsey, Amy; Palacios, Patsy, comps. Proceedings of the 63rd annual western international forest disease work conference; September 21–25, 2015; Newport, OR. Olympia, WA: Washington Department of Natural Resources; Logan, UT: Utah State University, Quinney College of Natural Resources: 145–149. http://www.treesearch.fs.fed.us/pubs/52084.

Forest health in a changing world: Effects of globalization and climate change on forest insect and pathogen impacts. Ramsfield, T.D.; Bentz, B.J.; Faccoli, M.; Jactel, H.; Brockerhoff, E.G. 2016. Forestry, 89:245–252. http://www.treesearch.fs.fed.us/pubs/52203.

Forest operations and woody biomass logistics to improve efficiency, value, and sustainability. Anderson, Nathaniel; Mitchell, Dana. 2016. Bioenergy Research. 9: 518–533. http://www.treesearch.fs.fed.us/pubs/50966.

Journals and Other Publications

Genetic diversity and population structure of *Raffaelea quercus-mongolicae*, a fungus associated with oak mortality in South Korea. Kim, M. -S.; Hohenlohe, P. A.; Kim, K. -H.; Seo, S. -T.; Klopfenstein, N. B. 2016. Forest Pathology. 46: 164-167. http://www.treesearch.fs.fed.us/pubs/52102.

Herbivory and advance reproduction influence quaking aspen regeneration response to management in southern Utah, USA. Britton, Justin M.; DeRose, R. Justin; Mock, Karen E.; Long, James N. 2016. Canadian Journal of Forest Research. 46: 674–682. http://www.treesearch.fs.fed.us/pubs/51054.

An integrated taxonomic approach to survey *Armillaria* in Iran. Jafarpour, Saeideh; Fotouhifar, Khalil-Berdi; Javan-Nikhhah, Mohanimad; Reza Ase, Mohhamad; Davis, Anthony S.; Ross-Davis, Amy L.; Hanna, John W.; Margaritescu, Simona; Moncalvo, Jean-Marc; Klopfenstein, Ned B. 2015. In: Ramsey, Amy; Palacios, Patsy, comps. Proceedings of the 63rd annual western international forest disease work conference; September 21–25, 2015; Newport, OR. Olympia, WA: Washington Department of Natural Resources; Logan, UT: Utah State University, Quinney College of Natural Resources: 125–128. http://www.treesearch.fs.fed.us/pubs/52099.

Long-term soil changes from forest harvesting and residue management in the northern Rocky Mountains. Jang, Woongsoon; Page-Dumroese, Deborah S.; Keyes, Christopher R. 2016. Soil Science Society of America Journal. doi: 10.2136/sssaj2015.11.0413. http://www.treesearch.fs.fed.us/pubs/51073.

Long-term thinning alters ponderosa pine reproduction in northern Arizona. Flathers, Kelsey N.; Kolb, Thomas E.; Bradford, John B.; Waring, Kristen M.; Moser, W. Keith. 2016. Forest Ecology and Management. 374: 154–165. http://www.treesearch.fs.fed.us/pubs/50969.

Meeting forest restoration challenges: Using the Target Plant Concept. Dumroese, R.K.; Landis, T.D.; Pinto, J.R.; Haase, D.L.; Wilkinson, K.W.; Davis, A.S. 2016. Reforesta 1: 37–52. http://www.treesearch.fs.fed.us/pubs/52082.

Molecular genetic characterization of the koa-wilt pathogen (*Fusarium oxysporum*): Application of molecular genetic tools toward improving koa restoration in Hawai'i. Kim, Mee-Sook; Stewart, Jane E.; Dudley, Nicklos; Dobbs, John; Jones, Tyler; Cannon, Phil G.; James, Robert L.; Dumroese, R. Kasten; Klopfenstein, Ned B. 2015. In: Ramsey, Amy; Palacios, Patsy, comps. Proceedings of the 63rd annual western international forest disease work conference; September 21-25, 2015; Newport, OR. Olympia, WA: Washington Department of Natural Resources; Logan, UT: Utah State University, Quinney College of Natural Resources: 133–135. http://www.treesearch.fs.fed.us/pubs/52101.

Observed and anticipated impacts of drought on forest insects and diseases in the United States. Kolb, T.E.; Fettig, C.J.; Bentz, B.J; Stewart, J.E.; Weed, A.S.; Hicke, J.A.; Ayres, M.P.; Mathiasen, R. 2016. Forest Ecology and Management. doi:10.1016/j.foreco.2016.04.051. http://www.treesearch.fs.fed.us/pubs/52201.

Population dynamics of bark beetles. Weed, A.S.; Ayres, M.P.; Bentz, B.J. 2015. In: Vega, F.; Hofstetter, R., eds. Bark beetles: Biology and ecology of native and invasive species. Elsevier: 157–176.

Population genomic analyses of the brown root-rot pathogen, Phellinus noxius, examine potential invasive spread among Pacific islands. Stewart, Jane E.; Kim, Mee-Sook; Shuey, Louise; Sahashi, Norio; Ota, Yuko; Schlub, Robert L.; Cannon, Phil G.; Klopfenstein, Ned B. 2016. In: Ramsey, Amy; Palacios, Patsy, comps. Proceedings of the 63rd annual western international forest disease work conference; September 21–25, 2015; Newport, OR. Olympia, WA: Washington Department of Natural Resources; Logan, UT: Utah State University, Quinney College of Natural Resources: 151–153. http://www.treesearch.fs.fed.us/pubs/52104.

Responses of tree-killing bark beetles to a changing climate. Raffa, K.F.; Aukema, B.H.; Bentz, B.J.; Carroll, A.L.; Hicke, J.A.; Kolb, T.E. 2015. In: Bjorkman, Christer; Niemela,

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Soil enzyme activities in *Pinus tabuliformis* (Carriere) plantations in northern China. Wang, Weiwei; Page-Dumroese, Deborah; Lv, Ruiheng; Xiao, Chen; Li, Guolei; Liu, Yong. 2016. Forests. 7(6): 112. http://www.treesearch.fs.fed.us/pubs/51072.

Spatial and temporal quantification of forest residue volumes and delivered costs. Wells, Lucas A.; Chung, Woodam; Anderson, Nathaniel M.; Hogland, John S. 2016. Canadian Journal of Forest Research. 46: 832–843. http://www.treesearch.fs.fed.us/pubs/50967.

Grasslands, shrublands, and desert ecosystems

Great Basin Native Plant Project: 2015 Progress Report. Kilkenny, Francis; Edwards, Fred; Malcomb, Alexis. 2016. Boise, ID: U.S. Department of Agriculture, Rocky Mountain Research Station, Boise Aquatic Sciences Lab. 238 p. http://www.treesearch.fs.fed.us/pubs/52087.

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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. Website: http://www.fs.fed.us/rm/boise/awae_home.shtml. Contact Frank McCormick, Program Manager, for more information: 208-373-4351.

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. Website: http://leopold.wilderness.net. 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. Website: http://www.firelab.org. Contact Bret Butler, Acting Program Manager, for more information: 406-329-4801.

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 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. 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 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. Website: http://www.fs.fed.us/rm/ogden/. Contact Michael Wilson, Program Manager, 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. Website: http://www.fs.fed.us/rm/science-application-integration/. 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. Website: http://www.rmrs.nau.edu/wildlife/. Contact William Block, Program Manager, for more information: 928-556-2161.

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