

Postfire treatments alter forest canopy structure up to three decades after fire

www.nrfirescience.org/resource/24170

We evaluated the effects of postfire management on forest structure in mixed-conifer forests of northeastern Washington, USA. Postfire treatments were harvest-only, harvest combined with planting, planting-only, and postfire prescribed fire. We used aerial light detection and ranging (LIDAR) to measure vertical and horizontal...

Author(s): C. Alina Cansler, Van R. Kane, Bryce N. Bartl-Geller, Derek J. Churchill, Paul F. Hessburg, Nicholas A. Povak, James A. Lutz, Jonathan T. Kane, Andrew J. Larson

Year Published: 2022

Type: Document

Book or Chapter or Journal Article

Young forests and fire: Using lidar–imagery fusion to explore fuels and burn severity in a subalpine forest reburn

www.nrfirescience.org/resource/24649

Anticipating fire behavior as climate change and fire activity accelerate is an increasingly pressing management challenge in fire-prone landscapes. In subalpine forests adapted to infrequent, stand-replacing fire, self-limitation of burn severity in short-interval fire is incompletely understood. Spatially explicit fuels data can...

Author(s): Kristin H. Braziunas, Diane Abendroth, Monica G. Turner

Year Published: 2022

Type: Document

Book or Chapter or Journal Article

Tree mortality response to drought-density interactions suggests opportunities to enhance drought resistance

www.nrfirescience.org/resource/24340

The future of dry forests around the world is uncertain given predictions that rising temperatures and enhanced aridity will increase drought-induced tree mortality. Using forest management and ecological restoration to reduce density and competition for water offers one of the few pathways that forest managers can potentially...

Author(s): John Bradford, Robert K. Shriver, Marcos D. Robles, Lisa McCauley, Travis J. Woolley, Caitlin M. Andrews, Michael A. Crimmins, David M. Bell

Year Published: 2022

Type: Document

Book or Chapter or Journal Article

Low- and moderate-severity fire offers key insights for landscape restoration in ponderosa pine forests

www.nrfirescience.org/resource/24406

Restoration goals in fire-prone conifer forests include mitigating fire hazard while restoring forest structural components linked to disturbance resilience and ecological function. Restoration of overstory spatial pattern in forests often falls short of management objectives due to complexities in implementation, regulation, and...

Author(s): Jeffery B. Cannon, Katarina J. Warnick, Spencer Elliott, Jennifer S. Briggs

Year Published: 2022

Type: Document

Book or Chapter or Journal Article

A CONUS-scale study of wildfire and evapotranspiration: spatial and temporal response and controlling factors

www.nrfirescience.org/resource/23978

Evapotranspiration (ET) accounts for a substantial portion of regional water budgets in much of the southeast and fire-prone western United States (US). Even small changes in ET rates can translate to meaningful shifts in runoff patterns and makes forecasting the direction and magnitude of wildfire-induced ET alteration of critical...

Author(s): Natalie M. Collar, Samuel Saxe, Ashley J. Rust, Terri S. Hogue

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Propagule availability drives post-wildfire recovery of peatland plant communities

www.nrfirescience.org/resource/23684

Question: Northern peatlands are increasingly threatened by wildfire. Severe peatland wildfires can provide opportunities for new non-peatland species to colonise post-fire. Changes in plant colonisation could lead to longer-term shifts in community composition, compromising recovery of peatland structure and function. Understanding...

Author(s): Harry E. R. Shepherd, Jane A. Catford, Magda N. Steele, Marc G. Dumont, Robert T. E. Mills, Paul D.M. Hughes, Bjorn J. M. Robroek

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Determination of burn severity models ranging from regional to national scales for the conterminous United States

www.nrfirescience.org/resource/23649

Identifying meaningful measures of ecological change over large areas is dependent on the quantification of robust relationships between ecological metrics and remote sensing products. Over the past several decades, ground observations of wildfire and prescribed fire severity have been acquired across hundreds of wildland fires in...

Author(s): Joshua J. Picotte, C. Alina Cansler, Crystal A. Kolden, James A. Lutz, Carl H. Key, Nathan C. Benson, Kevin M. Robertson

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Roles of pre-fire vegetation, soil, and climate in Great Basin ecosystem recovery

www.nrfirescience.org/resource/23477

Great Basin shrublands in the United States are rapidly converting to annual grass-dominated ecosystems, driven primarily by increased wildfire activity. Post-fire vegetation recovery trajectories vary spatially and temporally and are influenced by the effects of topography, climate, soils, and pre-fire vegetation. Our study...

Author(s): Jody Vogeler, Eric Jensen, Beth A. Newingham

Year Published: 2021

Type: Document

Technical Report or White Paper

Quantifying merging fire behaviour phenomena using unmanned aerial vehicle technology

www.nrfirescience.org/resource/22854

Catastrophic wildfires are often a result of dynamic fire behaviours. They can cause rapid escalation of fire behaviour, increasing the danger to ground-based emergency personnel. To date, few studies have characterised merging fire behaviours outside the laboratory. The aim of this study was to develop a

simple, fast and accurate...

Author(s): Alexander I. Filkov, Brett Cirulis, Trent D. Penman

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

The U.S. EPA wildland fire sensor challenge: performance and evaluation of solver submitted multi-pollutant sensor systems

www.nrfirescience.org/resource/22763

Wildland fires can emit substantial amounts of air pollution that may pose a risk to those in proximity (e.g., first responders, nearby residents) as well as downwind populations. Quickly deploying air pollution measurement capabilities in response to incidents has been limited to date by the cost, complexity of implementation, and...

Author(s): Matthew S. Landis, Russell W. Long, Jonathan Krug, Maribel Colón, Robert Vanderpool, Andrew Habel, Shawn P. Urbanski

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Mapping soil burn severity at very high spatial resolution from unmanned aerial vehicles

www.nrfirescience.org/resource/22715

The evaluation of the effect of burn severity on forest soils is essential to determine the impact of wildfires on a range of key ecological processes, such as nutrient cycling and vegetation recovery. The main objective of this study was to assess the potentiality of different spectral products derived from RGB and multispectral...

Author(s): David Beltrán-Marcos, Susana Suárez-Seoane, José Manuel Fernández-Guisuraga, Víctor Fernández-García, Rayo Pinto, Paula García-Llamas, Leonor Calvo

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

Turbulent thermal image velocimetry at the immediate fire and atmospheric interface

www.nrfirescience.org/resource/24004

We present novel in-field vegetation fire observations and the analyses using brightness temperatures recorded by longwave infrared camera and thermal image velocimetry. The brightness temperatures from a wind-driven stubble wheat fire were obtained with a 60 frames per second (fps) video acquisition. Multi-level sonic anemometers...

Author(s): Marwan Katurji, Jiawei Zhang, Ashley Satinsky, Hamish McNair, Benjamin Schumacher, Tara Strand, Andres Valencia, Mark A. Finney, H. Grant Pearce, Jessica Kerr, Daisuke Seto, Hugh Wallace, Peyman Zavar-Reza, Christina Dunker, Veronica R. Clifford, Katharine O. Melnik, Torben Grumstrup, Jason M. Forthofer, Craig B. Clements

Year Published: 2021

Type: Document

Book or Chapter or Journal Article

A new approach to characterize firebrand showers using advanced 3D imaging techniques

www.nrfirescience.org/resource/23702

A new approach to characterize airborne firebrands during Wildland-Urban Interface (WUI) fires is detailed. The approach merges the following two imaging techniques in a single field-deployable diagnostic tool: (1) 3D Particle Tracking Velocimetry (3D-PTV), for time-resolved mapping of firebrand 3D trajectories, and (2) 3D Particle...

Author(s): Nicolas Bouvet, Eric Link, Stephen A. Fink
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Post-fire conifer regeneration hinders digital estimation of understory plant cover in subalpine forest vegetation

www.nrfirescience.org/resource/23676

Question: Reliable estimates of understory (non-tree) plant cover following fire are essential to assess early forest community recovery. Photographic digital image analysis (DIA) is frequently used in seral, single-strata vegetation, given its greater objectivity and repeatability compared to observer visual estimation; however,...

Author(s): Brandi E. Wheeler, Andrew J. Andrade, Elizabeth R. Pansing, Diana F. Tomback
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Thermal infrared video stabilization for aerial monitoring of active wildfires

www.nrfirescience.org/resource/23637

Aerial Thermal Infrared (TIR) imagery has demonstrated tremendous potential to monitor active forest fires and acquire detailed information about fire behavior. However, aerial video is usually unstable and requires inter-frame registration before further processing. Measurement of image misalignment is an essential operation for...

Author(s): M.M. Valero, Steven Verstockt, Christian Mata, Daniel M. Jimenez, Lloyd P. Queen, O. Rios, Elsa Pastor, Eulalia Planas
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

The role of fire in global forest loss dynamics

www.nrfirescience.org/resource/23268

Fires, among other forms of natural and anthropogenic disturbance, play a central role in regulating the location, composition and biomass of forests. Understanding the role of fire in global forest loss is crucial in constraining land-use change emissions and the global carbon cycle. We analyzed the relationship between forest...

Author(s): Dave van Wees, Guido R. Van der Werf, James T. Randerson, Niels Andela, Yang Chen, Douglas C. Morton
Year Published: 2021
Type: Document
Book or Chapter or Journal Article

Rapidly mapping fire effects on biodiversity at a large-scale using citizen science

www.nrfirescience.org/resource/22754

The unprecedented scale of the 2019-2020 eastern Australian bushfires exemplifies the challenges that scientists and conservation biologists face monitoring the effects on biodiversity in the aftermath of large-scale environmental disturbances. After a large-scale disturbance, conservation policy and management actions need to be...

Author(s): Casey Kirchhoff, Corey T. Callaghan, David A. Keith, Dony Indiarso, Guy Taseski, Mark K. J. Ooi, Tom D. Le Breton, Thomas Mesaglio, Richard T. Kingsford, William K. Cornwell
Year Published: 2021
Type: Document

Book or Chapter or Journal Article

Bayesian decision network modeling for environmental risk management: a wildfire case study

www.nrfirescience.org/resource/22173

Environmental decision-making requires an understanding of complex interacting systems across scales of space and time. A range of statistical methods, evaluation frameworks and modeling approaches have been applied for conducting structured environmental decision-making under uncertainty. Bayesian Decision Networks (BDNs) are a...

Author(s): Trent D. Penman, Brett Cirulis, Bruce G. Marcot

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Creating photographic loading sequences in the field for the photoload sampling technique

www.nrfirescience.org/resource/22113

The photoload technique provides a quick and accurate means of estimating the loadings of six wildland fuel components including 1 hr, 10 hr, 100 hr, and 1,000 hr downed dead woody, shrub, and herbaceous fuels. It involves visually comparing fuel loading conditions observed in the field with a set of photographed sequences to...

Author(s): Christine Stalling, Robert E. Keane

Year Published: 2020

Type: Document

Technical Report or White Paper

An adaptive and extensible system for satellite-based, large scale burnt area monitoring in near-real time

www.nrfirescience.org/resource/21688

In the case of ongoing wildfire events, timely information on current fire parameters is crucial for informed decision making. Satellite imagery can provide valuable information in this regard, since thermal sensors can detect the exact location and intensity of an active fire at the moment the satellite passes over. This...

Author(s): Michael Nolde, Simon Plank, Torsten Riedlinger

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Investigating live fuel moisture content estimation in fire-prone shrubland from remote sensing using empirical modelling and RTM simulations

www.nrfirescience.org/resource/21676

Previous research has demonstrated that remote sensing can provide spectral information related to vegetation moisture variations essential for estimating live fuel moisture content (LFMC), but accuracy and timeliness still present challenges to using this information operationally. Consequently, many regional administrations are...

