USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Rocky Mountain Research Station

New Publications

July–September 2022

CONTENTS

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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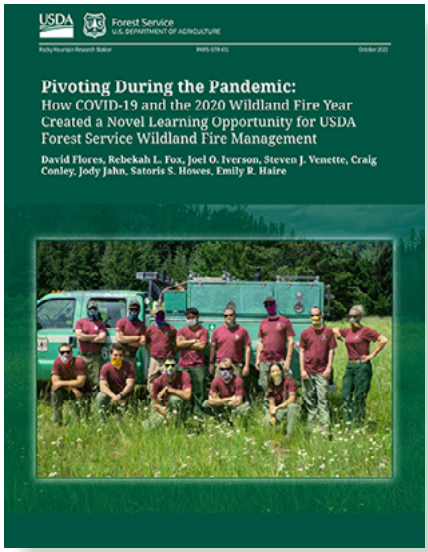
New RMRS Series Publications

All RMRS Series publications are available on Treesearch at the links below.

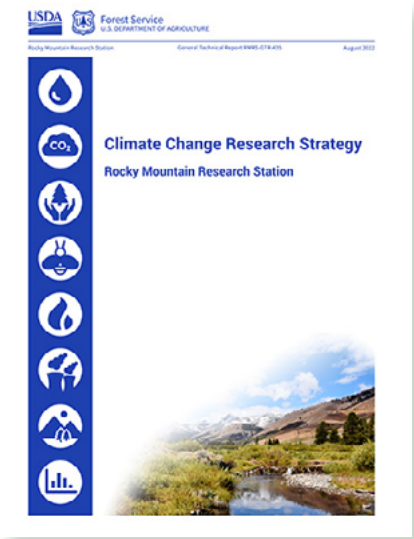


Flores, David; Fox, Rebekah L.; Iverson, Joel O.; Venette, Steven J.; Conley, Craig; Jahn, Jody; Howes, Satoris S.; Haire, Emily R. 2022. Pivoting during the pandemic: How COVID-19 and the 2020 wildland fire year created a novel learning opportunity for USDA Forest Service wildland fire management. Gen. Tech. Rep. RMRS-GTR-431. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 52 p.

The USDA Forest Service anticipated that COVID-19 outbreaks among fire management personnel would potentially impact the agency's ability to maintain the readiness of the wildland fire system and to respond to large complex wildfires across the country. In response, the agency implemented emergency action plans across the United States in March 2020 to reduce spread of COVID-19. When pandemic conditions were first emerging and information about how to mitigate risk of the virus was highly uncertain, fire personnel were learning to adapt their everyday work practices and to navigate an overwhelming amount of conflicting information regarding virus mitigation, transmission, and spread. Forest Service field personnel provided hundreds of everyday lessons learned and corresponding suggested tactics across the 194 focus groups administered during this project. To organize the large amount of data and facilitate future application of on-the-ground lessons, we situate each lesson within one of three overarching categories: communication, organizational culture, and organizational learning. We anticipate that decision uncertainty arising from the pandemic such as tensions between policies and procedures, decision space, and personal life will have wide and lasting impacts for wildland firefighters at all levels.

Keywords: fire management; pandemic; uncertainty; risk; organizational learning; organizational culture; communication; focus groups

Online: https://www.fs.usda.gov/research/treesearch/65311

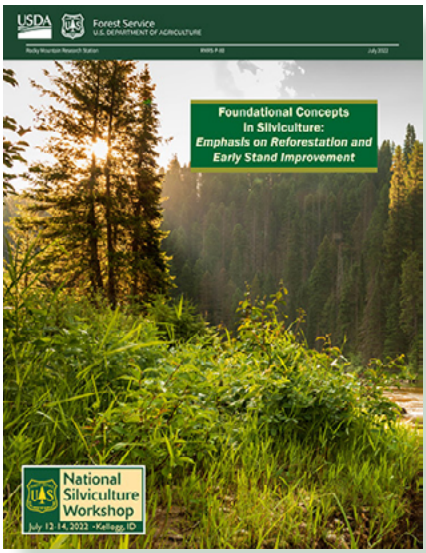


Rocky Mountain Research Station. 2022. Climate change research strategy–Rocky Mountain Research Station. Gen. Tech. Rep. RMRS-GTR-435. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 16 p.

This report presents the strategic direction for research at the Rocky Mountain Research Station to address climate change challenges in the context of resilience, disturbance, and recovery. It describes how current and future RMRS research programs could be enhanced and applied to address emerging challenges.

Keywords: carbon sequestration; climate change; Interior West; land and resource management; resilience

Online: https://www.fs.usda.gov/research/treesearch/64687

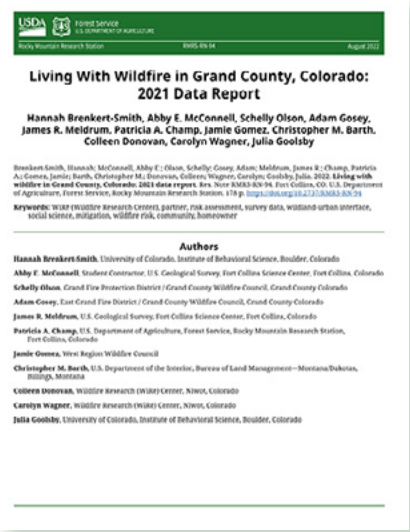


Jain, Theresa B.; Schuler, Thomas M. [comp.]. 2022. Foundational concepts in silviculture with emphasis on reforestation and early stand improvement - 2022 National Silviculture Workshop. Proc. RMRS-P-80. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. n.p.

