SPECIAL SESSION ONE: Fuel Treatments in the 21st Century - Do They Matter?

Moderators: Laurie Kurth & Henry Bastian

SS01.2. Wildland Fuels Management: Expectations and Aspirations

***Presenter**: Reinhardt, PhD, Elizabeth, US Forest Service, Assistant Director, Fire and Aviation Management*

The Forest Service and Department of Interior have been managing fire for over 100 years. During that time, our concept of fire management has evolved. In particular, a program that initially was limited to suppression grew to include prescribed fire, managed wildfire, and fuel treatments. Prescribed fire has been used by federal agencies to manage ecosystems and reduce fuel buildups for more than forty years while aggressive efforts to manage fuels have been occurring for fifteen years. Fifteen years into an aggressive effort to manage fuels proactively, and as In the early 21st century, our agencies continues to be are strained by a series of extreme fire years. This presentation is an attempt to take stock of the opportunities and realities of fire and fuels management in the context of changing human landscapes, climate, and political environment. What have we accomplished? What do we hope to accomplish? What may be unrealistic for us to hope to accomplish?

Bio: Elizabeth has degrees in English (A.B., Harvard University), and forestry (M.S. 1982, and Ph.D., 1991, University of Montana). She has been with the Forest Service for 30 years. She spent a number of years as a Research Forester at the Rocky Mountain Research Station, Missoula Fire Sciences Laboratory, Missoula, MT. Her research there focused on wildland fire effects and fuel treatment. She worked as a Policy Analyst in Washington Dc, and then as a program specialist in the Climate Change Office. Subsequently she served as National Program Leader for Fire Research. Currently she is the Assistant Director of Fire and Aviation Management, with responsibility for fire ecology, fuels, and partnerships. She is a past associate of the Harvard Kennedy School of Government’s Science, Environment and Development Group and faculty affiliate of the University of Montana’s College of Forestry and Conservation.

SS01.3. Fuel treatments in the 21st century – Do they matter: from the eyes of the administration

***Presenter**: Dixon, Tony, US Forest Service, Director, Strategic Planning, Budget and Accountability*

Wildland fire management, particularly large wildfires, places increasing demands on federal agencies to accomplish multiple facets of their missions within limited budgets. Current upward trends in wildfire numbers and acres mean that a greater percentage of appropriated funds are required for fire management. Agencies continue to assess fire management programs to develop cost effective measures, but climatic and ecologic factors beyond human control continue to have a major influence. Fuels management is one tool agencies use to modify fire behavior and provide safe and effective areas for personnel to work. However, with continued increasing fire suppression costs, the value of fuels management must be assessed. This presentation will identify important issues that agencies are asked to address related to fuels management, setting the stage for later presentations on the social and ecological values and challenges of hazardous fuels management.

Bio: Tony Dixon is the Director, Strategic Planning, Budget and Accountability for the US Forest Service.

SS01.4. Fuel Treatments and the National Cohesive Wildland Fire Management Strategy: Social, Economic and Ecological implications

Presenter: *Burnett, Sandra, USDA Forest Service, Fire Management Specialist*
Additional Author(s):
Bastian, Henry; Natural Resource Manager / Fire Ecologist; Office of Wildland Fire, Department of the Interior

From the beginning, the Cohesive Strategy has been a collaborative process with active involvement across all levels of government (Federal, State, County, Cities, Tribal) and non-governmental organizations to develop a national all-lands approach that holistically addresses wildland fire management challenges by focusing on three key areas: Restore and Maintain Landscapes, Fire Adapted Communities, and Response to Fire.

The vision for this effort is to, "Safely and effectively extinguish fire when needed; use fire where allowable; manage our natural resources; and as a nation, live with wildland fire." Wildland fire is not specific to any one entity but pervades many organizations. As land managers contend with ever increasing complexity and competing demands in managing the nation's natural resources, the Cohesive Strategy provides a common foundation to address multiple purposes from the social, economic as well as ecological aspects of wildland fire.
These presentations will focus on the role of the National Cohesive Wildland Fire Management Strategy and its intersection with fuels in managing wildland fire in the United States.

Bio: Ms. Burnett is a Fire Management Specialist in the Washington Office, Fire & Aviation Managment in USDA, US Forest Service.
Mr. Bastian is a enterprise systems and decision support manager within the Office of Wildland Fire, in the Department of the Interior.

SS01.5. Agency Administrators Perspective - Fuel Treatment in the 21st Century

Presenter: *Harbour, Tom, US Forest Service, Director, Fire and Aviation Management*

Natural resource management agencies are faced with challenges of managing our nation's resources for diverse purposes including recreation, timber, minerals, grazing, wilderness and natural and cultural resource conservation. Wildland fire management is central to these challenges on much of our public land. Federal wildland fire policy places human safety as the top priority while it recognizes the role of wildland fire as a necessary ecological process and change agent. Fire management, both prescribed and wildfire, is based on risk assessment that incorporates ecological, social, and legal consequences of a fire. The circumstances under which a fire occurs, and the likely consequences on firefighter and public safety and welfare, natural and cultural resources, and, values to be protected, dictate the appropriate response to the fire. These presentations will focus on the role of hazardous fuels management in wildland fire management within the US Forest Service and Department of Interior.

Bio: Tom Harbour is the Director of Fire and Aviation management for the US Forest Service. Tom's first experience with wildfire was firefighting in central California in 1970. Since then, Tom has been involved in wildland Fire and Aviation Management his entire career. Beginning as a firefighter, Tom has had opportunities to fight, prescribe, and manage fires across the United States and internationally. His emergency management experiences have included fires, hurricanes, earthquakes, riots, floods, and other types of disasters all across America. His prescribed fire experience includes opportunities across the United States. He has been a Burn Boss, an Incident Commander, and Area Commander at the highest levels of complexity. He has a Bachelor of Science degree in civil engineering from the University of California Davis and a Bachelor of Science degree in forest management from Washington State University. He graduated summa cum laude from the University of California at Davis and with Presidential Honors for a 4.0 GPA from Washington State University. He has done post-graduate work at the JFK School of Government, Harvard University and the Kenan-Flager School of Business at the University of North Carolina. He served with faculty and leaders at the Marine Corps University, Quantico, Virginia. The US Forest Service Fire and Aviation Management program employs over 10,000 firefighters and has a budget over $2 billion (US). He has been happily married for over 35 years, and is a proud Father and Grandfather.

SS01.6. Fuel treatments in the 21st century – Do they matter: agency administrator's perspective

***Presenter**: Douglas, James, Dept. of the Interior, Office of the Secretary, Office of Wildland Fire, Director*
Additional Author(s):
Tom Harbour, Director; Fire and Aviation Management USDA Forest Service

Natural resource management agencies are faced with challenges of managing our nation's resources for diverse purposes including recreation, timber, minerals, grazing, wilderness and natural and cultural resource conservation. Wildland fire management is central to these challenges on much of our public land. Federal wildland fire policy places human safety as the top priority while it recognizes the role of wildland fire as a necessary ecological process and change agent. Fire management, both prescribed and wildfire, is based on risk assessment that incorporates ecological, social, and legal consequences of a fire. The circumstances under which a fire occurs, and the likely consequences on firefighter and public safety and welfare, natural and cultural resources, and, values to be protected, dictate the appropriate response to the fire. These presentations will focus on the role of hazardous fuels management in wildland fire management within the US Forest Service and Department of Interior.

Bio: Mr. Douglas is the Director of the Office of Wildland Fire, in the Department of the Interior; office of the Secretary.

SS01.7. Panel Discussion - Wildland Fire, Society's Reality, Not just a Federal Issue

***Presenter**: Bastian, Henry, Dept. of the Interior, Vegetation Manager / Fire Ecologist*
Additional Author(s):
Chris Topik – The Nature Conservancy
Morgan Varner – Coalition of Prescribed Fire Council
Patti Blankenship – US Fire Administration, FEMA
Vernon L. Stearns, Jr. – Spokane Tribe of Indians
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Wildland fire management was once a concern primarily for state and federal resource agencies. Increasing populations and development in formerly rural areas has shifted the burden of protection of private property and infrastructure to include significant participation from local agencies, corporations, and individuals. Fires in the wildland-urban interface are more common and some are very devastating. Successful fire management must include development and maintenance of resilient landscapes that burn at lower severity in and around fire adapted communities. Fuel treatments are now completed on federal, state, and private lands. This panel will explore what fuel treatments accomplish as well as what they do not. Participants will share examples of effects of fuel treatments and address questions such as:
What are the benefits of fuel treatments?
What views do the businesses and publics you represent hold regarding treatment of fuels?
Do fuel treatments on or adjacent to private landholdings affect the owners behavior in regards to preparedness for wildfire?
What partnerships have you used or would like to develop that are key to managing fuels in the wildland-urban interface?
What are some potential benefits of fuel treatments that we don't fully realize and how can we work to realize them?
What are the biggest obstacles to conducting fuel treatments?

Bio: Panel participants
Chris Topik – The Nature Conservancy
Morgan Varner – Coalition of Prescribed Fire Council
Patti Blankenship – US Fire Administration, FEMA
Vernon L. Stearns, Jr. – Spokane Tribe of Indians
Potential Panel Representatives
A). National League of Cities or City Mayors,
B). National Association of Counties
C). National Association of State Foresters
D). National Alliance of Forest Owners

SS01.9. How severe are large fires?

***Presenter**: Wadleigh, Linda, US Forest Service, Coconino National Forest, Mogollon Rim District Ranger*
Additional Author(s):
Nicolet, Tessa, Regional Fire Ecologist, US Forest Service

The fire season of 2011 stands as an historic one in the southwestern United States, both in number of fires and the number of acres burned. Following closely on its' heels, the fire season of 2012 saw the largest recorded fire in New Mexico's history, although overall numbers of acres burned in the Southwest were down from 2011. Media outlets report the total number of acres burned, possibly exaggerating the ecological impacts, not adequately reflecting fire severity or fire effects, and missing the short and long-term ecological story. Fire behavior depends on fuels, weather and terrain. Recognizing the infinite combinations of these factors that make up the fire environment, fire effects are unlimited over such large fires. This translates to multiple fire effects and severities experienced within the perimeter of a wildfire, and within vegetation existing across the landscape. This analysis examines

several of the largest fires that burned in the Southwest during the 2011 and 2012 fire seasons. We investigate fire effects and fire severity by potential natural vegetation type, and qualify the broad range of severities experienced over these landscapes by comparing to historical reference conditions. RAVG uses a change detection process summary of satellite imagery collected before and immediately after a fire to estimate burn severity in the existing vegetation. We compare current fire severity to historic fire regime characteristics in order to assess whether fire effects are within a natural range of variability.

Bio: Linda currently works on the Coconino National Forest in Arizona as the District Ranger for the Mogollon Rim Ranger District. She is originally from Ohio, and attended Utah State University, receiving a Bachelor of Science in Forest Management, and a Master's Degree in Fire Ecology. Her career spans over 30 years in fire management, from her first job on an engine on the Uinta National Forest to a Regional Fire Ecologist in the Southwest and includes diversions as an Assistant Fire Management Officer, a Forest Ecologist and a Fuels Specialist.

She has been fortunate to travel the country for the U.S. Forest Service, living in Utah, New Hampshire, Washington, Maine, and Arizona, and working on wildfires and prescribed fires in states from coast to coast.

Her other diversions include a husband and two children, cheering for Ohio State sports, and whatever sport her kids are participating in at the time. She is an avid reader and Dutch oven cook, loves camping and hiking, volunteers with the Boy Scouts of America, and regularly participates in 60-mile walks for the Susan G. Komen Foundation.

When she recently became a District Ranger, someone asked her why she left Fire Management. Her response was working in natural resources in the Southwest, you never really leave fire. Her District has a legacy of managed wildfire and a very active fuels program, and she is proud to join that program.

SS01.11. When Wildfires Become Fuel Treatments: Examples of the Interactions of Past Wildfires with Subsequent Wildfires

***Presenter**: Prichard, PhD, Susan, University of Washington School of Environmental and Forest Sciences, Research Scientist and Gus Smith, Fire Ecologist, National Park Service*

This talk will be co-presented by Susan Prichard and Gus Smith. In the first half of the presentation, Susan will provide an overview on the state of knowledge of how antecedent wildfire scars interact with burn scars of previous wildland fires. Several recent studies have examined fire-on-fire interactions with mixed findings across forest landscapes in the western United States. The following topics will be reviewed, including the relative effectiveness of past wildfires in mitigating wildfire behavior and effects and the effect of wildfire size and time since fire. Results from retrospective studies of surface fuels in two wildfires (the 2006 Tripod Complex fires in north-central Washington and the 2013 Octopus Mountain Fire in the Canadian Rockies) will be presented with a discussion of under what weather and surface conditions can managers anticipate that past wildfires will mitigate subsequent wildfire behavior and effects.

Gus will then present examples from reburn studies in Yosemite National Park and other areas in the Sierra Nevada. In Yosemite National Park (YNP), 94% of the park is wilderness where fire can burn as a natural process. With over 40 years of managing fire in the park, YNP has examples of where wildfires intersected with one or more previous fires allowing us to investigate the role previous fire scars play in subsequent fire effects. Gus will present the latest thinking on how antecedent fires modify fire severity, fire size, and carbon stability of subsequent wildfires and use the Rim Fire as a specific example. The Rim Fire burned over 104,000 ha on the Stanislaus National Forest and Yosemite National Park. The Fire burned from foothill chaparral to lodgepole pine and intersected dozens of old fire scars and fuels treatments.

Bio: Susan Prichard is a forest ecologist with a specialty in fire ecology. Her main interests are in the effects of fire and other disturbances on forest dynamics, climatic change on forest ecosystems, and fuel treatment options to mitigate wildfire effects. Susan works for the University of Washington through a cooperative agreement with the US Forest Service Pacific Northwest Research Station. Her current projects include evaluation of prescribed fire and other fuel reduction treatments to mitigate wildfire severity; fuel consumption and emissions; and scientific development of the Fuel Characteristic Classification System and Consume.

Bio: Gus Smith is the Fire Ecologist at Yosemite National Park, Board Member of the Association for Fire Ecology, Advisory Board member of the California Fire Science Consortium, and Southern Sierra Fire Science Working Group. Gus is interested in carbon stocks and fire management, how fire and environmental conditions structure forests, and fire effects on vegetation after wildfires and prescribed fires. Gus was a resource advisor for Yosemite National Park during the 2013 Rim Fire and helped plan burn out operations to protect old growth mixed conifer and a giant sequoia grove.

SS01.12. Wildfires/Fuel Treatments Intersect - Changes in Fire Management, Fire Behavior and Fire Ecology

***Presenter**: Menakis, James, USDA, Forest Service, WO Fire & Aviation Management, Fire Ecologist*
Additional Author(s):
Mueller, David; Fuels Management Specialist, Bureau of Land Management (BLM), National Interagency Fire Center (NIFC), Boise ID
Romero, Francisco (Frankie), Fire Use Specialist, USFS WO Fire & Aviation Management, National Interagency Fire Center (NIFC), Boise, ID

The United States Department of Agriculture Forest Service (USFS) and Department of Interior (DOI) land management bureaus initiated a program to monitor the effectiveness of fuel treatments when tested by wildfire in 2006. Initially reporting of interactions between fuel treatments and wildfire was voluntary but became mandatory in 2011 for the USFS and 2012 for the DOI. The purpose of the fuel treatment effectiveness monitoring (FTEM) program is to help answer the following questions. 1) Are fuel treatments affecting fire behavior by reducing the fire intensity and/or rate of spread? 2) Does suppression effectiveness improve through enhanced firefighter safety and/or reduced potential fire damage? 3) What are the lessons learned that are important to help improve the effectiveness of the USFS and DOI hazardous fuels programs?

In this presentation we will: 1) Introduce and summarize the results of the FTEM program. 2) Highlight common dominators from some of the more successful fuels treatments. 3) Share observed success stories where fuel treatments improved initial attack, aided in protecting homes and communities from wildfires, reduced wildfire damage thus improving forest resilience to wildfire, and provided wildfire managers options for minimizing risk, reducing costs, and enhancing fire-adapted ecosystems. 4) Discuss other lessons learned and things to consider when planning future fuel treatments.

Bio: Jim Menakis is a Fire Ecologist with the US Forest Service, Washington Office Fire & Aviation Management out of Fort Collins, Colorado. His primary responsibilities include evaluating fuel treatment effectiveness, developing fire ecology/fuels monitoring program, coordinating the fire ecologist within and across agencies, and participating on the Joint Fire Science Program governing board. Prior to 2011, Menakis worked at the Fire, Fuels, and Smoke Science Program in USFS Rocky Mountain Research Station for over 20 years. Menakis received his B.S. degree in Forestry in 1985 and M.S. degree in Environmental Studies in 2004 both from the University of Montana.

David Mueller is a fuels management specialist for the BLM at NIFC in Boise Idaho. His primary responsibilities include providing national level fuels management program policy, guidance, and direction. Dave has been involved with wildland fire and fuels management since 1984, beginning his carreer as a lookout, working as a hot shot, BLM Boise smokejumper, Eastern MT BLM fuels specialist, AZ BLM State Fuels Program Lead and in his current position since 2005.

Frankie Romero is a Fire Use Program Specialist with the US Forest Service, National Interagency Fire Center in Boise, Idaho. He works on any number of national policy or program issues related to Hazardous Fuels with the primary emphasis being on the use of both prescribed fire and wildfire to achieve desired land management outcomes. Frankie has been involved in wildfire management since 1985. He received a B.B.A. degree in Business Computer Systems from New Mexico State University (1989) and a M.S. in Forestry (Fire Science Emphasis) from Colorado State University (1997).

SS01.13. Integrating Fuels Treatment Into Land Management Planning and Wildfire Incident Response

***Presenter**: Elenz, Lisa, Development & Applicaiton Program (WFMRDA), USDA Forest Service, Deputy Program Manager of the Wildland Fire Mangment Research*
Additional Author(s):
Hovorka, Marlena, Fire Technology Transfer, Wildland Fire Managment RDA, USDA Forest Service

Agencies have been treating fuels on the landscape for many years. Documentation and planning around treatments has varied based on agency, technology use, and effort. Now more than ever, with data at our fingertips, there are opportunities to use this information in all aspects of land management planning and decision making for all federal fire agencies. The availability of information provides linkages between past events, land management planning, pre-planning and during incident decision making. These linkages are critical in making informed risk-based decisions in managing natural resources, preparing for wildfire, and during incidents. We will briefly touch on the recent technology developments, demonstrate the technology potential, and look at real world examples that tie it all together.

Bio: Lisa works with the WFMRDA to provide the latest research to the field by developing tools and training; and providing decision and analysis support. Until fall 2009 she was the FMO at Grand Teton National Park and prior she had worked as the AFMO and completed the NPS Intake Program there as well. she worked seasonally on crews and engines at Gran Canyon and Yosemite NP. She graduated from Northern Arizona University in 1988 with a General Chemistry Degree and a Minor in Mathematics.

SS01.14. Do Fuel Treatments Matter Now and Into the Future?

***Presenter**: Christiansen, Erik, DOI Office of Wildland Fire, Fuels/Biomass Coordinator*

The DOI and USDA Forest Service fuels management programs are aligned with the three goals of the National Cohesive Wildland Fire Management Strategy. Specifically, the programs are designed to Manage fuels to reduce spread, intensity, frequency and/or severity of wildfire in order to protect values at risk and meet land use plan objectives.
Restore and maintain resilience of natural systems to wildfire, so that when wildfire occurs, ecological impacts are positive or neutral.

Provide strategic opportunities to increase the capability to manage wildfire for resource benefits and increase public protection and firefighter safety.

Fuels treatments do not eliminate fire from our landscapes; however they do result in improved outcomes on the land including clean water, scenic and recreational values, wood products, and biodiversity. More resilient and healthier ecosystems provide many benefits to society and treatments provide safer conditions and more strategic options for firefighters to support communities that are better able to withstand wildfire.

Recently, the DOI and USDA Forest Service fuels management programs have undertaken efforts to create a risk-based approach that supports the Cohesive Strategy while focusing on three strategic issues

- The nature and extent of the fuels problem in terms of risk from wildfire to key values.
- Determination of treatment and funding priorities based on those risks.
- Measurement of accomplishment and program success, in terms of reduction of those risks.

This presentation will be a report of our progress to date in satisfying those three issues, supporting the conclusion that fuels treatments surely do matter, now and into the future.

Bio: Mr. Christiansen is the Fuels and Biomass Lead for the Department of the Interior in the Office of Wildland Fire.

SPECIAL SESSION TWO: Rim Fire
Moderator: Neil Sugihara

SS02.1. 2013 Rim Fire Overview, Stanislaus National Forest, California

***Presenter**: Crook, Shelly, Stanislaus National Forest, Pacific Southwest Region, USDA Forest Service, Forest Fire Planner*
Additional Author(s):
Ewell, Carol, Adaptive Management Services Enterprise Team, Stanislaus National Forest, Sonora, CA
Estes, Becky, Provence Ecologist, Eldorado National Forest, Placerville, CA

Sugihara, Neil, Regional Fire Ecologist, Pacific Southwest Region, Fire and Aviation Management, McClellan, CA

The Rim Fire that started in August 2013 on the Stanislaus National Forest in the Central Sierras of California and burned on land managed by several federal and state agencies and private land owners. The Rim Fire grew to a final size of 257,314 acres, the largest documented fire in the Sierra Nevada and the third largest in California history. The information collected for this presentation comes from a variety of Rim Fire reports and presentations assembled by several integrated teams since August 2013. This overview includes: the fuel and weather conditions preceding and during the Rim Fire, the fire's progression, the fire behavior and associated soil and vegetation severity, the post-fire Fuel Treatment Effectiveness Monitoring efforts, the Burned Area Emergency Rehabilitation, the post-fire salvage and restoration efforts incorporating vegetation resiliency, and into the future with a variety of research endeavors.

The Rim Fire has some unique characteristics including a 2-day period of plume dominated rapid growth accounting for 90,000 acres (34%) of the total fire area and resulting in some of the largest recorded high severity patch sizes. The Rim Fire burned actively for 23 days crossing through several ecological zones. In the aftermath of the Rim Fire, the Stanislaus National Forest is facing many challenges and opportunities working with the wide range of interested and vested parties in the development of the salvage and restoration plans. The restoration of the Rim Fire has been identified as the top priority of the 2013 fires in the USFS Pacific Southwest Region.

Bio: Shelly Crook currently works on the Stanislaus National Forest as the Fire Planner. In 1988, Shelly Graduated from Colorado State University with a BS in Forest Management with a Fire Science concentration. In her 28 year career in fire management Shelly has work on helitack and hotshot crews; been a smokejumper, District AFMO & FMO, Forest Fire and Fuels Planner and a Forest FMO. In 2006 Shelly became qualified as a Fire Behavior Analyst (FBAN) and has worked as an FBAN on several prominent large wildland fires including the Station, Basin Complex, Bar Complex and Siskiyou Complex.

SS02.2. Near real-time wildfire mapping using spatially-refined satellite data: The Rim fire case study

***Presenter**: Oliva, PhD, Patricia, Department of Geographical Sciences, University of Maryland, Research Associate*
Additional Author(s):
Schroeder, Wilfrid, Research Associate Professor, Department of Geographical Sciences, University of Maryland

The demand for near real time active fire mapping of wildfires is increasing systematically over the last five years. The recently developed VIIRS active fire detection algorithm at 375 m improves the current spatial resolution of active fire detection products, showing a higher level of agreement with available airborne data. In addition, the improved spatial sampling of VIIRS sensor and the 12 h revisiting time produce consistent daily data allowing multiple observations of fires lasting several days. Here we present the application of 375 m VIIRS active fire detection product to monitor the evolution of the Rim fire. The Rim fire was one of the largest wildfires in California's history, having burned 257,314 acres (1,041.31 km2). The fire started on August 17, 2013 in the Sierra Nevada region, and was contained on

September 27, 2013, although interior isolated smoldering areas continue burning until October 24, 2013.

The VIIRS active fire detection algorithm was applied to the images acquired from August 17 to September 27. The U.S. Department of Agriculture – Forest Service National Infrared Operations (NIROPS) airborne data were used to assess the performance of the 375 m VIIRS fire detections. First, we evaluated qualitatively the performance of the VIIRS fire detections to map the active fire front, comparing the VIIRS fire detections with near-coincident airborne data. We then performed a quantitative assessment of the fire-affected area estimated by VIIRS fire detections and NIROPS. Regarding the qualitative assessment, the VIIRS fire detections showed a very high spatial agreement with the intense heat areas mapped by NIROPS within less than 3 h. In terms of burned area mapping the VIIRS fire detections followed the same trend as the NIROPS estimates. An average of 10% burned area overestimation was observed, although most of it is attributed to VIIRS larger pixel footprint. The results of this case study showed that the 375 m VIIRS active fire detection product offers valuable information for near real-time wildfire mapping. The data can be used to supplement limited airborne imaging resources in support of tactical fire applications and also serve as a first evaluation method to estimate burned area at near real time.

Bio: Patricia Oliva is a Research Associate at the Department of Geographical Sciences in the University of Maryland. She received her undergraduate and Master's degree in Environmental Sciences and PhD in Cartography, GIS and Remote Sensing from the University of Alcala, Madrid (Spain). Dr. Oliva's research is focused on the use of multi-spectral remote sensing data for biomass burning monitoring. She is currently working on the development and validation of NPP-VIIRS active fire detection algorithm.

SS02.3. Using the 2013 Rim Fire to Develop an Improved Short-term Predictor of Satellite-Observed Fire Activity

Presenter*: Peterson, PhD, David, National Research Council, Monterey, CA, Postdoctoral Research Associate*
Additional Author(s):
Hyer, Edward, PhD, Marine Meteorology Division, Naval Research Laboratory, Monterey, CA

The 2013 Rim Fire was an exceptional event because of its long duration, overall size, and rapid rate of spread. The Rim Fire was also known for its large and persistent smoke plume, which extended from California to central Canada, highlighting the need for accurate estimates of smoke emissions in air quality forecast models. With an emphasis on variations in synoptic and mesoscale meteorology, this study provides a detailed overview of the fire front evolution, large blowups, and pyroconvection, including their combined effect on smoke plume evolution and transport. The implications for smoke, fire weather, and pyrocumulonimbus (pyroCb) forecasting are also explored using numerical weather prediction (NWP) and fire observations from polar-orbiting and geostationary satellite sensors. Results highlight the importance of upper-level disturbances, and their effect on nighttime surface conditions, for driving large blowups. The Rim Fire and other large fire events also show that development of pyroconvection occurs in conjunction with a combination of factors, including an upper-level disturbance, convective available potential energy (CAPE), mid-level moisture, and high values of fire radiative power (FRP). The prediction of pyroCb events may be more important for determining the vertical distribution of a smoke plume, and less important for identifying explosive fire growth. Daily variations in the Canadian Initial Spread Index (ISI) and Fire Weather Index (FWI) seem to track the daily variations in FRP and area burned better than the Haines Index, suggesting they may be more useful for forecasting short-term fire growth or decay outside of the boreal regions. The ISI and FWI are also highly sensitive to precipitation, which can impact their predictive ability because the NWP grid resolution is usually too coarse to resolve the localized gradients observed during the Rim Fire. Therefore, while many variables are relevant for predicting large blowups and high-altitude smoke injections, only a small subset may be usable when combining satellite fire observations and NWP model output to predict biomass-burning emissions. This analysis is a critical step toward producing a global short-term fire prediction model and improving operational forecasts of smoke transport at large spatial scales.