Author(s): Eva Marino, Marta Yebra, Mariluz Guillén-Climent, Nur Algeet, José Luis Tomé, Javier Madrigal, Mercedes Guijarro, Carmen Hernando

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

A satellite data driven approach to monitoring and reporting fire disturbance and recovery

across boreal and temperate forests

www.nrfirescience.org/resource/21285

The regular and consistent measurements provided by Earth observation satellites can support the monitoring and reporting of forest indicators. Although substantial scientific literature espouses the capabilities of satellites in this area, the techniques are under-utilised in national reporting, where there is a preference for...

Author(s): Samuel Hislop, Andrew Haywood, Simon D. Jones, Mariela Soto-Berelov, Andrew K. Skidmore, Trung H. Nguyen

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Experimental fire measurement with UAV multimodal stereovision

www.nrfirescience.org/resource/22131

In wildfire research, systems that are able to estimate the geometric characteristics of fire, in order to understand and model the behavior of this spreading and dangerous phenomenon, are required. Over the past decade, there has been a growing interest in the use of computer vision and image processing technologies. The majority...

Author(s): Vito Ciullo, Lucile Rossi, Antoine Pieri

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Severe western Canadian wildfire affects water quality even at large basin scales

www.nrfirescience.org/resource/21971

Wildfires can have severe and lasting impacts on the water quality of aquatic ecosystems. However, our understanding of these impacts is founded primarily from studies of small watersheds with well-connected runoff regimes. Despite the predominance of large, low-relief rivers across the fire-prone Boreal forest, it is unclear to...

Author(s): Craig A. Emmerton, Colin A. Cooke, Sarah Hustins, Uldis Silins, Monica B. Emelko, Ted Lewis, Mary K. Kruk, Nadine Taube, Dongnan Zhu, Brian Jackson, Micheal Stone, Jason G. Kerr, John F. Orwin

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Linking forest flammability and plant vulnerability to drought

www.nrfirescience.org/resource/21684

Globally, fire regimes are being altered by changing climatic conditions. New fire regimes have the potential to drive species extinctions and cause ecosystem state changes, with a range of consequences for ecosystem services. Despite the co-occurrence of forest fires with drought, current approaches to modelling flammability...

Author(s): Rachael H. Nolan, Chris J. Blackman, Víctor Resco de Dios, Brendan Choat, Belinda Medlyn, Ximeng Li, Ross A. Bradstock, Matthias M. Boer

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Changes to the Monitoring Trends in Burn Severity program mapping production procedures and data products

www.nrfirescience.org/resource/21407

Background: The Monitoring Trends in Burn Severity (MTBS) program has been providing the fire science community with large fire perimeter and burn severity data for the past 14 years. As of October 2019, 22 969 fires have been mapped by the MTBS program and are available on the MTBS website (<https://www.mtbs.gov>(link is external))....

Author(s): Joshua J. Picotte, Krishna Bhattarai, Danny Howard, Jennifer Lecker, Justin Epting, Brad Quayle, Nathan C. Benson, Kurtis J. Nelson

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Simulating the Effectiveness of Improvement Cuts and Commercial Thinning to Enhance Fire Resistance in West Coast Dry Mixed Conifer Forests

www.nrfirescience.org/resource/21176

Nine multipurpose silvicultural treatments, formulated as a synthesis of recently implemented prescriptions offered by forest managers, were simulated to evaluate their effectiveness at enhancing fire resistance. The Forest Vegetation Simulator was applied, within the BioSum Framework, on over 3,000 Forest Inventory and Analysis...

Author(s): Theresa B. Jain, Jeremy S. Fried, Sara Loreno

Year Published: 2020

Type: Document

Book or Chapter or Journal Article

Identifying and protecting wildfire refugia in a warmer, drier Pacific Northwest - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/22814

Wildfires are common across the Pacific Northwest, however climate change is projected to cause increases in wildfire activity and severity. Wildfires create a heterogeneous pattern across the landscape from severely burned areas to unburned patches. Unburned areas that are associated with critical habitat where biota can persist (e...

Author(s): Arjan J. H. Meddens, Andrew T. Hudak, Crystal A. Kolden

Year Published: 2020

Type: Document

Technical Report or White Paper

LiDAR-Based Wildfire Prevention in WUI: The Automatic Detection, Measurement and Evaluation of Forest Fuels

www.nrfirescience.org/resource/19311

This paper describes a methodology using LiDAR point clouds with an ultra-high resolution in the characterization of forest fuels for further wildfire prevention and management. Biomass management strips were defined in three case studies using a particular Spanish framework. The data were acquired through a UAV platform. The...

Author(s): Marta Fernández-Álvarez, Julia Armesto, Juan Picos

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

A disturbance weighting analysis model (DWAM) for mapping wildfire burn severity in the presence of forest disease

www.nrfirescience.org/resource/19095

Forest ecosystems are subject to recurring fires as one of their most significant disturbances. Accurate mapping of burn severity is crucial for post-fire land management and vegetation regeneration

monitoring. Remote-sensing-based monitoring of burn severity faces new challenges when forests experience both fire and non-fire...

Author(s): Yinan HE, Gang Chen, Angela De Santis, Dar A. Roberts, Yuyu Zhou, Ross K. Meentemeyer
Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Estimating uncertainty in the volume and carbon storage of downed coarse woody debris

www.nrfirescience.org/resource/19043

Downed coarse woody debris, also known as coarse woody detritus or downed dead wood, is challenging to estimate for many reasons, including irregular shapes, multiple stages of decay, and the difficulty of identifying species. In addition, some properties are commonly not measured, such as wood density and carbon concentration. As a...

Author(s): John L. Campbell, Mark B. Green, Ruth D. Yanai, Christopher W. Woodall, Shawn Fraver, Mark E. Harmon, Mark A. Hatfield, Charles J. Barnett, Craig R. See, Grant M. Domke

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

A review of the applications of remote sensing in fire ecology

www.nrfirescience.org/resource/20491

Wildfire plays an important role in ecosystem dynamics, land management, and global processes. Understanding the dynamics associated with wildfire, such as risks, spatial distribution, and effects is important for developing a clear understanding of its ecological influences. Remote sensing technologies provide a means to study fire...

Author(s): David M. Szpakowski, Jennifer L. Rooker Jensen

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Fuel Characteristic Classification System (FCCS) field sampling and fuelbed development guide

www.nrfirescience.org/resource/19832

The Fuel Characteristic Classification System (FCCS) was designed to store and archive wildland fuel characteristics within fuelbeds, defined as the inherent physical characteristics of fuels that contribute to fire behavior and effects. The FCCS represents fuel characteristics in six strata including canopy, shrubs, herbaceous...

Author(s): Susan J. Prichard, Anne Andreu, Roger D. Ottmar, Ellen Eberhardt

Year Published: 2019

Type: Document

Technical Report or White Paper

A review of forest fire surveillance technologies: mobile ad-hoc network routing protocols perspective

www.nrfirescience.org/resource/19405

Mobile Ad-Hoc Network (MANET) is a type of structure-less wireless mobile network, in which each node plays the role of the router and host at the same time. MANET has gained increased interest from researchers and developers for various applications such as forest fire detection. Forest fires require continuous monitoring and...

Author(s): Fahad Taha AL-Dhief, Naseer Sabri, S. Fouad, N.M. Abdul Latiff, Musatafa Abbas Abbood Albader

Year Published: 2019

Type: Document
Book or Chapter or Journal Article

Object-based classification of forest disturbance types in the conterminous United States

www.nrfirescience.org/resource/19360

Forest ecosystems provide critical ecosystem goods and services, and any disturbance-induced changes can have cascading impacts on natural processes and human socioeconomic systems. Forest disturbance frequency, intensity, and spatial and temporal scale can be altered by changes in climate and human activity, but without baseline...

Author(s): Lian-Zhi Huo, Luigi Boschetti, Aaron M. Sparks

Year Published: 2019

Type: Document
Book or Chapter or Journal Article

The downed and dead wood inventory of forests in the United States

www.nrfirescience.org/resource/19180

The quantity and condition of downed dead wood (DDW) is emerging as a major factor governing forest ecosystem processes such as carbon cycling, fire behavior, and tree regeneration. Despite this, systematic inventories of DDW are sparse if not absent across major forest biomes. The Forest Inventory and Analysis program of the United...

Author(s): Christopher W. Woodall, Vicente J. Monleon, Shawn Fraver, Matthew B. Russell, Mark H. Hatfield, John L. Campbell, Grant M. Domke

Year Published: 2019

Type: Document
Book or Chapter or Journal Article

A Device for Instantaneously Estimating Duff Moisture Content Is also Effective for Grassland Fuels

www.nrfirescience.org/resource/19056

Fine-fuel moisture is an important variable in the wildland fire environment, but measuring live fuel moisture is time-consuming. There is a strong incentive to develop technologies that provide instantaneous measurements of fine-fuel moisture. Campbell Scientific, Inc. markets a device that uses dielectric permittivity to measure...

Author(s): Devan A. McGranahan

Year Published: 2019

Type: Document
Book or Chapter or Journal Article

Comparison of measured and modelled change in coarse woody debris carbon stocks in New Zealand's natural forest

www.nrfirescience.org/resource/19028

Natural forest comprises approximately 78% of New Zealand's total forest area and their dead wood carbon pools contribute to the national carbon balance reported under the United Nations Framework Convention on Climate Change. We investigate the accuracy of coarse woody debris (CWD) carbon stock estimates obtained from periodic...

Author(s): Mark O. Kimberley, Peter N. Beets, Thomas S.H. Paul

Year Published: 2019

Type: Document
Book or Chapter or Journal Article

Relationships between satellite-based spectral burned ratios and terrestrial laser scanning

www.nrfirescience.org/resource/19851

Three-dimensional point data acquired by Terrestrial Lidar Scanning (TLS) is used as ground observation in comparisons with fire severity indices computed from Landsat satellite multi-temporal images through Google Earth Engine (GEE). Forest fires are measured by the extent and severity of fire. Current methods of assessing fire...

Author(s): Akira Kato, L. Monika Moskal, Jonathan L. Batchelor, David Thau, Andrew T. Hudak

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

LANDFIRE Remap Prototype Mapping Effort: Developing a New Framework for Mapping Vegetation Classification, Change, and Structure

www.nrfirescience.org/resource/19747

LANDFIRE (LF) National (2001) was the original product suite of the LANDFIRE program, which included Existing Vegetation Cover (EVC), Height (EVH), and Type (EVT). Subsequent refinements after feedback from data users resulted in updated products, referred to as LF 2001, that now served as LANDFIRE's baseline datasets and are the...

Author(s): Joshua J. Picotte, Daryn Dockter, Jordan Long, Brian Tolk, Anne Davidson, Birgit Peterson

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Peatland vegetation change and establishment of re-introduced Sphagnum moss after prescribed burning

www.nrfirescience.org/resource/19377

Fire, including prescribed burning, is common on peatlands globally and can affect vegetation, including peat-forming Sphagnum mosses, and affect ecosystem services. We monitored vegetation in different burn-age categories at three UK peatland sites over a 19-month period. Half of the plots had Sphagnum fragments added and their...

Author(s): Alice Noble, Sheila M. Palmer, David J. Glaves, Alistair Crowle, Joseph Holden

Year Published: 2019

Type: Document

Book or Chapter or Journal Article

Long-term effects of restoration fire and thinning on soil fungi, fine root biomass, and litter depth - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/16982

To increase ecosystem resiliency, and achieve the desired future condition of stands with large tree retention and low fuel loads, federal agencies have actively implemented a large number of fuel reduction and forest restoration projects in low-elevation dry conifer forests throughout the western United States. A noteworthy example...

Author(s): Jane E. Smith, Daniel L. Luoma, Benjamin T. N. Hart

Year Published: 2018

Type: Document

Technical Report or White Paper

High-severity fire: Evaluating its key drivers and mapping its probability across western US forests

www.nrfirescience.org/resource/17541

Wildland fire is a critical process in forests of the western United States (US). Variation in fire behavior,

which is heavily influenced by fuel loading, terrain, weather, and vegetation type, leads to heterogeneity in fire severity across landscapes. The relative influence of these factors in driving fire severity, however, is...