Beginning in 1973, the National Silviculture Workshop (NSW) purposely brought together USDA Forest Service scientists from Research and Development and forest managers from the National Forest System to meet face-to-face to build a science and management partnership in silviculture. Recently, scientists from universities and other partners have joined this annual gathering. The 2022 NSW theme is "Foundational Concepts in Silviculture: Emphasis on Reforestation and Early Stand Improvement." In 2022, the workshop is scheduled to take place in Kellogg, Idaho and is being jointly hosted by the National Forest System (NFS) and Research and Development (R&D) and sponsored by the Forest Management, Rangeland Management and Vegetation Ecology (NFS) and Sustainable Forest Management Research (R&D) staff areas. In addition, regional hosts will be the Forest Service Northern Region and the Rocky Mountain Research Station. Unique to this workshop was the occurrence of COVID-19, which resulted in the postponement of the workshop scheduled for 2021 when the workshop participants could meet in person. The intent of the workshop is to provide face-to-face interactions among the attendees to build a community of scientists and managers in the field of silviculture to better manage our national forests. Critical to this effort are field tours where scientists and managers can see firsthand how treatments have been implemented and share different perspectives where everyone can be heard. Each paper in this proceedings follows a designed template that includes an overview, summary, silvicultural concepts, and management applications, or in some cases, highlighted management opportunities.

Keywords: silviculture; stand improvement; artificial and natural regeneration; forest thinning; forest management; restoration; stand tending reforestation

Online: https://www.fs.usda.gov/research/treesearch/64530
Also includes links to individual papers.


Living With Wildfire in Grand County, Colorado: 2021 Data Report

Hannah Brenkert-Smith, Abby E. McConnell, Schelly Olson, Adam Gosey, James R. Meldrum, Patricia A. Champ, Jamie Gomez, Christopher M. Barth, Colleen Donovan, Carolyn Wagner, Julia Goolsby

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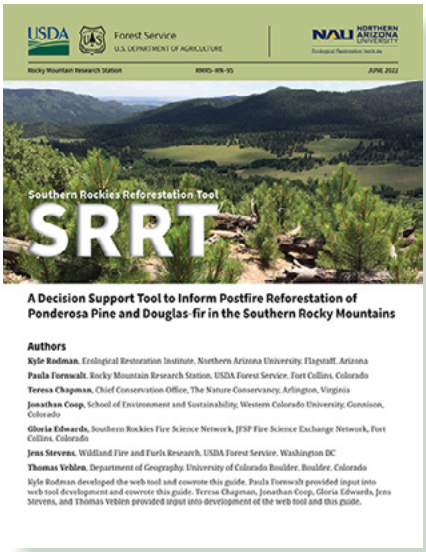
Brenkert-Smith, Hannah; McConnell, Abby E.; Olson, Schelly; Gosey, Adam; Meldrum, James R.; Champ, Patricia A.; Gomez, Jamie; Barth, Christopher M.; Donovan, Colleen; Wagner, Carolyn; Goolsby, Julia. 2022. Living with wildfire in Grand County, Colorado: 2021 data report. Res. Note RMRS-RN-94. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 178 p.

Wildfire affects hundreds of wildland-urban interface communities each year, and yet most communities lack data reflecting the conditions before an event. This study was conducted before the devastating 2020 East Troublesome Fire, which spread across 193,812 acres and resulted in two lives lost and 366 homes and 214 other structures burned. The fire's dramatic run threatened over 7,000 structures and led to a mandatory evacuation of over 35,000 people in Grand and Larimer Counties. The data reported here serve as baseline data to aid in understanding the parcel and social conditions before the fire. This report presents results from WiRē Rapid Wildfire Risk Assessment (WiRē RA) data, collected from 1,162 private residential properties in six communities in five fire protection districts (FPDs), the majority (72%) of which were characterized as high, very high, or extreme risk.

This report also presents results from household surveys sent to homeowners in the study area. Household survey respondents underestimated their risk compared to the conditions observed through the professional risk assessment. Respondents consistently overestimated the amount of defensible space and the distance from their homes to nonvegetative combustibles. Respondents also overestimated the availability of driveway clearance that would enable access for response vehicles and for safe passing of residents evacuating and responders arriving to their homes.

Keywords: WiRē (Wildfire Research Center); partner; risk assessment; survey data; wildland-urban interface; social science; mitigation; wildfire risk; community; homeowner

Online: https://www.fs.usda.gov/research/treesearch/64675



Rodman, Kyle; Fornwalt, Paula; Chapman, Teresa; Coop, Jonathan; Edwards, Gloria; Stevens, Jens; Veblen, Thomas. 2022. SRRT: A decision support tool to inform postfire reforestation of ponderosa pine and Douglas-fir in the southern Rocky Mountains. Res. Note RMRS-RN-95. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 12 p.

Recent increases in area burned, combined with poor natural regeneration in some areas, have promoted concerns about widespread forest losses throughout the western U.S. Postfire reforestation is one strategy commonly employed by land managers and land owners to facilitate forest recovery, but the area in need of planting only becomes larger each year. The Southern Rockies Reforestation Tool (SRRT) is a simple web-mapping tool that was developed to help prioritize sites for postfire reforestation. This tool can be used to develop maps of fire severity and seedling suitability for ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*), two abundant conifer species in the Southern Rocky Mountains. The seedling suitability map identifies areas that are (1) distant from live seed sources, but (2) have high topoclimatic suitability for the species of interest. In combination, these factors may help to locate sites where natural regeneration is unlikely to occur quickly, but relatively cool and wet conditions may enhance planting success. Finally, these maps can be restricted based on operational constraints such as slope angle or distance to road, and exported for use in external GIS software.

Keywords: climate adaptation; climate suitability; decision support tool; fire severity; post-fire reforestation; USFS Region 2; USFS Region 3; wildfire

Online: https://www.fs.usda.gov/research/treesearch/64517

Journals and Other Publications

External publications written by RMRS scientists, available on Treesearch and grouped by Science Program Areas. For more information on our Science Program Areas, please visit our web site: www.fs.usda.gov/rmrs/science-program-areas/.

Fire, Fuel and Smoke

Ager, Alan A. 2022. Contribution of risk science and scenario planning to build the 2022 US wildfire crisis strategy. Environmental Science Proceedings. 17: 15.

Ager, Alan A.; Barros, Ana M. G.; Day, Michelle A. 2022. Contrasting effects of future wildfire and forest management scenarios on a fire excluded western US landscape. Landscape Ecology. 37: 1091-1112.