Bio: Dr. Dave Peterson is a National Research Council Postdoc at the Naval Research Laboratory in Monterey, California. Dave has experience in meteorology and satellite remote sensing. He is currently working on combining satellite observations of fire activity and numerical weather prediction to improve the prediction of smoke emissions.

SS02.4. The immediate effects of California's Rim Fire on tree injuries and in-stand severity in fuels treated plantations

Presenter*: Kobziar, PhD, Leda, University of Florida, School of Forest Resources & Conservation, Associate Professor of Fire Science*
Additional Author(s):
Johnson, Morris, Fire Ecologist, USDA Forest Service
Watts, Adam C., Assistant Professor, Desert Research Institute
Godwin, David R., Southern Fire Exchange Coordinator, Tallahassee, Florida
Camp, James, Biological Scientist, NEON TN

California's Rim Fire, the largest on record in the Sierra Nevada, burned over 257,000 acres during the late summer of 2013 across a diversity of forest structures in the Stanislaus National Forest and Yosemite National Park. Included in the burned area were the Granite pine plantations, which had been established near the border between the National Forest and Park after a 1974 large wildfire. These predominantly ponderosa and Jeffrey pine plantations were treated for fuels reduction and habitat improvement between 2000 and 2008. Treatments included not only overstory thinning, but also understory mastication, prescribed burning, and combinations thereof. Previous research, based on fire behavior modeling, suggested that these fuels reduction treatments would affect potential fire behavior and severity. Although the Rim Fire burned a number of years since the latest data were collected, detailed fuels, soil carbon flux, and stand characteristics were documented in 2006. This work describes the stand-scale evaluation of the Rim Fire's severity and first order fire effects (tree injuries, fuels consumption, soil impacts) in ten Granite plantation stands, where the goal of the 7-year-old fuels treatments was to reduce wildfire behavior and resultant severity. The work has clear implications for reducing fire hazard in the plantation stands likely to be established following postfire salvage timber harvesting in the Stanislaus Forest, and for evaluating agreement between remotely sensed fire severity and ground-level fire severity assessments.

Bio: Dr. Leda N. Kobziar earned her PhD at the University of California at Berkeley in 2006. In the same year she joined the School of Forest Resources at the University of Florida and is now the Associate

Professor of Fire Science and Forest Conservation. She conducts federal, state, and internationally sponsored research in the ecological effects of fuels reduction treatments and prescribed fire use. She sits on the Board of Directors of the Association for Fire Ecology, is an Associate Editor for the Journal of Fire Ecology, and is the PI of the Southern Fire Exchange, one of the Joint Fire Science Program's Regional Knowledge Exchange Consortia.

SS02.5. Fuel Treatment Effectiveness in the 2013 Rim Fire, Stanislaus National Forest, California

Presenter*: Ewell, Carol, USFS, AMSET, Ecologist*
Additional Author(s):
Crook, Shelly L., Fire Planner, Stanislaus National Forest
Estes, Becky L., Ecologist, Eldorado National Forest
Johnson, Morris C., Research Fire Ecologist, USFS Pacific Northwest Research Station
Sugihara, Neil G., Regional Fire Ecologist, USFS Pacific Southwest Region
Wilmore, Brenda L., Fire Use Specialist, USFS Rocky Mountain Region

The fuel treatment objectives within the 2013 Rim fire included managing for forest resilience, protection of the wildland urban interface and recreation sites, and reducing hazardous fuels by activities that remove or rearrange vegetation and fuels. Over half of the treatments implemented by the Stanislaus NF within the Rim fire perimeter were impacted by the two-day period of rapid growth (34% of the nearly 257,000 acres in total size), which burned under 97th percentile weather conditions (treatments are typically designed for 90th percentile weather). The purpose of the national fuel treatment effectiveness monitoring (FTEM) program is to help answer the following questions: 1) Are fuel treatments affecting fire behavior by reducing the fire intensity and/or rate of spread; 2) Does effectiveness improve through enhanced firefighter safety and/or reduced potential fire damage; and 3) What are the lessons learned that are important to help improve the effectiveness of the USFS and DOI hazardous fuels programs?

Field visits, eyewitness accounts and spatial analysis were combined to answer treatment effectiveness questions. Within the Rim fire, over 200 treated areas were first identified using a combination of GIS (Geographic Information System) and the FACTS (Forest Service Activity Tracking System) database, then field visits were completed on a subset of sites. When possible, interviews were conducted of incident staff that witnessed fire behavior in or near the treatments.

Initial monitoring found that these treatments exhibited variable success at altering fire behavior. The treatments that burned outside the two large progression days more clearly altered fire behavior. Treatments that implemented mechanical thinning with a follow up prescribed fire were most successful at altering fire behavior and subsequent immediate post-fire severity. Fires the size of the Rim fire present challenges to assessing fuel treatment effectiveness, particularly when they burn under conditions that are outside of the treatment design.

Bio: Carol Ewell serves as a fire ecologist with the U.S. Forest Service's Adaptive Management Services Enterprise Team (AMSET). She has completed several fuel characterization, treatment effectiveness, and fire severity studies since starting with AMSET in 2003. Prior to that, Carol worked as a fire effects and fire monitor for the National Park Service in California. Carol uses her experience in fire management along with her academic and ecological background to do strong science knowledge exchange that is useful for land and fire management.

SS02.6. Fire and the assembly of pollinator communities

***Presenter**: Ponisio, Lauren, UC Berkeley*

Fire is a major force driving the structure and function of ecosystems globally. Pyro-diversity, the diversity of fire size, severity and frequency, is thought to promote biodiversity. Many factors associated with climate change and land management practices, including drier summers, logging and grazing, and fire suppression, have acted to decrease pyro-diversity and instead create large, homogeneous high severity burns. The Rim Fire, which burned over 200,000 acres this past summer in Yosemite National Park (YOSE), is an example of such a fire (A. Colwell, personal communication). Fire regimes are changing but we have little understanding of the effects on plant and animal populations. Particularly, little is known about the effects of fire on pollinator communities. Because pollinators are essential for wild flower reproduction, they play a critical role in maintaining the persistence of flowering plants and the numerous other guilds that depend upon floral resources. Using a chronosequence of post-burn communities in the Illilouette Creek Basin in YOSE, I propose to examine how post-fire succession influences pollinator populations, and how that process interacts with fire severity. This work will contribute to understanding the process of community assembly and disassembly generally and the impacts of fire regimes on pollinators specifically. A key management aim is to facilitate assembly of communities that are resilient to species extinction and recover quickly after disturbance. Thus, studying how fire influences the assembly of plant-pollinator communities will inform fire-related management decisions such as controlled burns and fire suppression.

Bio: I am a Ph.D. candidate in the Kremen lab at the University of California, Berkeley. My research focuses on the assembly of pollinator communities. Mutualisms are one of the most influential of all biological interactions for the generation and maintenance of biodiversity. Plant-pollinator mutualisms are particularly ubiquitous, with animal pollination positively influencing the reproduction of 87% of all flowering plant species and 75% of all crop species. Pollination systems, however, are under increasing anthropogenic threats from land-use change, habitat fragmentation, pesticide use, and invasions of non-native plants and animals. Understanding how pollinator populations respond to environmental impacts like fire and how plant-pollinator will prove critical to managing and restoring biodiversity. I hope to contribute to the understanding of mechanisms underlying the maintenance of species and interaction diversity in plant-pollinator communities and their assembly through time and space.

SPECIAL SESSION THREE: Multi-scale, Global Perspectives on the Causes and Consequences of Changing Wildland Fire Regimes

Moderator: Gabriel Yospin

SS03.1. Reconstructing human use of fire in the Blue Mountains of central Otago, New Zealand from human arrival c. 720 yrs ago to present: a coupled lake-sediment – dendrochronological approach

***Presenter**: McWethy, PhD, David, Montana State University, Assistant Research Professor*
Additional Author(s):
Tepley, Alan, Postdoctoral Research Fellow, University of Colorado-Boulder

Whitlock, Cathy, Professor - Department of Earth Sciences and Director, Institute on the Environment, Montana State University
Wilmshurst, Janet, Research Scientist, Landcare Research, New Zealand
McGlone, Matt, Research Scientist, Landcare Research, New Zealand
Perry, George, Professor, University of Auckland, New Zealand

The arrival of humans in New Zealand c. 700 years ago was accompanied by widespread forest transitions linked to human-set fires. In the South Island, paleoecological data from wetland and lake-sediment cores suggest an Initial Burning Period (IBP) was responsible for conversion of forests to open grasslands and shrublands. Most drier lowland and mid-elevation beech and podocarp forests east of the crest of the Southern Alps were converted to grass and shrublands as a result of human initiated fire-vegetation feedbacks. Native forests rarely experienced natural ignitions until human-set fires increased the amount of highly flammable seral vegetation, creating more fire-prone landscapes. European colonization of South Island initiated a second wave of fires in the 19th to early 20th century that expanded the distribution of open vegetation and facilitated the establishment of numerous introduced plant species. While paleorecords implicate fire as the primary mechanism for forest conversion, detailed reconstruction of the pattern and configuration of fires responsible is still not well understood. The grass and shrublands that persist today do not provide a long data record with which to reconstruct the sequence of events that led to forest conversion and the spatial characteristics of the initial fires or the consequences on forest structure and succession. In the Blue Mountains of southern South Island, New Zealand, a mosaic of forest patch patterns linked to human-set fires, provides a unique opportunity for better understanding the characteristic of fires on forest succession and the ecological consequences. We couple lake-sediment and tree-ring records to reconstruct fire and vegetation change and succession for the last several millennia. Records indicate large increases in charcoal accumulation coincided with human arrival and a sequence of fires over the next several centuries that shaped the current mosaic of forest ages, structure and succession. The Blue Mountains represent one of the few areas east of the Southern Alps where native forests have been documented to reestablish following fire activity. Results from our coupled lake sediment – dendrochronological study provide new insights into post-fire successional dynamics and the character of fires that accompanied both Polynesian and European arrival in New Zealand.

Bio: David McWethy is an Assistant Research Professor in the Department of Earth Sciences, Montana State University. His research centers on how past and present human and natural disturbances shape vegetation and influence the structure and function of ecosystems.

SS03.2. Landscape Legacies of Human Fire Use in the Blue Mountains of Central Otago, New Zealand, from the Late Māori Period (ca. 1600 AD) through European Settlement (ca. 1850 AD) to the Present: a Coupled Lake-Sediment—Dendroecological Approach

***Presenter**: Tepley, Alan, University of Colorado at Boulder, Postdoctoral Research Associate*
Additional Author(s):
McWethy, David B., Assistant Research Professor, Montana State University
Veblen, Thomas, T., Professor of Geography, University of Colorado at Boulder
Stewart, Glenn, Associate Professor of Urban Ecology, Lincoln University, New Zealand
Perry, George, L. W., Associate Professor, University of Auckland, New Zealand

As one of the last large land masses colonized by people, New Zealand offers a unique opportunity to evaluate the legacies of human fire use. Paleo-ecological studies indicate fire was exceptionally rare until Māori colonization ca. 720 years ago, when widespread burning rapidly converted nearly half of the forest area to grasslands and shrublands. A second wave of burning and forest loss followed European settlement in the 19th century. Southern beech (Nothofagus) forests are difficult to burn, but when they do, it initiates a positive feedback cycle where the warm, dry microclimate and highly flammable fuel of post-fire shrublands is prone to repeated fire. Thus, fire is widely assumed to cause near permanent forest loss. To evaluate this assumption and characterize the vegetation patterns generated by centuries of human fire use, we applied coupled lake-sediment and dendro-ecological approaches to a 1,200-ha landscape in the Blue Mountains of the southern South Island of New Zealand. Vegetation structure and > 1,600 tree and shrub ages were sampled in 37 stands. Two lake-sediment cores were collected to provide a fire record spanning pre-human, Māori, and European fire activity.
Lake-sediment analyses indicate few if any fires occurred in the pre-human period, but large increases in fire activity followed both Māori and European arrival. Unlike other areas of New Zealand, where burning of beech forests generated persistent shrublands, the tree-age data suggest nearly half of the forest area of the Blue Mountains regenerated after fire. Unburned stands have complex forest structure with tree establishment nearly continuous over several centuries. Burned stands have uniform-sized trees whose ages are concentrated in a window of 60-120 years. Initiation of these stands is staggered from the early 17th to the late 19th century. They occupy small patches (<100 ha) along ridgelines and dry aspects. Charred stumps and trees with catfaces were found in the youngest stands. The unusual fire history in this landscape may reflect its position along a moisture gradient: wetter areas were largely unburned whereas drier areas experienced extensive fire-driven forest loss. The small burned patches in the Blue Mountains and their association with the driest sites suggest extensive fire spread was unlikely, leaving opportunity for post-fire tree colonization from adjacent unburned stands. Although fire-initiated vegetation feedbacks are an important factor enabling landscape transformation in response to changing fire regimes, this study clarifies that the strength of those feedbacks varies along environmental gradients.

Bio: Alan Tepley is a postdoc under the Wildfire PIRE project that evaluates fire regimes and ecological feedbacks in temperate ecosystems of western North America, New Zealand, and Tasmania in the context of historical and on-going climatic and land-use change. He has worked on fire regimes in Douglas-fir/western hemlock forests of the Pacific Northwest, mixed-conifer forests of southwestern Colorado, and southern beech forests of New Zealand. His work combines field sampling of vegetation structure and dendroecological data with GIS analyses and various analytical and simulation modeling approaches to explore implications of the field findings at broader spatial and temporal scales.

SS03.3. Impacts of Pinus contorta invasion on fuel, fire effects and plant communities in Patagonia and New Zealand

***Presenter**: Taylor, Kimberley*
Additional Author(s):
Bruce Maxwell PhD Montana State University
Aníbal Pauchard PhD Universidad de Concepcion, Chile
Martín Nuñez PhD Laboratorio Ecotono, INIBIOMA, CONICET, Argentina

Plant invasions can have significant impacts on ecosystems by altering the abundance, distribution and flammability of fuels in ways that promote or inhibit fire activity. Pines (Pinus spp.) have been widely introduced across the Southern Hemisphere and some species have become highly invasive. Pines often invade shrub-steppe communities where fuel loads are low and fuels are discontinuous. In areas with higher densities of invading pines, positive feedbacks can occur where increased fuel loads and overall landscape flammability promote fire which further facilitates pine dominance. Positive feedbacks between fire and invasive pines have been observed but not formally tested. Here we examine the potential formation of a positive feedback between Pinus contorta and fire by looking at changes in fuel loads, first order fire effects, and post-fire vegetation regeneration in invaded areas in New Zealand, Argentina, and Chile. Fuel loads were measured across a gradient of P. contorta invasion densities. Vegetation regeneration post-fire was studied in recently burned plantations, invaded areas, and non-invaded areas. Additionally, P. contorta density was recorded along transects that passed through burned and unburned areas to determine how previous fires affect the probability of P. contorta occurrence. Fuel loads were significantly higher in areas invaded by P. contorta. P. contorta dominated after fire in plantations but not in invaded or non-invaded areas. Our results suggest that P. contorta has the ability to alter fuel loads, but high invasion densities are necessary to trigger a positive feedback with fire. In plantations or areas with high invasion densities there is the potential for the formation of an alternative stable state dominated by pines and other exotic species.

Bio: Kimberley Taylor is a graduate student in the Land Resources and Environmental Sciences Department at Montana State University. Her research focuses on the interaction between invasive plants and fire.

SS03.4. Late Holocene Fire Histories from the Subalpine Interior of Tasmania, Australia

Presenter*: Morris, Jesse, University of Idaho, Postdoctoral Fellow*
Additional Author(s):
Higuera, Philip, Assistant Professor, University of Idaho

Historically the interior highlands of Tasmania are known to be a flammable landscape. In the summer of 1962-63 a severe bushfire burned across the subalpine zone of the Central Plateau and consumed much of the native habitat for pencil pine (Athrotaxis cupressoides), which is a protected conifer endemic to Tasmania. Throughout much of the burn area the post-fire recruitment of pencil pine is rare, which raises important questions about novel fire-vegetation interactions. To improve the understanding of the precedence of the 1962-63 burn, we retrieved and analyzed sedimentary records from eight small hollow sites along a 2 km transect. The transect spans across sites surrounded by stands of pencil pine killed by the 1962-63 fire as well as stands of live pencil pine not known to have been affected historically by fire. The sediment cores were analyzed at high temporal resolution for pollen and charcoal to produce millennial-scale records of vegetation composition and response to wildfire.

Bio: Dr. Morris is currently a postdoctoral fellow at the University of Idaho. He graduated magna cum laude from the University of South Carolina with a B.A. and earned M.S. and Ph.D. degrees from the University of Utah. After graduating from Utah he worked as a postdoctoral fellow at the University of Helsinki, Finland. He is interested in how coniferous forest ecosystems respond to climate and disturbances, particularly bark beetles and wildfire. His recent research activities include investigations on climate-mediated changes to latitudinal treeline in the Russian Arctic and wildfire interactions with conifer recruitment in Tasmania and in western North America.

SS03.5. Postglacial Fire Activity from Cradle Mountain, Tasmania, Australia

Presenter*: Stahle, Laura, Montana State University,*
Additional Author(s):
Stahle, Laura, Doctoral Student, Department of Earth Sciences, Montana State University, Bozeman, MT, USA
Whitlock, Cathy, Professor of Earth Sciences and MSU Director of the Institute on Ecosystems, Montana State University, Bozeman, MT, USA
Iglesias, Virginia, Postdoctoral Fellow, Montana Institute on Ecosystems, Montana State University, Bozeman, MT, USA
Simon Haberle, Professor, Archaeology and Natural History, Australian National University, Canberra, Australia

Large wildfires are important drivers of ecological change in western Tasmania, Australia. Yet a dearth of fire history data limits our understanding of these changes over long time scales. Two high-resolution charcoal records from Cradle Mountain National Park were examined to (1) reconstruct the postglacial fire history from forests occurring in the cool, wet subalpine region in Cradle Mountain National Park; and (2) assess the relative influence of climate, vegetation and anthropogenic impact on past fire regimes. The sites lie two km apart and are inhabited by a mosaic of subalpine trees and shrubs, many of which are endemic to Tasmania, including fire-adapted Eucalyptus and the fire-sensitive conifer Athrotaxis. The broader region is composed of a mosaic of pyrophytic and pyrophobic vegetation types that has persisted through the Holocene. Trends in biomass burning were detected through the use of GAMs fitted to the two charcoal records, and the results were compared with other paleoenvironmental and archeological information. The late-glacial period (14,000-11,700 cal yr BP) was characterized by very low charcoal levels, in spite of the prevailing dry conditions, suggesting that fire activity was limited by lack of fuels or fuel continuity. Elevated levels of charcoal in the early Holocene (11,700-7500 cal yr BP) imply high fire activity, which corresponds with dry and steadily warming conditions in the early Holocene inferred from regional pollen data. The middle Holocene (7,500-4,500) had relatively decreased levels of biomass burning associated with increased effective moisture, and the late Holocene (4,500-present) experienced a return of high fire activity. Although it is possible that pre-European populations were a source of ignition at watershed scales, the correspondence of the reconstructed fire history trends from Cradle Mountain National Park with large-scale climate patterns suggests the climate was the primary driver of large-scale biomass burning over the Holocene, both through its direct effects on moisture and its indirect effects on fuel continuity.

Bio: Laura Stahle is a doctoral student pursuing the geography track in the Earth Sciences Department at Montana State University. She is interested in the long-term interactions between climate, vegetation and humans at local and regional scales.

SS03.6. Effect of high severity fire drove the population collapse of the subalpine Tasmanian endemic conifer Athrotaxis cupressoides

Presenter*: Holz, Andres, Portland State University, Assistant Professor*

Additional Author(s):
Wood, Sam, Postdoctoral Research Fellow, University of Tasmania, Australia
Veblen, Thomas, Professor, University of Colorado, Boulder
Bowman, David, Professor, University of Tasmania, Australia

Athrotaxis cupressoides is a slow growing and long-lived conifer that occurs in the subalpine temperate forests of Tasmania, a continental island to the south of Australia. In 1960-61 human-ignited wildfires occurred during an extremely dry summer that killed many A. cupressoides stands on the high plateau in the center of Tasmania. That fire year, coupled with subsequent regeneration failure, caused a loss of ca. 10% of the geographic extent of this endemic Tasmanian forest type. To provide historical context for these large scale fire events we (a) collected dendroecological, floristic and structural data, (b) documented the postfire survival and regeneration of A. cupressoides and co-occurring understory species, and (c) assessed postfire understory plant community composition and flammability. We found that fire frequency did not vary following the arrival of European settlers, and that A. cupressoides populations were able to persist under a regime of low-to-mid- severity fires prior to the 1960 fires. Our data suggest the 1960 fires were of greater severity than previous fires and herbivory by native marsupials may limit seedling survival in both burned and unburned A. cupressoides stands. The loss of A. cupressoides populations appears to be largely irreversible given the relatively high fuel loads of postfire vegetation communities that are dominated by resprouting shrubs. We suggest the feedback between regeneration failure and increased flammability will be further exacerbated by a warmer and drier climate causing A. cupressoides to contract to the most fire-proof landscape settings.

Bio: Andres Holz studies the causes and consequences of climate variability and human activity on ecological change and disturbances in temperate forests, primarily in the West of the Americas, SE Australia and New Zealand. His work engages a multi-scalar and interdisciplinary approach that uses an assortment of techniques, including dendrochronology, landscape ecology, remote sensing and geographic information systems, spatially-explicit modeling and geostatistics, field studies, and historical and documentary records.

SS03.7. Uplands Areas in Sub-Alpine Tasmania Serve as Refugia for Endemic Conifers under Varying Fire Regimes in Ecosystem Process Simulations

Presenter*: Yospin, PhD, Gabriel, Montana State University,*
Additional Author(s):
Keane, Robert, Supervisory Research Ecologist, USDA Forest Service Rocky Mountain Research Station, Fire Sciences Laboratory, Missoula, MT, USA
Whitlock, Cathy, Director, Institute on Ecosystems, and Professor, Department of Earth Sciences, Montana State University, Bozeman, MT, USA
WildFIRE Pire Team, www.wildfirepire.org

Sub-alpine Tasmania contains a mixture of vegetation types, including rainforest dominated by endemic conifer species, wet sclerophyll forest, heathlands, and moorlands. Human settlement and land-use in this area dates back at least 35,000 years. Fire is the principal agent of disturbance in sub-alpine Tasmania, and abundant evidence indicates that aboriginal Australians used fire as a tool for landscape management. Conservation of these cultural and biological resources is a local and international priority, but the long-term effects of potential fire management remains unknown. Given the legacy effects of

anthropogenic burning, current vegetation dynamics may be highly responsive to alternative fire management strategies. Simulation modeling allows us to test different management scenarios in experimental frameworks and over time scales that are otherwise intractable. Locally parameterized simulations with the ecosystem process model FireBGCv2, run under three climate scenarios and three fire management scenarios, indicate that endemic conifer species will be able to persist in upland areas under present climate for centuries. This persistence in upland areas is accompanied by an attenuation of endemic conifer dominance in lowland areas. Upland persistence and lowland attenuation occur regardless of the fire management scenario, indicating that, barring climatic change, endemic conifer conservation is unlikely to depend on fire management in this region. Simulations also indicated strong interactions between potential future climate scenarios and alternative fire management strategies. Under a warmer, drier simulated climate, increasing fuel loads lead to increased fire frequency and severity, regardless of fire management. Under these scenarios, endemic conifers were unable to persist on the landscape for more than a century, even in upland areas. While lowland vegetation composition appears to be sensitive to fire management and climate, the potential for endemic conifer species to persist on the landscape appears to be sensitive only to climate, and insensitive to fire management. Our simulation results can help land managers prioritize their conservation goals and identify fire management best practices as climate changes in sub-alpine Tasmania.

Bio: Gabriel Yospin is a post-doctoral research fellow for the Institute on Ecosystems at Montana State University. His work there is part of the WildFIRE PIRE research group, which seeks to identify historic and current drivers of wildland fire behavior. His principal research interests are climate change impacts on ecosystems, and the interplay between land use decisions and ecosystem processes. He has experience working with a wide variety of vegetation models. These include dynamic global vegetation models, fire behavior models, and a new model that he developed to work directly with an agent-based model of land-use changes.

SS03.8. Spatially explicit quantification of heterogeneous fire effects over long time series: a comparison of multiple methods and patterns from two forest types in the northern U.S. Rockies

***Presenter**: Naficy, Cameron, University of Colorado, Boulder,*
Additional Author(s):
Veblen, Thomas T.
Hessburg, Paul F.

Quantification of the spatiotemporal patterns of fire severity is critical for understanding fire effects, the drivers of fire severity, post-fire recovery and interactions with future disturbances. In mixed-severity fire regimes (MSFRs), where spatiotemporal variation of fire severity is high, long-term, spatially explicit records of fire severity are needed to effectively characterize the fire regime. However, due to the short time frame of satellite data and the methodological challenges of reconstructing spatial and temporal variation of fire severity from historical data sources (i.e. tree rings, historical surveys) fire severity patterns in MSFR systems are still poorly understood. We present results of an analysis of fire severity patterns for two widespread low-mid elevation forest types in the Northern Rockies thought to exhibit MSFRs: Douglas-fir dominated forests of the Greater Yellowstone Ecosystem (GYE) and western larch-mixed conifer forests of the Northern Continental Divide Ecosystem (NCDE). We reconstructed patterns of historical fire severity (~1600-present) across six watersheds (each > 8,000 ha) using a combined dataset of 1) patch-level forest structures interpreted from high resolution historical aerial photography and 2) reconstructions of fire history and tree establishment derived from a spatial network of dendroecological sites within the photo-interpreted watersheds. To evaluate the influence of each method's limitations and assumptions on inference of fire severity patterns we compare reconstructed fire severity patterns derived from each method alone. We also test the feasibility of scaling dendroecological point data up to the patch scale of aerial photo interpretation and present results from the application of k-nearest neighbor methods to impute tree cohort structure to patches where dendroecological samples were not collected. The resulting dataset allows robust spatial quantification of fire severity patterns over multiple centuries and provides a useful framework for evaluating the utility of point- vs. area-based methods of fire severity reconstruction in relation to fire regime characteristics.

