Climate, environment, and disturbance history govern resilience of western North American forests

Before the advent of intensive forest management and fire suppression, western North American forests exhibited a naturally occurring resistance and resilience to wildfires and other disturbances. Resilience, which encompasses resistance, reflects the amount of disruption an ecosystem can withstand before its structure or...

Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Contrasting human influences and macro-environmental factors on fire activity inside and outside protected areas of North America

Human activities threaten the effectiveness of protected areas (PAs) in achieving their conservation goals across the globe. In this study, we contrast the influence of human and macro-environmental factors driving fire activity inside and outside PAs. Using area burned between 1984 and 2014 for 11 ecoregions in Canada and the...

Author(s): Nicolas Mansuy, Carol Miller, Marc-Andre Parisien, Sean A. Parks, Enric Batllori, Max A. Moritz
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Resilience and fire management in the Anthropocene

Fire management around the world is now undergoing extensive review, with a move toward fire management plans that maintain biodiversity and other ecosystems services, while at the same time mitigating the negative impacts to people and property. There is also increasing recognition of the historical and anthropogenic dimensions...

Author(s): Lindsey Gillson, Cathy L. Whitlock, Glynis Humphrey
Year Published: 2019
Type: Document
Book or Chapter or Journal Article

Decision Support Approaches in Adaptive Forest Management

Climate and social changes place strong demands on forest managers. Forest managers need powerful approaches and tools, which could help them to be able to react to the rapidly changing conditions. However, the complexity of quantifying forest ecosystems services as well as the complexity of current decision theories, technologies...

Author(s): Jan Kaspar, Pete Bettinger, Harald Vacik, Robert Marusak, Jordi Garcia-Gonzalo
Year Published: 2018
Type: Document
Book or Chapter or Journal Article
Appropriate Sample Sizes for Monitoring Burned Pastures in Sagebrush Steppe: How Many Plots are Enough, and Can One Size Fit All?
www.nrfirescience.org/resource/18950
Statistically defensible information on vegetation conditions is needed to guide rangeland management decisions following disturbances such as wildfire, often for heterogeneous pastures. Here we evaluate sampling effort needed to achieve a robust statistical threshold using > 2 000 plots sampled on the 2015 Soda Fire that burned...
Author(s): Cara Applestein, Matthew J. Germino, David S. Pilliod, Matthew R. Fisk, Robert S. Arkle
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Collaborative restoration effects on forest structure in ponderosa pine-dominated forests of Colorado
www.nrfirescience.org/resource/17786
In response to large, severe wildfires in historically fire-adapted forests in the western US, policy initiatives, such as the USDA Forest Service’s Collaborative Forest Landscape Restoration Program (CFLRP), seek to increase the pace and scale of ecological restoration. One required component of this program is collaborative...
Author(s): Jeffery B. Cannon, Kevin J. Barrett, Benjamin Gannon, Rob Addington, Michael A. Battaglia, Paula J. Fornwalt, Gregory H. Aplet, Anthony S. Cheng, Jeffrey L. Underhill, Jennifer S. Briggs, Peter M. Brown
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Where you stand depends on where you sit: Qualitative inquiry into notions of fire adaptation
www.nrfirescience.org/resource/16190
Wildfire and the threat it poses to society represents an example of the complex, dynamic relationship between social and ecological systems. Increasingly, wildfire adaptation is posited as a pathway to shift the approach to fire from a suppression paradigm that seeks to control fire to a paradigm that focuses on “living with”...
Author(s): Hannah Brenkert-Smith, James R. Meldrum, Patricia A. Champ, Christopher M. Barth
Year Published: 2017
Type: Document
Book or Chapter or Journal Article

Adapt to more wildfire in western North American forests as climate changes
www.nrfirescience.org/resource/15327
Wildfires across western North America have increased in number and size over the past three decades, and this trend will continue in response to further warming. As a consequence, the wildland–urban interface is projected to experience substantially higher risk of climate-driven fires in the coming decades. Although many plants,....
Author(s): Tania L. Schoennagel, Jennifer Balch, Hannah Brenkert-Smith, Philip E. Dennison, Brian J. Harvey, Meg A. Krawchuk, Nathan Mietkiewicz, Penelope Morgan, Max A. Moritz, Ray Rasker, Monica G. Turner, Cathy L. Whitlock
Year Published: 2017
Type: Document
Book or Chapter or Journal Article
Adaptive silviculture for climate change: a national experiment in manager-scientist partnerships to apply an adaptation framework
www.nrfirescience.org/resource/15232
Forest managers in the United States must respond to the need for climate-adaptive strategies in the face of observed and projected climatic changes. However, there is a lack of on-the-ground forest adaptation research to indicate what adaptation measures or tactics might be effective in preparing forest ecosystems to deal with...
Author(s): Linda Nagel, Brian J. Palik, Michael A. Battaglia, Anthony W. D'Amato, James M. Guldin, Christopher W. Swanston, Maria K. Janowiak, Matthew P. Powers, Linda A. Joyce, Constance I. Millar, David L. Peterson, Lisa Ganio, Chad Kirschbaum, Molly R. Roske
Year Published: 2017
Type: Document
Book or Chapter or Journal Article