Jimenez-Ruano, Adrian; Jolly, William M.; Freeborn, Patrick H.; Vega-Nieva, Daniel Jose; Monjaras-Vega, Norma Angelica; Briones-Herrera, Carlos Ivan; Rodrigues, Marcos. 2022. Spatial predictions of human and natural-caused wildfire likelihood across Montana (USA). Forests. 13: 1200.

Keane, Robert E.; Bentz, Barbara; Holsinger, Lisa M.; Saab, Victoria A.; Loehman, Rachel. 2022. Modeled interactions of mountain pine beetle and wildland fire under future climate and management scenarios for three western US landscapes. Fire Ecology. 18: 12.

McKinney, Shawn T.; Abrahamson, Ilana; Jain, Theresa; Anderson, Nathaniel. 2022. A systematic review of empirical evidence for landscape-level fuel treatment effectiveness. Fire Ecology. 18: 21.

Nikolov, Ned; Bothwell, Phillip; Snook, John. 2022. Developing a gridded model for probabilistic forecasting of wildland-fire ignitions across the lower 48 States. USFS-CSU Joint Venture Agreement Phase 2 (2019-2021) - Final Report. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 33p.

Palaiologou, Palaiologos; Kalabokidis, Kostas; Day, Michelle A.; Ager, Alan A.; Galatsidas, Spyros; Papalampros, Lampros. 2022. Modelling fire behavior to assess community exposure in Europe: Combining open data and geospatial analysis. ISPRS International Journal of Geo-Information. 11: 198.

Ridder, Luke W.; Morris, Lesley R.; Day, Michelle A.; Kerns, Becky K. 2022. Ventenata (*Ventenata dubia*) response to grazing and prescribed fire on the Pacific Northwest Bunchgrass Prairie. Rangeland Ecology and Management. 80: 1-9.

Short, Karen C.; Finney, Mark A. 2022. Agency records of wildfires caused by firearms use in the United States. Fire Safety Journal. 131: 103622.

Tomback, Diana F.; Keane, Robert E.; Schoettle, Anna W.; Sniezko, Richard A.; Jenkins, Melissa B.; Nelson, Cara R.; Bower, Andrew D.; DeMastus, Clay R.; Guiberson, Emily; Krakowski, Jodie; Murray, Michael P.; Pansing, Elizabeth R.; Shamhart, Julee. 2022. Tamm review: Current and recommended management practices for the restoration of whitebark pine (*Pinus albicaulis Engelm.*), an imperiled high-elevation Western North American forest tree. Forest Ecology and Management. 522: 119929.

Urbanski, Shawn P.; O'Neill, Susan M.; Holder, Amara L.; Green, Sarah A.; Graw, Rick L. 2022. Emissions. In: Peterson, David L.; McCaffrey, Sarah M.; Patel-Weynand, Toral, eds. 2022. Wildland Fire Smoke in the United States: A Scientific Assessment. Cham, Switzerland: Springer Nature Switzerland AG. 121-165. Chapter 5. https://doi.org/10.1007/978-3-030-87045-4_5.

Forest and Woodland Ecosystems

Bentz, Barbara J.; Hansen, E. Matthew; Davenport, Marianne; Soderberg, David. 2022. Complexities in predicting mountain pine beetle and spruce beetle response to climate change [Chapter 2]. In: Gandhi, Kamal J. K.; Hofstetter, Richard W., eds. Bark beetle management, ecology, and climate change. Elsevier, Academic Press. p. 31-54.

Bright, Benjamin C.; Hudak, Andrew T.; McCarley, Ryan; Spannuth, Alexander; Sanchez-Lopez, Nuria; Ottmar, Roger D.; Soja, Amber J. 2022. Multitemporal lidar captures heterogeneity in fuel loads and consumption on the Kaibab Plateau. Fire Ecology. 18:18.

Caballero, Jorge R. Ibarra; Lalande, Bradley M.; Hanna, John W.; Klopfenstein, Ned B.; Kim, Mee-Sook; Stewart, Jane E. 2022. Genomic comparisons of two *Armillaria* species with different ecological behaviors and their associated soil microbial communities. Microbial Ecology. https://doi.org/10.1007/s00248-022-01989-8.

Cannon, Philip G.; Klopfenstein, Ned B.; Kim, Mee-Sook; Stewart, Jane E.; Chung, Chia-Lin. 2022. Brown root rot disease caused by *Phellinus noxius* in U.S.-Affiliated Pacific Islands. Gen. Tech. Rep. PNW-GTR-1006. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 99 p. https://doi.org/10.2737/PNW-GTR-1006.

Corrao, Mark V.; Hudak, Andrew T.; Desautel, Cody; Bright, Benjamin C.; Carlo, Edil Sepulveda. 2022. Carbon monitoring and above ground biomass trends: Anchor forest opportunities for tribal, private and federal relationships. Trees, Forests and People. 9: 100302.

Davis, Thomas S.; Meddens, Arjan J. H.; Stevens-Rumann, Camille S.; Jansen, Vincent S.; Sibold, Jason S.; Battaglia, Mike A. 2022. Monitoring resistance and resilience using carbon trajectories: Analysis of forest management-disturbance interactions. Ecological Applications. 2022: e2704.

Franco, Carlos Rodriguez; Page-Dumroese, Deborah S.; Archuleta, James. 2022. Forest management and biochar for continued ecosystem services. Journal of Soil and Water Conservation. 77(4): 60A-64A.

Herzog, Molly M.; Hudak, Andrew T.; Weise, David R.; Bradley, Ashley M.; Tonkyn, Russell G.; Banach, Catherine A.; Myers, Tanya L.; Bright, Benjamin C.; Batchelor, Jonathan L.; Kato, Akira; Maitland, John S.; Johnson, Timothy J. 2022. Point cloud based mapping of understory shrub fuel distribution, estimation of fuel consumption and relationship to pyrolysis gas emissions on experimental prescribed burns. Fire. 5: 118.