Fire regimes of both MSFR forest types varied along topographic gradients within each watershed and between watersheds with distinct local climatic regimes. Fire frequency generally increased at lower elevations, near grasslands, or in drier cover types. Dry mixed conifer forests of the NCDE were characterized by higher fire frequency, more variable fire size and a greater proportion of multi-cohort, but younger, stands than Douglas-fir forests of the GYE. Even-aged stand components were prominent across all forest types, fire frequencies and topographic gradients suggesting non-equilibrium landscape dynamics and complex interactions between fire severity controls.

SS03.9. Post-Fire Tree Recruitment in the U.S. Northern Rockies: The Influence of Seed Source Proximity and Patch Size

***Presenter**: Kemp, Kerry, College of Natural Resources, University of Idaho, Ph.D. Candidate*
Additional Author(s):
Higuera, Philip E., Assistant Professor, College of Natural Resources, University of Idaho

In the U.S. northern Rockies, low elevation mixed-conifer forests historically burned in low- and mixed-severity fire regimes. Legacies of past management practices, including historical logging and fire exclusion, combined with predicted climate warming are likely to contribute to changes in the frequency, intensity, and spatial patterning of fires in the future, potentially influencing post-fire patterns of seedling establishment. To anticipate how post-fire recovery may vary in low elevation mixed conifer forests, we quantified relationships among burn severity, environmental gradients, and post-fire tree recruitment.

We sampled post-fire seedling density and species composition at 183 sites that burned in 2000 and 2007 in central Idaho and western Montana. Sites were stratified by burn severity (unburned, low, moderate, and high), elevation (675 -2200 m) and aspect. We used logistic regression to predict the probability of seedling presence 6 to 12 years post-fire, as a function of fire legacies (burn severity, distance to nearest live trees, and time since fire), landscape features (elevation, aspect, and slope), and ecological conditions (vegetation and canopy cover, tree density). Forward-backward stepwise selection with AIC criteria was then applied to determine the most parsimonious model.
Seedling densities varied widely across sites and burn severities (0 – 127,500 seedlings/ha). Our final logistic regression model (Full Model: AIC = 172.0; Reduced Model: AIC = 163.5) predicted seedling presence based on the average distance to the nearest live seed source ($z = -4.129$, $p \ll 0.001$), tree density ($z = 2.924$, $p = 0.003$), and time since fire ($z = 2.540$, $p = 0.010$) The probability of seedling reestablishment was below 30% at distances greater than 250 m from the nearest live seed source.

Distance to the nearest live seed source was the most significant variable predicting seedling presence for Douglas-fir, ponderosa pine, and grand fir, whereas elevation ($z = 4.43$, $p << 0.001$) and tree density ($z = 4.40$, $p << 0.001$) were the best predictors of lodgepole pine presence. Our results highlight the overarching importance of nearby live seed sources for post-fire regeneration, across broad gradients in climate. The size of high burn severity patches in mixed-severity wildfire regimes will therefore likely strongly determine patterns of reestablishment. In low and moderate burn severity patches, where seed sources are close, seedling regeneration varies widely, indicating that other environmental, climatic, or landscape features may determine seedling recruitment.
Bio: Kerry Kemp is a landscape and forest ecology Ph.D. candidate at the University of Idaho. Her research focuses on spatial patterns of tree regeneration in relation to climate, landscape features, and wildfire in the Northern Rockies. She is also interested in the effects of climate change on vegetation species distributions and disturbance.

SS03.10. Sensitivity and complacency of high-severity fire regimes to climatic variability from centuries to millennia

***Presenter**: Higuera, PhD, Philip, University of Idaho, Assistant Professor*

Robust links between climate and wildfire activity at annual timescales suggest that climatic warming will lead to increases in fire frequency and severity. However, feedbacks and interactions with vegetation, in response to climate itself and altered fire regimes, will mediate the direct impact of climatic change on wildfire regimes. Understanding these mechanisms is challenging, particularly in high-severity fire regimes, because their dynamics evolve over multiple decades to centuries. Retrospective analyses utilizing fire history records offer one of the best ways to assess fire-regime sensitivity to climatic variability across multiple time scales. We use historical and paleo records of fire, climate, and vegetation to highlight themes from high-severity fire regimes from western North America relevant for anticipating fire-regime response to future climate change.
At millennial time scales, the paleo record indicates that fire regimes can be particularly sensitive to climate-induced changes in vegetation. In the absence of large-scale vegetation change, the millennial-scale average rate of burning in many paleo records is surprisingly complacent despite evidence of notable climatic change. This long-term complacency is observed in Holocene records from the southern Rocky Mountains north to the Alaskan arctic. At small spatial and temporal scales, high variability exists and can often be attributed to the direct impacts of climatic variability on summer moisture deficits, consistent with fire-climate relationships in stand-replacing fire regimes at annual timescales. Feedbacks among climate, vegetation, and fire are also apparent at these shorter temporal scales, with vegetation changes limiting or promoting flammable fuels at landscape scales, and subsequently mediating the links between climate and fire activity. The paleo record supports predictions that 21st-century warming will likely lead to increased burning, but it further suggests that fire-regime response will be more complicated than expected based on direct, annual-scale fire-climate relationships.

Bio: Philip Higuera is an assistant professor in the College of Natural Resources at the University of Idaho, where he directs the PaleoEcology and Fire Ecology Lab and teaches in the undergraduate Fire Ecology and Management program. His research focuses on understanding relationships and interactions among climate change, vegetation change, and fire regimes over time scales from decades to millennia. Most of his work has focused on arctic, boreal, and subalpine ecosystems, from Alaska to

Tasmania, Australia.Philip Higuera is an assistant professor in the College of Natural Resources at the University of Idaho.

SS03.11. Persistent and episodic changes in global fire weather season length from 1979 to 2012

***Presenter**: Jolly, PhD, W. Matt, USFS, RMRS, Fire, Fuel and Smoke Science Program, Research Ecologist*
Additional Author(s):
Mark Cochrane
Patrick Freeborn
Zack Holden

The timing, intensity and duration of global wildland fires is driven by available burnable vegetation (fuel), sources of ignition and weather. Weather is a dominant factor of fire activity and it is highly spatially and temporally variable. Many indices have been developed to integrate weather conditions into metrics that best depict wildland fire potential. These "Fire Danger Indices" are used world-wide to assess the likelihood that a fire will ignite and spread. Here we present the first global, long-term comparison of three fire danger rating systems calculated using gridded weather data from three separate sources. We use these indices to develop a global daily ensemble fire danger index to examine changes in fire weather season length (FWSL) from 1979 to 2012. We show that global FWSL has increased by 13.3% since 1979 and that these changes varied spatially. Western United States, Northeastern South America and Eastern Africa have recorded 80%, 146% and 60% increases in FWSL respectively over the last decade while Western Africa and Andean South America showed FWSL decreases. These trend patterns were consistent across thousands of square kilometers. Additionally, the global land area experiencing unusually long fire weather seasons has more than doubled over this time period and in 2010, over 13% of the global vegetated land area experienced unusually long fire weather seasons. Finally, many areas showed an increase in the frequency of extremely long fire seasons since 1998, even if they did not display any significant long-term trends. This suggests that climatic changes over the last three decades are significantly impacting the length of time that wildland fires can ignite and burn. If these changes were coupled with sufficient fuel loads and sources of ignition, they would have resulted in an increase in the frequency of and global area burned by wildfires.

Bio: Dr. W. Matt Jolly is a Research Ecologist in the Fire, Fuel and Smoke Science Program of the US Forest Service, Fire Sciences Laboratory in Missoula, MT. He received a BA in Environmental Science from the University of Virginia and a PhD in Forestry from the University of Montana. His main research interest is to improve our understanding of the roles that live fuels play in wildland fires and to use this improved understanding to develop predictive tools that can help support strategic and tactical fire management decisions.

SPECIAL SESSION FOUR: Social-ecological study of western fires: Developing an integrated framework for research in times of change
Moderator: Winslow Hansen

SS04.1. Social-Ecological Study of Western Fires: Developing an Integrated Framework for Research in Times of Change. Introduction and Objectives

***Presenter**: Hansen, Winslow, University of Wisconsin, Madison,*
Additional Author(s):
Harvey, Brian J., Ph.D. student, Department of Zoology, University of Wisconsin, Madison
Naughton, Helen T., Associate Professor, Economics Department, University of Montana

A warmer and drier future climate in western landscapes of North America is likely to increase fire frequency and severity. Simultaneously, exurban expansion into semi-rural areas throughout the west means that more people are living in landscapes with high fire risk. Fire management and suppression costs have risen sharply in recent decades and are expected to continue increasing. Thus, there is a need to better understand the linkages between people and fire to inform more cost-effective and ecologically sound management strategies. This session will attempt to stimulate research that further integrates study of wildfire effects on ecosystem services with the associated implications for human wellbeing and fire management in the inter-mountain west. We ask the question: Can interdisciplinary research lead to new insights in understanding and managing wildfires, and what do we need to know to conduct rigorous interdisciplinary wildfire research?

Ecologists have characterized how western wildfires and post-fire successional trajectories alter important ecosystem services such as carbon storage, wildlife and wildflower abundance, water quality, air quality, forest-stand density, and nutrient cycling. In parallel, social scientists have explored how wildfires influence people, quantifying the economic impacts of wildfire, the influence on human wellbeing, and improving our understanding of community vulnerability and adaptive capacity to wildfire. Rarely, however, has research been conducted that directly quantifies the reciprocal interactions between ecological fire effects and peoples' responses to fire. For example, people often have economic, risk-management, and aesthetic concerns with post-fire landscapes, which can lead to salvage logging. Salvage logging is likely to alter successional trajectories, which can alter ecosystem structure and function, and change surface-fuel profiles, influencing future wildfire dynamics.
The objectives of this session are to 1) develop a conceptual framework that identifies key reciprocal interactions between people and fire-driven ecosystems; 2) determine the similarities and differences between these reciprocal interactions in geographic regions where fire regimes and human communities differ; 3) Identify future research needs to better understand these reciprocal interactions and improve social and ecological outcomes in fire-driven ecosystems. To address these objectives, the session will consist of a series of individual talks by fire ecologists and social scientists, grouped by geographic region. Interspersed throughout the talks will be brief conceptualization sessions focused on synthesis across talks and conceptual framework development.

Bio: Winslow D. Hansen is a Ph.D. student in the Department of Zoology, University of Wisconsin. He received his Master's degree from the University of Alaska, and B.A.'s in economics and ecology from the University of Montana. Winslow's research focuses on society and ecosystems, studying their relative effects on each other. He has addressed topics ranging from land conversion in the Amazon, to the effects of climate change on rural Alaskan livelihoods. More recently, he studies the effects of natural disturbances on landscapes and people, including bark beetles and fire in Alaska, and fire and climate in the Greater Yellowstone Ecosystem.

SS04.2. Complex Interactions Between People and Natural Disturbance: Lessons Learned and Questions Raised from a Case Study of Beetle Outbreak, Wildfires, and Property Values in South-central Alaska

***Presenter**: Hansen, Winslow, Department of Zoology, University of Wisconsin, Madison,*
Additional Author(s):
Naughton, Helen, T. Associate Professor, Economics Department, University of Montana

People in the western United States increasingly live in the wildland-urban interface (WUI), or semi-rural areas where homes are interspersed in natural vegetation. Development often occurs in forests where natural disturbances, such as bark beetle outbreak and wildfire, are important ecosystem processes that shape the forest. At the intersection of society and ecosystems, the WUI can be a site of conflict between the needs of people and ecosystems. For example, residential expansion, in parallel with climate-driven increases in fire frequency and severity, has led to rapidly expanding wildfire suppression and protection costs. Federal expenditures average more than three billion dollars per year. Society needs to develop innovative and flexible strategies to ensure human wellbeing while preserving the ecologically critical role of disturbance. Fostering flexibility will likely require designing strategies based on an improved understanding of how people perceive and respond to disturbance.
In the 1990s, a bark beetle outbreak (Dendroctonus rufipennis) affected over one million ha of forest in south-central Alaska and the Kenai Peninsula. Subsequently, residential expansion has occurred in many post-outbreak stands. Residents are rightly concerned with post-outbreak fire risk; studies on the Kenai Peninsula show that the beetle outbreak has been associated with increased wildfire probability. To provide insights into how people respond to disturbances, we asked how does the occurrence of bark beetle outbreak and wildfire influence people living in the WUI of the Kenai Peninsula? Applying a hedonic model that uses property values as a metric of human response, we related changes in assessed WUI property values with the occurrence of and time since natural disturbance. We hypothesized that disturbances occurring within one km would be associated with decreased property values and the negative effect would diminish with time since disturbance. We found the opposite. Wildfires and BB outbreaks were associated with increased property values and effects magnified with time. We speculate that emerging views of Cook Inlet, resulting from disturbance, outweigh the costs. The post-outbreak residential expansion is also consistent with these speculations. These results highlight important conceptual questions: What components of natural disturbances benefit or harm people? How do tradeoffs between costs and benefits shape human response? How does human response feedback and interact with other drivers to shape ecosystem processes?

Bio: Winslow D. Hansen is a Ph.D. student in the Department of Zoology, University of Wisconsin. He received his Master's degree from the University of Alaska, and B.A.'s in economics and ecology from the University of Montana. Winslow's research focuses on society and ecosystems, studying their relative effects on each other. He has addressed topics ranging from land conversion in the Amazon, to the effects of climate change on rural Alaskan livelihoods. More recently, he studies the effects of natural disturbances on landscapes and people, including bark beetles and fire in Alaska, and fire and climate in the Greater Yellowstone Ecosystem.

SS04.3. Frontiers in Wildfire Economics

***Presenter**: Naughton, Helen, University of Montana, Associate Professor*

One challenge with interdisciplinary research is that adequate background information in each of the participating disciplines is required. Geared for a broad scientific audience, this presentation provides a review of wildfire economics in an accessible format. Some of the major themes include economic valuation of wildfire impacts on nearby and down-wind populations, incentive structures for wildfire risk mitigation and management of wildfire suppression. In addition to the brief overview of this literature, the presentation summarizes recommendations for advancement of wildfire economics and integration with other relevant disciplines. These recommendations are drawn from previously published articles and intend to communicate what the experts believe to be the key gaps in our understanding of the economics of wildfire. The ultimate goal of the presentation is to effectively integrate existing wildfire economics research into an interdisciplinary conceptual framework meant to foster holistic research on wildfire-human interactions.

Bio: Helen Naughton is an Associate Professor of Economics at the University of Montana. Her research focuses on environmental economics including wildfire issues. She was involved in a project examining the drivers of wildfires in Alaska and estimating the non-market values of wildfire using a hedonic property value model. Helen's current research is determining cost-effectiveness of seven different fire emissions inventory systems. As part of this special session she hopes to help integrate economic perspective to the interdisciplinary framework of analyzing wildfire-human interactions.

SS04.4. Restoration of fire-adapted forests: lessons learned from implementation of the National Fire Plan in the western United States

***Presenter**: Nelson, Cara, University of Montana, Associate Professor*

Management of fire –adapted forests of the western United States has focused primarily on reducing fuels and restoring historic fire regimes. During recent years, federal managers have implemented over 50,000 treatments to accomplish these goals. Despite the large amount investment in fuels treatment, there has been little synthetic assessment of whether the assumed ecologic and social benefits are realized. Many of the benefits, such as deterring adverse ecological and social impacts of catastrophic fire and reducing the costs of suppression and post-fire rehabilitation, are based on the assumption that treated stands will burn within the relevant treatment lifespan. There is very little information in the literature about the life expectancy of fuels treatments. However, evaluation of forest area treated for restoration and fire mitigation under the US National Fire Plan show that only a small proportion (ca 9%) of area treated was located within 1km of a subsequent wildfire within six years after treatment. In addition, the majority of area treated in forests was predicted to have relatively low probability of burning. Findings suggest the need for 1) more accurate information about social and ecological benefits of treatments, 2) greater focus on the time period over which benefits might be realized, and 3) expanding the objectives of forest restoration treatments to improve ecological outcomes in the absence of subsequent wildfire.

Bio: Cara R. Nelson is an Associate Professor in the Department of Ecosystem and Conservation Sciences and Director of the ecological restoration program at University of Montana's College of Forestry and Conservation. Cara also serves as Chair of the Society for Ecological Restoration. Cara's research focuses on: 1) effects of large-scale disturbance on forest ecosystems, 2) efficacy and effects of ecological restoration treatments, and 3) sampling methods for detecting changes in plant abundance.

SS04.5. Socio-economic vulnerability to wildfire hazards in the face of climate change: Comparisons from the southwest and northwest United States

***Presenter**: Hand, Michael, USDA Forest Service, Rocky Mountain Research Station,*

Climate change is expected to dramatically alter forest and grassland habitats, ecosystem functions and disturbance regimes, and the ecosystem goods and services that people value and depend on. Of particular importance among likely climate-related changes is the potential for increased frequency and severity of wildfires. Communities across the Western United States are exposed to the potential effects of wildfire to varying degrees. Ongoing research in the Southwest and Northwest regions of the United States seeks to assess the vulnerability of people and communities to climate-related changes to forests. In this study, the socio-economic vulnerability to wildfire under a changing climate is compared in the two regions. Changing wildfire regimes in the future will affect people and communities in the two regions in different ways, and within-region variation in vulnerability to future wildfire risks is also evident. This suggests that there is significant heterogeneity between and within regions in the nature and magnitude of effects on people exposed to wildfire risks. Further, heterogeneity suggests that adaptation to climate-related changes to forests by public agencies and communities will require spatially detailed analyses to develop locally tailored approaches.

Bio: Michael Hand is a research economist with the USDA Forest Service, Rocky Mountain Research Station. His research focuses on the economics of wildland fire management and the role of publicly managed natural resources as a provider of ecosystem goods and services.

SS04.6. Post-fire subalpine forest regeneration varies with climate in patches of stand-replacing wildfire

***Presenter**: Harvey, Brian, University of Wisconsin, Madison, PhD candidate*
Additional Author(s):
Donato, Daniel C., Natural Resource Scientist, Washington State DNR
Turner, Monica G., Professor, University of Wisconsin

Warming and drying climate conditions in western North America have increased wildfire activity and created more stressful growing conditions for trees. These changes may be particularly important for subalpine forests of the Northern Rocky Mountains (USA) where most tree species must regenerate from seed following infrequent severe (i.e., stand-replacing) fire. If recent severe fires are followed by conditions that are inhospitable for post-fire tree seedling establishment, successional trajectories may be altered or forest reestablishment substantially delayed. Such changes would have important consequences for forest-associated ecosystem services (e.g., carbon storage, wildlife habitat, recreation). In subalpine forests of the Greater Yellowstone Ecosystem (hereafter Yellowstone) and Glacier National Park (hereafter Glacier), we asked whether patterns of natural post-fire tree regeneration differed in recent fires that were followed by contrasting climate conditions. We were also interested in how establishment varied spatially (i.e., with increasing distance from edge of burn patch) and among tree species.

Using field-calibrated satellite indices of burn severity, we identified patches of stand-replacing fire that occurred in years followed by periods of anomalously warm/dry or cool/wet climate conditions. We sampled post-fire tree seedling densities in 184 plots situated along 32 transects extending from the edge to the middle of severe burn patches, distributed across different topographic and directional (i.e., direction from nearest seed source) contexts.

Post-fire forest regeneration was abundant, with nearly all plots in both regions exhibiting post-fire seedling densities greater than pre-fire tree density, and densities were greater in Glacier than in Yellowstone. However, post-fire seedling densities were substantially lower in fires followed by warm/dry vs. cool/wet conditions in both study regions (74% lower in Yellowstone; 88% lower in Glacier). Sensitivity of tree seedling establishment to distance from burned edge varied among species, with wind-dispersed conifers exhibiting the strongest distance-to-edge effects, followed by seedbanking conifers and re-sprouting trees; distance-to-edge effects also were stronger in Yellowstone. These results suggest that post-fire forest recovery in subalpine forests of the Northern Rockies may be very sensitive to climate during the tree establishment phase, and that effects of fire size may be most pronounced in fires followed by drought conditions. We illustrate a wide range of early resilience to severe fire, but important questions remain about how variability in post-fire forest recovery rates interact with the provision of ecosystem services, human perceptions of post-fire forest resilience, and potential management response in the Northern Rockies.

Bio: Brian J Harvey is a PhD candidate in the Ecosystem and Landscape Ecology Lab at the University of Wisconsin. His research is focused on changing disturbance regimes, disturbance interactions, and ecosystem resilience. Specifically, he is examining how two climate-driven disturbances (native bark beetles and wildfire) may lead to regional changes in western North American forest ecosystems. Using field data, remote sensing, and spatial analysis, he evaluates how different conifer species of the Northern Rockies might vary in their response to changes in spatial patterns of burn severity, and where transitions to non-forest may occur under future climate and disturbance regimes.

SS04.7. Economic Evaluation of Bushfire Risk Mitigation Strategies in Australia

***Presenter**: Venn, Tyron, The University of Montana, Associate Professor of Natural Resource Economics*
Additional Author(s):
Quiggin, John, Professor, The University of Queensland

Given the large and increasing bushfire threat to lives and property in Australia, there is a need for economic evaluation of risk mitigation strategies that can be implemented by governments and homeowners. Three broad strategies for existing at-risk communities are evaluated: expanded use of prescribed fire; treatment of fuels within the home ignition zone (HIZ); and early evacuation on extreme fire danger days. All three strategies are expected to substantially reduce expected annual bushfire fatalities, and prescribed fire and HIZ treatment are expected to substantially reduce expected annual house losses. However, no strategy is found to be economically efficient. Early evacuation is the least inefficient (best) strategy and is the most cost-effective at saving lives. When coupled with the fact that substantially more Australians have been killed by bushfires when not attempting to evacuate than when evacuating late, this analysis raises serious questions about the economic efficiency and cost-effectiveness of contemporary Australian bushfire policy that permits residents to stay and defend their homes.

Bio: Dr. Venn is a natural resource economist at The University of Montana. He has published numerous journal articles and book chapters on the economics of wildfire management, forest and rangeland management, risk analysis, non-market environmental values, and indigenous property rights.

SS04.8. Contemporary megafires in the Pacific Northwest: What drives the biggest of the big?

***Presenter**: Meigs, Garrett, Oregon State University, Graduate Research Assistant*
Additional Author(s):
Kennedy, Robert, Assistant Professor, Boston University
Bailey, John, Associate Professor, Oregon State University
Reilly, Matthew, Graduate Research Assistant

What are the drivers and ecological impacts of so-called megafires? What role do humans play in facilitating or hindering extreme wildfire events? Are there generalities among the biggest of the big? This presentation investigates the natural and anthropogenic drivers of contemporary fire regimes through a case study of the largest 20 forest fires in Oregon and Washington from 1984 to 2010. Specifically, we use the MTBS dataset, management agency records, and geospatial analysis to characterize fire extent, effects, ignition source, timing, climatic conditions, vegetation and fuel type, topography, fire suppression, and pre-fire insect damage. Although the largest 20 fires accounted for 4% of large fire ignitions (n = 500 fires >400 ha in forested ecoregions), they encompassed 36% of large fire extent (775,000 of 2,146,000 ha). In general, these top 20 fires were ignited by lightning (17 lightning, 3 anthropogenic), and they occurred on lands administered by the U.S. Forest Service in remote areas with rugged topography. In addition, the top 20 fires tended to occur in relatively dry, mixed-conifer forest types, exhibiting mixed-severity mosaics. About one third of these large fires occurred in areas with substantial pre-fire insect disturbance activity, highlighting the potential for complex disturbance interactions. A strong majority of large fires occurred in the most recent decade of the MTBS record (15 of the 20 fires occurred since the year 2000), supporting the common assumption that very large fires have become more frequent over time. The 2002 Biscuit Fire (~200,000 ha), the largest fire in the contemporary fire record, was nearly three times larger than the next largest fire, the 2006 Tripod Fire, and the median extent of all top 20 fires was 23,000 ha. Given projected increases of fire activity in western U.S. forests, the accurate characterization of the spatiotemporal patterns and impacts of fire will become increasingly crucial. Particularly important topics for future research include: (1) anthropogenic controls on novel fire regimes (both indirect effects, such as climate change and legacy fuels from past management, and direct effects, such as fire suppression policies and tactics); (2) climate-mediated disturbance interactions; (3) social perceptions of rapid environmental change; (4) collaborative natural resource management.

Bio: Garrett Meigs is a PhD candidate in the College of Forestry at Oregon State University. He is a NASA Earth and Space Science Fellow studying the interactions of insect and wildfire disturbance in the Pacific Northwest. He also grew up in a zoo.

SS04.9. Restoring mixed severity fire in the Crown of the Continent: from stands to landscapes and WUI to wilderness.

***Presenter**: Belote, Travis, The Wilderness Society, Lead Ecologist*

Understanding the role fire historically played in maintaining local and landscape composition and biodiversity remains an active research front. In many forest types, fire suppression and land use have altered the structure and composition of forests. In response to altered conditions, various management strategies have been used to restore forest structure, biological diversity, and the ecological role of fire. Fire regimes of forests that historically burned with frequent, low-severity fires are widely studied and provide a useful guide for ecological restoration. In contrast, setting goals for ecosystem management and restoration targets in mixed-severity fire regimes, where the frequency, severity, and effects of fires historically varied in time and space has proven more difficult. Mixed severity fire regimes historically maintained landscape heterogeneity in fuels and ecological conditions, which both limited fire spread and supported diverse species assemblages. Variability in forest conditions and fire severity in space and time make active treatments in forests of mixed severity fire regimes controversial where restoration targets of forest conditions may be based on limited historical evidence and where the relationships between spatially-complicated patterns and processes are not fully understood. I will discuss several ongoing research projects related to the ecology of forests historically characterized by mixed severity fire including (1) a conceptual and empirical overview of mixed severity fire, and (2) hypothesized mechanisms governing fire severity in forests characterized by a mixed severity fire regime. Specifically, I will discuss research on tree mortality following a mixed severity fire in western larch forests in the Bob Marshall Wilderness, climate-driven fire thresholds across ecoregions of Montana and Idaho, and topographic controls on fire severity in the Crown of the Continent. My research on in mixed severity fire regimes was driven by my work with the Southwestern Crown of the Continent Collaborative (SWCC), formed in response to the Collaborative Forest Landscape Restoration Program (CFLRP). We are attempting to use a collaborative adaptive management process to design and monitoring forest restoration projects across three districts of three national forests dominated by forests historically characterized by mixed severity fire. I will end by discussing the application and challenges of applying fire ecology to mixed severity fire restoration with the SWCC.