Author(s): Sean A. Parks, Lisa M. Holsinger, Matthew Panunto, William Matt Jolly, Solomon Z. Dobrowski, Gregory K. Dillon

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Overlapping bark beetle outbreaks, salvage logging and wildfire restructure a lodgepole pine ecosystem

www.nrfirescience.org/resource/17365

The 2010 Church's Park Fire burned beetle-killed lodgepole pine stands in Colorado, including recently salvage-logged areas, creating a fortuitous opportunity to compare the effects of salvage logging, wildfire and the combination of logging followed by wildfire. Here, we examine tree regeneration, surface fuels, understory plants...

Author(s): Charles C. Rhoades, Kristen Pelz, Paula J. Fornwalt, Brett Wolk, Anthony S. Cheng

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Quaking aspen woodland after conifer control: Herbaceous dynamics

www.nrfirescience.org/resource/16720

Western juniper (*Juniperus occidentalis* Hook.) woodlands are replacing low elevation (< 2100 m) quaking aspen (*Populus tremuloides* Michx.) stands in the northern Great Basin. Restoring aspen woodlands is important because they provide wildlife habitat for many species and contain a high diversity of understory shrubs and...

Author(s): Jonathan D. Bates, Kirk W. Davies

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

A Sybil attack detection scheme for a forest wildfire monitoring application

www.nrfirescience.org/resource/17268

Wireless Sensor Networks (WSNs) have experienced phenomenal growth over the past decade. They are typically deployed in human-inaccessible terrains to monitor and collect time-critical and delay-sensitive events. There have been several studies on the use of WSN in different applications. All such studies have mainly focused on...

Author(s): Mian Ahmad Jan, Priyadarsi Nanda, Xiangjian He, Ren Ping Liu

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Tree spatial patterns and stand attributes in temperate forests: The importance of plot size, sampling design, and null model

www.nrfirescience.org/resource/16713

Detection of tree spatial patterns and structural attributes in a forest stand can provide critical information on occurring dynamics, and steer management decisions. However, since tree spatial distribution depends on factors that operate at different scales, including environmental heterogeneity and tree-to-tree interactions, both...

Author(s): Marco Carrer, Daniele Castagneri, Ionel Popa, Mario Pividori, Emanuele Lingua

Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Wildfires managed for restoration enhance ecological resilience

www.nrfirescience.org/resource/17222

Expanding the footprint of natural fire has been proposed as one potential solution to increase the pace of forest restoration programs in fire-adapted landscapes of the western USA. However, studies that examine the long-term socio-ecological trade-offs of expanding natural fire to reduce wildfire risk and create fire...

Author(s): Ana M. G. Barros, Alan A. Ager, Michelle A. Day, Meg A. Krawchuk, Thomas A. Spies
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

It matters when you measure it: using snow-cover Normalised Difference Vegetation Index (NDVI) to isolate post-fire conifer regeneration

www.nrfirescience.org/resource/18734

Landsat Normalized Difference Vegetation Index (NDVI) is commonly used to monitor post-fire green-up; however, most studies do not distinguish new growth of conifer from deciduous or herbaceous species, despite potential consequences for local climate, carbon and wildlife. We found that dual season (growing and snow cover) NDVI...

Author(s): Melanie K. Vanderhoof, Todd J. Hawbaker
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Pinus albicaulis Engelm. (Whitebark Pine) in Mixed-Species Stands throughout Its US Range: Broad-Scale Indicators of Extent and Recent Decline

www.nrfirescience.org/resource/17184

We used data collected from >1400 plots by a national forest inventory to quantify population-level indicators for a tree species of concern. Whitebark pine (*Pinus albicaulis*) has recently experienced high mortality throughout its US range, where we assessed the area of land with whitebark pine present, size-class distribution of...

Author(s): Sara Goeking, Deborah Kay Izlar
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Overstory structure and surface cover dynamics in the decade following the Hayman Fire, Colorado

www.nrfirescience.org/resource/17140

The 2002 Hayman Fire burned with mixed-severity across a 400-ha dry conifer study site in Colorado, USA, where overstory tree and surface cover attributes had been recently measured on 20 0.1-ha permanent plots. We remeasured these plots repeatedly during the first post-fire decade to examine how the attributes changed through time...

Author(s): Paula J. Fornwalt, Camille Stevens-Rumann, Byron J. Collins
Year Published: 2018
Type: Document
Book or Chapter or Journal Article

Bridging the Divide: Integrating Animal and Plant Paradigms to Secure the Future of Biodiversity in Fire-Prone Ecosystems

www.nrfirescience.org/resource/18075

Conserving animals and plants in fire-prone landscapes requires evidence of how fires affect modified ecosystems. Despite progress on this front, fire ecology is restricted by a dissonance between two dominant paradigms: 'fire mosaics' and 'functional types'. The fire mosaic paradigm focuses on animal responses to fire...

Author(s): Luke T. Kelly, Lluís Brotons, Katherine M. Giljohann, Michael A. McCarthy, Juli G. Pausas, Annabel L. Smith

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Post-fire surface fuel dynamics in California forests across three burn severity classes

www.nrfirescience.org/resource/17129

Forest wildfires consume fuel and are followed by post-fire fuel accumulation. This study examines post-fire surface fuel dynamics over 9 years across a wide range of conditions characteristic of California fires in dry conifer and hardwood forests. We estimated post-fire surface fuel loadings (Mg ha⁻¹) from 191 repeatedly...

Author(s): Bianca N. I. Eskelson, Vicente J. Monleon

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Fuel mass and stand structure 13 years after logging of a severely burned ponderosa pine forest in northeastern Oregon, U.S.A

www.nrfirescience.org/resource/17723

Stand structure and fuel mass were measured in 2011, 13 years after logging of a seasonally dry, ponderosa pine-dominated forest that had burned severely in the 1996 Summit Wildfire, Malheur National Forest, northeastern Oregon, U.S.A. Data are compared to those taken one year after post-fire logging (1999), and analyzed in the...

Author(s): James D. McIver, Roger D. Ottmar

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Long-Term Effect of Prescribed Burning Regimes and Logging on Coarse Woody Debris in South-Eastern Australia

www.nrfirescience.org/resource/17624

Coarse woody debris (CWD) is vital within forest ecosystems for an array of fauna. Forest management practices, such as prescribed burning and logging, influence the creation or loss of CWD. We examined the effect of long-term prescribed burning and logging on (i) the abundance of hollow-bearing CWD, (ii) the volume of CWD in...

Author(s): Mitchell G. Stares, Luke Collins, Bradley Law, Kristine French

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Survey design for precise fire management conservation targets

www.nrfirescience.org/resource/17305

Common goals of ecological fire management are to sustain biodiversity and minimize extinction risk. A novel approach to achieving these goals determines the relative proportions of vegetation growth stages (equivalent to successional stages, which are categorical representations of time since fire) that maximize a biodiversity...

Author(s): Holly Sitters, Julian Di Stefano, Timothy J. Wills, Matthew Swan, Alan York

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Quaking aspen woodland after conifer control: Tree and shrub dynamics

www.nrfirescience.org/resource/16719

Western juniper (*Juniperus occidentalis* spp. *occidentalis* Hook.) woodlands are replacing many lower elevation (< 2100 m) quaking aspen (*Populus tremuloides* Michx.) stands in the northern Great Basin. We evaluated two juniper removal treatments (Fall, Spring) to restore aspen woodlands in southeast Oregon, spanning a 15-year...

Author(s): Jonathan D. Bates, Kirk W. Davies

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Combination of Landsat and Sentinel-2 MSI data for initial assessing of burn severity

www.nrfirescience.org/resource/17251

Nowadays Earth observation satellites, in particular Landsat, provide a valuable help to forest managers in post-fire operations; being the base of post-fire damage maps that enable to analyze fire impacts and to develop vegetation recovery plans. Sentinel-2A MultiSpectral Instrument (MSI) records data in similar spectral...

Author(s): Carmen Quintano, Alfonso Fernández-Manso, O. Fernández-Manso

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Surface analysis as a method to reconstruct past and recent dynamics of forest ecosystems

www.nrfirescience.org/resource/16707

The most direct way of deciphering the dynamics of an ecosystem is to examine its biotic and abiotic components based on analysis of living and dead organisms distributed above ground. The surface analysis method presented here provides a centennial to millennial stand-scale composition and disturbance history and is applicable in...

Author(s): Vanessa Pilon, Serge Payette, Pierre-Luc Couillard, Jason Laflamme

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Applications of the United States Forest Inventory and Analysis dataset: a review and future directions

www.nrfirescience.org/resource/18287

The United States Forest Inventory and Analysis (FIA) program has been monitoring national forest resources in the United States for over 80 years; presented here is a synthesis of research applications for FIA data. A review of over 180 publications that directly utilize FIA data is broken down into broad categories of application...

Author(s): Wade T. Tinkham, Patrick R. Mahoney, Andrew T. Hudak, Grant M. Domke, Michael J. Falkowski, Christopher W. Woodall, Alistair M. S. Smith

Year Published: 2018
Type: Document
Book or Chapter or Journal Article

A numerical study of atmospheric perturbations induced by heat from a wildland fire: sensitivity to vertical canopy structure and heat source strength

www.nrfirescience.org/resource/17142

An improved understanding of atmospheric perturbations within and above a forest during a wildland fire has relevance to many aspects of wildland fires including fire spread, smoke transport and dispersion, and tree mortality. In this study, the ARPS-CANOPY model, a version of the Advanced Regional Prediction System (ARPS) model...

Author(s): Michael T. Kiefer, Shiyuan Zhong, Warren Heilman, Joseph J. Charney, Xindi Bian

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Environmental, Structural, and Disturbance Influences over Forest Floor Components in Interior Douglas-Fir Forests of the Intermountain West, USA

www.nrfirescience.org/resource/18077

Downed woody material (DWM) is a key component in forest ecosystems with age, structure, and disturbance described as primary factors that influence DWM dynamics. In particular, much emphasis is placed on large coarse woody debris (CWD). Fine woody debris (FWD) (less than 7.62 cm diameter), duff, and litter also contribute to carbon...

Author(s): Andrew D. Giunta, John D. Shaw

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Mixed-severity fire fosters heterogeneous spatial patterns of conifer regeneration in a dry conifer forest

www.nrfirescience.org/resource/17138

We examined spatial patterns of post-fire regenerating conifers in a Colorado, USA, dry conifer forest 11–12 years following the reintroduction of mixed-severity fire. We mapped and measured all post-fire regenerating conifers, as well as all other post-fire regenerating trees and all residual (i.e., surviving) trees, in three 4-...

Author(s): Sparkle L. Malone, Paula J. Fornwalt, Michael A. Battaglia, Marin Chambers, Jose M. Iniguez, Carolyn Hull Sieg

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Determining the minimum sampling frequency for ground measurements of burn severity

www.nrfirescience.org/resource/17932

Understanding burn severity is essential to provide an overview of the precursory conditions leading to fires as well as understanding the constraints placed on fire management services when mitigating their effects. Determining the minimum sampling frequency for ground measurements is not only essential for accurately assessing...

Author(s): Alexander W. Holmes, Christoph Rüdiger, Sarah Harris, Nigel J. Tapper

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Automatic Assessment of Crown Projection Area on Single Trees and Stand-Level, Based on Three-Dimensional Point Clouds Derived from Terrestrial Laser-Scanning

www.nrfirescience.org/resource/17630

Crown projection area (CPA) is a critical parameter in assessing inter-tree competition and estimating biomass volume. A multi-layer seeded region growing-based approach to the fully automated assessment of CPA based on 3D-point-clouds derived from terrestrial laser scanning (TLS) is presented. Independently repeated manual CPA-...