Jenkins, Melissa B.; Schoettle, Anna W.; Wright, Jessica W.; Anderson, Karl A.; Fortier, Joseph; Hoang, Linh; Incashola, Tony, Jr.; Keane, Robert E.; Krakowski, Jodie; LaFleur, Dawn M.; Mellmann-Brown, Sabine; Meyer, Elliott D.; Pete, ShiNaasha; Renwick, Katherine; Sissons, Robert A. 2022. Restoring a forest keystone species: A plan for the restoration of whitebark pine (*Pinus albicaulis* Engelm.) in the Crown of the Continent ecosystem. Forest Ecology and Management. 522: 120282.

Kim, Mee-Sook; Heinzelmann, Renate; Labbe, Frederic; Ota, Yuko; Elías-Roman, Ruben Damian; Pildain, María Belen; Stewart, Jane E.; Woodward, Stephen; Klopfenstein, Ned B.2022. *Armillaria* root diseases of diverse trees in wide-spread global regions [Chapter 20]. Forest Microbiology. 2: 361-378.

Kourouma, Jean Moussa; Phiri, Darius; Hudak, Andrew T.; Syampungani, Stephen. 2022. Land use/cover spatiotemporal dynamics, and implications on environmental and bioclimatic factors in Chingola district, Zambia. Geomatics. Natural Hazards and Risk. 13(1): 1898-1942.

Kuo, Chi-Jui (Barry); Kimsey, Mark; Page-Dumroese, Deborah S.; Kirker, Grant; Fu, Audrey Qiuyan; Cai, Lili. 2022. Investigating soil effects on outcomes of a standardized soil-block test. Forest Products Journal. 72(3): 140-146.

Liu, Jun-Jun; Schoettle, Anna W.; Sniezko, Richard A.; Waring, Kristen M.; Williams, Holly; Zamany, Arezoo; Johnson, Jeremy S.; Kegley, Angelia. 2022. Comparative association mapping reveals conservation of major gene resistance to white pine blister rust in southwestern white pine (*Pinus strobiformis*) and limber pine (*P. flexilis)*. Phytopathology. 112: 1093-1102.

Morris, Jenna E.; Buonanduci, Michele S.; Agne, Michelle C.; Battaglia, Mike A.; Harvey, Brian J. 2022. Does the legacy of historical thinning treatments foster resilience to bark beetle outbreaks in subalpine forests? Ecological Applications. 32(1): e02474.

Nigro, Katherine M.; Rocca, Monique E.; Battaglia, Mike A.; Coop, Jonathan D.; Redmond, Miranda D. 2022. Wildfire catalyzes upward range expansion of trembling aspen in southern Rocky Mountain beetle-killed forests. Journal of Biogeography. 49: 201-214.

Page-Dumroese, Deborah S.; Franco, Carlos Rodriguez; Archuleta, James G.; Taylor, Marcus E.; Kidwell, Kraig; High, Jeffrey C.; Adam, Kathleen. 2022. Forest biomass policies and regulations in the United States of America. Forests.13: 1415.

Penjor, Ugyen; Cushman, Samuel A.; Kaszta, Zaneta M.; Sherub, Sherub; Macdonald, David W. 2022. Effects of land use and climate change on functional and phylogenetic diversity of terrestrial vertebrates in a Himalayan biodiversity hotspot. Diversity and Distributions. https://doi.org/10.1111/ddi.13613.

Prichard, Susan J.; Rowell, Eric M.; Hudak, Andrew T.; Keane, Robert E.; Loudermilk, E. Louise; Lutes, Duncan C.; Ottmar, Roger D.; Chappell, Linda M.; Hall, John A.; Hornsby, Benjamin S. 2022. Fuels and consumption [Chapter 2]. In: Peterson, David L.; McCaffrey, Sarah M.; Patel-Weynand, Toral, eds. Wildland Fire Smoke in the United States. Springer, Cham. p. 11-49.

Ritter, Scott M.; Hoffman, Chad M.; Battaglia, Mike A.; Jain, Theresa B. 2022. Restoration and fuel hazard reduction result in equivalent reductions in crown fire behavior in dry conifer forests. Ecological Applications. 2022: e2682.

Schoettle, Anna W.; Burns, Kelly S.; McKinney, Shawn T.; Krakowski, Jodie; Waring, Kristen M.; Tomback, Diana F.; Davenport, Marianne. 2022. Integrating forest health conditions and species adaptive capacities to infer future trajectories of the high elevation five-needle white pines. Forest Ecology and Management. 521: 120389.

Schoettle, Anna W.; Kegley, Angelia; Sniezko, Richard A.; Burns, Kelly S.; Vogler, Detlev; Bovin, Phyllis Pineda; Baker, Gretchen. 2022. Preparing for invasion: Rust resistance in limber, Great Basin bristlecone, and Rocky Mountain bristlecone pines. In: Murray, M. P.; Smith, C. M.; McKinney, S. T.; Achuff, P. L. Research and Management of High-Elevation Five-Needle Pines in Western North America: Proceedings of the Second High-Five Conference; 5-7 October 2021. Arcata, CA: The Press at Cal Poly Humboldt. p. 77-80. Online: https://digitalcommons.humboldt.edu/h5ii/9/.

Silva, Carlos Alberto; Hudak, Andrew T.; Vierling, Lee A.; Valbuena, Ruben; Cardil, Adrian; Mohan, Midhun; de Almeida, Danilo Roberti Alves; Broadbent, Eben N.; Almeyda Zambrano, Angelica M.; Wilkinson, Ben; Sharma, Ajay; Drake, Jason B.; Medley, Paul B.; Vogel, Jason G.; Prata, Gabriel Atticciati; Atkins, Jeff W.; Hamamura, Caio; Jonson, Daniel J.; Klauberg, Carine. 2022. Treetop: A Shiny-based application and R package for extracting forest information from LiDAR data for ecologists and conservationists. Methods in Ecology and Evolution. 13: 1164-1176.

Soderberg, David N.; Bentz, Barbara J.; Runyon, Justin B.; Hood, Sharon M.; Mock, Karen E. 2022. Chemical defense strategies, induction timing, growth, and trade-offs in *Pinus aristata* and *Pinus flexilis*. Ecosphere. 13: e4183.