Bio: Travis Belote serves as a research ecologist in the Northern Rockies Office of The Wilderness Society in Bozeman, MT. His research focuses on understanding the basic science of ecosystems to inform conservation and restoration under pressures of global change. In recent years, his work has focused on relationships between forest composition, structure, and function from stand to landscape scales with an emphasis on understanding fire regimes to apply to forest restoration and climate adaptation projects in Montana. He completed his M.S. at the University of Tennessee, Ph.D. at Virginia Tech, and conducted postdoctoral research with the USGS in Flagstaff, AZ.

SS04.10. Estimating the Benefits of Forest Restoration Using Non-Market Valuation

***Presenter**: Mueller, PhD, Julie, The W. A. Franke College of Business, Northern Arizona University, Assistant Professor*

Forest restoration reduces the probability of catastrophic wildfire and post-fire flooding; it therefore protects the quantity and quality of water in a restored watershed. The Four Forest Restoration Initiative (4FRI) is a landscape scale restoration initiative in Northern Arizona. 4FRI plans to restore the majority of the forested watersheds that provide the municipal water supply for the City of Flagstaff, Arizona (population 65 000). While start-up funding is available for 4FRI, funding sources for future monitoring and maintenance remain uncertain. One way to promote financial sustainability for the restoration initiative is to establish a payments system wherein Flagstaff residents pay for a portion of the costs. I present results from a contingent valuation survey estimating Flagstaff residents' willingness to pay for restoration of the Lake Mary and Upper Rio de Flag watersheds. I find the average household is willing to pay $4.89 per month to contribute to forest restoration, resulting in potential annual monetary net benefits of up to $1.3M. Thus, the results provide statistically significant evidence in favor for establishing a payments system. This survey focused solely on residents of Flagstaff, Arizona; however, the results are applicable in areas with similar ecosystems where forest restoration provides improved watershed services.

Bio: Dr. Mueller is an environmental economist. She has been an Assistant Professor in the W. A. Franke College of Business since 2008. She has an undergraduate degree in Economics from the University of North Carolina-Chapel Hill, a Masters in Economics from the University of Oregon, and a PhD in Agricultural and Resource Economics from Colorado State University. Her research focuses on non-market valuation of environmental goods and services, spatial econometrics, and Bayesian econometrics. She also teaches courses in Environmental Economics, Econometrics, and Principles of Economics for graduate and undergraduate students.

SS04.11. Recent large fires in Sierra Nevada mixed-conifer forests: causes, ecological effects, and forest responses

> ***Presenter**: Collins, Brandon, USFS Pacific Southwest Research Station AND UC Berkeley, Research Forester*

Many forests adapted to frequent, low- to moderate-severity fire regimes in the western US are experiencing uncharacteristically high proportions of stand-replacing fire. A recent assessment of land cover change in California demonstrated that fire now accounts for a greater proportion of forest "loss" than any other activity (e.g., timber harvesting, development). Given the observed and predicted future trends toward increasing temperatures and longer fire seasons it appears that fire-driven forest change will only continue to increase. Recent fire activity in the northern Sierra Nevada has been particularly high, relative to the rest of the range. Since 2000 there have been three large wildfires (>10,000 ha) that have burned in primarily mixed-conifer forests, burning a total of 73,000 ha. These fires burned through approximately 60 California spotted owl protected activity centers. Cumulatively, 34% of the area burned in these three fires was stand-replacing (> 95% dominant tree mortality). Perhaps more important than the total proportion is the distribution of stand-replacing area, which tended to be aggregated in large patches (defined here as >1000 ha). In these three fires large patches accounted for a disproportionate amount of the total stand-replacing area, which will likely have adverse impacts on forest regeneration and California spotted owls. The observed effects of these large fires point to a pressing need to implement landscape-scale fire-mitigation efforts (e.g., fuel reduction/restoration projects). However, such efforts are difficult where there is a complex arrangement of land ownerships, federal land designations, and human communities, as is the case in the northern Sierra Nevada.

Bio: Brandon Collins is a Research Scientist with the USFS Pacific Southwest Research Station and UC Berkeley. Brandon's background is in forestry, and as such much of his research is applied. Brandon has investigated effects of long-term managed wildland fire programs. He has also done fire modeling to assess effectiveness of landscape fuel treatment projects. Additionally, Brandon is currently working on characterizing forest/fuel dynamics following both fuel treatments and wildland fire.

SS04.12. Changes in Wildland Fire Suppression Costs due to Restoration Treatments

***Presenter**: Fitch, Ryan, Ecological Restoration Institute and Northern Arizona University, PhD Candidate*
Additional Author(s):
Kim, Yeon-Su, Professor, NAU
Waltz, Amy, Program Director of Science Delivery, Ecological Restoration Institute

Increased wildland fire suppression expenditure has led to a growing interest in the modeling effectiveness of fuel treatments, in terms of the changes in wildland fire burn probabilities and fire behavior. There have been considerable efforts to understand the factors affecting the overall costs of wildland fires. The link between fire size and suppression costs is well established in previous literature. However, restoration treatments are often to mitigate fire severity rather than strictly limiting fire size. We investigated the effects of fire behavior characteristics on the wildland fire suppression costs. Distance to the wildland urban interface and proportion of fires with high and mixed burn severity were found to be significant factors in explaining total wildland fire suppression expenditure and suppression cost per acre. We estimate a range for wildland suppression costs based on different treatment alternatives within the southwest ponderosa pine ecosystem for different months of the fire season under increasing percentiles of wind strength. We estimate a one unit (one percent) increase in the proportion of landscape with a high burn severity would increase suppression costs by approximately 4.6%, ceteris paribus, for total expenditure and cost per acre. Alternatively, a one unit (one percent) increase in the proportion of landscape with a mixed burn severity would increase suppression costs by approximately 3.2%, ceteris paribus, for total expenditure and cost per acre. Estimated total suppression costs for the no treatment alternative range from approximately $2.3 - $2.8 million, $2.4 - $2.9 million, and $3.2 - $19.4 million for the months of July, June, and May respectively. Estimated total suppression costs for the moderate treatment alternative range from approximately $2.3 - $2.7 million, $2.4 - $2.8 million, and $2.5 - $14.2 million for the months of July, June, and May respectively.

Bio: Ryan Fitch is a PhD student at Northern Arizona University (NAU). His master's degree is from the University of Oslo, Norway in Environmental and Developmental Economics. Ryan's research interests include the economics of wildfire suppression, fire management policy, and externalities of forest restoration treatments.

SPECIAL SESSION FIVE: Southern Great Plains Wildfire Outbreaks
Moderator: Todd Lindley

SS05.1. An Introduction to Southern Great Plains Wildfire Outbreaks, Historical and Synoptic Perspectives

***Presenter**: Lindley, T. Todd, NOAA/National Weather Service - Amarillo, Texas, Science & Operations Officer*

Although typically considered to be less intense and long-lived than forest fires, wildfires present a major threat to life and property within the grass-dominated fuelscape of the Great Plains. Since 2005, eighteen violent outbreaks of massive wind-driven wildfires have cumulatively burned 3.9 million acres (1.6 million ha), destroyed 1,826 structures, killed 27 people and injured more than 200 others on the southern Great Plains prairies of eastern New Mexico, Texas, and Oklahoma. Each of these widespread and devastating fire episodes culminated in tens of large wildland fires that simultaneously consumed areas of 104 to 106 acres (4x103 to 4x105 ha) within a single diurnal burn period. Texas officials have referred to these wildfire outbreaks as “a ‘perfect storm’ for extreme fire”, and the phenomenon is a preeminent natural hazard in the region. Fire meteorologists first documented the occurrence of dangerous southern Great Plains wildfire outbreaks following a series of widespread and destructive fire episodes during the 2005/06 southern Great Plains drought. It was recognized through use of meteorological composites, a technique analogous to methods employed in the infancy of tornado forecasting half a century ago, that such destructive fire outbreaks occur when the passage of mid latitude cyclones exacerbate climatic and environmental regimes that support abundant and particularly dry herbaceous vegetation. This presentation will introduce the concept of southern Great Plains wildfire outbreaks. Historical perspectives on their devastating public impacts as well as an analysis of the synoptic scale weather pattern that support them will be discussed.

Bio: Todd Lindley is the Science & Operations Officer at NWS Amarillo, and has 18 years of experience in operational meteorology in Texas and Oklahoma. Mr. Lindley has led research aimed at predicting violent wildfire outbreaks in the southern Great Plains since witnessing the historic impacts of Texas wildfires in 2006. The application of this research was credited with mitigating losses of life and property during the 2011 Texas wildfire disasters, and was recognized with the NWS’s 2011 National Isaac M. Cline Award and the Department of Commerce’s Bronze Medal among other honors shared by several of today’s presenters.

SS05.2. Climate Variability, Drought and Texas Fire Weather Impacts

***Presenter**: Van Speybroeck, Kurt, NOAA/NWS, Incident/Emergency Response Meteorologist*

Climatic variability and weather conditions often result in exceptional droughts across Texas. Recent episodic droughts include September 2005-May 2006, 2007-2009, and again in 2011 -2013. The peak conditions of these recent droughts often were coincident with peak fire activity around the state, and in particular across West Texas. The events of 2005-2006 and 2011 led to devastating wildfires of historic proportions across the state. The climatic record suggests a pattern of development with relatively gradual drying, then critical drying of fuels and vegetation prior to significant outbreaks. At this point, synoptic weather patterns favorable for critical fire weather conditions develop, setting the stage for rapid fire growth and spread. Red Flag Warnings and Fire Weather Watches are frequently issued by National Weather Service offices throughout the state. In 2011, the NWS Southern Region Headquarters standardized fire weather and climate information for strategic planning use by the Texas A&M Forest Service and the Texas Emergency Operation Center.
The substantial climatic departures from normal of temperature and rainfall, combined with the seasonal weather patterns, all contribute to a major/significant prolonged fire weather situation over most of Texas.

The climate record for the various regions of Texas was reviewed. The data (including linkages to global/hemispheric signals) indicate Texas is subject to periodic multiyear droughts, and studies of expected global change scenarios suggest the state of Texas might become more susceptible to such multiyear droughts. That, coupled with the increasing population in the state over the past 25 years, will likely result in a greater potential for wildfire ignitions and also a greater threat to life and property, as more people move into the wildland/urban interface.

An overview of the synoptic fire weather patterns that facilitated the rapid growth and spread of major fires in Texas in 2005-2006, 2008-2009, and 2011 will be presented. Finally, the human efforts (ICP and inter-agency contributions) to mitigate the deadly fire potential will be described.

Bio: Kurt has been a meteorologist with the NWS since 1993 and currently is an IMET/ERmet in the NWS Southern Region Operations Center. Kurt has been a forecaster with the Spaceflight Meteorology Group at the Johnson Space Center in Houston, a Science and Operations Officer, a lead forecaster in several NWS offices and a severe storms forecaster at the Storm Prediction Center.

SS05.3. Wildland fire in grass-dominant fuels during southern Great Plains wildfire outbreaks and efforts to mitigate adverse societal impacts

***Presenter**: Smith, Brad, Texas A&M Forest Service, Wildland Fire Analyst*

A close look at the extremity of wildland fire behavior and growth observed in grass-dominant fuels during southern Great Plains wildfire outbreaks provides insight as to why Texas officials have labelled these events as "firestorms, a force of nature". These outbreak episodes, though relatively brief in duration, can have long lasting implications for citizens and communities on the Texas Plains. Field observations of rates of spread as high as 2.7 m s–1 for wind-driven fire in mixed short grass prairie illustrate why this violent wildland fire phenomenon presents a unique threat life and property on the Plains environment. Recently, Texas A&M Forest Service fire analysts have worked with National Weather Service meteorologists to develop methods that improve forecast skill for these outbreak events. By implementing strategies analogous to early advancements in tornado forecasting, warnings for impending southern Great Plains wildfire outbreaks have been successfully issued. This presentation will document the extreme fire behavior observed during southern Great Plains wildfire outbreaks, as well as the mitigating strategies implemented by Texas policy makers prior to and during the historic 2011 Texas fire siege.

Bio: Brad has served as a wildland firefighter for the Texas A&M Forest Service since 1981. Since 2000 Brad has worked to increase awareness of Texas wildland fuel conditions as a fire analyst for the Texas A&M Forest Service Predictive Services department. Brad has also served on the S-590 steering committee and the National Predictive Service Group. He still enjoys taking assignments as FBAN and ICT3.

SS05.4. Wildfire Outbreaks - Enhanced Fire Department Response

***Presenter**: Angerer, Christopher, Texas A&M Forest Service, Chief Incident Response Training Coordinator*

Lubbock, Texas is located in the panhandle of Texas. Grass fueled wildfires are common in and around the city. The Lubbock Fire Department and local volunteer fire departments are charged with extinguishing these fires and protecting lives and property. In 2011, wind-driven wildfires were a significant threat to cities on the High Plains. Utilizing research from the from National Weather Service fire weather forecasters and Texas A&M Forest Service fire behavior analysts, the Lubbock Fire Department made more effective staffing decisions for predicted dangerous southern Great Plains wildfire outbreak days. The Lubbock Fire Department was able to avert major disasters on predicted significant wildfire outbreak days because of enhanced staffing. The model adopted and used to enhance staffing for predicted significant wildfire outbreak days is the topic of this presentation.

Bio: Chris Angerer currently serves as the Texas A&M Forest Service Chief Incident Response Training Coordinator. Chris has been employed with TFS since May 2013. Prior to his Texas A&M Forest Service hiring, Chris was employed for 26 years with the Lubbock Fire Department in Lubbock, Texas. The last six years of his Lubbock Fire Department career he served as Deputy Chief of Operations. He retired from the Lubbock Fire Department in October 2012.

SS05.5. Mesoscale meteorology of the Southern Great Plains Wildfire Outbreaks: The thermal ridge

Presenter: Murdoch, Greg, NWS, Science Operations Officer

The presence of discrete meso-α scale meteorological features has been observed to be a pre-requisite of fire outbreak-bearing synoptic scale patterns on the southern Great Plains. The low-level thermal ridge has been observed to be the most important sub-synoptic feature in the outbreak of wildfires on the southern Great Plains. Unlike the western CONUS counterpart, the thermal trough, it is a common feature across the southern extent of the plains from September through June. Therefore it is especially critical that operational fire weather forecasters discriminate low-level thermal ridges associated with fire effective and potentially outbreak- bearing weather systems. A comparison of the southern Great Plains low-level thermal ridge and the western U.S. thermal trough is provided. Further, the operational utility of the low-level thermal ridge as a meso-α scale indicator of enhanced wildfire risks is demonstrated for the 9 April 2009 and 27 February 2011 southern Great Plains wildfire outbreaks.

Bio: Greg is a Sr. Forecaster, Fire Weather Program Leader, and Incident Meteorologist at the NWS in Midland. Greg is the recipient of the Charles L Mitchell award, and two agency Bronze medals for service in fire weather. Greg has authored and co-authored several pier reviewed articles in the realm of fire weather operations, most recently the Red Flag Threat Index.

SS05.6. Weather and Soil Moisture Impacts on Large Oklahoma Wildfires from 2000 to 2012

Presenter: Carlson, PhD, J. D., Oklahoma State University, Associate Researcher
Additional Author(s):
Krueger, Erik, Oklahoma State University
Ochsner, Tyson, Oklahoma State University

Oklahoma wildfire data from 2000 to 2012 (over 38,000 fires) were obtained from the Office of the State Fire Marshal and analyzed last year with respect to the role of weather- and soil-based variables on fire numbers and fire size. Weather and soil moisture data from the Oklahoma Mesonet, the state's automated weather station network of 120 sites, was used in these studies. In this presentation we will look only at the "large" wildfires, those of 1000 acres or larger (over 200 fires). Three new analyses will be discussed – one looking at weather/soil data with respect to individual fires, a second looking at monthly weather/soil data and monthly fires, and a third looking at seasonal (growing and dormant seasons) weather/soil data and seasonal fires.

The first analysis will look at individual wildfires and the associated weather and soil moisture data from the start day of each fire (using the nearest Mesonet station to the fire location). Variables to be studied include minimum relative humidity (RH), average wind speed, fractional available water (40-cm soil column), the KBDI drought index, and 100-hr and 1000-hr dead fuel moisture. The latter three variables are calculated for hourly input to the fire danger model in the OK-FIRE system, an operational tool for wildland fire management. Scatterplots of fire size versus these individual variables will be presented, as well as correlation coefficients.

The second analysis will look at monthly time scales and all fires occurring during that month. Monthly average statewide weather and soil-based variables (a similar set as in the first analysis) will be correlated to monthly total statewide fires and total statewide acreage burned. In addition, correlations will be made of the statewide weather and soil-based variables for the month immediately before to see if there can be any predictive possibilities. This analysis will be twofold: for months during the growing season (May through October) and for months during the dormant season (November through April). The third analysis will look at seasonal time scales (growing and dormant) and all fires occurring during that season. Similar to the monthly analysis, seasonal average statewide weather and soil-based variables will be correlated to seasonal total statewide fires and total statewide acreage burned. Correlations will also be made of the statewide weather and soil-based variables for the season immediately before to see if there are any predictive possibilities for these longer time scales.

Bio: Dr. J. D. Carlson has been a faculty member since 1991 in the Biosystems & Agricultural Engineering department at Oklahoma State University, where he serves as fire meteorologist and manager of the operational OK-FIRE program. In particular, his expertise includes boundary-layer meteorology, fire danger, and atmospheric dispersion. His degrees include a BS in Physics from Michigan State University, an MS in Meteorology from the University of Wisconsin, and a PhD in Atmospheric Sciences from The Ohio State University. Dr. Carlson is a member of the American Meteorological Society and a Fellow in the Royal Meteorological Society.

SPECIAL SESSION SIX: Landscape Level Fire Use to Restore Ecosystems in Canada: Applications and Challenges

Moderator: Jane Park

SS06.1 Cliff White: Overview of Landscape Level Fire Management/Use Policy in Canada

***Presenter**: White, Cliff, Parks Canada, Manager, Fire and Vegetation (retired) Banff National Park*

Large, often high intensity fires were historically a predominant component of Canada's northern ecosystems. The transition from First Nation to the modern industrial management and possibly climate change has resulted in sharp reductions in burn area across southern areas of the country, but large fires, usually ignited by lightning, remain common in the northern boreal forest. Thirteen provincial and territorial agencies have primary responsibility for forest and resource management in Canada, with the national parks under federal jurisdiction. The general policy of all agencies is rigorous fire suppression in the southern portion of the country, with a lower priority on suppressing fires in northern areas. Prevention of random human ignitions on most private, public, and First Nation lands is a high priority. In parks and protected areas, policy has evolved from a utilitarian management paradigm (fire suppression and predator control), through a natural regulation phase (minimal human interference), to a current paradigm of ecological restoration. Fire use is increasing to achieve this objective. Parks Canada, the federal agency responsible national parks, gives high priority to maintaining ecological integrity, or the characteristic condition of ecosystems. Large, high intensity fires (either through planned or random ignitions) are now routinely used to meet targets of 20 to 50% of the long-term burn areas in several national parks. As a precautionary comment, we will provide a brief critique of the scientific approaches that over time seem to support evolving land and fire management paradigms.

SS06.2 Interagency Landscape Level Fire Management Planning in Alberta

Presenter(s)*: Cordy Tymstra/Dave Finn, Alberta Environment and Sustainable Resource Development, Edmonton and Rocky Mountain House, AB, Canada*

The R11 Forest Management Unit (FMU) encompasses 521,900 ha of Rocky Mountains and foothills adjacent to the White Goat and Siffleur Wilderness Areas, and Banff and Jasper National Parks. Sundre Forest Products, Weyerhaeuser, and Sundance Forest Industries Forest Management Agreement areas also surround this management unit. Approximately 50 % half of the land base is covered by coniferous forests. Rock and barren areas account for another 30 %. A three-day Charrette Planning Session provided an opportunity to engage stakeholders in the development of an initial plan for the R11 FMU. This lead to the development of the R11 Forest Management Plan. This plan recognizes that fire exclusion changed the landscape conditions in the R11 FMU. The R11 Fire Management Plan supports the objectives in the Forest Management Plans by allowing for the use of prescribed fire (prescribed burns and prescribed wildfires) as the main disturbance tool to maintain natural disturbance patterns at the landscape level. A 50-year disturbance strategy was developed with stakeholder input to mitigate the threat of escaped large-scale, catastrophic wildfires. This strategy incorporates information from fire regime and fire regime departure studies, and landscape simulation modeling to evaluate the effectiveness of the strategy. Implementing the disturbance strategy and prescribed burn target of 1,500 ha/yr requires inter-jurisdictional support. This is a key element that has contributed to the success achieved to date.

BIO: David Finn grew up in Crowsnest Pass, Alberta and developed childhood interests into a career with the Alberta Forest Service as a Forest Officer in 1988. David has since worked in numerous locations around Alberta, most recently as the Wildland Fire Management Specialist in Rocky Mountain House supervising the prescribed fire program there. David is currently the Fire Behaviour Specialist for the Alberta Provincial Forest Fire Centre. David been deployed to wildfires across Canada and in Montana. David owns and operates a commercial greenhouse with his wife and enjoys playing guitar and banjo and working in his shop.

SS06.3. Use Of Area Burned By Condition Class And Burn Targets For Fire Management Planning And Monitoring

***Presenter**: Walker, Gregg, Parks Canada Agency, A/Fire & Vegetation Specialist*

Parks Canada is the agency responsible for the management of wildland fire within National Parks in Canada. Fire management specialists use wildfire management, prescribed fires, and forest fuel management as mechanisms to achieve public safety and ecological integrity objectives. One key objective is to maintain the appropriate amount and spatial distribution of fire as a natural disturbance process. The planning and implementation of fire management in Canadian national parks is done at the landscape scale. Methods for planning and monitoring results have been under development since Parks Canada began implementing prescribed fires in the early 1980s. In recent years, Parks Canada has developed a novel approach to setting targets and monitoring for the appropriate level of fire activity. This method, the Area Burned Condition Class (ABCC) provides a quantitative, scientific protocol for relating recent area burned with the historic range of variation in area burned for a landscape-scale study area. The numerical result is categorized into descriptive classes that provide clear information on fire condition for non-technical audiences.

Bio: Gregg started his career in fire management in the early 1990s, working on fires and research in the boreal forest in Prince Albert National Park, Saskatchewan. Since then he has worked in fire management in the Columbia Mountains in Glacier National Park, BC and recently in Kootenay National Park in the Rockies. When not working, Gregg is usually recreating in the mountains with his family, mostly catching frogs and bugs with his wife and 3-year old son.

SS06.4. Managing SARA and multiple objectives using prescribed fire

***Presenter**: Smith, David, Parks Canada, Jasper National Park Fire and Vegetation Specialist*

The Species at Risk Act (SARA) is a key Government of Canada commitment to prevent flora and fauna from becoming extinct and secure the necessary actions for their recovery. The act provides for the legal protection of species and the conservation of their biological diversity by creating prohibitions to protect listed threatened and endangered species and their critical habitat. In Jasper National Park the Species at Risk act has created some interesting challenges for fire management specialists dealing with both prescribed fire and wildfires. Woodland Caribou (Rangifer tarandus caribou) are a threatened species in western Canada. In Jasper National Park, fall monitoring counts show that the caribou population decreased by more than 50% in the last 20 years. Based on trend data, population modelling projects the south Jasper caribou herd could be extirpated within 30 years. Occupying similar habitat is Whitebark Pine (Pinus albicaulis), a rapidly declining species throughout its range and recently listed as endangered under SARA. Parks Canada identifies fire as both a direct and indirect threat to critical caribou habitat. At the same time, fire is seen as a critical process (and tool) to be utilized in the restoration of Whitebark Pine habitat. This presentation will highlight some of the complexity of using prescribed fire while working to achieve the objectives of the Canadian Species at Risk Act.

Bio: Dave spent his first eleven years working for Parks Canada as a public safety warden at the Columbia Icefield, where mountain rescue operations, avalanche control and general warden duties filled his days. In the late 1990's Dave moved into the Fire Management branch of the Warden Service.

Dave is now the Fire and Vegetation Specialist for Jasper National Park. The focus of his work is on the use of prescribed fire for ecological restoration, fire control and issues related to the spread of non-native vegetation. Dave is an Incident Commander on a Parks Canada type I Incident Management Team.

SS06.5. Consultation with stakeholders, staff and public during prescribed fire planning and implementation

***Presenter**: Drummond, Anastasia, Alberta Environment and Sustainable Resource Development, Provincial Wildfire Information Officer*

Over the last decade the prescribed fire program has been ramping up in Alberta with not only small hazard reduction burns increasing, but large scale, highly visible, smoke causing projects becoming more prevalent on the landscape. Gone are the days of lighting on a whim and justifying later.
In a political climate where a well-connected individual can shut down a major operation, as prescribed fire planners, we must ensure, to the best of our abilities, that no individual or organization is caught off guard by our projects. The more buy-in and support we can garner prior to and during operations, the more likely we are to gain approval as we move forward with new, important projects.
Not everyone will see prescribed fire as a positive, as most fire organizations undoubtedly do. By understanding different viewpoints and working as much as possible to accommodate those opposing views, each fire organization can benefit from greater understanding, and in turn, more stakeholder and political buy-in.This session will explore Alberta's and Parks Canada's standards in prescribed fire communications before, during and after operations. In addition, lessons learned over the last 5 years of being in the smoke with public and media will be explored, and in particular the benefit of working with partner organizations to increase credibility.

Bio: Anastasia has been working in her current capacity as a Provincial Wildfire Information Officer for the Province of Alberta for nearly nine years. In that time, she has conducted hundreds of media interviews, planned several conferences and served as lead information officer on multiple major wildfires and prescribed fires. She is a member of the Wildfire Information Unit, responsible for all provincial messaging related to wildfires, including social media, advertising and media relations. In addition to emergency wildfire information, Anastasia is project lead on communication planning for Alberta's extensive prescribed fire program. Anastasia holds a Bachelor of Science in Conservation Biology from the University of Alberta and is an ICS certified Information Officer. She reports to the Provincial Forest Fire Center in Edmonton, Alberta working from the Calgary Wildfire Management Area field office in Southern Alberta.