Author(s): Tim Ritter, Arne Nothdurft

Year Published: 2018

Type: Document

Book or Chapter or Journal Article

Surface fuel characteristics, temporal dynamics, and fire behavior of masticated mixed-conifer fuelbeds of the U.S. Southeast and Rocky Mountains

www.nrfirescience.org/resource/15582

Mastication is a wildland fuel treatment technique that is rapidly becoming popular with fire managers for fire hazard reduction projects, especially in areas where reducing fuels with prescribed fire is particularly challenging. Mastication is the process of mechanically modifying the live and dead surface and canopy biomass by...

Author(s): Robert E. Keane, Pamela G. Sikkink, Theresa B. Jain, James J. Reardon

Year Published: 2017

Type: Document

Technical Report or White Paper

Prediction of forest canopy and surface fuels from lidar and satellite time series data in a bark beetle-affected forest

www.nrfirescience.org/resource/15535

Wildfire behavior depends on the type, quantity, and condition of fuels, and the effect that bark beetle outbreaks have on fuels is a topic of current research and debate. Remote sensing can provide estimates of fuels across landscapes, although few studies have estimated surface fuels from remote sensing data. Here we predicted and...

Author(s): Benjamin C. Bright, Andrew T. Hudak, Arjan J. H. Meddens, Todd J. Hawbaker, Jennifer S. Briggs, Robert E. Kennedy

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Short-term ecological consequences of collaborative restoration treatments in ponderosa pine forests of Colorado

www.nrfirescience.org/resource/15484

Ecological restoration treatments are being implemented at an increasing rate in ponderosa pine and other dry conifer forests across the western United States, via the USDA Forest Service's Collaborative Forest Landscape Restoration (CFLR) program. In this program, collaborative stakeholder groups work with National Forests (NFs)...

Author(s): Jennifer S. Briggs, Paula J. Fornwalt, Jonas A. Feinstein

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

The effect of salvage logging on surface fuel loads and fuel moisture in beetle-infested lodgepole pine forests

www.nrfirescience.org/resource/15246

Widespread tree mortality from mountain pine beetle (MPB; *Dendroctonus ponderosae* Hopkins) outbreaks has prompted forest management activities to reduce crown fire hazard in the Rocky Mountain region. However, little is known about how beetle-related salvage logging and biomass utilization options affect woody surface fuel loads and...

Author(s): Paul R. Hood, Kellen N. Nelson, Charles C. Rhoades, Daniel B. Tinker

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

The effects of thinning and burning on understory vegetation in North America: A meta-analysis

www.nrfirescience.org/resource/16668

Management in fire-prone ecosystems relies widely upon application of prescribed fire and/or firesurrogate (e.g., forest thinning) treatments to maintain biodiversity and ecosystem function. The literature suggests fire and mechanical treatments proved more variable in their effects on understory vegetation as compared to their...

Author(s): Joshua Willms, Anne Bartuszevige, Dylan W. Schwilk, Patricia L. Kennedy

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Does the presence of large down wood at the time of a forest fire impact soil recovery?

www.nrfirescience.org/resource/15068

Fire may remove or create dead wood aboveground, but it is less clear how high severity burning of soils affects belowground microbial communities and soil processes, and for how long. In this study, we investigated soil fungal and bacterial communities and biogeochemical responses of severely burned "red" soil and less severely...

Author(s): Jane E. Smith, Laurel A. Kluber, Tara N. Jennings, Donaraye McKay, Greg Brenner, Elizabeth W. Sulzman

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Post-fire vegetation response at the woodland-shrubland interface is mediated by the pre-fire community

www.nrfirescience.org/resource/16496

Understanding the drivers of ecosystem responses to disturbance is essential for management aimed at maintaining or restoring ecosystem processes and services, especially where invasive species respond strongly to disturbance. In this study, we used repeat vegetation surveys from a network of prescribed fire treatments at the...

Author(s): Alexandra K. Urza, Peter J. Weisberg, Jeanne C. Chambers, Jessica M. Dhaemers, David Board

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Understory recovery after low- and high-intensity fires in ponderosa pine forests of northern Idaho

www.nrfirescience.org/resource/18266

Researchers compared early postfire vegetation recovery on sites burned with different intensities in seral ponderosa pine communities of the Douglas-fir/mallow ninebark habitat type. The plots were burned over 30 days burned under varying conditions of temperature, fuel moisture, and relative humidity, resulting in fires of varying...

Year Published: 2017

Type: Document

Synthesis

Density-dependent woody detritus accumulation in an even-aged, single-species forest

www.nrfirescience.org/resource/16462

Deadwood in forests influences fire intensity, stores carbon and nutrients, and provides wildlife habitat. We used a 54-year-old density management experiment in *Larix occidentalis* Nutt. forests to evaluate density dependence of woody detritus accumulation. Based on self-thinning theory, we expected woody detritus produced by the...

Author(s): Michael S. Schaedel, Andrew J. Larson, Cullen J. Weisbrod, Robert E. Keane

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Do fuel treatment costs affect wildfire suppression costs and property damages? An analysis of costs, damages avoided and return on investment - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/16993

Spatial wildfire suppression costs regressions have been re-estimated at a more disaggregated level for the nine Geographic Area Coordination Center (GACC's) regions using five years of data for fires involving National Forests. Results of these revised regression determined that only in the California GACCs did mechanical fuel...

Author(s): Armando Gonzalez-Caban, John B. Loomis, Robin Reich, Douglas B. Rideout, José J. Sánchez

Year Published: 2017

Type: Document

Technical Report or White Paper

Effect of particle aging on chemical characteristics, smoldering, and fire behavior in mixed-conifer masticated fuel

www.nrfirescience.org/resource/15782

Mastication is a silvicultural technique that grinds, shreds, or chops trees or shrubs into pieces and redistributes the biomass onto the forest floor to form a layer of woody debris. Unlike other fuel treatments that remove this biomass, masticated biomass often remains on site, which increases total fuel loading and causes concern...

Author(s): Pamela G. Sikkink, Theresa B. Jain, James J. Reardon, Faith A. Heinsch, Robert E. Keane, Bret W. Butler, Scott L. Baggett

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Surface fuel changes after severe disturbances in northern Rocky Mountain ecosystems

www.nrfirescience.org/resource/15549

It is generally assumed that severe disturbances predispose damaged forests to high fire hazard by creating heavy fuel loading conditions. Of special concern is the perception that surface fuel loadings become high as recently killed trees deposit foliage and woody material on the ground and that these

high fuel loadings may cause...

Author(s): Christine Stalling, Robert E. Keane, Molly L. Retzlaff

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Selecting Control Sites for Post-Fire Ecological Studies Using Biological Criteria and MODIS Time Series Data

www.nrfirescience.org/resource/16737

Wildland fires play a key role in the functioning and structure of vegetation. The availability of sensors aboard satellites, such as Moderate Resolution Imaging Spectroradiometer (MODIS), makes possible the construction of a time series of vegetation indices (VI) and the monitoring of post-fire vegetation recovery. One of the...

Author(s): Marcos A. Landi, Carlos Di Bella, Silvia Ojeda, Paola Salvatierra, Juan Argañaraz, Laura M. Bellis

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

An evaluation of the Forest Service Hazardous Fuels Treatment Program—Are we treating enough to promote resiliency or reduce hazard?

www.nrfirescience.org/resource/15522

The National Cohesive Wildland Fire Management Strategy recognizes that wildfire is a necessary natural process in many ecosystems and strives to reduce conflicts between fire-prone landscapes and people. In an effort to mitigate potential negative wildfire impacts proactively, the Forest Service fuels program reduces wildland fuels...

Author(s): Nicole M. Vaillant, Elizabeth D. Reinhardt

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Fine-scale spatial climate variation and drought mediate the likelihood of reburning

www.nrfirescience.org/resource/17220

In many forested ecosystems, it is increasingly recognized that the probability of burning is substantially reduced within the footprint of previously burned areas. This self-limiting effect of wildland fire is considered a fundamental emergent property of ecosystems and is partly responsible for structuring landscape...

Author(s): Sean A. Parks, Marc-Andre Parisien, Carol Miller, Lisa M. Holsinger, Scott L. Baggett

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Aging masticated fuels - How do they change over time?

www.nrfirescience.org/resource/15226

Mastication is becoming a common fuel treatment method in forests and shrublands of the United States, especially where prescribed fire or mechanical fuel removal is difficult. Such sites are often located in the wildland urban interface (WUI) where fuel treatments must be carefully administered because of the risk to nearby...

Author(s): Pamela G. Sikkink

Year Published: 2017

Type: Document

Improving forest sampling strategies for assessment of fuel reduction burning

www.nrfirescience.org/resource/16665

Land managers typically make post hoc assessments of the effectiveness of fuel reduction burning (FRB), but often lack a rigorous sampling framework. A general, but untested, assumption is that variability in soil and fuel properties increases from small (1 m) to large spatial scales (10–100 km). Based on a recently published...

Author(s): Mana Gharun, Malcolm Possell, Meaghan E. Jenkins, Lai Fan Poon, Tina L. Bell, Mark A. Adams

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Site preparation severity influences lodgepole pine plant community composition, diversity, and succession over 25 years

www.nrfirescience.org/resource/16474

Lodgepole pine (*Pinus contorta* var. *latifolia* Engelm.) ecosystems of central British Columbia face cumulative stresses, and management practices are increasingly scrutinized. We addressed trade-offs between “light-on-the-land” versus more aggressive silvicultural approaches by examining plant communities and indicator species (...)

Author(s): Sybille Haeussler, Torsten Kaffanke, Jacob O. Boateng, John McClarnon, Lorne Bedford

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Long-term impacts of wildfire on fuel loads, vegetation composition, and potential fire behavior and management in sagebrush-dominated ecosystems - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/17010

An understanding of the long-term vegetation structure, patterns of fuel succession, and potential for reburn in sagebrush-dominated ecosystems is important for managing the landscape at a temporal scale that is appropriate for the ecological interactions in these systems. Our overarching research objective was to fill existing...

Author(s): Lisa M. Ellsworth, J. Boone Kauffman

Year Published: 2017

Type: Document

Technical Report or White Paper

Mapping tree canopy cover in support of proactive prairie grouse conservation in western North America

www.nrfirescience.org/resource/14922

Invasive woody plant expansion is a primary threat driving fragmentation and loss of sagebrush (*Artemisia* spp.) and prairie habitats across the central and western United States. Expansion of native woody plants, including conifer (primarily *Juniperus* spp.) and mesquite (*Prosopis* spp.), over the past century is...

Author(s): Michael J. Falkowski, Jeffrey S. Evans, David E. Naugle, Christian A. Hagen, Scott A. Carleton, Jeremy D. Maestas, Azad Henareh Khalyani, Aaron J. Poznanovic, Andrew J. Lawrence

Year Published: 2017

Type: Document

Book or Chapter or Journal Article

Artemisia tridentata subsp. vaseyana (mountain big sagebrush)

www.nrfirescience.org/resource/16200

Mountain big sagebrush is a widely distributed shrub native to the western United States. Mountain big sagebrush ecosystems support hundreds of plant and animal species, including several sagebrush obligates. The distribution of mountain big sagebrush has been reduced since European-American settlement, and is likely to be further...

Author(s): Robin J. Innes

Year Published: 2017

Type: Document

Synthesis

Estimating ladder fuels: a new approach combining field photography with LiDAR

www.nrfirescience.org/resource/14768

Forests historically associated with frequent fire have changed dramatically due to fire suppression and past harvesting over the last century. The buildup of ladder fuels, which carry fire from the surface of the forest floor to tree crowns, is one of the critical changes, and it has contributed to uncharacteristically large and...

Author(s): Heather A. Kramer, Brandon M. Collins, Frank K. Lake, Marek K. Jakubowski, Scott L. Stephens, Maggi Kelly

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Burning the legacy? Influence of wildfire reburn on dead wood dynamics in a temperate conifer forest

www.nrfirescience.org/resource/14473

Dynamics of dead wood, a key component of forest structure, are not well described for mixed-severity fire regimes with widely varying fire intervals. A prominent form of such variation is when two stand-replacing fires occur in rapid succession, commonly termed an early-seral "reburn." These events are thought to strongly...