Soderberg, David N.; Kyre, Bethany; Bonello, Pierluigi; Bentz, Barbara J. 2021. Lignin concentrations in phloem and outer bark is not associated with resistance to mountain pine beetle among high elevation pines. PLoS ONE. 16(9): e0250395.

Human Dimensions

Campbell, Michael J.; Dennison, Philip E.; Thompson, Matthew P. 2022. Predicting the variability in pedestrian travel rates and times using crowdsourced GPS data. Computers, Environment and Urban Systems. 97: 101866.

Donnelly, Alison; Yu, Rong; Jones, Katherine; Belitz, Michael; Li, Bonan; Duffy, Katharyn; Zhang, Xiaoyang; Wang, Jianmin; Seyednasrollah, Bijan; Gerst, Katherine L.; Li, Daijiang; Kaddoura, Youssef; Zhu, Kai; Morisette, Jeffrey; Ramey, Colette; Smith, Kathleen. 2022. Exploring discrepancies between in situ phenology and remotely derived phenometrics at NEON sites. Ecosphere. 13: e3912.

Flint, Hilary Byerly; Cada, Paul; Champ, Patricia A.; Gomez, Jamie; Margoles, Danny; Meldrum, James R.; Brenkert-Smith, Hannah. 2022. You vs. us: Framing adaptation behavior in terms of private or social benefits. Climatic Change. 174: 11.

Haire, Emily. 2022. COVID 'shots: Hotshot superintendents reflect on the COVID fire year of 2020. Fire Management Today. 80(1): 41-48.

Heidari, Hadi; Arabi, Mazdak; Warziniack, Travis; Kao, Shih-Chieh. 2020. Assessing shifts in regional hydroclimatic conditions of U.S. river basins in response to climate change over the 21st century. Earth's Future. 8: e2020EF001657.

Jaffe, Daniel A.; Peterson, David L.; McCaffrey, Sarah M.; Hall, John A.; Brown, Timothy J. 2022. Assessing the State of Smoke Science. In: Peterson, David L.; McCaffrey, Sarah M.; Patel-Weynand, Toral, eds. 2022. Wildland Fire Smoke in the United States: A Scientific Assessment. Cham, Switzerland: Springer Nature Switzerland AG. 1-10. Chapter 1. https://doi.org/10.1007/978-3-030-87045-4_1.

Jones, Benjamin A.; McDermott, Shana; Champ, Patricia A.; Berrens, Robert P. 2022. More smoke today for less smoke tomorrow? We need to better understand the public health benefits and costs of prescribed fire. International Journal of Wildland Fire. https://doi.org/10.1071/WF22025.

McCaffrey, Sarah M.; Rappold, Ana G.; Hano, Mary Clare; Navarro, Kathleen M.; Phillips, Tanya F.; Prestemon, Jeffrey P.; Vaidyanathan, Ambarish; Abt, Karen L.; Reid, Colleen E.; Sacks, Jason D. 2022. Social Considerations: Health, Economics, and Risk Communication. In: Peterson, David L.; McCaffrey, Sarah M.; Patel-Weynand, Toral, eds. 2022. Wildland Fire Smoke in the United States: A Scientific Assessment. Cham, Switzerland: Springer Nature Switzerland AG. 199-237. Chapter 7. https://doi.org/10.1007/978-3-030-87045-4_7.

McCarthy, Nicholas; Calkin, David. 2022. Understanding limits: Wildland fire response and pandemic interactions in 2020. Fire Management Today. 80(1): 32-36.

Nagy, R. Chelsea; Balch, Jennifer K.; Bissell, Erin K.; Morisette, Jeffery T.; et. al. 2021. Harnessing the NEON data revolution to advance open environmental science with a diverse and data-capable community. Ecosphere. 12(12): e03833.

Novak, Katie McGrath; McCaffrey, Sarah; Schultz, Courtney A. 2022. Comparing land manager and community perceptions of a Colorado prescribed fire outreach program. Journal of Forestry. https://doi.org/10.1093/jofore/fvac026.

Thompson, Matthew P.; MacGregor, Donald G.; Calkin, David E.; Iverson, Joel O. 2022. Wildfire, COVID-19, and enterprise risk management in the Forest Service. Fire Management Today. 80(1): 37-40.

van Rees, Charles B.; Hand, Brian K.; Carter, Sean C.; Bargeron, Chuck; Cline, Timothy J.; Daniel, Wesley; Ferrante, Jason A.; Gaddis, Keith; Hunter, Margaret E.; Jarnevich, Catherine S.; McGeoch, Melodie A.; Morisette, Jeffrey T.; Neilson, Matthew E.; Roy, Helen E.; Rozance, Mary Ann; Sepulveda, Adam; Wallace, Rebekah D.; Whited, Diane; Wilcox, Taylor; Kimball, John S.; Luikart, Gordon. 2022. A framework to integrate innovations in invasion science for proactive management. Biological Reviews. 97: 1712-1735.

Maintaining Resilient Dryland Ecosystems

Abrams, Marc D.; Hanberry, Brice B.; Ruffner, Charles M. 2022. A comparison of witness tree and contemporary compositions for old-growth forests at Savage Mountain, Maryland, and secondary forests of the northern Allegheny Mountains. The Journal of the Torrey Botanical Society. 149(2): 151-158.

Bishop, Tara B. B.; Molinari, Rebecca Lee; St. Clair, Samuel B. 2022. Post-fire restoration seeding success increases with early fall seeding and simulated precipitation in the Great Basin Desert of North America. Restoration Ecology. https://doi.org/10.1111/rec.13752.

Cannon, Philip; Friday, James B.; Harrington, Thomas; Keith, Lisa; Hughes, Marc; Hauff, Rob; Hughes, Flint; Perroy, Ryan; Benitez, David; Roy, Kylle; Peck, Robert; Smith, Sheri; Luiz, Blaine; Cordell, Susan; Giardina, Christian; Juzwik, Jennifer; Yelenik, Stephanie; Cook, Zachary. 2022. Rapid ʻOhiʻa death in Hawaiʻi [Chapter 15]. Forest Microbiology. 2: 267-289.