SS06.6 Using an Eco-Cultural Paradigm to Define Landscape-Level Fire Use Prescriptions

***Presenter**: Cliff White, Research Director, Canadian Rockies Bison Initiative, Canmore, AB*

Indigenous peoples have occupied the northern Rocky Mountains since deglaciation over 10,000 years ago. The cultures used fire for numerous ecosystem maintenance objectives including clearing of travel routes, enhancing wildlife habitat, ungulate hunting drives, maintaining gathering areas for berry's and other plant resources, warfare, and protecting high value areas from mid-season high severity fires. In many cases, these objectives yield results that are similar to the resource management objectives of the current human culture occupying these areas. Implementing an eco-cultural paradigm for modern fire management requires an interdisciplinary approach of careful, unbiased analysis of long-term fire regimes (spatial fire frequency, timing, cause), multi-factor analysis of changes in the regime over time and space, consideration of traditional knowledge and integration of Native American into decision making processes, evaluating fire effects on a wide range of valued ecosystem components, and an adaptive, experimental management approach. Explicitly using fire techniques to enhance Rocky Mountain ecosystem components valued by humans such as bison, elk, grizzly bears, white bark pine, human occupation areas, and traditional cultural use areas can attract a wide range stakeholders into participating in the planning and evaluation process. Initial test application an eco-cultural paradigm for fire management suggest that eco-cultural use of fire can enhance ecological integrity while providing opportunities for safer use of larger lightning and random ignition human-caused fire during periods of extreme fire weather.

SS06.7. Landscape Level Prescribed Fire Use In The Rocky Mountain National Parks

***Presenter**: Park, Jane, Parks Canda, Fire and Vegetation Management Specialist*

The history of prescribed fire in Banff National Park can perhaps be traced back to first nation's burning of valley bottoms to increase foraging habitat for game such as bison, elk and deer. Following nearly a century of fire suppression, Parks Canada began implementing prescribed fire in Banff National Park in 1983 with a small prescribed fire near Two Jack Lake. Since then Parks Canada's prescribed fire program in the rocky mountain national parks (Banff, Kootenay, Yoho, Waterton Lakes and Jasper) has evolved to include landscape level implementation of fire, large-scale fuel modification to facilitate large prescribed fires, and complex inter-jurisdictional operations. Furthermore, the prescribed fire program is multi-disciplinary and aims to meet multiple ecological objectives. Restoring historic fire cycles and vegetation complexes, improving wildlife habitat, improving forest resilience to forest insects and disease, minimizing threat of wildfire to communities, conducting fire effects monitoring and research, and generating stakeholder and public support are all critical components of the program. This presentation will highlight the balance between strategic and ecological management of fire in the rocky mountain national parks. The planning, communications, consultation and implementation of several recent landscape scale (2000 ha +) prescribed fires will be discussed.

Bio: Jane Park is the fire and vegetation management specialist for Banff Field Unit in Banff National Park. She obtained her M.Sc. from the University of Calgary in Forest Ecology. Her interests include prescribed fire for ecosystem management in protected areas, ecological effects of fire on various ecosystem components. She has collaborated with numerous universities to study the interactions between fire and insect population dynamics and wildlife habitat.

SS06.8. Fescue Grassland Restoration Through Prescribed Fire - Prince Albert National Park

***Presenter**: Guedo, Dustin, Prince Albert National Park - Parks Canada, Ecologist Team Leader*

Once common across the prairies, the historic range of plains rough fescue (Festuca hallii) has been significantly reduced through agricultural practices (cultivation and extensive grazing), fire suppression, forest encroachment, and urban development. The majority of fescue grassland areas still intact are found to be extremely fragmented, small (<65 ha), and isolated from one another. Prince Albert National Park (PANP) is found in an important transitional zone at the northern extent for plains rough fescue grasslands. Similar to the rest of the northern prairie, the remaining grasslands in PANP are fragmented and require active management to ensure their survival. The greatest threats to PANP's fescue grasslands are the encroachment by Trembling Aspen (Populous tremuloides), and the lack of wildfire on the landscape due to suppression. The encroachment of aspen forest has limited the fescue grasslands in PANP to approximately one-fifth of their known 1947 extent. To deal with these threats, PANP has implemented a program to apply fire to prescribed fire units every 2 to 3 years for over a 10 to 15 period. It is expected that by utilizing successive fires, the fescue grassland areas will increase in size to resemble their known historic extents. These prescribed fires will help to kill and suppress aspen in the core grasslands, support the expansion of the fescue grasslands into areas that have been encroached by forest, and create large areas of burned landscape to restore the historical fire regime. By introducing fire back into the environment we are restoring one of the key ecological processes required to enhance plains rough fescue grasslands.

Bio: Dusty is an ecologist/vegetation specialist with Parks Canada. He started his career with Parks Canada as a Park Warden in Banff National Park and then decided to have a change in topography and worked in Grasslands National Park. More recently, he now works as a Park Ecologist in Prince Albert National Park, specializing in ecological monitoring, invasive species management and control, ecological restoration of disturbed areas, and prescribed fire restoration in the southern boreal forest and aspen parkland. Many of the ongoing projects he manages are intertwined towards using landscape level prescribed fires as a tool for restoration and habitat improvement. He graduated from the University of Saskatchewan with a Masters degree in Physical Geography, studying the effects of fire severity and salvage logging on post-fire succession in the mixedwood boreal forest of Saskatchewan.

SS06.9. 400 Years of Fire History in Central British Columbia, Canada

***Presenter**: Harvey, Jill, University of Victoria, PhD Candidate*

Forest fires in southcentral British Columbia are considered the dominant natural forest disturbance. To anticipate the consequences of climatic change on fire activity, an understanding of the causes of variation in historical fire regimes is required. Dendroecological methods were applied to reconstruct fire history in the Douglas-fir (Pseudotsuga menziesii) forests of the Churn Creek Protected Area, central British Columbia, Canada. Fire records from 90 fire-scarred trees and stand demography from 27 plots reveals a complex and varied spatiotemporal pattern of fire occurrence over the 700 ha study area. Relationships between fire occurrence and the top-down (regional climate) and bottom-up (topography and forest structure) controls of fire are presented. This study provides new evidence of historic stand-maintaining fires and infrequent stand-replacing fires in the Cariboo-Chilcotin of British Columbia.

Bio: Jill Harvey is in her third year of a PhD program in the Geography Department at the University of Victoria. Her research focuses on the relationships between fire, climate and insect disturbances in the Douglas-fir forests of central and northern British Columbia, Canada. Jill's research applies analytical techniques to tree ring data to explore the variability in these relationships through time and space.

SS06.10. The Great Fire of 1919

***Presenter**: Murphy, PhD, Peter, University of Alberta, Professor Emeritus*
Additional Author(s):
Tymstra, Cordy, Wildfire Science Coordinator, Alberta Environment and Sustainable Development

“Cold, windy, eclipse of the sun, Lac La Biche wiped out by flames.” This laconic journal entry was written by Alberta police constable Fred Moses for Monday, the 19th of May 1919. He could not have known he was describing just the western end of a series of fires burning during the ten days that weather records indicate could have supported free-burning fires. They spread within an area of about 380 km in length and up to 130 km from south to north. We estimate at least 2 million ha actually burned, based on interviews, historical accounts, satellite imagery and forest age-class data.
The results of the burn were typically described in terms of “destruction”: loss of the village, at least 13 lives and more injured, homestead buildings and livestock, timber, Aboriginal hunting and trapping areas; end of a logging railroad, closing of two major sawmills with loss of economic activity and conversion of spruce forests to poplar. On the other hand, Lac la Biche took the opportunity to redesign the community plan, homesteading was easier on areas cleared of forests, additional funding was provided for forest protection services and timber losses on the Sturgeon Forest Reserve enabled its restructuring to become a new National Park. These social, political and economic effects are described for five areas within the perimeter of the area within which the fires occurred: the village of Lac La Biche and relief train from Edmonton, Alberta; fatalities among Aboriginal people, J.D. McArthur’s railway to Cold Lake; and in Saskatchewan, homesteaders in the St.Walburg-Meadow Lake area; Big River and Prince Albert Lumber companies closure and rededication of forest reserve to a national park.
Though uncommon, big fires continue to shape the Alberta landscape. The lessons learned from the Great Fire of 1919 still resonate and have application today.

Bio: Peter Murphy is Professor Emeritus (Forestry), University of Alberta; teaching 1973-1995, and serving as Chair of Forest Science and Associate Dean for Forestry. Graduating in forestry (University of New Brunswick) in 1953, he worked for the B.C. Forest Service, moving to Alberta in 1954 (Alberta Forest Service). In 1956 he became head of the Training Branch and Director of the new AFS Forest Technology School in 1960. Authored/co-authored five books and chapter contributions to two others; was Chair of the Technical Committe on Sustainable Forest Management (CSA) 1998-2004; President of Canadian Institute of Forestry 1993-94; President of the Forest History Society Inc. 1993-95; President, Alberta Registered Professional Foresters Asscoiation 1985-86.

SS06.11. Saskatchewan Wildfire Management Strategies: Lessons Learned

***Presenter**: Roberts, Steve, Executive Director of Wildfire Management, Ministry of Environment, Government of Saskatchewan*

The costs of wildfire management are increasing across jurisdictions throughout North America and around the world due to escalation of firefighting costs, expanding land use, and population growth within Wildland Urban Interface areas. Wildfire management organizations are faced with the challenge of finding the proper balance between strategies targeted at protecting values at risk and the management of wildfire to maintain healthy and diverse ecosystems. Saskatchewan Wildfire Management acknowledged that adjustments in strategy were required if wildfire management was to remain effective while addressing this balance. In 2004, the program made changes to its wildfire

management strategies; establishing four wildfire response zones to reflect strategic operational priorities (focusing on the protection of values, with human life and communities as the program's top priority). These wildfire response zones enable results-based operational decisions and tactics and provide guidance for the deployment of resources to best achieve desired outcomes. Through the implementation of this strategy, Saskatchewan Wildfire Management has operated their program for the past ten years. Lessons learned on the development, communication, and implementation of the strategy shift will be highlighted in the presentation.

Bio: Steve Roberts is a Registered Professional Forester working for the Ministry of Environment for the Government of Saskatchewan. For the past 10 years he has been the Executive Director for the province's Wildfire Management program including oversight of the operational, support, safety, prevention and policy sections. He is also the Accountable Executive for Saskatchewan's aerial wildfire suppression fleet operations. He serves as a Director for the Canadian Interagency Forest Fire Centre and is a Northwest Fire Compact and Alliance of Forest Fires Compacts representative.

SPECIAL SESSION SEVEN: The Evolution of Fire Behavior Analysis and Management of Large, Long-duration Incidents as Experienced on the Mustang Complex
Moderator: Tami Parkinson

SS07.1. Intro & Fire Behavior

Presenter*: Boursier, Don, Orange County Fire Authority, Fire Chief*
Additional Author(s):
Zimmerman, Tom, (IC, FBAN/LTAN), Retired Program Manager, Wildland Fire Management RD&A

The role of the fire analyst is to provide information that improves safety of fireline personnel and long-term decision support for managers. New tools and technology are providing a broader look at the fire environment – fire history, weather, fuels and climatology – which allows the fire analyst to work with other subject matter experts such as the National Weather Service and Research Stations, etc., to interpret this information for planning and incident management.

Bio: After completing a B.S. in Biology/Vocational Education from Cal State Long Beach, Don began his fire career in 1985 as an Engineer/Paramedic with the California Department of Forestry. Two years later, Don transferred to the Orange County Fire Authority in 1987. After successfully working many different positions, within the ICS, he strove to combine his Fire experience with his formal education. That was achieved with qualification as a FBAN and LTAN on Cal Fire IMT #1. Participation on the NWCG Fire Behavior Sub-Committee along with a Chair position on the Fire Behavior Calculations Curriculum Unit complements many long term goals. Don was the co-developer of the OCFA Fire Behavior Decision Support website and continues teaching many ICS classes including S-495 and S-590. The summer of 2013 brought a great career experience of Long Term Analyst on the Rim Fire (California's third largest). Current assignment is at Silverado Canyon on a Type 3 Engine Company. Sharing a station with Cleveland National Forest Personnel allows collaboration with the USFS in many facets. In his off-time he enjoys his working ranch on the outskirts of Tombstone, AZ and is working towards a Masters Degree in Forestry from NAU.

SS07.2. IMET Program

***Presenter**: VanBussum, Larry, National Weather Service, National IMET Program Manager*

The fires of 1910 resulted in the federal government taking a more active role in wildland fire management. It soon became evident that accurate and timely onsite weather forecasts were vital to this effort. The National Weather Service has been delivering this service for nearly 90 years. Incident Meteorologists provide onsite weather information and forecasts to ensure the safety of first responders and the general public. This information is also used by incident personnel to make tactical decisions on incident management.

Bio: Larry Van Bussum is the NOAA's National Weather Service's (NWS) National Fire Weather Operations Coordinator. He has worked at the National Interagency Fire Center (NIFC) in Boise, ID, since 2001. A native of Wisconsin, he graduated from the University of Wisconsin -- Madison in 1994, and has worked in Alaska and California as both a forecaster and an Incident Meteorologist (IMET). As the National Fire Weather Operations Coordinator, Larry is in charge of the NWS's IMET program. The IMET program consists of 85 meteorologists stationed throughout the nation that respond to wildland fires and other disasters. IMETs maintain a weather safety watch for incident responders as well as provide tactical weather information and forecasts to emergency managers at the incident.

SS07.3. Evolution/Decision Making

***Presenter**: Sexton, Tim, Wildland Fire Management RD&A, Program Manager*
Additional Author(s):

As a line officer, Incident Commander, Fire Use Manager and fire analyst, Tim Sexton has experienced the evolution of decision support and has had the opportunity to apply this information in support of many incidents. Understanding that change does not always come easily for some managers, Sexton will use his personal perspective to demonstrate how decision makers can use the new technology and tools to manage ris

Bio: Tim is currently the Program Manager for the Wildland Fire Research Development & Applications Program. His responsibilities include management of the Wildland Fire Decision Support System as well as facilitating technology transfer of new science associated with wildland fire to the field.

Tim started his fire career as an engine and fuels crewmember on the Shasta-Trinity NF at Weaverville Ranger District.

He has served as a Type I Incident Commander on Great Basin IMT 1 and as a Type II IC on Rocky Mountain IMT #2. He remains active in large fire management, serving on Area Command and the Command and General Staff of Type I IMTs. Tim has served as a Strategic Operational Planner on large and small wildfires including the Station Fire (Angeles NF 2009) and the Southern Idaho Area Command (2012). He also served on Fire Use Management Teams as IC, Planning Section Chief, Operations, and Fire Use Manager (SOPL).

Tim has a Bachelor's Degree in History from Boise State University and a Master's Degree in Fire Ecology from Oregon State University.

SS07.4. Home Unit overview

***Presenter**: Guzman, Frank, FAM, Assistant Director*

Home units are able to utilize decision support tools during large fires that may not have been available to them a couple decades ago. Line officers are using this science-based data in fire management which improves interaction and communication with IMTs and fire analyst. Line officers also take this information into consideration when working with the public, other agencies, regions and forests.

Bio: Frank started his career with the Forest Service on an Engine crew on the Fremont NF in 1984. From there he worked on the Umatilla, Malheur NF's in Eastern Oregon as a Range Management Specialist and became qualified as a Crew Boss, Type 4 IC, and Crew Representative. He moved to the Bitterroot NF in 1998 as the Forest Range Staff, and detailed as a Deputy District Ranger. During the fires of 2000, he represented the Forest with IMT's, BAER Teams and at public meetings, and became familiar with Area Command.
In 2001 Frank moved to the Dakota Prairie Grasslands as the District Ranger, and while there became qualified as Strike Team Leader, Field Observer and ultimately Division Supervisor . Frank also acted as an Agency Administrator coach on the Helena NF for a 14 day stint in 2003.
In 2006, Frank became the Deputy Forest Supervisor on the Boise NF, and in 2010 the Forest Supervisor on the Salmon-Challis NF in Central Idaho. During this time, he worked with IMT's, NIMO and Area Command on a regular basis. Frank is currently OSC2 trainee and an Advanced Agency Administrator. Recently, Frank accepted the position of Assistant Director in FAM, in the National Office over Workforce and training planning.

Frank is a graduate of Oregon State in Rangeland Resources, and in his spare time he enjoys running, river kayaking, and training mustangs.

SS07.5. SOPL

***Presenter**: Burgard, Mitch, RMRS, Fire Application Specialist*

The role of the Strategic Operational Planner (SOPL) is to provide decision support to the local Agency Administrator and Incident Commander to help ensure that actions taken on a wildfire will achieve incident objectives and are consistent with the local agency's land/resource management plan and fire management plan, as well as Federal wildland fire management policy. The SOPL is a relatively new position in incident management. Burgard will share how the SOPL contributed to decision making on the Mustang Complex.

Bio: Mitch Burgard is a Fire Technology Transfer Specialist with the Wildland Fire Management RD&A since 2009. He works out of his hometown of Kalispell, Montana. Prior to this position, Mitch was the Prescribed Fire and Fuels Specialist at Glacier National Park. He worked on the Yellowstone and Bandelier Fire Use Modules from 1995 - 2000 and on helitack, fuels and engine crews for several years prior to that. Mitch is passionate about fire ecology, resource benefit fires and working with the fire behavior models to support decision making and risk analysis.

SS07.6. FBAN/LTAN

***Presenter**: Kern, John, Florida Forest Service, Deputy Chief of Field Operations*

The FBAN and LTAN create and provide products and interpretation to provide insight on predicted fire behavior in the near, medium and long term for many users. First and foremost the FBAN is concerned with the support of operations and safety of the fireline personnel with short-term fire behavior forecasts and briefings for each operational shift. The LTAN is responsible for producing products that support the local managers, the SOPL, the Geographic Area Coordination Center or Area Command, as well as other members of the Incident Management Team assigned to the fire. Both work closely with the IMETs to ensure coordinated information sharing and provide the highest quality forecasts. On the Mustang Fire the FBANs and LTANs worked closely with the SOPL and Team Leadership by producing short, medium and long term fire growth predictions for the development of Management Action Points, evacuation plans and other evolving concerns over the life of this large fire.

SS07.7. IMET

***Presenter**: Nester, Bob, NWS, National Weather Service Meteorologists*
Additional Author(s):
Van Bussum, Larry, (IMET), National Weather Service Meteorologists, NWS

The Mustang Fire of 2012 was a long term event. Bob Nester, IMET from Missoula, MT, was one of the first IMETs on the incident and Larry Van Bussum was the last IMET on the incident. They will discuss how IMET weather support evolved from an emerging incident to mop up and containment.

Bio: Bob Nester is an Incident Meteorologist (IMET) and Lead Forecaster with the National Weather Service (NWS) in Missoula, Montana. He has worked with the NWS since 1987 and has been an IMET since 1994. He is a graduate from Purdue University and has worked in Washington DC, Michigan, California, Nevada and now Missoula, MT (2001-Present), all with the NWS. Aside from his lead forecaster and IMET duties Bob is also a member of the IMET training Cadre. IMETs maintain a weather safety watch for incident responders as well as provide tactical weather information and forecasts to emergency managers at the incident.

SS07.8 Trainee

Presenter: *Rita Chandler, Fire Staff Officer, Olympic National Forest*

Trainees gain valuable experience on incidents where fire analysts are involved with decision making and planning. This presentation will give a trainee an opportunity to share lessons learned working with fire analysts, IMETs, other incident personnel and the home unit.

Bio: Rita started her career in the federal service on the Clearwater National Forest in 1986 - 1992. She worked seasonally as a lookout, planting trees, working with hand crews and engines on wildfire and prescribed fires on the Powell Ranger District for several years before becoming a District Dispatcher there. In 1992 she moved to Jackson Hole, WY on the Bridger-Teton NF as the assistant Forest Dispatcher then promoted into the Forest Dispatcher position till 1998. She continued development in Fire Management with prevention, fuels, prescribed fire, NFDRS, suppression and aviation through 1998.

Fall of 1998, Rita became the Assistant Center Manager at Bozeman Interagency Dispatch in South Central Montana then detailed to the Center Manager in 2000. During her time on the Gallatin NF, she completed TFM and worked in operational wildfire and prescribed fire positions. Then in 2004-2011 served as Assistant Forest Fire Management Officer on the Helena NF in the Northern Rockies, continuing with dispatch coordination, fire behavior and suppression assignments. June 2011, Rita moved to the Olympic Peninsula out of Olympia WA in the Pacific Northwest (PNW). She became a member of the PNW Long Term Assessment Team and continues to work on her LTAN and DIVS qualifications.

SPECIAL SESSION EIGHT: The ecological importance of maintaining severe fire on the western forested landscape
Moderator: Richard Hutto

SS08.1. Has High-Severity Fire Always Been An Important Component of Large Fires?

***Presenter**: Keane, Robert, US Forest Service Rocky Mountain Research Station Missoula Fire Sciences Laboratory, Research Ecologist*

Many assume that today's large fires (>10,000 acres) are an ecological catastrophe because the perception is that they burn vast areas with uncharacteristically high intensities and severities. However, there is little evidence to support this claim, and many have found that large fires were historically common and they burned in a patchwork of intensities and severities. There is certainly ample debate that surrounds both the causes and ecological consequences of large fires and their pattern of high severity fires. Here, I present a general review of our current understanding of the historical prevalence of large fires and their severities in some United States ecosystems by considering important North American biomes that are now experiencing large fires. The ecosystems covered are 1) ponderosa pine-Douglas-fir, 2) sagebrush-grasslands, 3) piñon-juniper, 4) chaparral, 5) mixed conifer, and 6) spruce-fir. Many important issues associated with large fires are addressed including preconditioning factors, departure of current large-fire effects with those that occurred historically, biotic responses to large fires, and comparisons across major biomes. Basically, large fires were common on historical landscapes of the western US and they will continue to be a major component of today's fire regimes. Sagebrush ecosystems are currently experiencing larger, more severe, and more frequent large fires compared to historical conditions due to exotic cheatgrass invasions. Large fires in southwest ponderosa pine forest historically created a low- to mixed-severity mosaic with some high-severity patches, but historical large fires were dominated by non-lethal surface fires while today's large fires have a proportionately larger high-severity crown fire component. Fire management must address the role that large fires and high severity fires play in maintaining the health of many US fire-dominated ecosystems.

Bio: Robert E. Keane's most recent research includes 1) developing ecological computer simulation models for the exploring landscape, fire, and climate dynamics, 2) conducting field research on the sampling, describing, modeling, and mapping of fuel characteristics, and 3) investigating the ecology and restoration of whitebark pine. He received his B.S. degree in forest engineering from the University of Maine, Orono; his M.S. degree in forest ecology from the University of Montana, Missoula; and his Ph.D. degree in forest ecology from the University of Idaho, Moscow.

SS08.2. Examining historical mixed-severity fire regimes in ponderosa pine and mixed-conifer forests of western North America

***Presenter**: Sherriff, PhD, Rosemary, Humboldt State University, Associate Professor*
Additional Author(s):
Odion, Dennis, Research Ecologist, Southern Oregon University and the Earth Research Institute at UC Santa Barbara
Hanson, Chad, Ecologist, Earth Island Institute

There is widespread belief that fire exclusion has led to an unprecedented threat of uncharacteristically severe fires in ponderosa pine (Pinus ponderosa Dougl. ex. Laws) and mixed-conifer forests of western North America. These extensive montane forests are considered to be adapted to a low/moderate-severity fire regime that maintained stands of relatively old trees. However, there is increasing recognition from landscape-scale assessments that, prior to any significant effects of fire exclusion, fires and forest structure were quite variable in these forests. A better understanding of historical fire regimes in the ponderosa pine and mixed-conifer forests of western North America is therefore needed to define reference conditions and help maintain characteristic ecological diversity of these systems. We present landscape-scale evidence of historical fire severity patterns in the ponderosa pine and mixed-conifer forests from published literature sources and stand ages available from the Forest Inventory and Analysis program in the USA. We highlight examples from the Colorado Front Range and other regional locations in the West. The consensus from this evidence is that most forests appear to have been characterized by mixed-severity fire that included ecologically significant amounts of weather-driven, high-severity fire. Prior to fire exclusion, these fires resulted in diverse forests in different stages of succession, with a high proportion in relatively young stages. Over the past century, this successional diversity created by fire is likely to have decreased. Thus, our findings suggest that the characteristic biodiversity associated with most ponderosa pine and mixed-conifer forests of western North America can be maintained only through the adoption of ecological management goals that incorporate successional diversity created by significant amounts of weather-driven, high-severity fire.

Bio: Dr. Sherriff is an Associate Professor in the Department of Geography and graduate faculty in the Forestry and Wildland Resources Program at Humboldt State University. Her research interests include disturbance ecology, dendroecology, climate-vegetation interactions, and forest stand dynamics. Her current research focus is on understanding past and present effects of climate change and disturbance (e.g., wildfire, insect outbreaks, forest management practices, wildland-urban interface) on forest ecosystems with relevance for current and future land-use management in western North America.

SS08.3. Not all Habitats are Disturbed Equally: Black-backed Woodpecker Population Dynamics in Burned Forests and Mountain Pine Beetle Infestations

***Presenter**: Rota, Christopher, University of Missouri, Postdoctoral Fellow*
Additional Author(s):
Millspaugh, Joshua, Professor, University of Missouri
Rumble, Mark, Research Wildlife Biologist, Rocky Mountain Research Station
Lehman, Chad, Senior Wildlife Biologist, South Dakota Department of Game, Fish, and Parks
Kesler, Dylan, Assistant Professor, University of Missouri

Wildfire and mountain pine beetle infestations are naturally occurring disturbances that benefit numerous wildlife species. Black-backed Woodpeckers are emblematic of the important role these natural disturbances play in creating wildlife habitat since they are almost completely restricted to recently killed forests. Previous research suggests that Black-backed Woodpeckers are relatively restricted to recently burned forest conditions. However, Black-backed Woodpeckers are known to use mountain pine beetle infestations in certain portions of their range and will also use forests treated by prescribed fire. Thus, the relative value of these forest disturbances in maintaining regional populations remains unknown. We studied habitat-specific adult (n = 137 adults) and juvenile (n = 73 juveniles) survival probabilities and reproductive rates (n = 95 nests) of Black-backed Woodpeckers between April 2008 and August 2012 in the Black Hills, South Dakota, which we used to calculate habitat-specific asymptotic population growth rates. We coupled the demographic study with an evaluation of habitat-specific home range size and foraging behavior. Mean population growth rates indicated growing populations only in habitat created by summer wildfire and indicated declining populations in fall prescribed fire and mountain pine beetle infestations. Consistent with habitat-specific population growth rates, we found home ranges in mountain pine beetle infestations were nearly four times larger than in recently burned forest. We also found Black-backed Woodpeckers captured nearly twice as many wood-boring beetles, a primary prey item, in summer wildfire relative to fall prescribed fire. Our findings suggest that Black-backed Woodpeckers depend on forests recently burned by summer wildfires.