Opportunities to utilize traditional phenological knowledge to support adaptive management of social-ecological systems vulnerable to changes in climate and fire regimes
www.nrfirescience.org/resource/13956
The field of adaptive management has been embraced by researchers and managers in the United States as an approach to improve natural resource stewardship in the face of uncertainty and complex environmental problems. Integrating multiple knowledge sources and feedback mechanisms is an important step in this approach. Our objective...
Author(s): Christopher A. Armatas, Tyron J. Venn, Brooke Baldauf McBride, Alan E. Watson, Stephen J. Carver
Year Published: 2016
Type: Document
Book or Chapter or Journal Article

Achievable future conditions as a framework for guiding forest conservation and management
www.nrfirescience.org/resource/13788
We contend that traditional approaches to forest conservation and management will be inadequate given the predicted scale of social-economic and biophysical changes in the 21st century. New approaches, focused on anticipating and guiding ecological responses to change, are urgently needed to ensure the full value of forest ecosystem...
Author(s): Stephen W. Golladay, Katherine L. Martin, James M. Vose, David N. Wear, Alan P. Covich, Richard J. Hobbs, Kier D. Klepzig, Gene E. Likens, Robert J. Naiman, Allan W. Shearer
Year Published: 2016
Type: Document
Book or Chapter or Journal Article, Synthesis

Managing ungulate browsing for sustainable aspen
www.nrfirescience.org/resource/16376
In montane forests of the Intermountain West composition and function are often defined by what happens with quaking aspen. Aspen is a pioneer species that regenerates quickly following disturbance and then establishes ecological conditions under which the rest of the biological community develops. Quaking aspen forests have high...
Author(s): Samuel B. St. Clair, Paul C. Rogers, Michael R. Kuhns
Year Published: 2015
Type: Document
Research Brief or Fact Sheet

The role of fire in aspen ecology and restoration
Quaking aspen is generally considered to be a fire-adapted species because it regenerates prolifically after fire, and it can be replaced by more shade-tolerant tree species in the absence of fire. As early-successional aspen stands transition to greater conifer-dominance, they become increasingly fire prone, until fire returns, and...

Author(s): Douglas J. Shinneman, Kevin Krasnow, Susan K. McIlroy
Year Published: 2015
Type: Document
Research Brief or Fact Sheet

Learning to coexist with wildfire

The impacts of escalating wildfire in many regions — the lives and homes lost, the expense of suppression and the damage to ecosystem services — necessitate a more sustainable coexistence with wildfire. Climate change and continued development on fire-prone landscapes will only compound current problems. Emerging strategies for...

Author(s): Max A. Moritz, E. Batllori, Ross A. Bradstock, A. Malcolm Gill, J. Handmer, Paul F. Hessburg, J. Leonard, Sarah M. McCaffrey, Dennis C. Odion, Tania L. Schoennagel, Alexandra D. Syphard
Year Published: 2014
Type: Document
Book or Chapter or Journal Article

Challenges and opportunities for large landscape-scale management in a shifting climate: the importance of nested adaptation responses across geospatial and temporal scales

The Yellowstone to Yukon Conservation Initiative (Y2Y) was established over 20 years ago as an experiment in large landscape conservation. Initially, Y2Y emerged as a response to large scale habitat fragmentation by advancing ecological connectivity. It also laid the foundation for large scale multi-stakeholder conservation...

Author(s): Gary M. Tabor, Anne Carlson, R. Travis Belote
Year Published: 2014
Type: Document
Technical Report or White Paper

Summary of science, activities, programs, and policies that influence the rangewide conservation of greater sage-grouse (Centrocercus urophanianus)

Because of their broad range, variations in population traits and characteristics across this range, and the variability in habitat conditions and threats within this range, conservation of sage-grouse is a unique challenge compared to isolated or range-restricted species, primarily due to the scale of the effort. This complexity is...

Year Published: 2013
Type: Document
Technical Report or White Paper

Making monitoring count: project design for active adaptive management

Ongoing environmental change requires that managers develop strategies capable of achieving
multiple objectives in an uncertain future. Active adaptive management (AAM) offers a robust approach to reducing uncertainty while also considering diverse stakeholder perspectives. Important features of AAM include recognition of learning...