Clark, Autumn S.; McGranahan, Devan Allen; Geaumont, Benjamin A.; Wonkka, Carissa L.; Ott, Jacqueline P.; Kreuter, Urs P. 2022. Barriers to prescribed fire in the US Great Plains, Part I: Systematic review of socio-ecological research. Land. 11: 1521.

Clark, Autumn S.; McGranahan, Devan Allen; Geaumont, Benjamin A.; Wonkka, Carissa L.; Ott, Jacqueline P.; Kreuter, Urs P. 2022. Barriers to prescribed fire in the US Great Plains, Part II: Critical review of presently used and potentially expandable solutions. Land . 11: 1524.

Fettig, Christopher J.; Runyon, Justin B.; Homicz, Crystal S.; James, Patrick M. A.; Ulyshen, Michael D. 2022. Fire and insect interactions in North American forests. Current Forestry Reports. https://doi.org/10.1007/s40725-022-00170-1.

Gaffke, Alexander M.; Dudley, Tom L.; Bean, Daniel W.; Drus, Gail M.; Johnson, Matthew J.; Knutson, Allen E.; Weaver, David K.; Sing, Sharlene E.; Orr, Bruce K.; Thompson, David C. 2022. *Tamarix* biological control in North America [Chapter 28]. In: Van Driesche, R. G.; Winston, R. L.; Perring, T. M. ; Lopez, V. M., eds. Contributions of Classical Biological Control to the U.S. Food Security, Forestry, and Biodiversity. FHAAST-2019-05. Morgantown, WV: U.S. Department of Agriculture, Forest Service. p. 329-355.

Hanberry, Brice B. 2022. From 20,000 years ago to near present climate classification of North America. Open Quaternary. 8:(11): 1-11.

Hartway, Cynthia R.; Ott, Jacqueline P.; Grulke, Nancy E. 2022. Plant life span and persistence of soil seedbanks predict the emergence of herbicide resistance in noxious weeds. Weed Science. 70: 448-454.

Innes, Peter; Gossweiler, Andre; Jensen, Scott; Tilley, Derek; St. John, Loren; Jones, Thomas; Kitchen, Stanley; Hulke, Brent S. 2022. Assessment of biogeographic variation in traits of Lewis flax (*Linum lewisii*) for use in restoration and agriculture. AoB PLANTS. 14(2): plac005.

Malone, Shealyn C.; Menalled, Fabian D.; Weaver, David K.; Seipel, Tim F.; Hofland, Megan L.; Runyon, Justin B.; Bourgault, Maryse; Boss, Darrin L.; Trowbridge, Amy M. 2022. Cropping systems alter plant volatile emissions in the field through soil legacy effects. Renewable Agriculture and Food Systems. https://doi.org/10.1017/S174217052200014X.

Montagnoli, Antonio; Chiatante, Donato; Godbold, Douglas L.; Koike, Takayoshi; Rewald, Boris; Dumroese, R. Kasten. 2022. Editorial: Modulation of growth and development of tree roots in forest ecosystems. Frontiers in Plant Science. 13: 850163.

Montagnoli, Antonio; Dumroese, R. Kasten; Negri, Giulia; Scippa, Gabriella Stefania; Chiatante, Donato; Terzaghi, Mattia. 2022. Asymmetrical copper root pruning may improve root traits for reforesting steep and/or windy sites. New Forests. https://doi.org/10.1007/s11056-022-09913-1.

Ott, Jeffrey E.; Kilkenny, Francis F.; Irwin, Jessica. 2017. Dispersal rates of forage kochia (*Bassia prostrata*) from seeded areas in southern Idaho. Final Report, U.S. Fish and Wildlife Service Recovery Grant IAA F16PG00075. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 12 p.

Pyke, David A.; Shaff, Scott E.; Chambers, Jeanne C.; Schupp, Eugene W.; Newingham, Beth A.; Gray, Margaret L.; Ellsworth, Lisa M. 2022. Ten-year ecological responses to fuel treatments within semiarid Wyoming big sagebrush ecosystems. Ecosphere. 13: e4176.

Richardson, Bryce A.; Massatti, Rob; Islam-Faridi, Nurul; Johnson, Skylar; Kilkenny, Francis F. 2022. Assessing population genomic structure and polyploidy: A crucial step for native plant restoration. Restoration Ecology. https://doi.org/10.1111/rec.13740.

Runyon, Justin B.; Bentz, Barbara J.; Qubain, Claire A. 2022. Constitutive and induced defenses in long-lived pines do not trade off but are influenced by climate. Journal of Chemical Ecology. https://doi.org/10.1007/s10886-022-01377-z.

Sing, Sharlene E.; Tosevski, Ivo; Ward, Sarah M.; Randall, Carol B.; Weaver, David K.; Gaffke, Alexander M.; Nowierski, Robert M. 2022. Biological control of invasive *Linaria* spp. in the western United States [Chapter 26]. In: Van Driesche, R. G.; Winston, R. L.; Perring, T. M. ; Lopez, V. M., eds. Contributions of Classical Biological Control to the U.S. Food Security, Forestry, and Biodiversity. FHAAST-2019-05. Morgantown, WV: U.S. Department of Agriculture, Forest Service. p. 294-311.

Yelenik, Stephanie; Rose, Eli; Cordell, Susan; Victoria, Michelle; Kellner, James R. 2022. The role of microtopography and resident species in post-disturbance recovery of arid habitats in Hawai'i. Ecological Applications. 2022: e2690.

RMRS-FIA (Forest Inventory, and Analysis)

Bullock, Eric L.; Healey, Sean P.; Yang, Zhiqiang; Houborg, Rasmus; Gorelick, Noel; Tang, Xiaojing; Andrianirina, Carole. 2022. Timeliness in forest change monitoring: A new assessment framework demonstrated using Sentinel-1 and a continuous change detection algorithm. Remote Sensing of Environment. 276: 113043.