Author(s): Daniel C. Donato, Joseph B. Fontaine, John L. Campbell

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Development and validation of fuel height models for terrestrial lidar - RxCADRE 2012

www.nrfirescience.org/resource/13846

Terrestrial laser scanning (TLS) was used to collect spatially continuous measurements of fuelbed characteristics across the plots and burn blocks of the 2012 RxCADRE experiments in Florida.

Fuelbeds were scanned obliquely from plot/block edges at a height of 20 m above ground. Pre-fire blocks were scanned from six perspectives and...

Author(s): Eric Rowell, Carl A. Seielstad, Roger D. Ottmar

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Landscape variation in tree regeneration and snag fall drive fuel loads in 24-year old post-fire lodgepole pine forests

www.nrfirescience.org/resource/14901

Escalating wildfire in subalpine forests with stand-replacing fire regimes is increasing the extent of early-seral forests throughout the western USA. Post-fire succession generates the fuel for future fires, but little is known about fuel loads and their variability in young post-fire stands. We sampled fuel profiles in 24-year-old...

Author(s): Kellen N. Nelson, Monica G. Turner, William H. Romme, Daniel B. Tinker

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Bayesian techniques for surface fuel loading estimation

www.nrfirescience.org/resource/14681

A study by Keane and Gray (2013) compared three sampling techniques for estimating surface fine woody fuels. Known amounts of fine woody fuel were distributed on a parking lot, and researchers estimated the loadings using different sampling techniques. An important result was that precise estimates of biomass required intensive...

Author(s): Kathy L. Gray, Robert E. Keane, Ryan Karpisz, Alyssa Pedersen, Rick Brown, Taylor Russell

Year Published: 2016

Type: Document

Technical Report or White Paper

The Interagency Fuels Treatment Decision Support System: functionality for fuels treatment planning

www.nrfirescience.org/resource/14255

The Interagency Fuels Treatment Decision Support System (IFTDSS) is a web-based software and data integration framework that organizes fire and fuels software applications into a single online application. IFTDSS is designed to make fuels treatment planning and analysis more efficient and ...

Author(s): Stacy Drury, H. Michael Rauscher, Erin M. Banwell, Shih Ming Huang, Tami L. Lavezzo

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Using the photoload technique with double sampling to improve surface fuel loading estimates

www.nrfirescience.org/resource/13802

Accurate surface fuel load estimates based on the planar intercept method require a considerable amount of time and cost. Recently the photoload method has been proposed as an alternative for sampling of fine woody surface fuels. To evaluate the use of photoload fuel sampling, six simulated fuel beds of 100 photoload visual...

Author(s): Wade T. Tinkham, Chad M. Hoffman, Jesse M. Canfield, Emma Vakili, Robin Reich

Year Published: 2016

Type: Document

Book or Chapter or Journal Article

Measurements, datasets and preliminary results from the RxCADRE project - 2008, 2011 and 2012

www.nrfirescience.org/resource/13696

The lack of independent, quality-assured field data prevents scientists from effectively evaluating and advancing wildland fire models. To rectify this, scientists and technicians convened in the south-eastern United States in 2008, 2011 and 2012 to collect wildland fire data in six integrated core science disciplines defined by the...

Author(s): Roger D. Ottmar, J. Kevin Hiers, Bret W. Butler, Craig B. Clements, Matthew B. Dickinson, Andrew T. Hudak, Joseph J. O'Brien, Brian E. Potter, Eric Rowell, Tara Strand, Thomas J. Zajkowski

Year Published: 2015
Type: Document
Book or Chapter or Journal Article

Keeping it wild 2: an updated interagency strategy to monitor trends in wilderness character across the National Wilderness Preservation System

www.nrfirescience.org/resource/13591

Keeping It Wild 2 is an interagency strategy to monitor trends in selected attributes of wilderness character based on lessons learned from 15 years of developing and implementing wilderness character monitoring across the National Wilderness Preservation System. This document updates and replaces Keeping It Wild: An Interagency...

Author(s): Peter Landres, Chris Barns, Steve Boutcher, Tim Devine, Peter Dratch, Adrienne Lindholm, Linda Merigliano, Nancy Roeper, Emily Simpson

Year Published: 2015

Type: Document

Technical Report or White Paper

Post-fire logging reduces surface woody fuels up to four decades following wildfire

www.nrfirescience.org/resource/16307

Severe wildfires create pulses of dead trees that influence future fuel loads, fire behavior, and fire effects as they decay and deposit surface woody fuels. Harvesting fire-killed trees may reduce future surface woody fuels and related fire hazards, but the magnitude and timing of post-fire logging effects on woody fuels have not...

Author(s): David W. Peterson, Erich K. Dodson, Richy J. Harrod

Year Published: 2015

Type: Document

Book or Chapter or Journal Article

Initial results from a field experiment to support the assessment of fuel treatment effectiveness in reducing wildfire intensity and spread rate

www.nrfirescience.org/resource/16917

Hazardous fuel reduction treatments conducted both through prescribed fire and mechanical means are a critical part of the mitigation of wildland fire risk in the United States. The US Federal Government has spent an average of \$500 million each year on fuel reduction, from 2002-2012 (Gorte 2011). At present, however, rigorous...

Author(s): Eric Mueller, Nick Skowronski, Kenneth L. Clark, Robert L. Kremens, Michael R. Gallagher, Jan C. Thomas, M. El Houssami, Alexander I. Filkov, Bret W. Butler, John L. Hom, William E. Mell, Albert Simeoni

Year Published: 2015

Type: Document

Conference Proceedings

Automated integration of lidar into the LANDFIRE product suite

www.nrfirescience.org/resource/13609

Accurate information about three-dimensional canopy structure and wildland fuel across the landscape is necessary for fire behaviour modelling system predictions. Remotely sensed data are invaluable for assessing these canopy characteristics over large areas; lidar data, in particular, are uniquely suited for quantifying three-...

Author(s): Birgit Peterson, Kurtis J. Nelson, Carl A. Seielstad, Jason Stoker, William Matt Jolly, Russell A. Parsons

Year Published: 2015

Type: Document
Book or Chapter or Journal Article

Tracking progress - The monitoring process used in collaborative forest landscape restoration projects in the Pacific Northwest

www.nrfirescience.org/resource/13348

Several trends have emerged in recent years that affect the management of the National Forest System, particularly in the western U.S. One is the recognition of landscapes departed from a natural range of variation, especially with implications for wildfire management. Another trend is the economic...

Author(s): Thomas DeMeo, Amy Markus, Bernard Bormann, Jodi Leingang

Year Published: 2015

Type: Document

Technical Report or White Paper

Crown fire potential in lodgepole pine forests during the red stage of mountain pine beetle attack

www.nrfirescience.org/resource/12926

Mountain pine beetle (MPB) outbreaks within the previous 10-15 years have affected millions of hectares of lodgepole pine forests in western North America. Concerns about the influence of recent tree mortality on changes in fire behaviour amongst firefighters and fire managers have led researchers to attempt to quantify the effects...

Author(s): Wesley G. Page, Michael J. Jenkins, Martin E. Alexander

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

A comprehensive guide to fuel management practices for dry mixed conifer forests in the northwestern United States: monitoring

www.nrfirescience.org/resource/12920

Short- and medium-term evaluation of how fuel treatments are working is the only way to know if the hundreds of activities on the ground are adding up to the goals of more resilient landscapes and increased safety of people and property. Monitoring is a critical resource for decision makers who design fuels management programs,...

Author(s): Theresa B. Jain, Michael A. Battaglia, Han-Sup Han, Russell T. Graham, Christopher R. Keyes, Jeremy S. Fried, Jonathan Sandquist

Year Published: 2014

Type: Document

Research Brief or Fact Sheet

Spectroscopic analysis of seasonal changes in live fuel moisture content and leaf dry mass

www.nrfirescience.org/resource/13001

Live fuel moisture content (LFMC), the ratio of water mass to dry mass contained in live plant material, is an important fuel property for determining fire danger and for modeling fire behavior. Remote sensing estimation of LFMC often relies on an assumption of changing water and stable dry mass over time. Fundamental understanding...

Author(s): Yi Qi, Philip E. Dennison, William Matt Jolly, Rachel C. Kropp, Simon C. Brewer

Year Published: 2014

Type: Document

Book or Chapter or Journal Article

A comprehensive guide to fuel management practices for dry mixed conifer forests in the northwestern United States: inventory and model-based economic analysis of mechanical fuel treatments

www.nrfirescience.org/resource/12921

Implementing fuel treatments in every place where it could be beneficial to do so is impractical and not cost effective under any plausible specification of objectives. Only some of the many possible kinds of treatments will be effective in any particular stand and there are some stands that seem to defy effective treatment. In many...

Author(s): Theresa B. Jain, Michael A. Battaglia, Han-Sup Han, Russell T. Graham, Christopher R. Keyes, Jeremy S. Fried, Jonathan Sandquist

Year Published: 2014

Type: Document

Research Brief or Fact Sheet

Comparing three sampling techniques for estimating fine woody down dead biomass

www.nrfirescience.org/resource/12038

Designing woody fuel sampling methods that quickly, accurately and efficiently assess biomass at relevant spatial scales requires extensive knowledge of each sampling method's strengths, weaknesses and tradeoffs. In this study, we compared various modifications of three common sampling methods (planar intercept, fixed-area microplot...

Author(s): Robert E. Keane, Kathy L. Gray

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Wildfire exposure and fuel management on western US national forests

www.nrfirescience.org/resource/12756

Substantial investments in fuel management activities on national forests in the western US are part of a national strategy to reduce human and ecological losses from catastrophic wildfire and create fire resilient landscapes. Prioritizing these investments within and among national forests remains a challenge, partly because a...

Author(s): Alan A. Ager, Michelle A. Day, Charles W. McHugh, Karen C. Short, Julie W. Gilbertson-Day, Mark A. Finney, David E. Calkin

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Modeled forest inventory data suggest climate benefits from fuels management

www.nrfirescience.org/resource/13480

As part of a recent synthesis addressing fuel management in dry, mixed-conifer forests, we analyzed more than 5,000 Forest Inventory and Analysis (FIA) plots, a probability sample that represents 33 million acres of these forests throughout Washington, Oregon, Idaho, Montana, Utah, and extreme northern California. We relied on the...

Author(s): Jeremy S. Fried, Theresa B. Jain, Jonathan Sandquist

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Bark beetle effects on fuel profiles across a range of stand structures in Douglas-fir forests of Greater Yellowstone

www.nrfirescience.org/resource/13301

Consequences of bark beetle outbreaks for forest wildfire potential are receiving heightened attention, but little research has considered ecosystems with mixed-severity fire regimes. Such forests are widespread, variable in stand structure, and often fuel limited, suggesting that beetle outbreaks could substantially alter fire...

Author(s): Daniel C. Donato, Brian J. Harvey, William H. Romme, Martin Simard, Monica G. Turner

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Evaluating the performance and mapping of three fuel classification systems using Forest Inventory and Analysis surface fuel measurements

www.nrfirescience.org/resource/12015

Fuel Loading Models (FLMs) and Fuel Characteristic Classification System (FCCSs) fuelbeds are used throughout wildland fire science and management to simplify fuel inputs into fire behavior and effects models, but they have yet to be thoroughly evaluated with field data. In this study, we used a large dataset of Forest Inventory and...

Author(s): Robert E. Keane, Jason M. Herynk, Chris Toney, Shawn P. Urbanski, Duncan C. Lutes, Roger D. Ottmar

Year Published: 2013

Type: Document

Book or Chapter or Journal Article

Making monitoring count: project design for active adaptive management

www.nrfirescience.org/resource/12768

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

Do carbon offsets work? The role of forest management in greenhouse gas mitigation

www.nrfirescience.org/resource/12450

As forest carbon offset projects become more popular, professional foresters are providing their expertise to support them. But when several members of the Society of American Foresters questioned the science and assumptions used to design the projects, the organization decided to convene a task force to examine whether these...