Author(s): Andrew J. Larson, R. Travis Belote, Matthew A. Williamson, Gregory H. Aplet
Year Published: 2013
Type: Document
Book or Chapter or Journal Article

**Adaptation: planning for climate change and its effects on federal lands**
[www.nrfirescience.org/resource/12449](http://www.nrfirescience.org/resource/12449)
National forest managers are charged with tackling the effects of climate change on the natural resources under their care. The Forest Service National Roadmap for Responding to Climate Change and the Climate Change Performance Scorecard require managers to make significant progress in addressing climate change by 2015. To help land...

Author(s): Marie Oliver
Year Published: 2012
Type: Document
Research Brief or Fact Sheet

**Can we manage for resilience? The integration of resilience thinking into natural resource management in the United States**
[www.nrfirescience.org/resource/12693](http://www.nrfirescience.org/resource/12693)
The concept of resilience is now frequently invoked by natural resource agencies in the US. This reflects growing trends within ecology, conservation biology, and other disciplines acknowledging that social–ecological systems require management approaches recognizing their complexity. In this paper, we examine the concept of...

Author(s): Melinda Harm Benson, Ahjond S. Garmestani
Year Published: 2011
Type: Document
Book or Chapter or Journal Article

**Dry forests and wildland fires of the inland Northwest USA: contrasting the landscape ecology of the pre-settlement and modern eras**
[www.nrfirescience.org/resource/7941](http://www.nrfirescience.org/resource/7941)
Prior to Euro-American settlement, dry ponderosa pine and mixed conifer forests (hereafter, the 'dry forests') of the Inland Northwest were burned by frequent low- or mixed-severity fires. These mostly surface fires maintained low and variable tree densities, light and patchy ground fuels, simplified forest structure, and favored...

Author(s): Paul F. Hessburg, James K. Agee, Jerry F. Franklin
Year Published: 2005
Type: Document
Book or Chapter or Journal Article, Synthesis

**An environmental narrative of Inland Northwest United States forests, 1800-2000**
[www.nrfirescience.org/resource/18561](http://www.nrfirescience.org/resource/18561)
Fire was arguably the most important forest and rangeland disturbance process in the Inland Northwest United States for millennia. Prior to the Lewis and Clark expedition, fire regimes ranged from high severity with return intervals of one to five centuries, to low severity with fire-free periods lasting three decades or less....

Author(s): Paul F. Hessburg, James K. Agee
Year Published: 2003
Status of native fishes in the western United States and issues for fire and fuels management
www.nrfirescience.org/resource/8131
Conservation of native fishes and changing patterns in wildfire and fuels are defining challenges for managers of forested landscapes in the western United States. Many species and populations of native fishes have declined in recorded history and some now occur as isolated remnants of what once were larger more complex systems.
Author(s): Bruce E. Rieman, Danny C. Lee, Denver P. Burns, Robert E. Gresswell, Michael K. Young, Rick Stowell, John N. Rinne, Phil Howell
Year Published: 2003
Type: Document
Book or Chapter or Journal Article, Synthesis

Wildfire and native fish: issues of forest health and conservation of sensitive species
www.nrfirescience.org/resource/8129
Issues related to forest health and the threat of larger, more destructive wildfires have led to major new initiatives to restructure and recompose forest communities in the western United States. Proposed solutions will depend, in part, on silvicultural treatments and prescribed burning. Large fires can produce dramatic changes in...
Author(s): Bruce E. Rieman, Jim Clayton
Year Published: 1997
Type: Document
Book or Chapter or Journal Article

Ecological implications of sagebrush manipulation: A literature review
www.nrfirescience.org/resource/15427
The Montana Department of Fish, Wildlife & Parks (FWP) has long recognized the importance of sagebrush/grassland vegetative communities as wildlife habitat. Efforts to manipulate these communities concern FWP because of the potential implications to wildlife. Some groups believe sagebrush control generally will have beneficial...
Author(s): Joel G. Peterson
Year Published: 1995
Type: Document
Management or Planning Document

Germination and establishment ecology of big sagebrush: Implications for community restoration
Big sagebrush (Artemisia tridentata) seedling recruitment is limited by seed production and dispersal in space and time, by genetic constraints of specific ecotypes, and by environmental factors that include weather, microsite attributes, soil microbiota, herbivory, and inter- and intraspecific competition.

Establishing this species...
Author(s): Susan E. Meyer
Year Published: 1994
Type: Document
Conference Proceedings

Adaptive fire policy
Adaptive resource management is a continuous learning process in which current knowledge always leads to further experimentation and discovery. Adaptive management evolves by learning from mistakes. Designing adaptive management strategies involves four tasks. First, the problem must be defined and bounded. There is growing...
Author(s): James M. Saveland
Year Published: 1991
Type: Document
Conference Proceedings, Technical Report or White Paper