Dubayah, Ralph; Armston, John; Healey, Sean P.; Bruening, Jamis M.; Patterson, Paul L.; Kellner, James R.; Duncanson, Laura; Saarela, Svetlana; Stahl, Goran; Yang, Zhiqiang; Tang, Hao; Blair, J. Bryan; Fatoyinbo, Lola; Goetz, Scott; Hancock, Steven; Hansen, Matthew; Hofton, Michelle; Hurtt, George; Luthcke, Scott. 2022. GEDI launches a new era of biomass inference from space. Environmental Research Letters. 17(9): 095001.

Goeking, Sara A.; Tarboton, David G. 2022. Spatially distributed overstory and understory leaf area index estimated from forest inventory data. Water. 14: 2414.

Hurtt, George C.; Andrews, Arlyn; Bowman, Kevin; Brown, Molly E.; Chatterjee, Abhishek; Escobar, Vanessa; Fatoyinbo, Lola; Griffith, Peter; Guy, Maddie; Healey, Sean P.; et. al. 2022. The NASA carbon monitoring system phase 2 synthesis: Scope, findings, gaps and recommended next steps. Environmental Research Letters. 17: 063010.

Kralicek, Karin M. 2022. Characterizing uncertainty and assessing the impact of rapid climate change on the distribution of important tree species in the Pacific Northwest. Corvallis, OR: Oregon State University. 176 p. Dissertation.

Kralicek, Karin; Barrett, Tara M.; Ver Hoef, Jay M.; Temesgen, Hailemariam. 2022. Forests at the fringe: Comparing observed change to projected climate change impacts for five tree species in the Pacific Northwest, United States. Frontiers in Forests and Global Change. 5: 966953.

Moris, Jose V.; Reilly, Matthew J.; Yang, Zhiqiang; Cohen, Warren B.; Motta, Renzo; Ascol, Davide. 2022, Using a trait-based approach to assess fire resistance in forest landscapes of the Inland Northwest, USA. Landscape Ecology. 37: 2149-2164.

Saarela, Svetlana; Holm, Soren; Healey, Sean P.; Patterson, Paul L.; Yang, Zhiqiang; Andersen, Hans-Erik; Dubayah, Ralph O.; Qi, Wenlu; Duncanson, Laura I.; Armston, John D.; Gobakken, Terje; Naesset, Erik; Ekstrom, Magnus; Stahl, Goran. 2022. Comparing frameworks for biomass prediction for the Global Ecosystem Dynamics Investigation. Remote Sensing of Environment. 278: 113074.

Westfall, James A.; Schroeder, Todd A.; McCollum, Joseph M.; Patterson, Paul L. 2022. A spatial and temporal assessment of nonresponse in the national forest inventory of the U.S. Environmental Monitoring and Assessment. 194: 530.

Woolman, Ashley M.; Coop, Jonathan D.; Shaw, John D.; DeMarco, Jennie. 2022. Extent of recent fire-induced losses of ponderosa pine forests of Arizona and New Mexico, USA. Forest Ecology and Management. 520: 120381.

Wulder, Michael A.; Roy, David P.; Radeloff, Volker C.; Loveland, Thomas R.; Anderson, Martha C.; Johnson, David M.; Healey, Sean; et. al. 2022. Fifty years of Landsat science and impacts. Remote Sensing of Environment. 280: 113195.

Water and Watersheds

Al-Hamdan, Osama Zuhair; Pierson, Fred B.; Robichaud, Peter; Elliot, William J.; Williams, Christopher Jason. 2022. New erodibility parameterization for applying WEPP on rangelands using ERMiT. Journal of the ASABE. 65(2): 251-264.

Dobre, Mariana; Long, Jonathan W.; Maxwell, Charles; Elliot, William J.; Lew, Roger; Brooks, Erin S.; Scheller, Robert M. 2022. Water quality and forest restoration in the Lake Tahoe basin: impacts of future management options. Ecology and Society. 27(2): 6.

Elliot, William J.; Rhee, Hakjun. 2022. Impacts of forest biomass operations on forest hydrologic and soil erosion processes. Trees, Forests and People. 7: 100186.

Jacobs, Gregory R.; Thurow, Russell F.; Buffington, John H.; Isaak, Daniel J.; Wenger, Seth J. 2022. Erratum: Climate, fire regime, geomorphology, and conspecifics influence the spatial distribution of Chinook salmon redds. Transactions of the American Fisheries Society. 151: 390-395.

Mallet, Jerry; Thurow, Russell F. 2022. Resurrecting an Idaho icon: How research and management reversed declines of native westslope cutthroat trout. Fisheries. 47(3): 104-117.

Nelson, Amelia R.; Narrowe, Adrienne B.; Rhoades, Charles C.; Fegel, Timothy S.; Daly, Rebecca A.; Roth, Holly K.; Chu, Rosalie K.; Amundson, Kaela K.; Young, Robert B.; Steindorff, Andrei S.; Mondo, Stephen J.; Grigoriev, Igor V.; Salamov, Asaf; Borch, Thomas; Wilkins, Michael J. 2022. Wildfire-dependent changes in soil microbiome diversity and function. Nature Microbiology. 7: 1419-1430.

Rhea, Allison E.; Covino, Timothy P.; Rhoades, Charles C.; Brooks, Alexander C. 2022. Use of geostatistical models to evaluate landscape and stream network controls on post-fire stream nitrate concentrations. Hydrological Processes. 36: e14689.

Shuman, Jacquelyn K.; Balch, Jennifer K.; Barnes, Rebecca T.; Leonard, Jackson; Moser, W. Keith; Yelenik, Stephanie; et. al. 2022. Reimagine fire science for the anthropocene. PNAS Nexus. 2022(1): 1-14.

Tonina, Daniele; McKean, James A.; Isaak, Daniel; Benjankar, Rohan M.; Tang, Chunling; Chen, Qiuwen. 2022. Climate change shrinks and fragments salmon habitats in a snow-dependent region. Geophysical Research Letters. 49: e2022GL098552.