Bio: Chris Rota is a postdoctoral fellow at the University of Missouri. Chris has research interests in combining population ecology, conservation biology, and statistical ecology to inform conservation and management of wildlife population. Chris completed his BS in Wildlife Biology from the University of Montana in Missoula, his MS in Wildlife Ecology and Conservation from the University of Florida in Gainesville, and his PhD in Fisheries and Wildlife Sciences from the University of Missouri. He is currently completing a MA in statistics as part of his postdoctoral duties.

SS08.4. Resilience of native trout populations to fire in the U.S. Rocky Mountain West

Presenter*: Eby, Lisa, University of Montana, Associate Professor*
Additional Author(s):
Mike Young, Research Fisheries Biologist, USDA Forest Service, Rocky Mountain Research Station, Missoula, Montana
Jason Dunham, Research Aquatic Ecologist, USGS FRESC, Corvallis, Oregon

Wildfire often results in striking changes to the landscape and consequently we historically considered that it would have negative effects on and pose serious risk to trout populations in the West. But to date, empirical evidence of negative effects on fish populations from wildfire has been equivocal. The immediate effects of fire are variable and lethal events are localized and patchy. Typically these events are only problematic for fish populations that are already small and fragmented from anthropogenic habitat loss, such as the Gila trout in the southwestern US. Very few studies have examined the decadal scale effects of fire on fish populations, but severe fire can alter stream habitat for decades. Loss of vegetation can result in increased fine sediment loading, warmer water temperature associated with reduced riparian shading, as well as increased nutrient loading. Not surprisingly studies in Oregon and Idaho, US have demonstrated increased growth in young trout after fires. In several sites across the Rocky Mountain region, we see elevated water temperature 1-3^{o}C persisting over a decade after the fire. This is concerning as trout species in this region exhibit temperature-dependent competition with nonnative species typically "winning" at warmer temperatures. To explore these concerns, we examined changes in the trout populations after extensive wildfires in the Bitterroot Basin, MT in sites with and without severe wildfire over the last 12 years. In the Bitterroot Basin, large wildfires in 2000 burned 1184 km2 in a complex mosaic that varied in severity. Intense thunderstorms in late July 2001 triggered flash floods and debris flows in several burned drainages, resulting in substantial channel scouring, high sediment inputs, and localized fish kills. Postfire native cutthroat trout density was negatively correlated with the proportion of basin area that burned at moderate to high severity, but recovery of cutthroat trout was generally rapid in severely affected reaches. Over a decade later cutthroat are abundant throughout the basin and more densely populated at sites that previously burned. Additionally, there was low to no impact on native bull trout associated with fire. Even though it appears bull trout are slowly declining, it is unrelated to fire. Exotic brook trout exhibited the most severe declines in reaches influenced by debris flow. In all but one of these populations, brook trout have yet to recover over a decade later. Thus, native fish in these connected ecosystems are resilient to wildfire.

Bio: Dr. Lisa Eby is an Associate Professor of Aquatic Ecology at The University of Montana. She received her B.S. in Zoology and M.S. in Limnology and Oceanography from the University of Wisconsin in Madison and Ph.D. in Aquatic Ecology from Duke University. After a postdoctoral research position at Arizona State University, she was hired by the University of Montana. Her previous research has spanned a range of questions and ecosystems, but a consistent theme has included examining the influences of chronic stress and catastrophic disturbances in aquatic communities of estuaries, desert streams, and aquatic systems in the Rocky Mountain Region.

SS08.5. ECOLOGICAL CONSEQUENCES OF POST-FIRE MANAGEMENT ACTIVITIES FOLLOWING WILDLAND FIRE

***Presenter**: Saab, PhD, Victoria, U.S. Forest Service, Rocky Mountain Research Station, Research Biologist*
Additional Author(s):
Dudley, Jonathan, Ecologist, U.S. Forest Service, Rocky Mountain Research Station

Post-fire salvage logging has become increasingly prevalent as the amount of forested area burned by wildfire has increased over the past 2 decades in western North American forests. Increased tree mortality from fire has created more opportunities for salvage logging and other post-fire management activities, e.g., seeding and planting seedlings. Salvage logging removes dead, dying, or weakened trees that otherwise would provide breeding, foraging, and roosting habitat for many vertebrate species associated with recently burned forests. Other post-fire management activities, such as seeding with non-native plant species, alter the process of natural recovery after wildland fire. Severe fire (moderate-to-high burn severity) is a natural disturbance in many forest types and is ecologically necessary to provide benefits for many vertebrate species. Thus, land managers face significant challenges balancing fire management policies, while concurrently conserving wildlife habitat for species associated with recently burned forests. Here, we review the effects of post-fire management activities on terrestrial systems after wildland fire, with an emphasis on salvage logging and vertebrate species reliant on dead trees (i.e. woodpeckers).

Bio: Vicki has been a Research Biologist with the Rocky Mountain Research Station of the Forest Service since 1989. She currently works at the Bozeman Lab on the Montana State University campus, where she is also Affiliate Faculty. The focus of her work has been on evaluating the effects of large-scale disturbances, including fire, pine beetles, and land management activities on bird populations, and identifying appropriate measures for bird conservation. Since 1994 she has been leading long-term studies of fire effects on habitats and populations of wildlife in dry mixed-conifer forests of the Interior West.

SS08.6. IT'S TIME TO INTEGRATE THE ECOLOGICAL BENEFITS AND NECESSITY OF SEVERE FIRE IN NATIONAL FIRE AND FOREST MANAGEMENT PLANS

***Presenter**: Hutto, PhD, Richard, University of Montana, Professor*

It should be clear to anyone armed with the facts presented by the first five speakers in this special session that (1) severe fires are a natural part of, and play an important ecological role in, every mixed-conifer forest type (including the dry forest types) in western North America; (2) numerous plant and animal species have evolved not to tolerate such fires, but to depend on such fires for their presence and reproductive success; and (3) compounding natural disturbance with human disturbance from salvaging logging, seeding, or planting after such fires always carries negative ecological consequences. Given the benefits and ecological necessity of severe fire in our forests, it is problematic that Smokey, the press, politicians, and the public-at-large view such fires uniformly negatively. Public land management agencies have a responsibility (and are legally mandated) to manage for the maintenance of natural disturbance processes in disturbance-based systems. Knowledge that severe fire in most disturbance-based forest systems is not only ecologically beneficial, but necessary, should force us to reconsider when and where we ought to fight fire, whether we should be conducting fuel reduction harvests outside the WUI, whether we should be conducting prescribed fires outside the normal fire season in areas outside the WUI, and whether we should be salvaging logging when there is no shortage of green trees for harvest elsewhere in our forests.

Bio: Dr. Richard L. Hutto is Professor of Biology and Wildlife Biology at the University of Montana. Hutto has conducted research on migratory landbirds in Mexico in winter, the Southwest during spring and fall, and in the Northern Rockies in summer for more than 35 years. In 1990, he developed the USFS Northern Region Landbird Monitoring Program, and he has been studying the ecological effects of fire on bird communities for the last 25 years. Hutto tries to promote ecological awareness and informed decision making by listening to what western birds tell us about the ecological effects of human land-use practices.

SPECIAL SESSION NINE: Working with American Indian Tribes on Large Wildland Fires - Effective Consultation and Coordination

Moderator: Frank Lake

SS09.1. Introduction to Session SS09-A Resource Advisor's Experience Working with Incident Management Teams, Agencies and Tribes

***Presenter**: Lake, PhD, Frank, USDA-Forest Service, Research Ecologist*

This presentation will share a lesson's learned approach from a USDA Forest Service research ecologist who serves as a Resource Advisor working with tribes on larger wildfires and prescribed burns in Northwestern California. Emphasis of the presentation is placed on how to address and be inclusive of tribal values for places of cultural significance, natural and cultural resources. Examples will include the development of Delegation of Authority Letters between the local federal agency and tribe, and Agency-Tribe Fire management agreements, and cooperative working relationships between agency resource advisors and tribal heritage consultants and representatives. Topics include incorporating tribal values and natural and cultural resources of concern in the Wildland Fire Decision Support System (WFDSS) and assessing fire suppression effects on tribal heritage and cultural resources. The presentation concludes with recommendations for effective agency- tribal consultation and coordination for wildland fires.

Bio: Frank completed a Bachelor of Science degree from University of California-Davis (1995) in Integrated Ecology and Culture with a minor in Native American Studies. In 2007 Frank completed his PhD graduate degree from Oregon State University, Environmental Sciences Program. He is currently working for the USDA Forest Service-Pacific Southwest Research Station, Fire and Fuels Program, on tribal and community forestry and related natural resource issues. His research focuses on traditional ecological knowledge related to tribal fire management, fire ecology/effects, and Climate Change in the Klamath-Siskiyou bioregion.

SS09.2 Tribal Government Large Fire Consultation and Coordination Issues

Presenter: *Tony Harwood, Division Manager for Forest Inventory and Planning, Confederated Salish and Kootenai Tribes, Ronan, Montana*

A significant portion of lands in the western United States lies within or adjacent to Indian reservations. Even more lands are within native aboriginal territories considered by tribes to be areas of special concern. With increased size, intensity, and complexity; large wildland fires are more likely to burn in areas important to tribes and affecting tribally valued natural and cultural resources.
This presentation will describe actions and practices that neighboring fire agencies and fire incident management teams will need to know in preparing and conducting necessary consultation and large fire suppression response coordination with tribal organizations. It is crucial that Federal and State agencies and incident management teams develop good working relationships with tribes to appropriately manage large wildfires more effectively and efficiently.

The key to working effectively with tribes is the ability to build trust, find common ground, and to respect differences. Tribal customs, cultural and fire use practices, beliefs, and resource values are unique and specific to individual tribes. Tribal views about fire can be quite different from modern western views and should be fully understood and respected in consultation and coordination processes.

There are many challenges involved with the management of large fires on Indian lands. Appropriate information sharing involves a basic approach to cross-cultural communications that emphasizes knowing and understanding the history and culture of the tribe you are working with, tribal perceptions of the direct and indirect effects of wildfire, and the importance of cultural sensitivity when managing large fire situations. It is also important to practice effective inter-personal communication that is respectful of all participants and including various tribal groups and individuals. Mutual respect should be the framework of any working relationship associated with understanding tribal values and in regards to fire suppression actions and activities to protect tribal homelands and valued resources.

BIO: Tony Harwood started his fire management career in 1970 as an emergency fire fighter at the Blackfeet Indian Agency. In 1975, Tony received a B.A. in Journalism from the University of Montana. In 1979 he was hired as a Bureau of Indian Affairs Timber Sales Officer, at Flathead Agency, Montana and transferred into the Salish & Kootenai Tribes Division of Fire as the Wildland Fuels Specialist from 1990 to 2001 and the Fire Program Manager 2001-2007. Tony is currently the Division Manager for Forest Inventory and Planning for the Confederated Salish and Kootenai Tribes at Ronan, Montana.

SS09.3 Working with American Indian Tribes on Large Wildland Fires

Presenter: *John Philbin, Regional Forester for the Western Region of the Bureau of Indian Affairs*

When working with Tribes while managing a large fire, it is helpful to have an understanding of the historical and legal relationship of the federal and Tribal governments. A key component of that relationship is the federal trust responsibility. Tribes may have assumed day-to-day operation of the fire management program, under PL 93-638 or the program may still be staffed by federal employees. As an Incident Commander on large fire, it is imperative to recognize the Tribal connection with the land and resources. It is not just the forest burning, it is their home. Many of the challenges that are encountered revolve around authorities and expenditures. This presentation will provide some guidance on those issues.

Bio: John Philbin has served as the Regional Forester for the Western Region of the Bureau of Indian Affairs since 1986. Prior to that, he was the Regional Fire Management Officer and Timber Sale Forester. He started his career with the BIA at the Fort Apache Agency in Eastern Arizona, working in Timber Sales and then as the Training Officer in the Fire Management section. He has an extensive background in various aspects of wildland fire management. Since 2002 he has been the Incident Commander on more than 30 large wildfires in the West.

John received his Bachelor of Science degree in Environmental Resources Management from the SUNY College of Environmental Science and Forestry at Syracuse in 1974.

SS09.4. A Tribal Historic Preservation Officer's Experience Working with Federal Agencies and Incident Management Teams on Wildland Fires for Protection of Tribal Heritage and Cultural Resources

Presenter*: Ira Matt, Confederated Salish-Kootenai Tribe, Tribal Historic Preservation Officer*

Wildland fire planning strategies and management need to be inclusive of and consider effects on tribal heritage values and cultural resources. Many tribal traditions and values are directly linked to and are dependent on fire to perpetuate natural and cultural resource of tribal significance across the landscape. Changes in fire regimes and management of fires over the last century have affected tribal access to and the ability to fully utilize many resources. Federal agencies need to be aware of and consider these tribal values and American Indian dependence on natural and cultural resources. This presentation will provide examples of successful approaches for promoting tribal heritage values and protecting cultural resources in planning and implementing wildland fire management.

Bio: Ira Matt is an enrolled member of the Confederated Salish-Kootenai Tribes (CSKT) of the Flathead Reservation in Montana. He is currently the Tribal Historic Preservation Officer. In this role he implements the policy of the Tribal Preservation Department to protect cultural resources by identifying, evaluating, and protecting cultural, historic and archaeological resources and by regulating undertakings upon protected lands when they may result in changes in the character or use of such cultural resources. He was formally a Field Crew Supervisor at Confederated Salish and Kootenai Tribes, served as a Cultural Resource Technician at Confederated Salish and Kootenai Tribes (CSKT), and has worked as a Wildland Fire Engine Operator at CSKT - Division of Fire and a Type 1 Wildland Firefighter at CSKT - Division of Fire. Contact information: PO Box 278, Pablo, MT 59855, Tel: 406.675.2700 x 1083, Fax: 406.675.2629 , Email: iram@cskt.org, Website: www.cskt.org

SS09.5. 35 Years a Guest on Indian Reservations

***Presenter**: Steele, Jim, Consultant, Forester*

We have never known a time when Indian reservations did not exist. We did not see or experience the effects of US War Department management of Indians or their lands. Transition to the Department of Interior placed Indian reservations and their organizations into the pool of public agencies for funding and administrative rules while still being held accountable to their trustee, Congress of the United States. This has included Indian lands in funding streams and federal land management requirements of public agencies. Which has created issues and confusion for anyone working on tribal lands. My experience leads me to believe as long as tribes are considered a public agency the more difficult it is for them to assert their culture and the rest of us to understand it.

Bio: Jim is a graduate of the University of New Hampshire - Thompson School of Applied Sciences, and the University of Montana. He began his career with the US Forest Service on the White Mountain and Lolo National Forests. Jim transferred to the Bureau of Indian Affairs on the Flathead Indian Reservation in 1979. Since that time Jim has worked on the Warm Springs Indian Reservation in Oregon, and the Coeur d'Alene Reservation in North Idaho. Jim has worked as a federal employee for 28 years and tribal employee for 6 years, recently concluding a period as Fire Management Officer for the Confederated Salish and Kootenai Tribes. He is currently a Consulting Forester and Contract Trainer through his own business.

SPECIAL SESSION TEN: Analysis of large wildland fires using Forest Inventory & Analysis (FIA) data: A treasure trove for wildland fire analyses
Moderators: Bianca Eskelson & Vicente Monelon

SS10.1. Using Forest Inventory Data to Estimate Fire Effects: a Plot Matching Approach.

***Presenter**: Monleon, PhD, Vicente, US Forest Service PNW Reseach Station, Research Mathematical Statistician*
Additional Author(s):
Eskelson, Bianca, PhD, Research Associate, Oregon State University

The main objective of a large scale survey such as the US Forest Service national forest inventory (FIA) is to describe the current state and changes of the forest resource. However, the objective of analytical studies, such as those estimating the ecosystem effects of disturbances such as fire, is to establish cause an effect relationships. In this presentation, we briefly describe the FIA program, and then review approaches for causal inference from observational studies. We describe an application of data matching to obtain comparable subpopulations of burned and unburned plots, and thus reduce the selection bias inherent in observational studies. Finally, we discuss additional advantages of FIA data for studying fire effects, such as large spatial coverage and high degree of external validity, as well as difficulties, such as its complexity.

Bio: Vicente Monleon is a Research Statistician with the Research Monitoring and Analysis Program of the US Forest Service Pacific Northwest Research Stations. He has a Forestry degree from Spain, an MS in Forest Ecology and PhD in Statistics from Oregon State University. For the last 10 years, he has worked the Forest Inventory and Analysis Program of the US Forest Service.

SS10.2. Estimation of Coarse Woody Debris Combustion Factors using Forest Inventory and Analysis Data

Presenter*: Eskelson, PhD, Bianca, Oregon State University, Research Associate*
Additional Author(s):
Monleon, Vicente, Research Statistician, USDA Forest Service, PNW Research Station

The impact of forest wildfires on the amount of coarse woody debris (CWD) is often assumed to be small. We analyze the effects of forest fires on CWD using data collected by the Forest Inventory and Analysis (FIA) Program with a spatially balanced sampling design across all forestlands in California (CA) and Oregon and Washington (PNW). FIA plots that were burned within five years prior to plot measurement (2001-2011) were spatially matched with unburned plots resulting in 344 and 354 matched pairs of burned and unburned plots in the PNW and CA, respectively. Using multiplicative mixed effects models, we estimated combustion factors (CFs; fraction of CWD consumed by fire) of the number and biomass of CWD pieces. CFs were estimated for all pieces, pieces with diameter greater than 20 cm (large pieces), and pieces with diameter less than 20 cm (small pieces). In the PNW, CFs with their 95% confidence intervals for the total number of pieces, number of large pieces, and number of small pieces were 37.6% (29.3, 44.9), 34.1% (22.9, 43.7), and 38.5% (29.3, 46.6), respectively. The results suggest that large pieces burn less than small pieces; however, the difference is small. For CA, the CFs exceed those reported for the PNW: 72.3% (61.6, 80.0) for all pieces, 62.7% (41.2, 76.4) for large pieces, and 74.7% (64.1, 82.2) for small pieces. The results for CWD biomass were similar. Remotely-sensed burn severity classes have no impact on the number of CWD pieces consumed during large wildfires. This may be due to the fact that remotely-sensed burn severity classes reflect burn severity of crown fires; thus having little informative value about the burn severity on the ground that determines the CWD combustion. CFs reported in our study greatly exceed previously reported CWD combustion factors.

Bio: Bianca Eskelson grew up in central Europe and came to the Pacific Northwest in 2004 to complete a PhD in Forest Biometrics at Oregon State University (OSU). She is currently working as a Research Associate at OSU. Some of her work focuses on the analysis of Forest Inventory and Analysis data.

SS10.3. Woody Biomass Dynamics after Forest Fires: Augmenting Annual Inventory with Post-fire Plot Assessment

***Presenter**: Fried, PhD, Jeremy, USDA Forest Service, PNW Research Station, Research Forester*
Additional Author(s):
Eskelson, Bianca, Research Associate, Oregon State University
Monleon, Vicente, Research Statistician, USDA Forest Service, PNW Research Station

Forest Inventory and Analysis (FIA) plots in California within large fires were visited one year post-fire, and the annual inventory protocol was augmented with supplementary assessment of post-fire conditions. These additional FIA plot visits generated repeated measurements of forest biomass observations amenable to longitudinal analysis. We illustrate how this investment pays off in understanding how three forest biomass pools – live, standing dead, and down wood – evolve in the years after a fire occurs, across a spatially balanced sample of conditions, characteristic of California forest fires between 2002 and 2009. Using a mixed model, we estimate change in the woody biomass pools as a function of a post fire index (PFI), years since fire, and pre-fire woody biomass (live, standing dead, and down wood). PFI is a fire severity classification developed from post-fire crown observations that either shows presence of residual green crowns (“Alive”) or no evidence of residual green crowns (“Dead”). Our analysis relied on 86 FIA plots that were measured before and one year after fire, with one additional remeasurement within five years after fire. Our results suggest a loss of 2.52 Mg/ha/year of woody biomass (95% CI: -0.06, 5.10; p-value = 0.055), which corresponds to approximately 1% and 3% losses in woody biomass in stands classified as Alive and Dead by PFI, respectively. Stands classified as “Alive” lose 5.13 Mg/ha/year (95% CI: 2.27, 7.98; p-value=0.001) in live biomass and gain 1.86 Mg/ha/year (95% CI: 0.11, 3.59; p-value=0.038) in standing dead biomass. No significant change in live biomass was detected for stands classified as “Dead”, while a loss of 2.78 Mg/ha/year in standing dead biomass is suggested (95% CI: -0.23, 5.79; p-value=0.070). No significant change in down woody biomass was detected. This is an initial study to illustrate the longitudinal analysis approach. The sample size and number of remeasurements per plot will increase substantially within the next few years. In contrast to the conceptual models that dominate contemporary scientific and policy discourse on the impact of fire disturbance on forest biomass and carbon, these models provide actual estimates with confidence intervals. This application demonstrates one way that the annual inventory system, viewed as an ongoing and consistent information utility, can be leveraged with targeted investment in supplemental observations on the same sample frame.

Bio: Jeremy has been a Research Forester with the U.S. Forest Service at the PNW Research Station’s Forest Inventory and Analysis unit in Portland, Oregon, since 1999. He applies systems analysis and geographic information science to contemporary natural resource management issues using inventory data. Recent research includes economic analysis of landscape-scale fuel management, forest carbon accounting, initial attack optimization, impacts of climate change on wildland fire, and building inventory based models of fire effects. Jeremy previously served on the forestry faculties at Michigan State and Helsinki Universities and earned a Ph.D. in Forest Management and Economics at UC Berkeley and a Master’s in Forest Ecology and Soils at Oregon State University.

SS10.4. Evaluating the performance and mapping of three fuel classification systems using Forest Inventory and Analysis surface fuel measurements

***Presenter**: Keane, Robert, US Forest Service Rocky Mountain Research Station Missoula Fire Sciences Lab, Research Ecologist*
Additional Author(s):
Herynk, Jason M, Analyst, SEM LLC
Toney, Chris, US Forest Service, Forest Analysis and Inventory Program, Missoula Fire Sciences Laboratory
Urbanski, Shawn P., Scientist, US Forest Service, Rocky Mountain Research Station, Missoula Fire Sciences Laboratory
Lutes, Duncan C, Forester, US Forest Service, Fire Modeling Institute, Missoula Fire Sciences Laboratory
Ottmar, Roger D., Research Scientist, Pacific Wildland Fire Sciences Laboratory, US Forest Service Pacific Northwest Research Station

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 Analysis (FIA) surface fuel estimates (n=13,138) to create a new fuel classification called Fuel Type Groups (FTGs) from FIA forest type groups, and to evaluate the performance of the FLM, FCCS, and FCCS classifications by keying an FLM, FCCS, and FTG class to each FIA plot based on fuel loadings and stand conditions. We then compared FIA sampled loadings to the keyed class loading values for four surface fuel components (duff, litter, fine woody debris, coarse woody debris) and to mapped FLM, FCCS, and FTG class loading values from spatial fuel products. We found poor performances (R2<0.30) for most fuel component loadings in all three classifications that, in turn, contributed to poor mapping accuracies. The main reason for the poor performances is the high variability of the four fuel component loadings within classification categories and the inherent scale of this variability does not seem to match the FIA measurement scale or LANDFIRE mapping scale.

Bio: Robert E. Keane's most recent research includes 1) developing ecological computer simulation models for the exploring landscape, fire, and climate dynamics, 2) conducting field research on the sampling, describing, modeling, and mapping of fuel characteristics, and 3) investigating the ecology and restoration of whitebark pine. He received his B.S. degree in forest engineering from the University of Maine, Orono; his M.S. degree in forest ecology from the University of Montana, Missoula; and his Ph.D. degree in forest ecology from the University of Idaho, Moscow.

SS10.5. Forest Inventory and Analysis data is valuable for predicting post-fire outcomes from pre-fire forest structure

***Presenter**: Jain, PhD, Theresa, USDA Forest Service, Rocky Mountain Research Station, Research Forester*
Additional Author(s):
Fried, Jeremy, Research Forester, Pacific Northwest Research Station
Graham, Russell, Research Forester, Rocky Mountain Research Station
Wilson, Michael, Program Manager, Interior West FIA

We sought to predict post-fire outcomes from pre-fire forest structure assessed on Forest Inventory and Analysis (FIA) plots, while accounting for physical setting and weather. Towards that end, we revisited previously established FIA plots within the perimeters of 64 wildfires that burned between 2000 and 2003 in Arizona, California, Montana and Utah. The data collected on these plots were summarized using FFE-FVS to compute predictive site attributes (for example, canopy base height, top height, canopy cover, and tree size). We developed an integrated post-fire index that reflects fire's impacts on forest canopy –whether green trees dominate the site, or most trees are scorched or are transformed into black boles devoid of crowns. We used slope class and potential vegetation to account for physical setting. Localized weather data corresponding to a fire's encounter with a plot is rarely available; however, we did obtain weather parameters for each fire event, and grouped fires with similar weather using cluster analysis. Classification trees were useful for exploring the relationships between pre-fire forest characteristics and post-fire outcomes. Using FIA data for such analyses has the advantage of providing an unbiased, representative sample of all burned forestland; however, it is limited for characterizing the post-fire environment for a single fire, unless the fire is large enough to have burned through enough plots to provide a robust sample.

Bio: Theresa B. Jain, Research Forester from the Forest Service, Rocky Mountain Research Station is nationally recognized as a leader in silviculture and fire science, particularly in the field of integrated fuels management and alternative silviculture systems. Her research goal is to understand the influence of disturbance on forest dynamics over time and space. The result of this research is to provide science-based management strategies that address short-term success, such as altering fire behavior and effects, while simultaneously providing conditions that meet long-term benefits such creating and sustaining wildlife habitat, restoring forest resilience, and providing recreational and spiritual forest attributes.

SPECIAL SESSION ELEVEN: Decisions and operational resources for suppressing wildland fires
Moderator: Van Miller

SS11.1. Econometric Analysis of Wildfire Suppression Production Functions for Large Wildland Fires

***Presenter**: Holmes, Thomas, USDA Forest Service, Research Forester*
Additional Author(s):
Calkin, Dave, Research Forester, Rocky Mountain Research Station, USDA Forest Service

In this paper, we use operational data recorded for large wildland fires to estimate the parameters of economic production functions that relate the rate of fireline construction with the level of fire suppression inputs (hand crews, dozers, engines, and helicopters). The hypothesis that parameter estimates are no different than productivity estimates derived from direct observation and used as standard rates by the U.S. Forest Service was rejected for all purchased inputs. We suspect that production gaps between standard production rates and our econometric estimates are due to unobserved factors related to fire behavior, other resources at risk, firefighter fatigue, safety considerations, and managerial decision-making. Empirical evidence regarding decision-making on large fires is discussed.