Author(s): Marie Oliver

Year Published: 2013

Type: Document

Research Brief or Fact Sheet

Foliar moisture content variations in lodgepole pine over the diurnal cycle during the red stage of mountain pine beetle attack

www.nrfirescience.org/resource/12141

Widespread outbreaks of the mountain pine beetle (*Dendroctonus ponderosae* Hopkins) in the lodgepole pine (*Pinus contorta* Dougl. ex Loud. var. *latifolia* Engelm.) forests of North America have produced stands with significant levels of recent tree mortality. The needle foliage from recently attacked trees typically turns red within...

Author(s): Wesley G. Page, Michael J. Jenkins, Martin E. Alexander
Year Published: 2013
Type: Document
Book or Chapter or Journal Article

Relationships between moisture, chemistry, and ignition of *Pinus contorta* needles during the early stages of mountain pine beetle attack

www.nrfirescience.org/resource/8317

Very little is known about how foliar moisture and chemistry change after a mountain pine beetle attack and even less is known about how these intrinsic foliar characteristics alter foliage ignitability. Here, we examine the fuel characteristics and ignition potential of *Pinus contorta* (lodgepole pine) foliage during the early...

Author(s): William Matt Jolly, Russell A. Parsons, Ann M. Hadlow, Greg M. Cohn, Sara S. McAllister, John B. Popp, Robert M. Hubbard, Jose F. Negrón
Year Published: 2012
Type: Document
Book or Chapter or Journal Article

Spatial scaling of wildland fuels for six forest and rangeland ecosystems of the Northern Rocky Mountains, USA

www.nrfirescience.org/resource/8355

Wildland fuels are important to fire managers because they can be manipulated to achieve management goals, such as restoring ecosystems, decreasing fire intensity, minimizing plant mortality, and reducing erosion. However, it is difficult to accurately measure, describe, and map wildland fuels because of the great variability of...

Author(s): Robert E. Keane, Kathy L. Gray, Valentina Bacciu, Signe B. Leirfallom
Year Published: 2012
Type: Document
Book or Chapter or Journal Article

A comparison of two methods for estimating conifer live foliar moisture content

www.nrfirescience.org/resource/8319

Foliar moisture content is an important factor regulating how wildland fires ignite in and spread through live fuels but moisture content determination methods are rarely standardised between studies. One such difference lies between the uses of rapid moisture analysers or drying ovens. Both of these methods are commonly used in...

Author(s): William Matt Jolly, Ann M. Hadlow
Year Published: 2012
Type: Document
Book or Chapter or Journal Article

National to local: a pre & post assessment of the Fuel Characteristic Classification System (FCCS) landscape variables for the Confederated Salish and Kootenai Tribes

www.nrfirescience.org/resource/13486

A modified Fuel Characteristic and Classification System (FCCS) fuelbed was created for the Confederated Salish & Kootenai Tribes (CSKT) of Montana. This crosswalk of data combined two principal sources of data: (1) locally the Bureau of Indian Affairs (BIA) Continuous Forest Inventory Data (CFI) and (2) nationally the US Forest...

Author(s): Laurel L. James
Year Published: 2012
Type: Document

Deriving fuel mass by size class in Douglas-fir (*Pseudotsuga menziesii*) using terrestrial laser scanning

www.nrfirescience.org/resource/13152

Requirements for describing coniferous forests are changing in response to wildfire concerns, bio-energy needs, and climate change interests. At the same time, technology advancements are transforming how forest properties can be measured. Terrestrial Laser Scanning (TLS) is yielding promising results for measuring tree biomass...

Author(s): Carl A. Seielstad, Crystal S. Stonesifer, Eric Rowell, Lloyd P. Queen

Year Published: 2011

Type: Document

Book or Chapter or Journal Article

Guide for quantifying post-treatment fuels in the sagebrush steppe and juniper woodlands of the Great Basin

www.nrfirescience.org/resource/11108

Invasive species and woodland encroachment have caused extensive changes in the fire regimes of sagebrush steppe over the past 150 years. Land managers and resource specialists of the Great Basin are increasingly required to implement vegetation treatments to maintain habitat, reduce fire risk and restore landscapes to a more...

Author(s): Andrea Bourne, Stephen C. Bunting

Year Published: 2011

Type: Document

Research Brief or Fact Sheet

Critique of Sikkink and Keane's comparison of surface fuel sampling techniques

www.nrfirescience.org/resource/8370

The 2008 paper of Sikkink and Keane compared several methods to estimate surface fuel loading in western Montana: two widely used inventory techniques (planar intersect and fixed-area plot) and three methods that employ photographs as visual guides (photoload, photoload macroplot and photo series). We feel, however, that their study...

Author(s): Clinton S. Wright, Roger D. Ottmar, Robert E. Vihnanek

Year Published: 2010

Type: Document

Book or Chapter or Journal Article

Mapping and estimating forest fuel with radar remote sensing

www.nrfirescience.org/resource/11084

With an increase in the risk of large fires across much of the Western United States, along with a growing variety of fuel types that result from changes in the landscape and management strategies, there has never been a more pressing need for accurate, cost-efficient, large scale forest fuel maps. Emerging remote sensing...

Author(s): Rachel Clark

Year Published: 2009

Type: Document

Research Brief or Fact Sheet

Technical guide for monitoring selected conditions related to wilderness character

www.nrfirescience.org/resource/12437

The purpose of monitoring wilderness character is to improve wilderness stewardship by providing managers a tool to assess how selected actions and conditions related to wilderness character are changing over time. Wilderness character monitoring provides information to help answer two key questions about wilderness character and...

Author(s): Peter Landres, Steve Boutcher, Liese Dean, Troy E. Hall, Tamara Blett, Terry Carlson, Ann Mebane, Carol Hardy, Susan Rinehart, Linda Merigiano, David N. Cole, Andy Leach, Pam Wright, Deb Bumpus

Year Published: 2009

Type: Document

Technical Report or White Paper

Assessing the performance of sampling designs for measuring abundance of understory plants after forest restoration

www.nrfirescience.org/resource/13353

Accurate estimation of the responses of understory plants to natural and anthropogenic disturbance is essential for understanding efficacy and non-target effects of management and restoration activities. However, ability to assess changes in abundance of understory plants that result from disturbance may be hampered...

Author(s): Ilana L. Abrahamson

Year Published: 2009

Type: Document

Dissertation or Thesis

Analysing Designed Experiments In Distance Sampling

www.nrfirescience.org/resource/17472

Distance sampling is a survey technique for estimating the abundance or density of wild animal populations. Detection probabilities of animals inherently differ by species, age class, habitats, or sex. By incorporating the change in an observer's ability to detect a particular class of animals as a function of distance, distance...

Author(s): Stephen T. Buckland, Robin E. Russell, Brett G. Dickson, Victoria A. Saab, Donal N. Gorman, William M. Block

Year Published: 2009

Type: Document

Book or Chapter or Journal Article

Lubrecht State Experimental Forest prescribed fire effects study 1973-2006

www.nrfirescience.org/resource/11134

This data product contains pre and post fires stand and fuels data collected over a 33 year period. Rod Norum as part of his PhD dissertation work, began this study in 1973. He laid out 32 small (25 by 25 meter) plots in a Douglas fir/western larch stand on the University of Montana's Lubrecht Experimental Forest. Twenty of the...

Author(s): Elizabeth D. Reinhardt

Year Published: 2009

Type: Document

Technical Report or White Paper

Surface fuel litterfall and decomposition in the Northern Rocky Mountains, U.S.A.

www.nrfirescience.org/resource/11125

Surface fuel deposition and decomposition rates are important to fire management and research because they can define the longevity of fuel treatments in time and space and they can be used to design, build, test, and validate complex fire and ecosystem models useful in evaluating management

alternatives. We determined rates of...

Author(s): Robert E. Keane

Year Published: 2008

Type: Document

Technical Report or White Paper

Bark beetles, fuels, fires, and implications for forest management in the Intermountain West

www.nrfirescience.org/resource/8239

Bark beetle-caused tree mortality in conifer forests affects the quantity and quality of forest fuels and has long been assumed to increase fire hazard and potential fire behavior. In reality, bark beetles, and their effects on fuel accumulation, and subsequent fire hazard, are poorly understood. We extensively sampled fuels in...

Author(s): Michael J. Jenkins, Elizabeth G. Hebertson, Wesley G. Page, C. Arik Jorgensen

Year Published: 2008

Type: Document

Book or Chapter or Journal Article, Synthesis

Using bark char codes to predict post-fire cambium mortality

www.nrfirescience.org/resource/8171

Cambium injury is an important factor in post-fire tree survival. Measurements that quantify the degree of bark charring on tree stems after fire are often used as surrogates for direct cambium injury because they are relatively easy to assign and are non-destructive. However, bark char codes based on these measurements have been...

Author(s): Sharon M. Hood, Danny R. Cluck, Sheri L. Smith, Kevin C. Ryan

Year Published: 2008

Type: Document

Book or Chapter or Journal Article

Biophysical controls on surface fuel litterfall and decomposition in the Northern Rocky Mountains, USA

www.nrfirescience.org/resource/8161

Litterfall and decomposition rates of the organic matter that comprise forest fuels are important to fire management, because they define fuel treatment longevity and provide parameters to design, test, and validate ecosystem models. This study explores the environmental factors that control litterfall and decomposition in the...

Author(s): Robert E. Keane

Year Published: 2008

Type: Document

Book or Chapter or Journal Article

A comparison of five sampling techniques to estimate surface fuel loading in montane forests

www.nrfirescience.org/resource/8164

Designing a fuel-sampling program that accurately and efficiently assesses fuel load at relevant spatial scales requires knowledge of each sample method's strengths and weaknesses. We obtained loading values for six fuel components using five fuel load sampling techniques at five locations in western Montana, USA. The techniques...

Author(s): Pamela G. Sikkink, Robert E. Keane

Year Published: 2008

Type: Document

Book or Chapter or Journal Article

Assessing accuracy of point fire intervals across landscapes with simulation modeling

www.nrfirescience.org/resource/16896

We assessed accuracy in point fire intervals using a simulation model that sampled four spatially explicit simulated fire histories. These histories varied in fire frequency and size and were simulated on a flat landscape with two forest types (dry versus mesic). We used three sampling designs (random, systematic grids, and...

Author(s): Russell A. Parsons, Emily K. Heyerdahl, Robert E. Keane, Brigitte Dorner, Joseph Fall

Year Published: 2007

Type: Document

Book or Chapter or Journal Article

Fuel consumption and flammability thresholds in shrub-dominated ecosystems - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/11164

Research to quantify fuel consumption and flammability in shrub-dominated ecosystems has received little attention despite the widespread occurrence of fire-influenced, shrub-dominated landscapes across the arid lands of the western United States. While some research has addressed issues relating to fire behavior in some shrub-

Author(s): Clinton S. Wright, Roger D. Ottmar, Sue A. Ferguson, Robert E. Vihnanek

Year Published: 2007

Type: Document

Technical Report or White Paper

Stereo photo series for quantifying natural fuels. Volume X: sagebrush with grass and ponderosa pine-juniper types in central Montana

www.nrfirescience.org/resource/11191

A series of single and stereo photographs displaying a range of natural conditions and fuel loadings in sagebrush with grass and ponderosa pine-juniper types in central Montana. Each group of photos includes inventory data summarizing vegetation composition, structure, and loading: woody material loading and density by size class;...

Author(s): Roger D. Ottmar, Robert E. Vihnanek, Clinton S. Wright

Year Published: 2007

Type: Document

Technical Report or White Paper

The photoload sampling technique: estimating surface fuel loadings from downward-looking photographs of synthetic fuelbeds

www.nrfirescience.org/resource/11128

Fire managers need better estimates of fuel loading so they can more accurately predict the potential fire behavior and effects of alternative fuel and ecosystem restoration treatments. This report presents a new fuel sampling method, called the photoload sampling technique, to quickly and accurately estimate loadings for six common...