Wilderness (Aldo Leopold Wilderness Research Institute)

Margolis, Ellis Q.; Guiterman, Christopher H.; Chavardes, Raphael D.; Coop, ; Parks, Sean A.; North, Malcolm; Collins, Brandon M.; Dey, Daniel C.; Iniguez, Jose; Kitchen, Stanley G.; McKenzie, Donald; O'Connor, Christopher D.; et. al. 2022. The North American tree-ring fire-scar network. Ecosphere. 13: e4159.

Silva-Cardoza, Adrian Israel; Vega-Nieva, Daniel Jose; Briseno-Reyes, Jaime; Briones-Herrera, Carlos Ivan; Lopez-Serrano, Pablito Marcelo; Corral-Rivas, Jose Javier; Parks, Sean A.; Holsinger, Lisa M. 2022. Evaluating a new relative phenological correction and the effect of sentinel-based earth engine compositing approaches to map fire severity and burned area. Remote Sensing. 14: 3122.

Trammell, E. Jamie; Carlson, Matthew L.; Reynolds, Joel H.; Taylor, Jason J.; Schmidt, Niels M. 2022. Ecological integrity and conservation challenges in a rapidly changing Arctic: A call for new approaches in large intact landscapes. Ambio. https://doi.org/10.1007/s13280-022-01756-6.

Xu, Qingqing; Westerling, Anthony LeRoy; Notohamiprodjo, Andrew; Wiedinmyer, Christine; Picotte, Joshua J.; Parks, Sean A.; Hurteau, Matthew D.; Marlier, Miriam E.; Kolden, Crystal A.; Sam, Jonathan A.; Baldwin, W. Jonathan; Ade, Christiana. 2022. Wildfire burn severity and emissions inventory: An example implementation over California. Environmental Research Letters. 17: 085008.

Wildlife and Terrestrial Ecosystems

Chmura, Helen E.; Duncan, Cassandra; Saer, Ben; Moore, Jeanette T.; Barnes, Brian M.; Buck, C. Loren; Loudon, Andrew S. I.; Williams, Cory T. 2022. Effects of spring warming on seasonal neuroendocrinology and activation of the reproductive axis in hibernating Arctic ground squirrels. Integrative and Comparative Biology. https://doi.org/10.1093/icb/icac112.

Chmura, Helen E.; Duncan, Cassandra; Saer, Ben; Moore, Jeanette T.; Barnes, Brian M.; Buck, C. Loren; Christian, Helen C.; Loudon, Andrew S. I.; Williams, Cory T. 2022. Hypothalamic remodeling of thyroid hormone signaling during hibernation in the arctic ground squirrel. Communications Biology. 5: 492.

Chmura, Helen E.; Williams, Cory T. 2022. A cross-taxonomic perspective on the integration of temperature cues in vertebrate seasonal neuroendocrine pathways. Hormones and Behavior. 144: 105215.

Clark-Wolf, T. J.; Hahn, Philip G.; Brelsford, Eric; Francois, Jaleen; Hayes, Nicolette; Larkin, Beau; Ramsey, Philip; Pearson, Dean E. 2022. Preventing a series of unfortunate events: Using qualitative models to improve conservation. Journal of Applied Ecology. https://doi.org/10.1111/1365-2664.14231.

Ditmer, Mark A.; Wittemyer, George; Breck, Stewart W.; Crooks, Kevin R. 2022. Defining ecological and socially suitable habitat for the reintroduction of an apex predator. Global Ecology and Conservation. 38(4): e02192.

Franklin, Thomas W.; Dysthe, Joseph C.; Neville, Helen; Young, Michael K.; McKelvey, Kevin M.; Schwartz, Michael K. 2022. Lahontan cutthroat trout (*Oncorhynchus clarkii henshawi*) and Paiute cutthroat trout (*Oncorhynchus clarkii seleniris*) detection from environmental DNA samples: A dual-purpose assay. Western North American Naturalist. 82(2): 388-397.

Haire, Sandra L.; Villarreal, Miguel L.; Cortes-Montano, Citlali; Flesch, Aaron D.; Iniguez, Jose M.; Romo-Leon, Jose Raul; Sanderlin, Jamie S. 2022. Climate refugia for *Pinus* spp. in topographic and bioclimatic environments of the Madrean sky islands of Mexico and the United States. Plant Ecology. https://doi.org/10.1007/s11258-022-01233-w.

Kronenberger, John A.; Wilcox, Taylor M.; Mason, Daniel H.; Franklin, Thomas W.; McKelvey, Kevin S.; Young, Michael K.; Schwartz, Michael K. 2022. eDNAssay: A machine learning tool that accurately predicts qPCR cross-amplification. Molecular Ecology Resources. https://doi.org/10.1111/1755-0998.13681.

Pearson, Dean E.; Eren, Ozkan; Ortega, Yvette K.; Hierro, Jose L.; Karakus, Birsen; Kala, Sascha; Bullington, Lorinda; Lekberg, Ylva. 2022. Combining biogeographical approaches to advance invasion ecology and methodology. Journal of Ecology. https://doi.org/10.1111/1365-2745.13945.

Reynolds, Richard T.; Boyce, Douglas A., Jr.; Graham, Russell T. 2020. Gray ghosts and fire: Can efforts to restore the northern goshawk renew the fire-prone forests they inhabit? The Wildlife Professional. July/August: 42-46.

Smith, Austin B.; Vogeler, Jody C.; Bjornlie, Nichole L.; Squires, John R.; Swayze, Neal C.; Holbrook, Joseph D. 2022. Spaceborne LiDAR and animal-environment relationships: An assessment for forest carnivores and their prey in the Greater Yellowstone Ecosystem. Forest Ecology and Management. 520: 120343.

Wilcox, Taylor Matthew; Jensen, Mads Reinholdt. 2022. Drawing a line in the sand: Environmental DNA population genomics. Molecular Ecology Resources. https://doi.org/10.1111/1755-0998.13686.

Williams, Cory T.; Chmura, Helen E.; Deal, Cole K.; Wilsterman, Kathryn. 2022. Sex-differences in phenology: A Tinbergian perspective. Integrative and Comparative Biology. https://doi.org/10.1093/icb/icac035.

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