Bio: Dr. Holmes is a Research Forester with the Southern Research Station, USDA Forest Service. He received his Ph.D. in Natural Resource Economics from the University of Connecticut in 1986. His research interests include decision-making under risk and uncertainty, non-market valuation of forest ecosystem services, and conservation strategies for tropical forests.

SS11.2. The Influence of Suppression Actions on the Development of Wildfire Perimeters

Presenter*: Katuwal, Hari, University of Montana,*

Wildfires that are not contained by initial suppression efforts within the first 12 hours burning period are considered escaped fires. Although these escaped fires constitute a small proportion, they account for the majority of the suppression expenditure of all wildfires. Since large fires are responsible for most of the suppression expenditures, understanding the characteristics of large fires is crucially important for strategic planning and onsite fire management decision. In this study we examine fireline productivity and its effectiveness for large wildland fire as fire progresses using geo-spatial perimeter data. Determinants of suppression effectiveness are also identified and examined. Identification of the factors that hinder the productivity and effectiveness will enable fire manager increase the productivity and efficiency of the fireline construction and holding. In addition, it is expected to help identify appropriate intervention and corrective measures to increase productivity and effectiveness, and reduce growing fire suppression spending.

Bio: Hari Katuwal is a Post-Doctoral Researcher in Wildfire Economics and Non-market Valuation at The University of Montana. His areas of specialization lie at the intersection of Econometrics and applied Microeconomics with a specific focus on Environmental Economics. Hari's research is focused on providing information to support public forestland management, particularly in wildfire economics and non-market valuation of natural resources. Hari's current research focuses on examining large wildfire suppression effectiveness and understanding public preferences and effectiveness of wildfire management program.

SS11.3. The Influence of Incident Management Teams on Suppression Resource Use

Presenter*: Hand, Michael*
Additional Author(s):
Katuwal, Hari, Post-doctoral researcher, University of Montana
Calkin, David, Research Forester, USDA Forest Service, Rocky Mountain Research Station
Thompson, Matthew P, Research Forester, USDA Forest Service, Rocky Mountain Research Station

Wildfire incidents present complex management problems, even for experienced and highly trained management organizations. Each incident can exhibit unique circumstances, requiring managers to quickly adapt strategies to existing conditions. This presentation explores how managers of highly complex incidents - those requiring Type I or Type II incident management teams (IMTs) - adjust orders for available line-producing capacity in response to changing conditions. A panel-data approach to modeling daily resource orders indicates wide variation in how managers respond to existing fire conditions across geographic areas and between different types of teams. This research may be useful for system-wide decision support activities to identify circumstances where low-cost and low-exposure resource orders are warranted based on fire characteristics, and to assist managers in planning resource needs over the course of an incident.

Bio: Michael Hand is a research economist with the USDA Forest Service, Rocky Mountain Research Station. His research focuses on the economics of wildland fire management and the role of publicly managed natural resources as a provider of ecosystem goods and services.

SS11.4. What We Know and Don't Know About the Effectiveness of Suppression Actions on Large Wildfires.

***Presenter**: Calkin, PhD, Dave, USDA Forest Service RMRS, Research Forester*

Wildfire management currently represents over 50 percent of the USFS total expenditures. In both 2012 and 2013 large fire suppression exceeded the Agency's budget allocations by over $400 million. Despite the scale of this investment relatively little is understood about how suppression actions influence wildfire growth and net value change to highly valued resources. In this presentation I will review a number of studies that attempt to understand how suppression actions influence fire progression, wildfire cost, firefighter exposure, and associated economic impacts. Many recent research efforts have identifiied the considerable uncertanty associated with the effectiveness of suppression resources in containing large wildland fires and suggest that modeling large fire containment using approaches that have been established to estimate initial attack success is not appropriate. After reviewing our current knowledge base I will discuss areas of promising future inquiry.

Bio: Dave Calkin is a research forester at the USFS Rocky Mountain Research Station in Missoula, Montana. Dave's research interestes include wildfire risk assessment and economics. He is the team leader of the National Fire Decision Support Center's wildfire economics group. Dave holds a BS from the University of Virginia, MS from University of Montana and a PhD from Oregon State University.

SS11.5. An Evaluation of the Wildland Fire Decision Support System from Dueling Perspectives: Naturalistic Decision Making versus Heuristics & Biases

***Presenter**: Miller, PhD, Van, Central Michigan University, Professor*

In paper presentations (Miller, 2013), the two primary and conflicting decision making models germane to wildland firefighting (see Kahneman and Klein, 2009, for a thorough discussion of their respective models) were compared and contrasted. Though Klein's naturalistic decision making framework has been more readily accepted within the incident management field, Kahneman's heuristics & biases perspective has attained greater status among academic researchers due to the heightened scientific rigor that underlies its claims. This proposed paper for a special session at the 2014 wildland fire conference will evaluate the current Wildland Fire Decision Support System from the dueling perspectives. The purpose of such a review will be to ascertain the influence that each decision making model has upon the decisions made by Incident Command teams. For illustrative purposes, decisions formed during the 2011 Las Conchas wildfire in New Mexico will be scrutinized.

Bio: Van V. Miller earned his PhD from the University of New Mexico and has conducted multiple studies examining decision making in business venues. Since 2011, his focus has been on the Las Conchas wildfire and decisions made in its suppression. In 2013, he received his Type 2 wildland firefighter certificate.

SPECIAL SESSION TWELVE: Wildfire risk assessment and decision support
Moderator: Morgan Pence

SS12.1. Toward understanding and managing the human condition in risk management

***Presenter**: Black, PhD, Anne, Human Factors & Risk Management RD&A,*

Managing wildland fire is a risky business, so as a professional community, we spend considerable time, energy and resources trying to improve our risk management. We think about the physical fire environment and the myriad ways this complex system can cook up surprise. We devote tremendous resources to improving understanding and predictions of fire behavior, impacts to society, and resource preparedness. We construct ever more sophisticated job-aid tools to provide guidance and consistency to decisions. We've also begun taking a closer look at how fire managers frame their thinking about fire management. How do we, how should we as public land managers think about fire? What cognitive process should we use in our decision-making, what information should we compile and how should we process this to arrive at a reasonable solution? Ironically, one of the last places we've looked is at ourselves – how we are biologically and socially constructed – and how this bounds and influences risk management. Over the past decade or so, we've come to realize that taking a closer, more dedicated look at what happens within a person – the way an individuals and teams select, process, and share information – is essential to successful risk management.
I hope to pique your curiosity, to leave you wondering how you think, what you pick up on, what you miss all the time, every day, let alone under conditions of stress and fatigue. What might you do -- as an individual and as part of a team – to recognize, communicate, avoid, manage, transfer and/or mitigate these conditions --- essentially to apply the risk management framework to yourself and your team. Rather than present a neat packaged thought, I will offer a couple of insights into this condition of ours – drawing from new research results in neuroscience and in our own community. Concepts that help us understand our hardwired 'box' as well as how we might expand this. While this is an emerging area of research and understanding, we are not alone. By partnering with academics and external experts, we can learn more about what 'high performance' is, means and requires in our line of work, and how to build capability and capacity. I hope this is somewhat unsettling, provocative, and inspiring.

Bio: Anne studies the social and cognitive processes of wildland fire management at individual, team and organizational levels. She serves the interagency community as a researcher, facilitator, subject matter expert, and technical specialist on high reliability/resilience practices, organizational learning, group dynamics and human performance. Her work has contributed to efforts to more fully understand safety and performance as multi-dimensional concepts, support more effective and robust organizational learning and high reliability practices, and integrate fire use and suppression.

SS12.2. Strategic Planning Information: Improving the Delivery

***Presenter**: Brooks, Becky, US Fish and Wildlife Service, Fire Management Specialist - Planning*
Additional Author(s):
Fischer, Tate, Fire Planning Specialist, Bureau of Land Management
Barrett, Laura, Fire Planner, US Forest Service
Armstrong, Reeve, Natural Resource Specialist - Fire Planning, Bureau of Indian Affairs
Manley, Jeff, Fire Program Planner (retired), National Park Service

Federal Fire Policy requires that all "burnable" acres be covered by a fire management plan (FMP). FMPs define wildfire and prescribed fire and management activities within the context of approved land use plans.

Traditionally, FMPs are larger, text-based documents which are often underutilized.
An ongoing desire of the National Fire Planning Committee (IFPC) is to: improve planning efficiency, deliver efficient, effective planning products, and promote Interagency planning. In 2011, a fire manager from New South Wales, Australia delivered a presentation to the IFPC that showcased a fire planning process that replaced costly, ineffective, text-based FMPs with an FMP that places greater reliance on geospatial representation.

The IFPC recognized the value of the process and decided to investigate the feasibility in the United States. In September, 2011, the US Fish and Wildlife Service initiated the first pilot "Spatial Fire Management Plan" (SFMP) in New Mexico. The Finding of No Significant Impact (FONSI) for the NM District Environmental Assessment was signed November, 2012 making it the first SFMP to be fully implemented. Since then, Interagency planners have participated in discussions about the process and geospatial product development and to determine next-steps. Word of the success spread quickly within the fire community and the concept resonated with fire managers across all agencies. Consequently, many additional pilot projects were initiated throughout the country. DOI Fire Directors realized the value of SFMPs and approved the process for future FMPs development.

Resulting goals of the process are to move applicable text-based information to a geospatial/graphic representation on Mapsheets that effectively reflect local priorities and needs. A written portion of the FMP will remain but the size will be greatly reduced. The information on the Mapsheets are displayed in an easily accessible, visual format for use by unit employees/management, incoming fire management teams, stakeholders, and publics. Wildfire Incident Management Teams also recognize the value of spatial products and encourage Strategic Operational Planners (SOPL) and Long-Term Assessment Teams to utilize the concept for illustrating the long-term aspects of a wildfire incident.
Strategic advantages to spatially based fire management planning are many: representing information geospatially allows audiences to orient quickly to the landscape and its values, product production is quick and relatively inexpensive, and updating may be as simple as printing a new map. Despite the process still being in the early stages; with the power of geospatial mapping and mobile technology, it would appear that the sky's the limit… literally.

Bio: Becky Brooks has a degree in Forest Management, Botany and Urban Forestry from the University of Wisconsin - Stevens Point. She participated in a Forestry coop-position with the USDA Forest Service (FS) to start her career and worked in: reforestation, fire, forestry and planning. During a workforce reduction, Becky took a contract position as the American Samoan (AS) Territorial Forester in the Land Grant College. She developed/taught a natural resource curriculum and solidified forest stewardship/community forestry programs. Other positions held include: IA dispatcher BLM-Prineville, Wildland Urban Interface field coordinator and National Fire Planner for the US-Fish and Wildlife Service.

SS12.3. In the Line of Fire: Risk Mitigation and Protection of Cultural Resources in Fire-Prone Environments

***Presenter**: Loehman, PhD, Rachel, USFS Rocky Mountain Research Station, Fire Lab, Research Ecologist*

New, comprehensive management tools and guidelines are needed to reduce vulnerability of culturally significant resources (highly valued resources and assets) to damages from wildfires and fire management activities. Interactions of climate change and past management activities (e.g., fire suppression and subsequent fuels buildup) are linked to more frequent and more severe fires across the western U.S., including tribal lands. Uncharacteristically severe wildfires cause damage to and loss of information from prehistoric cultural resources such as archaeological structures and artifacts, and can also damage or destroy traditional cultural properties such as shrines and other sacred sites, alter lands used for subsistence and ceremony, and affect important heritage resources on and off of reservation lands. The shift toward fire patterns that are outside of the historical norm means that tribal cultural resources and landscapes are or will be exposed to conditions that are more extreme, and potentially more damaging, than have occurred in the past. The National Historic Preservation Act (NHPA 1966, as amended) directs land managers to account for potential or actual wildfire damage as part of inventory, evaluation, and preservation of historic properties. However, to date no comprehensive guidelines or sufficient tools exist that provide the full range of information that managers need to proactively and effectively protect cultural resources under changing climate and fire environments. Mitigation of wildfire risk is commonly achieved through fuel treatments and prescribed fire, both of which may reduce fire severity and fire effects. However, because the most severe damage to cultural resources often comes from physical disturbance related to firefighting (e.g., creating fire lines, vehicle travel across sites, and use of fire retardant chemicals), best practices for fuels management may not be optimal for mitigating risk to culturally significant landscapes. The USFS and other agencies routinely implement hazardous fuels treatments (e.g., thinning and prescribed fire) to reduce potential wildfire damages, yet fire managers lack critical information to guide these treatments in the context of cultural resource protection. This presentation summarizes current knowledge and information needs in three critical areas of land management: (1) planning and implementation of fuel treatments and fire risk mitigation; (2) operational wildfire activities; (3) post-fire rehabilitation.

Bio: Rachel Loehman is a Research Ecologist with the US Forest Service Rocky Mountain Research Station, Fire Sciences Lab in Missoula, MT. Her research focuses on understanding complex, multi-scale ecological dynamics in natural and coupled human-natural systems, including climate change impacts, long-term forest dynamics, short- and long-term landscape responses to disturbance processes (e.g., wildfire, insects), and management and restoration effectiveness. Dr. Loehman worked as an Archaeologist in the southwestern US, and is currently involved in collaborative projects aimed at developing methods to quantify, predict, and manage fire effects on cultural resources.

SS12.4. Strategic Decision Making for Wildfires Using a Risk Management Process

***Presenter**: Elenz, Lisa, Forest Service, Deputy Program Manager, Wildland Fire Management RD&A*
Additional Author(s):
Taber, Mary, Fire Ecologist/Long Term Analyst

Federal wildland fire policy going back to 1995 states as a Guiding Principle “Sound risk management is a foundation for all fire management activities. Risks and uncertainties relating to fire management activities must be understood, analyzed, communicated, and managed as they relate to the cost of either doing or not doing an activity. Net gains to the public benefit will be an important component of decisions." This presentation describes the use of a 6-step Risk Management Cycle and the principles of Risk-Informed Decision Making to select strategies for managing a wildfire incident consistent with this policy directive. The use of these processes will help ensure that sound risk management is the basis for wildifre decisions even as conditions, objectives and jurisdictions change as the fire moves across the landscape.

The Risk Management Cycle is similar and related to the risk management processes used at other levels of wildfire decision making, from instantaneous decisions made at the ground level and described in the Interagency Response Pocket Guide, to the national policy level as applied by the National Cohesive Wildland Fire Management Strategy. At the incident level—where decisions are made on strategies to manage an individual wildfire—the Risk Management Cycle consists of six elements, joined in a continuous process of gathering intelligence, analyzing information, developing strategies to reduce risk, deciding among strategies, implementing the decision, and evaluating the outcomes. In combination with the principles of risk-informed decision making, use of the Risk Management Cycle ensures that strategic decisions are sound, defensible, and based on reliable information and analyses.
The presentation concludes with a discussion of those areas where the Risk Management Cycle and Risk-Informed Decision Making may be useful in helping land managers expand the range of strategy alternatives. Expanding decision criteria can assist managers in considering options in responding to and managing fires which more closely meet the spirit of the "sound risk management" directive. Areas for greater alignment include analyzing potential benefits, addressing uncertainties, reducing firefighter exposure, and developing viable alternatives to costly and ineffective strategies.

Bio: LISA ELENZ - Fire Management Specialist, Wildland Fire Management Research Development & Application program, Rocky Mountain Research Station, US Forest Service, Boise, Idaho.
Lisa is the Deputy Program Manager for the Wildland Fire Management RDA (WFM RDA). The WFM RDA works to provide the latest research to the field through the development of tools, training, and by providing decision and analysis support. Until fall 2009 she was the FMO at Grand Teton National Park for 7 years and prior she had worked as the AFMO. She completed a NPS Intake Program there as well. She worked seasonally on crews and engines at Grand Canyon and Yosemite National Park until she was hired in 1994 as a Station Captain in Yosemite NP working in suppression, prescribed fire, fuels management, structural fire and emergency operations. She graduated from college in 1988 with a General Chemistry Degree and Minors in Mathematics and Nutrition from Northern Arizona University. Lisa has worked with within Teton Interagency Fire and on Incident Management Teams managing long duration fires developing long term plans (Fire Use Manager and Operations) and providing fire behavior analysis as an LTAN and FBAN.

SS12.5. Identification of Beneficial Fire Opportunities: An Evaluation of FMU Strategic Objectives in WFDSS

Presenter: *Stonesifer, Crystal, U.S. Forest Service, Biological Scientist*
Additional Author(s):
Thompson, Matthew, Research Forester, Rocky Mtn. Research Station, US Forest Service
Seli, Robert, Fire Technology Transfer Specialist, WFM RD&A, US Forest Service
Hovorka, Marlena, Fire Technology Transfer Specialist, WFM RD&A, US Forest Service

One of the key components to come out of the National Cohesive Wildland Fire Management Strategy is the need for land managers in the United States to respond appropriately to wildfire. This multi-agency effort recognizes the natural and beneficial role of wildland fire in many forest types. The strategy also emphasizes that when the protection of homes, property, and resources from wildfire is warranted, the proper management response is appropriately scaled to the values at risk. The Wildland Fire Decision Support System (WFDSS) was designed to facilitate these types of informed risk-based assessments by fire managers regarding suppression decisions. Spatial data delineating individual fire management units (FMUs) across the country have become increasingly available in the WFDSS database. Given the location of a wildfire, a fire manager should be able to efficiently access the corresponding FMU(s) and the associated strategic objectives provided by the fire management planning documentation through WFDSS, expediting an informed management response regarding the potential opportunities for utilizing natural fire starts to achieve land management objectives. We categorized all strategic objectives available in WFDSS to better understand how fire management objectives and corresponding planned incident responses vary across landscapes and ownerships. We then illustrate where spatial data or associated objectives are missing, where strategic objectives state that natural fire starts are permitted under certain circumstances, and where management objectives dictate the complete suppression of all wildland fire. These efforts identified an almost even split in total land area between where the strategic objectives indicate that fire for resource benefit may be considered, and where all fire is automatically suppressed, not necessarily with respect to values at risk. Here we provide the results of our analysis and discuss potential implications with respect to national wildland fire suppression.

Bio: Ms. Stonesifer is a researcher with the US Forest Service Rocky Mountain Research Station in the Human Dimensions program in Missoula, Montana. Her research is generally linked to questions associated with wildfire economics and risk. Most recently, she has focused on characterizing aviation use in wildfire suppression, particularly with respect to large airtankers.

SS12.6. Applying the Wildland Fire Decision Support System (WFDSS) to Support Risk-Informed Wildland Fire Decision Making": The Gold Pan Fire, Bitterroot National Forest, Montana

Presenter*: Noonan-Wright, Erin, USFS, WFM RDA,*
Additional Author(s):
Noonan-Wright, Erin, Fire Application Specialist, WFM RDA
Opperman, Tonja, Lead Fire Application Specialist, WFM RDA

Risk informed decision making has always been a component of managing wildland fires. Emphasis on documenting a deliberate, risk informed decision is more prevalent with recent national policy and guidance. The Wildland Fire Decision Support System (WFDSS) was developed to provide scale-able decision support for wildland fires at all levels of incident management. The number of users for both decision documentation and fire behavior analyses increases each fire season; however, the simplistic utilization of WFDSS is often ignored as a tool for managers of emerging fires. WFDSS can be used to gain immediate and relevant situational awareness and assessment as part of a risk-informed decision making process. Additionally, as an emerging fire increases in complexity, the ability of WFDSS to provide risk control is often underutilized. Using a case study from the Gold Pan Fire, Bitterroot National Forest, basic principles of risk management are highlighted using information and tools within WFDSS.

Examples of the scalability of WFDSS, ability to gain quick situational awareness, and evaluation of fire behavior potential and burn probability with respect to Highly Valued Resources and Assets (HVRA), is presented for the Gold Pan Fire as an emerging incident that evolves into a complex wildfire supported with sophisticated analyses to support decision making.

Bio: Erin has worked for the Wildland Fire Management Research, Development, & Application group since 2009 supporting fire managers and incident management personnel with fire behavior analyses and decision support. Before 2009, she worked as an SEM contractor for the Fire Sciences Lab in Missoula, MT.

Tonja has worked for the Wildland Fire Management Research, Development, & Application group since 2009 supporting fire managers and incident management personnel with fire behavior analyses and decision support. Before 2009, Tonja worked as a fire ecologist for the Bitterroot National Forest and Yellowstone National Park.

SS12.7. Applications of spatial weather data to support wildland fire management decisions

> ***Presenter**: Jolly, PhD, W. Matt, USFS, RMRS, Fire, Fuel and Smoke Science Program, Research Ecologist*

Weather is the most spatially and temporally variable component of wildland fire potential. Operational fire danger behavior and fire behavior decision support systems, such as the Wildland Fire Assessment System and the Wildland Fire Decision Support System (WFDSS) currently use point-source weather data to assess landscape scale fire weather changes. Additionally, many systems inputs are still performed manually each day at over 2000 weather stations throughout the United States. Historical analyses such as the North American Regional Reanalysis, operational data from the Real-Time Mesoscale Analysis (RTMA), emerging downcaled meteorological products provide by TOPOFIRE and forecasts from the National Digital Forecast Database (NDFD) can provide the suite of weather conditions that are necessary to meet operational fire management at local, regional and national scales. Here we explore these emerging resources and we present examples of how these data are currently used to support fire management decisions. We will then identify opportunities to further utilize spatial fire weather data for decision support and we will propose an integrated, national system architecture that can meet the real-time and historical weather needs of both fire danger and fire behavior assessments at any spatial scale.

Bio: Dr. W. Matt Jolly is a Research Ecologist in the Fire, Fuel and Smoke Science Program of the US Forest Service, Fire Sciences Laboratory in Missoula, MT. He received a BA with high distinction in Environmental Science from the University of Virginia and a PhD in Forestry from the University of Montana. His main research interest is to improve our understanding of the roles that live fuels play in wildland fires and to use this improved understanding to develop predictive tools that can help support strategic and tactical fire management decisions.

SS12.8. Decision Making under Uncertainty: Implications for the Wildland Fire Decision Support System (WFDSS)

***Presenter**: Thompson, PhD, Matthew, Rocky Mountain Research Station, US Forest Service, Research Forester*

The management of wildfire is a dynamic, complex, and fundamentally uncertain enterprise. Fire managers face uncertainties regarding fire weather and subsequent fire behavior, the effects of fire on socioeconomic and ecological resources, and the efficacy of alternative suppression actions on fire outcomes. In these types of difficult decision environments even well-trained and experienced individuals can become susceptible to cognitive limitations and decision biases, as indicated by several recent analyses of fire manager decision making. This presentation will focus on fire management decision making under uncertainty, in relation to current decision support provided by the Wildland Fire Decision Support System (WFDSS). How fire managers acquire, analyze, and apply wildland fire information within the WFDSS environment will be addressed, as will opportunities for improving WFDSS to better provide decision content and to better support decision processes.

Bio: BS Systems Engineering, University of Virginia. MS Industrial Engineering and Operations Research, University of California, Berkeley. MS Forest Management, Oregon State University. PhD Forest Engineering, Oregon State University. Research Forester with the Rocky Mountain Research Station since 2009. Focus on wildfire economics, risk assessment, and decision support.

SS12.9. Estimating Expected Suppression Costs (SCI) and Integration of Suppression Resource Use by Teams

***Presenter**: Hand, Michael, USDA Forest Service, Rocky Mountain Research Station,*
Additional Author(s):
Katuwal, Hari, Post-doctoral researcher, University of Montana
Calkin, David, Research Forester, USDA Forest Service, Rocky Mountain Research Station
Thompson, Matthew P, Research Forester, USDA Forest Service, Rocky Mountain Research Station

The escalating costs of wildfire management have been a persistent policy and land management problem for Federal agencies in the United States. Calls to better understand wildfire management costs have yielded insights into trends in suppression costs and the factors related to incident suppression costs. Although much progress has been made toward understanding expenditures on wildland fire management activities, sophisticated expenditure models are increasingly needed to inform land management planning and decision support tools. This study reviews advances in suppression cost modeling and presents a new analysis of suppression costs based on spatially descriptive data and team-level data on the use of suppression resources during an incident. The resulting models are capable of providing modest improvements in predicting expected suppression costs, and yield insights about the roles of spatial heterogeneity and management decisions about resource use in determining suppression costs. The models are potentially useful for predicting the effect of hazardous fuel treatment options on expected suppression costs, and providing information on expected costs in the Wildland Fire Decision Support System (WFDSS).

Bio: Michael Hand is a research economist with the USDA Forest Service, Rocky Mountain Research Station. His research focuses on the economics of wildland fire management and the role of publicly managed natural resources as a provider of ecosystem goods and services.

SS12.10. Improved Simulation of Probabilistic Wildfire Risk Components for the Conterminous United States

***Presenter**: Finney, PhD, Mark, USDA Forest Service, Missoula Fire Sciences Laboratory, Research Forester*
Additional Author(s):
Short, Karen, PhD, Research Ecologist, USDA Forest Service, Missoula Fire Sciences Laboratory

A national-scale assessment of wildfire risk offers a consistent means of understanding and comparing threats to valued resources and predicting and prioritizing investments in management activities that mitigate those risks. An actuarial approach to risk is well suited to strategic planning in fire and land management because it integrates fire probabilities with the consequences. We used a simulation system designed to estimate the probabilistic components of wildfire risk for Fire Planning Units (FPUs) across the conterminous US (CONUS). The system, referred to here as FSim, consists of modules for weather generation, and for modeling of fire occurrence, fire growth, and fire suppression. FSim is designed to simulate the occurrence and growth of fires under tens of thousands of hypothetical contemporary fire seasons in order to estimate burn probabilities and fire size distributions at multiple spatial scales, given current landscape conditions and fire management policies. These outputs have been generated for the CONUS in each of four consecutive years to support the Fire Program Analysis (FPA) application and other planning and risk assessment efforts. Over this period, changes have been made to the system itself, to the input data used, and to the reference data used to generate certain inputs and to calibrate the system and validate outputs. The fire suppression module of the system now includes a “perimeter trimming” component, which improves modeled fire size distributions. Default system inputs that were originally uniform across FPUs, which amount to >130 independent simulation units for the CONUS, are now based on analyses of FPU-specific wildfire activity data from recent decades, allowing for better alignment of modeled estimates of average annual burn probability (BP) with historical estimates. An ignition density grid, based on spatial fire occurrence data from the past two decades, is now used to improve fidelity between modeled and historical BP within FPUs and to minimize seamlines at FPU boundaries. The spatial fire occurrence data (FPA FOD) used to generate certain inputs and to calibrate the system and validate outputs has likewise been improved, based on evaluation of the FPA FOD against published estimates of wildfire numbers and area burned by state and year. Based on comparisons of system outputs and the recent historical wildfire activity data, these changes have improved the quality of the resulting BP dataset and our ability to characterize outcomes of spatially explicit ignitions under conditions conducive to large fire development across the CONUS.