Author(s): Robert E. Keane, Laura J. Dickinson

Year Published: 2007

Type: Document

Technical Report or White Paper

Development and evaluation of the photoload sampling technique

www.nrfirescience.org/resource/11204

Wildland fire managers need better estimates of fuel loading so they can accurately predict potential fire

behavior and effects of alternative fuel and ecosystem restoration treatments. This report presents the development and evaluation of a new fuel sampling method, called the photoload sampling technique, to quickly and...

Author(s): Robert E. Keane, Laura J. Dickinson

Year Published: 2007

Type: Document

Technical Report or White Paper

Delayed Conifer Tree Mortality Following Fire in California

www.nrfirescience.org/resource/16311

Fire injury was characterized and survival monitored for 5,246 trees from five wildfires in California that occurred between 1999 and 2002. Logistic regression models for predicting the probability of mortality were developed for incense-cedar, Jeffrey pine, ponderosa pine, red fir and white fir. Two-year post-fire preliminary...

Author(s): Sharon M. Hood, Sheri L. Smith, Danny R. Cluck

Year Published: 2007

Type: Document

Technical Report or White Paper

Design and objectives of FTM-West model

www.nrfirescience.org/resource/10975

The FTM-West ('fuel treatment market' model for U.S. West) is a dynamic partial market equilibrium model of regional softwood timber and wood product markets, designed to project future market impacts of expanded fuel treatment programs that remove trees to reduce fire hazard on forestlands in the U.S. West. The model solves...

Author(s): Peter J. Ince, Henry Spelter

Year Published: 2006

Type: Document

Conference Proceedings

Regression modeling and mapping of coniferous forest basal area and tree density from discrete-return lidar and multispectral satellite data

www.nrfirescience.org/resource/13131

We compared the utility of discrete-return light detection and ranging (lidar) data and multispectral satellite imagery, and their integration, for modeling and mapping basal area and tree density across two diverse coniferous forest landscapes in north-central Idaho. We applied multiple linear regression models subset from a suite...

Author(s): Andrew T. Hudak, Nicholas L. Crookston, Jeffrey S. Evans, Michael J. Falkowski, Alistair M. S. Smith, Paul E. Gessler, Penelope Morgan

Year Published: 2006

Type: Document

Book or Chapter or Journal Article

Biomass consumption during prescribed fires in big sagebrush ecosystems

www.nrfirescience.org/resource/11419

Big sagebrush (*Artemisia tridentata*) ecosystems typically experience stand replacing fires during which some or all of the ignited biomass is consumed. Biomass consumption is directly related to the energy released during a fire, and is an important factor that determines smoke production and the effects of fire on other resources....

Author(s): Clinton S. Wright, Susan J. Prichard

Year Published: 2006

Type: Document
Conference Proceedings

Accuracy and precision of two indirect methods for estimating canopy fuels

www.nrfirescience.org/resource/11036

We compared the accuracy and precision of digital hemispherical photography and the LI-COR LAI-2000 plant canopy analyzer as predictors of canopy fuels. We collected data on 12 plots in western Montana under a variety of lighting and sky conditions, and used a variety of processing methods to compute estimates. Repeated measurements...

Author(s): Abran Steele-Feldman, Elizabeth D. Reinhardt, Russell A. Parsons

Year Published: 2006

Type: Document
Conference Proceedings

Biomass utilization modeling on the Bitterroot National Forest

www.nrfirescience.org/resource/11008

ANNOTATION: The potential for biomass utilization to enhance the economics of treating hazardous forest fuels was examined on the Bitterroot National Forest and surrounding areas. Initial forest stand conditions were identified from Forest Inventory and Analysis (FIA) data and the Forest Vegetation Simulator (FVS) was used to...

Author(s): Robin P. Silverstein, Dan R. Loeffler, J. Greg Jones, David E. Calkin, Hans R. Zuuring, Martin Twer

Year Published: 2006

Type: Document
Conference Proceedings

FTM-West: fuel treatment market model for US West

www.nrfirescience.org/resource/10974

This paper presents FTM-West, a partial market equilibrium model designed to project future wood market impacts of significantly expanded fuel treatment programs that could remove trees to reduce fire hazard on forestlands in the U.S. West. FTM-West was designed to account for structural complexities in marketing and utilization...

Author(s): Peter J. Ince, Andrew Kramp, Henry Spelter, Kenneth E. Skog, Dennis P. Dykstra

Year Published: 2006

Type: Document
Conference Proceedings

Estimation of biophysical characteristics for highly variable mixed-conifer stands using small-footprint lidar

www.nrfirescience.org/resource/8254

Although lidar data are widely available from commercial contractors, operational use in North America is still limited by both cost and the uncertainty of large-scale application and associated model accuracy issues. We analyzed whether small-footprint lidar data obtained from five noncontiguous geographic areas with varying...

Author(s): Jennifer L. Rooker Jensen, Karen S. Humes, Tamara Conner, Christopher Jason Williams, John DeGroot

Year Published: 2006

Type: Document
Book or Chapter or Journal Article

An analytical framework for quantifying wildland fire risk and fuel treatment benefit

www.nrfirescience.org/resource/12720

Federal wildland fire management programs have readily embraced the practice of fuel treatment. Wildland fire risk is quantified as expected annual loss (\$ yr⁻¹ or \$ yr⁻¹ ac⁻¹). Fire risk at a point on the landscape is a function of the probability of burning at that point, the relative frequency of fire behaviors expected if the...

Author(s): Joe H. Scott

Year Published: 2006

Type: Document

Conference Proceedings

Broad-scale assessment of fuel treatment opportunities

www.nrfirescience.org/resource/10992

The Forest Inventory and Analysis (FIA) program has produced estimates of the extent and composition of the Nation's forests for several decades. FIA data have been used with a flexible silvicultural thinning option, a fire hazard model for preharvest and postharvest fire hazard assessment, a harvest economics model, and geospatial...

Author(s): Patrick D. Miles, Kenneth E. Skog, Wayne D. Shepperd, Elizabeth D. Reinhardt, Roger D. Fight

Year Published: 2006

Type: Document

Conference Proceedings, Technical Report or White Paper

Photo series for major natural fuel types of the United States - Phase II -- Progress Report

www.nrfirescience.org/resource/11170

The natural fuels stereo photo series is a collection of geo-referenced data and photographs that display a range of natural conditions, fuel loadings, and other fuelbed characteristics in a wide variety of forest-, woodland-, shrub-, and grass-dominated ecosystem types. The photo series are useful tools for quickly and...

Author(s): Roger D. Ottmar

Year Published: 2005

Type: Document

Technical Report or White Paper

Land-base changes in the United States: long-term assessments of forest land condition

www.nrfirescience.org/resource/126

Forest land conditions affect the potential of U.S. forests to sustain a wide array of forest goods and environmental services (e.g., biodiversity) that society demands. Forest survey data collected by U.S. Department of Agriculture Forest Service Forest Inventory and Analysis (FIA) units are being used in long-term assessments of U...

Author(s): Ralph J. Alig

Year Published: 2005

Type: Document

Technical Report or White Paper

Stereo photo guide for estimating canopy fuel characteristics in conifer stands

www.nrfirescience.org/resource/11199

Stereo photographs, hemispherical photographs, and stand data are presented with associated biomass and canopy fuel characteristics for five Interior West conifer stands. Canopy bulk density, canopy base height, canopy biomass by component, available canopy fuel load, and vertical distribution of canopy fuel are presented for each...

Author(s): Joe H. Scott, Elizabeth D. Reinhardt
Year Published: 2005
Type: Document
Technical Report or White Paper

The use of Landsat 7 (ETM+) and AVIRIS data to map fuel characteristic classes in western ecosystems - Final Report to the Joint Fire Science Program

www.nrfirescience.org/resource/11174

Summary of Findings: (1) Satellite imagery has the potential to map fuel models at the national and local levels: (a) Landsat. The Landfire project has shown that Landsat 7 (ETM+) data are useful for mapping fuels at the national level. Critical to developing accurate maps are data collected in the field on fuels and vegetation. At...

Author(s): Jan W. van Wagtendonk, Ralph Root, Carl H. Key
Year Published: 2005
Type: Document
Technical Report or White Paper

Estimating forest canopy bulk density using six indirect methods

www.nrfirescience.org/resource/7952

Canopy bulk density (CBD) is an important crown characteristic needed to predict crown fire spread, yet it is difficult to measure in the field. Presented here is a comprehensive research effort to evaluate six indirect sampling techniques for estimating CBD. As reference data, detailed crown fuel biomass measurements were taken on...

Author(s): Robert E. Keane, Elizabeth D. Reinhardt, Joe H. Scott, Kathy L. Gray, James J. Reardon
Year Published: 2005
Type: Document
Book or Chapter or Journal Article

A strategic assessment of forest biomass and fuel reduction treatments in Western States

www.nrfirescience.org/resource/11197

This assessment characterizes, at a regional scale, forest biomass that can potentially be removed to implement the fuel reduction and ecosystem restoration objectives of the National Fire Plan for the Western United States. The assessment area covers forests on both public and private ownerships in the region and describes all...

Author(s): Robert B. Rummer, Jeffrey P. Prestemon, Dennis May, Patrick D. Miles, John Vissage, Ronald E. McRoberts, Greg C. Liknes, Wayne D. Shepperd, Dennis E. Ferguson, William J. Elliot, I. Sue Miller, Stephen E. Reutebuch, R. James Barbour, Jeremy S. Fried, Bryce J. Stokes, Edward M. Bilek, Kenneth E. Skog
Year Published: 2005
Type: Document
Technical Report or White Paper

Characterizing and mapping forest fire fuels using ASTER imagery and gradient modeling

www.nrfirescience.org/resource/7925

Land managers need cost-effective methods for mapping and characterizing forest fuels quickly and accurately. The launch of satellite sensors with increased spatial resolution may improve the accuracy and reduce the cost of fuels mapping. The objective of this research is to evaluate the accuracy and utility of imagery from the...

Author(s): Michael J. Falkowski, Paul E. Gessler, Penelope Morgan, Andrew T. Hudak, Alistair M. S. Smith
Year Published: 2005

Type: Document
Book or Chapter or Journal Article

Analysis of algorithms for predicting canopy fuel

www.nrfirescience.org/resource/10958

We compared observed canopy fuel characteristics with those predicted by existing biomass algorithms. We specifically examined the accuracy of the biomass equations developed by Brown (1978). We used destructively sampled data obtained at 5 different study areas. We compared predicted and observed quantities of foliage and crown...

Author(s): Kathy L. Gray, Elizabeth D. Reinhardt

Year Published: 2004

Type: Document

Conference Proceedings

Fuels planning: science synthesis and integration; forest structure and fire hazard fact sheet 4: role of silviculture in fuel treatments

www.nrfirescience.org/resource/14955

The principal goals of fuel treatments are to reduce fireline intensities, reduce the potential for crown fires, improve opportunities for successful fire suppression, and improve forest resilience to forest fires. This fact sheet discusses thinning, and surface fuel treatments, as well as challenges associated with those treatments...

Author(s): Morris C. Johnson

Year Published: 2004

Type: Document

Research Brief or Fact Sheet

Fuels planning: science synthesis and integration; social issues fact sheet 2: developing personal responsibility for fuels reduction: types of information to encourage proactive behavior

www.nrfirescience.org/resource/14949

Fuels management responsibilities may include providing local property owners with the information for taking responsibility for reducing fuels on their land. This fact sheet discusses three different types of information that may be useful in programs to engage property owners in fuel reduction activities.

Author(s): Martha C. Monroe, Lisa Pennisi

Year Published: 2004

Type: Document

Research Brief or Fact Sheet

Mapping relative fire regime condition class for the western United States

www.nrfirescience.org/resource/10991

In 1999, a coarse-scale map of Fire Regime Condition Classes (FRCC) was developed for the conterminous United States (US) to help address contemporary fire management issues and to quantify changes in fuels from historical conditions. This map and its associated data have been incorporated into national policies (National Fire Plan...

Author(s): James P. Menakis, Melanie Miller, Thomas Thompson

Year Published: 2004

Type: Document

Conference Proceedings

Evaluating the ASTER sensor for mapping and characterizing forest fire fuels in northern Idaho

www.nrfirescience.org/resource/8437

Land managers need cost-effective methods for mapping and characterizing fire fuels quickly and accurately. The advent of sensors with increased spatial resolution may improve the accuracy and reduce the cost of fuels mapping. The objective of this research is to evaluate the accuracy and utility of imagery from the Advanced...

Author(s): Michael J. Falkowski, Paul E. Gessler, Penelope Morgan, Alistair M. S. Smith, Andrew T. Hudak

Year Published: 2004

Type: Document

Conference Proceedings

Fuels planning: science synthesis and integration; forest structure and fire hazard fact sheet 5: fuel treatment principles for complex landscapes

www.nrfirescience.org/resource/14956

Appropriate types of thinning and surface fuel treatments are clearly useful in reducing surface and crown fire hazards under a wide range of fuels and topographic situations. This paper provides well-established scientific principles and simulation tools that can be used to adjust fuel treatments to attain specific risk levels.

Author(s): David L. Peterson, Sarah M. McCaffrey

Year Published: 2004

Type: Document

Research Brief or Fact Sheet

Fuels planning: science synthesis and integration; social issues fact sheet 4: three critical topics to cover when talking about hazards

www.nrfirescience.org/resource/14952

The amount of science applicable to the management of wildfire hazards is increasing daily. In addition, the attitudes of landowners and policymakers about fire and fuels management are changing. This fact sheet discusses three critical keys to communicating about wildfire hazards.

Author(s): Dennis Mileti

Year Published: 2004

Type: Document

Research Brief or Fact Sheet

Mountains, fire, fire suppression, and the carbon cycle in the western United States

www.nrfirescience.org/resource/11044

Most mountain regions in the western United States are covered by forests, which are for the most part recovering from historical harvesting and have been experiencing active fire suppression over approximately the past 100 years (Tilman and others 2000). Whereas many western landscapes are currently perceived as pristine natural...

Author(s): David S. Schimel

Year Published: 2004

Type: Document

Technical Report or White Paper

Estimating live fuels for shrubs and herbs with BIOPAK

www.nrfirescience.org/resource/8175

ABSTRACT: This paper describes use of BIOPAK to calculate size classes of live fuels for shrubs and herbs. A library of equations to estimate such fuels in the Pacific Northwest and northern Rocky Mountains is presented and used in an example. These methods can be used in other regions if the user first enters fuel size-class...

Author(s): Carl E. Fiedler, Charles E. Keegan, Todd A. Morgan, Christopher W. Woodall
Year Published: 2003
Type: Document
Book or Chapter or Journal Article

Assessment of the line transect method: an examination of the spatial patterns of down and standing dead wood

www.nrfirescience.org/resource/13159

The line transect method, its underlying assumptions, and the spatial patterning of down and standing pieces of dead wood were examined at the Tenderfoot Creek Experimental Forest in central Montana. The accuracy of the line transect method was not determined due to conflicting results of t-tests and ordinary least squares...

Author(s): Duncan C. Lutes
Year Published: 2002
Type: Document
Conference Proceedings

Alternative ponderosa pine restoration treatments in the western United States

www.nrfirescience.org/resource/8409

Compared to presettlement times, many ponderosa pine forest of the United States are now more dense and have greater quantities of fuels. Widespread treatments are needed in these forests to restore ecological integrity and to reduce the risk of uncharacteristically severe fires. Among possible restorative treatments, however, the...

Author(s): James D. McIver, Charles P. Weatherspoon, Carleton B. Edminster
Year Published: 2001
Type: Document
Conference Proceedings

Methods for the quantification of coarse woody debris and an examination of its spatial patterning: a study from the Tenderfoot Creek Experimental Forest, MT.

www.nrfirescience.org/resource/13157

Methods for the quantification of coarse woody debris volume and the description of spatial patterning were studied in the Tenderfoot Creek Experimental Forest, Montana. The line transect method was found to be an accurate, unbiased estimator of down debris volume (>10cm diameter) on ½ hectare fixed area plots, when...

Author(s): Paul B. Alaback, Duncan C. Lutes
Year Published: 1997
Type: Document
Technical Report or White Paper

Germination and establishment ecology of big sagebrush: Implications for community restoration

www.nrfirescience.org/resource/15421

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

Predicting equilibrium moisture content of some foliar forest litter in the northern Rocky Mountains

www.nrfirescience.org/resource/11964

Forest foliage that comprises much of the forest floor litter has higher equilibrium moisture content, EMC, than woody components. The EMC's at 300 °K were found to increase as follows: grasses...

Author(s): Hal E. Anderson

Year Published: 1990

Type: Document

Technical Report or White Paper

Guidelines for prescribed burning sagebrush-grass rangelands in the northern Great Basin

www.nrfirescience.org/resource/11256

Summarizes recent literature on the effects of fire on sagebrush-grass vegetation. Also outlines procedures and considerations for planning and conducting prescribed fires and monitoring effects. Includes a comprehensive annotated bibliography of the fire-sagebrush-grass literature published since 1980.

Author(s): Stephen C. Bunting, Bruce M. Kilgore, Charles L. Bushey

Year Published: 1987

Type: Document

Technical Report or White Paper

A summary of ponderosa pine (*Pinus ponderosa*) management activities in the Lick Creek Drainage of the Bitterroot National Forest

www.nrfirescience.org/resource/13371

The objective of thesis was to summarize 80 years of changes associated with several cutting regimes in the Lick Creek Drainage. The Lick Creek Drainage was first selectively cut in 1906, followed by several commercial and precommercial thinnings occurring in the late 1950's through the early 1980's. Permanent...

Author(s): James P. Menakis

Year Published: 1985

Type: Document

Dissertation or Thesis

Photo guide for appraising downed woody fuels in Montana forests: lodgepole pine and Engelmann spruce - subalpine fir cover types

www.nrfirescience.org/resource/11262

Two series of color photographs show different levels of downed woody material resulting from natural processes in two forest cover types in Montana. Each photo is supplemented by fuel inventory data and potential fire- behavior ratings.

Author(s): William C. Fischer

Year Published: 1981

Type: Document

Technical Report or White Paper

Downed and dead woody fuel and biomass in the northern Rocky Mountains

www.nrfirescience.org/resource/11881

Weights and volumes of downed woody material in diameter classes of one-fourth to 1, 1 to 3, and greater than 3 inches and forest floor duff depths were summarized from extensive inventories in northern Idaho and Montana. Biomass loadings are shown by cover types and habitat types within

National Forests. Total downed woody biomass...

Author(s): James K. Brown, Thomas E. See

Year Published: 1981

Type: Document

Technical Report or White Paper

Photo guides for appraising downed woody fuels in Montana forests: how they were made

www.nrfirescience.org/resource/11101

Eight series of color photographs have been published as three separate photo guides for appraising downed woody fuels in Montana forests. This note tells how these photo guides were constructed. The techniques used to determine the weight and size class distribution of downed woody fuels are given.

The procedure used to rate...

Author(s): William C. Fischer

Year Published: 1981

Type: Document

Research Brief or Fact Sheet

Photo guide for appraising downed woody fuels in Montana forests: Interior ponderosa pine, ponderosa pine - larch - Douglas-fir, larch - Douglas-fir, and interior Douglas-fir cover types

www.nrfirescience.org/resource/11263

Four series of color photographs show different levels of downed woody material resulting from natural processes in four forest cover types in Montana. Each photo is supplemented by fuel inventory data and potential fire behavior ratings.

Author(s): William C. Fischer

Year Published: 1981

Type: Document

Technical Report or White Paper

Fire frequency in subalpine forests of Yellowstone National Park

www.nrfirescience.org/resource/12042

Dead woody fuels were sampled in 16 upland forest stands representing a chronosequence of forest successional stages. Different fuel components show different temporal patterns, but adequate levels of all components necessary for an intense crown fire are not present simultaneously until stand age 300-400 yr. Therefore, the average...

Author(s): William H. Romme

Year Published: 1980

Type: Document

Conference Proceedings, Technical Report or White Paper

Influence of harvesting and residues on fuels and fire management

www.nrfirescience.org/resource/13134

Fuel and fire behavior potential in clearcut lodgepole pine and in Douglas-fir/larch under clearcutting, group selection, and shelterwood silvicultural systems were compared after logging to near-complete and conventional utilization standards. Fuels and fire behavior potentials were unaffected by silvicultural...

Author(s): James K. Brown

Year Published: 1980

Type: Document

Technical Report or White Paper

Determining the moisture content of some dead forest fuels using a microwave oven

www.nrfirescience.org/resource/11926

This note describes tests conducted to evaluate performance of a standard kitchen-type microwave oven for determining moisture content of dead woody fuels. Procedures are suggested for using the microwave oven to obtain fuel moisture information. Examples are also provided of field use.

Author(s): Rodney A. Norum, William C. Fischer

Year Published: 1980

Type: Document

Research Brief or Fact Sheet

A method for determining fire history in coniferous forests in the Mountain West

www.nrfirescience.org/resource/11176

An improved version is presented of a method previously used [see FA 40, 169]. Instructions are given for: laying out transects; gathering stand data, including documenting fire-scarred trees; sampling fire-scarred trees; laboratory analysis of tree cross-sections; correlating fire chronologies; and calculating fire frequency. The...

Author(s): Stephen F. Arno, Kathy M. Sneck

Year Published: 1977

Type: Document

Technical Report or White Paper

Vegetal development on the Sleeping Child burn in western Montana, 1961 to 1973

www.nrfirescience.org/resource/11951

In the year following the 1961 Sleeping Child forest fire on the Bitterroot National Forest, Montana, 11 permanent transects were established within the burn. Vegetation development was recorded through 1973, but only four transects were considered indicative of seral forest succession independent of superimposed management...

Author(s): L. Jack Lyon

Year Published: 1976

Type: Document

Technical Report or White Paper

Inventory of slash fuels using 3P subsampling

www.nrfirescience.org/resource/11906

A recent large-scale study of prescribed broadcast burning in western Montana required the development of a system for inventory of clearcut logging slash furls before and after fire treatment. The system is best suited for inventorying material which tends to be oriented parallel to the ground. The inventory system uses line...

Author(s): William R. Beaufait, Michael A. Marsden, Rodney A. Norum

Year Published: 1974

Type: Document

Technical Report or White Paper

Lodgepole pine logging residues: management alternatives

www.nrfirescience.org/resource/12125

The dollar and nondollar effects of alternative levels of residue utilization in mature lodgepole pine are compared. Net dollar returns were greater in conventional logging (removal of green sawlogs to a 6-inch top, with slash piled and burned) than in near-complete harvesting (sawlog removal followed by field chipping of remaining...

Author(s): Robert E. Benson

Year Published: 1974

Type: Document
Technical Report or White Paper

Vertical distribution of fuel in spruce-fir logging slash

www.nrfirescience.org/resource/11941

About 70 percent of the volume and surface area of spruce-fir logging slash lies below the mid-depth of the slash. Material 0 to 1 centimeter in diameter was distributed vertically in the same proportions as all other material. Old slash in the first 20 centimeters above the ground contained a higher proportion of large material...

Author(s): James K. Brown

Year Published: 1970

Type: Document

Technical Report or White Paper

Quantification of canopy fuels in conifer forests - fact sheet

www.nrfirescience.org/resource/11096

The objectives of quantifying canopy fuels is to develop practical, validated methods for obtaining quantitative estimates of canopy fuel characteristics, notably bulk density, crown height, and fuel loading, all needed to predict fire behavior and fire effects.

Author(s): U.S. Department of Agriculture, Forest Service

Type: Document

Research Brief or Fact Sheet