Bio: Mark Finney is a Research Forester with the Fire, Fuel, and Smoke Science Program at the USFS Missoula Fire Sciences Laboratory. He received his Ph.D. from University of California Berkeley. Mark's research has included studies of fire spread in deep and discontinuous fuel beds and fire simulation for purposes of fire risk assessment, which has been done in direct support of the development of two major fire management systems: WFDSS (Wildland Fire Decision Support System) and FPA (Fire Program Analysis).

SS12.11. Integrated Risk Assessment to Facilitate Improved Decision Making

***Presenter**: Calkin, PhD, Dave, USFS RMRS, Research Forester*

Within the US Forest Service, wildfire management has exceeded 50 percent of total expenditures for the last two years and challenges the Agency's ability to meet its primary mission. Large fire suppression costs represent the largest component of wildfire management expenditures. For example between the years of 2007 and 2011 the Los Padres National Forest averaged over $60 million per year in large fire suppression costs alone with an additional $18 million in pre-suppression costs. Given these expenditures it appears the Agency has substantially underinvested in planning for large fire response. In this presentation I will identify current management challenges that have restricted cost effective decision making in wildfire management. I will then review several different risk based wildfire decision support systems and describe how an integrated risk assessment framework can improve strategic decision making and associated outcomes from wildfire management and conclude with recommendations for future research and management investments.

Bio: Dave Calkin is a research forester at the USFS Rocky Mountain Research Station's Human Dimensions Program in Missoula, MT. Dave is the team lead for the Wildfire Economics Group of the National Fire Decision Support Center. His work focuses on the interesection of wildfire risk assessment, economics, decision science, and policy. He holds a BS from the University of Virginia, MS from the University of Montana, and a PhD from Oregon State University.

SS12.12. Predicting Wildfire Ignitions, Escapes, and Large Fire Activity Using Fire Potential Forecasts in the Western USA

***Presenter**: Riley, PhD, Karin, University of Montana, Research Geoscientist*
Additional Author(s):
Stonesifer, Crystal, Biological Scientist, Rocky Mountain Research Station, US Forest Service
Calkin, Dave, Research Forester, Rocky Mountain Research Station, US Forest Service

The Predictive Services program was created under the National Wildfire Coordinating Group in 2001 to address the need for long- and short-term decision support information for fire managers and operations personnel. The primary mission of Predictive Services is to integrate fire weather, fire danger, and resource availability to enable strategic fire suppression resource allocation and prioritization. Each Geographic Area (GACC) is comprised of individual forecast units called Predictive Service Areas (PSAs), which are delineated within each GACC to represent geographic areas of similar climate based on statistical correlation of observed weather and fuel moisture data. In 2006, Predictive Services began daily production of the 7-Day Significant Fire Potential Forecasts for each PSA during the core fire season to support efforts at informed regional and national fire suppression resource allocation and prepositioning. The Fire Potential Forecasts are made on a categorical scale of 1 to 9 for each of the following 7 days, and combine forecasted fuel dryness level, ignition triggers (from lightning and recreation), critical burn environment conditions (windy, unstable, hot and dry), and resource availability. We utilized historical fire occurrence data and archived forecasts to assess how well the 7-Day forecast product predicts fire activity, fire escape, and large fire potential, ultimately to characterize the effectiveness of this tool for prepositioning national firefighting resources. The historical fire occurrence data track ignitions on all land ownerships; from this dataset, we established number and location of ignitions and final fire size for 2009-2011 for PSAs within the Northwest and Southwest Geographic Areas. These data were then matched to the corresponding PSA and appropriate forecast for each of the 7 days prior to the ignition date. Final fire size was used as our metric to establish whether an ignition escaped initial attack. Active Fire Detects from the MODIS satellite were obtained from the US Forest Service to provide a relative measure of daily large fire activity. Active Fire Detects were subset to within 2 km of wildfire perimeters from the Monitoring Trends in Burn Severity database, which excluded most, if not all, detects from agricultural and prescribed burns. Our results show that 7-Day Forecast values yield better-than-random prediction of fire ignition, fire escape, and large fire activity, although there is wide variation in this relationship among individual PSAs.

Bio: Karin Riley is a postdoctoral fellow in the Numerical Terradynamic Simulation Group at the University of Montana in Missoula, Montana, and is stationed at the USFS Missoula Fire Sciences Laboratory. Collaborating across these institutions, her current research includes effect of climate change and land management policies on wildfire probability and behavior, imputation of forest plot data to create a tree-level model of US forests, and relationship of fire occurrence with fire danger metrics.

SPECIAL SESSION THIRTEEN: The Las Conchas Fire: a case study of ecological and social impacts
Moderator: Edward Martinez

SS13.1. The Las Conchas Fire, New Mexico in Historical Context

Presenter*: Brown, PhD, Sara, New Mexico Highlands University, Assistant Professor of Forestry*
Additional Author(s):
Martinez, Edward, Associate Professor of Forestry, New Mexico Highlands University

Wildland fires have been increasing in spatial extent and severity in recent decades across the western US. Our research team has spent the past two and a half years researching the broad range of fire effects from one large, predominantly severe wildfire in the southwest region, the Las Conchas fire (2011) located in the Jemez mountains of New Mexico. As way of introduction, we will present a brief background surrounding our special session team and the subset of projects that will be presented. As context for our findings at the Las Conchas fire, I will describe a contemporary understanding of fire ecology and historic range of variability as it pertains to the ecosystem that was burned by the Las Conchas fire. A short summary of relevant ecology and dendrochronolgy studies pertaining to the Las Conchas Fire will act as a framework for this introductory presentation.

Bio: Sara Brown is in her third year as an Assistant Professor at New Mexico Highlands University in Las Vegas, NM. She teaches in the Forestry program, focusing primarily on wildland fire concentration courses, including fire ecology. She has been conducting fire effects research at the Las Conchas fire since October 2011, and is now working on a large study examining how vegetation and soils are impacted by prescribed fires that burn in masticated fuels. This is a large project funded by the USDA Forest Service and in collaboration with the New Mexico Forest and Watershed Restoration Institute.

SS13.2. Anatomy of the Las Conchas Fire, Jemez Mountains, New Mexico

Presenter*: Biggs,PhD, James, Northern New Mexico College, Assistant Professor*

New Mexico has experienced a prolonged drought with increasing temperatures and decreasing snowpack since the late 1990s. This has coincided with significant increases in wildfire activity resulting in the state’s largest and most destructive fires occurring since 2000. The winter and spring prior to the

Las Conchas Fire in 2011 were among the driest on record. Less than 1 mm of total precipitation was recorded in the burn area at least 30 days prior to fire ignition. Fuel conditions were very dry with 1 hour fuels at <1% fuel moisture and 1000 hour fuels at <6% fuel moisture. The Las Conchas Fire began at 1300 hours on June 27, 2011 from a tree that fell onto a powerline. It burned on U.S.F.S., National Preserve, private, and National Park Service property. Fire intensity and spread were driven by the combination of high topographic and vegetation diversity, fuel conditions, and wind. Deep extensive canyons dissect the burned area and are surrounded by steep mountain slopes and open expansive grasslands that allowed the fire to spread in multiple directions at varying speeds and intensities. The vegetation within the burned area was characterized by montane forest, grasslands, and shrublands in higher elevations and shrubland, grassland, and woodland at lower elevations. Within the first two days of the fire, spread occurred in multiple directions extending south, east, and north; typical directional spread is to the northeast driven by usually southwest winds. During the first five days of the fire, maximum temperatures averaged 28 C and minimum temperatures averaged 7 C; percent humidity averaged 15- 67%. Average wind speeds were 2.7 m/s and max winds averaged 12.5 m/s. At the time of ignition, atmospheric conditions were unstable resulting in strong winds at both the surface and aloft (40 mph gusts at 20 ft); the temperature was approximately 90°F with very low humidity. During the first 14 hours, fire behavior was erratic and moving fast burning approximately 43,000 acres at a rate-of-spread of about 1 acre/second. Flame lengths were >300 ft., including during evening hours. Over two weeks, it grew to 156,000 acres and was New Mexico's largest fire until 2012. The fire was largely wind-driven over the first two days becoming more plume-dominated thereafter. Two critical burn events took place that were characterized by extreme plume formation and collapse and extreme behavior in an upper watershed, both of which has led to severe flood events.

Bio: Dr. James Biggs has degrees in wildlife and range Science and has studied fire ecology for the past 15 years. His research has focused on ungulate-plant community response following wildfire and is currently focusing on plant community change following high severity fires as it relates to ongoing drought and climate change in the Southwest U.S. He has a background in fire ecology and management, forest restoration ecology, wildlife-habitat interactions, and ecosystem approaches to managing natural resources. He is an Assistant Professor at Northern New Mexico College and oversees the college's fire ecology and simulation laboratory and Wildland Fire Science Academy.

SS13.3. Consequences of the Las Conchas Fire on Santa Clara Pueblo

***Presenter**: Tafoya, Matt, Santa Clara Pueblo, Forestry Director of Santa Clara Pueblo*
Additional Author(s):
Chavarria, Michael, Governor, Santa Clara Pueblo

The Santa Clara Pueblo, 1.5 miles south of Española, New Mexico, has been drastically impacted by the Las Conchas Fire of 2011. Roughly 17,000 acres of Santa Clara Pueblo's Spiritual Sanctuary has been impacted, and many of the traditional cultural properties located within those 17,000 acres have been severely damaged or destroyed. The watershed and headwaters of the Santa Clara Creek have been altered, and the quality of water has been degraded. Flooding caused by the lack of vegetation and hydrophobic soils has impacted the Pueblo, including damage to many culturally significant plants and herbs, as well as wildlife species used for traditional purposes. The Las Conchas Fire has caused not only economical damage but emotional, psychological and mental distress to all of the Santa Clara Pueblo Community members. This has also drastically altered the Pueblo's traditional way of life. This

presentation will present real-time flood footage, share the extent to which the Pueblo has been affected, and present ways in which our people are dealing with changes this fire has made to our infrastructure and our daily lives.

Bio: Matt Tafoya is the Director of the Forestry Department for Santa Clara Pueblo, New Mexico.

SS13.4. Understanding Fire Severity Through Utilization of Novel Analysis Tools to Better Understand Catastrophic Wildfires

***Presenter**: Gallegos, PhD, Gil, New Mexico Highlands University, Assistant Professor CS/Engineering*

The analysis of wildland fires is very complex. The data analysis approach chosen is very important in order to maximize the extraction of relevant characteristics of the fire data. The approach that will be discussed utilizes a novel analysis scheme. This scheme relies on many interactions of fire fuel data in order to optimally extract relevant features from the data. This analysis will show quantitative correlation and extrapolation curves for specific data collected at the Las Conchas fire site.

Bio: Currently I am a tenured assistant professor in the Computer/Mathematical Sciences Department. I have been teaching for 9 years. I teach computer science and engineering courses. My professional interests include the following: Nonlinear Control Theory, Robotics, Inertial Navigation Systems, Embedded Systems, Real Time Control Systems, MEMS, Chaos Theory, Emergent Behavior, Autonomous Vehicles, Scientific Visualization, Interactive Art, and Webpage Design and Data Analysis.

SS13.5. Soil Characteristics Across Severity in the Las Conchas Fire

***Presenter**: Duran, Elyssa, New Mexico Highlands University, Candidate for Master's of Natural Sciences degree/Graduate Researcher*
Additional Author(s):
Lavadie, Anita, Graduate Researcher, New Mexico Highlands University
Brown, Sara, Assistant Professor of Forestry, New Mexico Highlands University
Zebrowski, Joseph, Visiting Professor of Forestry, New Mexico Highlands University
Martinez, Edward, Assistant Professor of Forestry, New Mexico Highlands University

Climate change is currently one of the major drivers of increasingly severe wildland fire behavior throughout the Southwest. The Las Conchas fire, Jemez Mountains, New Mexico, burned during the summer of 2011, which provided an excellent opportunity to study many of the fire effects on soil. Soil characteristics, texture and nutrient flux post fire is not well understood. The purpose of this study was to understand soil effects in differing fire severities, as these impacts can have major implications on water quality and vegetation recovery. We collected and analyzed soils for texture, potassium (K), aluminum (Al), manganese (Mn), ammonium (NH_4^+), iron (Fe), copper (Cu), nitrate-nitrogen (NO_3-N) and orthophosphate (PO_4) levels from a control (unburned) and three fire severity classes (low, moderate, and high). Soil texture was analyzed using the bouyoucos method, nutrient levels excluding [(NO_3-N) and (PO_4)] were analyzed using LaMotte Soil Nutrient Kits. NO_3-N and PO_4 levels were measured using an Analytical FS 3100 Automated Chemistry Analyzer. Our preliminary results suggest there is no strong relationship between severities and nutrient concentrations.

Bio: Elyssa Duran is a undergraduate of New Mexico Highlands University whom obtained a degree in Forestry with concentrations in Forest Management and Wildland Fire. Elyssa was involved as an undergraduate in research on fire effects by severity of the Las Conchas fire (2011). Elyssa is now pursuing a Master's of Natural Sciences with emphasis in Environmental Management at New Mexico Highlands University. Her thesis research is focused on the effects of prescribed burn in masticated fuel beds in three ecologically different ecosystems. Duran is also a former wildland firefighter.

SS13.6. Hydrologic Impacts of Burn Severity on Nutrient Concentrations in Surface Water, Jemez Mountains, NM

***Presenter**: Lavadie, Anita, New Mexico Highlands University, Graduate Student*
Additional Author(s):
Martinez, Edward. Associate Professor, NMHU
Brown, Sara. Associate Professor, NMHU
Zebrowski, Jospeh. Geospatial Applications In Natural Science, NMHU

Climate change is currently intensifying wildfire behavior and thus fire severity in the Southwest. Following large fires, or “mega-fires,” surface water runoff contributes high concentrations of nutrients to water bodies, which has the potential to impair surface water quality in the receiving aquatic systems. Although there is a considerable amount of research on the effects of nutrients in surface water runoff following fire, mega-fire conditions on nutrient levels transported from various fire severity classes is not well researched. The purpose of this study is to investigate the contributions of Total Suspended Solids (TSS), nitrate-nitrogen (NO3-N) and orthophosphate (PO4) concentrations in surface water runoff originating from qualified high, moderate, low, mixed, and control (unburned site) fire severity types from the Las Conchas fire in the Jemez Mountains, New Mexico. Using ISCO automated water samplers and buried single stage water samplers we collected surface water runoff for ten precipitation events during the 2012 monsoon season. TSS, NO3-N, and PO4 concentrations were determined using established analytical methods. Preliminary results reveal TSS and NO3-N concentrations are greatest in moderate and high severity fire regions and PO4 concentrations are lower in the high severity sites. In addition, NO3-N, and PO4 concentrations in the high severity regions are significantly different from the unburned area. TSS means are the greatest in the high and mixed severity areas. Our findings suggest that large wildfires or “mega-fires” experience amplified nutrient modifications and pose negative water quality effects on receiving aquatic systems. These results are significant because potential nutrient loading in runoff from the Las Conchas fire may be representative other high severity wildfires. Furthermore, understanding the contribution of TSS, nitrogen and phosphorus concentrations to aquatic and terrestrial ecosystems will provide scientists, land managers, and policy makers with the empirical information to make well-informed land management decisions in regard to large wildfires.

Bio: Anita Lavadie is a graduate student at New Mexico Highlands University where her research was centered on examining the impacts of climate change on Northern New Mexico water resources in a high elevation montane setting. Inclusive of this research, Ms. Lavadie managed a landscape scale research effort examining post fire effects on vegetation, surface water, soils, hydrophobicity, and erosion and deposition incidence from the Las Conchas fire at the Valles Caldera National preserve. In addition, Ms. Lavadie utilized geospatial applications and techniques to improve wildfire severity classification. Her research has been presented at several meetings and conferences within the public and academic communities.

SS13.7. Las Conchas Fire Impacts on Aquatic Macroinvertabrate Community Structure

***Presenter**: Garcia, Lorraine, New Mexico Highlands University,*
Additional Author(s):
West, Clinton, New Mexico Highlands University
Sandoval, Ernesto, New Mexico Highlands University
Martinez, Edward, Associate Proffesor of Forestry, New Mexico Highlands University

The Jemez Mountains, located in Northern New Mexico, have been experiencing the effects of climate change over the last several decades. Due to the two main effects of climate change in the region, increasing temperatures and decreasing snowpack, severity and frequency of wildfires are expected to increase. In the wake of wildfires, the potential for soil erosion, and increased rates of runoff which may result in stream channel alterations during precipitation events is also increased, therefore potentially leading to large degradation of aquatic systems. The two main purposes of this study were (1) to determine the impact the Las Conchas Wildfire had on diversity, richness, and abundance on aquatic macroinvertebrate communities, and (2) to determine how fast macroinvertabrate community structure is able to recover to pre-fire conditions. Pre and post fire macroinvertebrate samples were collected at three different locations along the San Antonio Creek at increasing distances from the source of post fire surface runoff. After samples were sorted, counted, and identified to family several metrics representing community structure were calculated. Results indicate that diversity, richness, and abundance decreased post fire, and as expected sites closest to burned areas experienced the largest impact to community structure when comparing pre and post fire data. However, one year after the fire, recovery of community structure to pre fire conditions has not occurred at sites closest to burned area.

Bio: Lorraine Garcia has an undergraduate degree in Environmental Geology, and currently pursuing her Master's degree in Natural Resource Management at New Mexico Highlands University. Her research interests include aquatic ecosystems, climate change, and water chemistry. More specifically, her thesis examines how total and dissolved arsenic is influenced by changes in climate, in aquatic systems.

SS13.8. Vegetation response to the Los Conchas fire, 2011.

***Presenter**: McNeill, Richard, new mexico forest and watershed restoration institute, ecologist*
Additional Author(s):
Brown, Sara, assistant professor, New Mexico Highlands University
Martinez, Edward Albert, professor, New Mexico Highlands University

The Los Conchas fire burned in the Jemez Mountains of northern New Mexico in 2011, and was the largest fire in New Mexico history until the Whitewater-Baldy fire surpassed it in 2012. The Los Conchas fire exhibited fire behavior that was unknown in New Mexico and burneed 178 km2/44,000 acres in the first 13 hours, and a total of 607 km2/150,000 acres. This study describes the vegetation response to the Los Conchas in the mixed coniferous forest of the Valles Caldera Preserve, New Mexico. Four factors were evaluated across three fire severity types (High, moderate and low severity) and a control: vegetation cover, diversity, biomass and seedbank. Cover, biomass and diversity were evaluated for two years post fire and seedbank data was collected for one.

Bio: Richard McNeill is an botanist/ecologist who has worked in every state west of the continenal divide for a variety of agencies. He currently works part time for the New Mexico Forest and Watershed Restoration Institute and does ecological consulting.

SS13.9. GEOMORPHIC EFFECTS OF A HIGH SEVERITY BURN IN THE LAS CONCHAS FIRE

Presenter: *Zebrowski, Joseph, New Mexico Highlands University, Geographic Information Specialist*
Additional Author(s):
McNeill, Richard, Botanist, Consultant
Lavadie, Anita, Student, New Mexico Highlands University
Martinez, Edward, Professor, New Mexico Highlands University
Brown, Sara, Professor, New Mexico Highlands University

High fuel loads and extremely dry conditions have led to previously unknown fire behavior and effects. This study investigated the effect runoff from burned areas had on erosion and arroyo formation in the Cerro del Medio drainage within the Valles Caldera National Preserve, which was burned in the Las Conchas Fire in 2011. This drainage is 139 hectares and 2.3 km long. The majority of the drainage was categorized as a moderate or low severity fire. 24 hectares of the drainage were categorized as a high severity fire. The first post-fire monsoon season was slightly above average with 129.79 mm of precipitation in September and October. The first monsoon season's runoff from the high severity patch has resulted in rapid geomorphic change. An arroyo has formed that ranges up to 9.8 m wide and to 2.45 m deep. Upon leaving the constrained drainage it has resulted in an alluvial fan deposit that is 24 hectares in two lobes with the longest lobe 1.9 km long. Light Detection and Ranging Data (LiDAR) collected before and after the fire, along with pre- and post-fire ortho-rectified aerial photography were used to characterize the debris flow and help refine burn severity estimates. Changing fire behavior has resulted in larger and more severe fires and this will likely result in rapid and extreme geomorphic changes on a landscape scale with a corresponding impact on human activities.

Bio: Joe Zebrowski is a visiting professor of Forestry at NMHU. He directs the University's Geosptial Applications in Natural Sciences lab and teaches geographic information systems and remote sensing. He has managed geospatial operations and taught in the mapping sciences within the Department of Defense and at the community college and university levels.

SS13.10. The Cost of a Wildfire in the West

Presenter: *Walter, Kara, University of New Mexico, Doctoral Student*
Additional Author(s):
Chermak, Janie, Professor of Economics, University of New Mexico

Wildfires in the west have increased in both frequency and size over the last several years and the costs of these fires has also grown. Costs occur over space and time. While suppression costs are readily available, full costs associated with wildfire are not. As a first step, we develop a framework of costs for a western wildfire, differentiated spatially and temporally. Costs are separated into six broad categories, first by location (burn area and non-bur area) and second by time (immediately verses long-term and/or one-time versus recurring). We also distinguish between market and non-market costs. This

framework is applied to the Las Conchas Fire, which burned over 156,000 acres in New Mexico in 2011 and was, at that time, the largest wildfire in New Mexico history. Utilizing estimation techniques from the extant literature, primary data where possible and benefit-transfers where necessary, we estimate the full cost to the state of New Mexico. We find, that while the suppression costs of the Las Conchas were approximately $48 million, the lower bound on total costs is over $150 million.

Bio: Kara Walter is enrolled in the Economics Ph.D. program at the University of New Mexico. She is in her third year and is interested in natural resource and environmental economics.

SS13.11. Linking Forest to Faucets in a Distant Municipal Area: Public Support for Forest Restoration and Water Security in Albuquerque, New Mexico

***Presenter**: Adhikari, Dadhi, University of New Mexico, Doctoral Student*
Additional Author(s):
Thacher, Jennifer, Associate Professor of Economics, University of New Mexico
Chermak, Janie M., Professor and Chair of Economics, University of New Mexico
Berrens, Robert, Professor of Economics and Water Resources Program Director, University of New Mexico

Due to a mix of natural and human factors, catastrophic or high severity wildfire risk is increasing in the western United States, and elsewhere. Annually, wildfire destroys millions of acres of forest and costs billions of dollars in damages. Growing suppression costs represent only a fraction of total damage costs, and strain federal budget support for forest restoration. High severity wildfires are major disturbance events to watershed health and water quality, and can impose high treatment costs on downstream public water supplies. Thus, for many communities, reducing the risk of wildfires through forest restoration is vital for the sustainability of watersheds and securing safe drinking water supplies. Identifying public support to help cover the costs of forest restoration is an important implementation challenge. Payment for ecosystem services (PES) models may be used to help meet restoration objectives. As PES approaches are considered, the proximal relationship between watersheds and a community may influence the degree of public support. An unresolved issue is whether households in a relatively distant municipal area would significantly support wildfire risk reduction efforts that restore forest health and improve water security. For many relatively large urban areas, the majority of households are located considerably distant from needed restoration activities. The public connection or link between forests and faucets may be complicated by: (i) uncertainty in the preferences households might have for water security as an important collectively-provided good ("preference uncertainty"); and (ii) uncertainty in the possibility that restoration activities in a distant forested landscape or watershed might actually deliver improved water security ("delivery uncertainty").

Using sample data from over 900 household responses to a combination mail+internet survey, conducted in the fall of 2013, the objective of this research is to investigate public support for a PES model, including annual household willingness to pay (WTP) estimation of a forest restoration program that improves water security in the Albuquerque, NM metropolitan area. Relative to the recent PES model implemented in Santa Fe, NM in the same watershed, this case involves a sample that is much more spatially removed from the proposed restoration activities. The econometric analysis of annual household WTP indicates significant public support for forest restoration and the importance of accounting for both preference and delivery uncertainty effects.

Bio: Dadhi Adhikari is a doctoral student in the Department of Economics at the University of New Mexico. He specialization is environmental and resource economics, included in this is an interest in the impact of drought on watersheds and wildfire risk and human response to this risk.

SS13.12. A Synthesis of The Las Conchas Fire: How Does it Compare?

Presenter: *Martinez, PhD, Edward, New Mexico Highlands University, Associate Professor*
Additional Author(s):
Brown, Sara, Assitant Professor, New Mexico Highlands University

As wildfires have been increasing in extent and severity throughout the Southwest, so have the fire effects. Unlike many other big fires, the Las Conchas fire of 2011 (156,593 ac) uncharacteristically burned more than 61,000 acres in a 24hr period on June 27. Its severity and extent provided the opportunity to develop better tools to understand and classify severity and its impact on ecological processes, natural resources, humans and our willingness to pay for prevention or restoration of these impacts. I will synthesize the impacts shared during this special session to both our natural resources and communities based on findings from our studies of the Las Conchas Fire. As a means to contextualize the significance of our findings and the fire effects produced by this fire we will compare Las Conchas to other recent, regionally relevant large fire events such as the Wallow (2011; 538,049 ac), Rodeo-Chediski (2002; 468,638 ac), Whitewater-Baldy (2012; 297,845), Horseshoe- 2 (2011; 222,954 ac), and Hayman (2002; 137,600 ac).

Bio: Edward Martinez is an Associate Professor at New Mexico Highlands University in Las Vegas NM. His research interests are in the multidisciplinary fields of pollutant impacts to aquatic systems. Since 2009, with NSF EPSCoR funding, he has been conducting research at the Valles Caldera Preserve and Rio Mora National Wildlife Refuge in NM determining changes in dissolved solutes with changing climate in the Valles Caldera streams and Mora River. He is also the PD of numerous STEM education grants from various granting agencies such as the USDA-HSI program, the US Department of Education, and the Kellogg Foundation.

SPECIAL SESSION FOURTEEN: Resistance is NOT Futile - Avoiding Post-fire Conversion to Annual Grasses in the Cold Desert

Moderator: Génie Montblanc

SS14.1. Altered fire regimes in rangelands overview

Presenter: *Bunting, Stephen, University of Idaho, Professor of Rangeland and Fire Ecology*

Scientists have frequently noted in recent years that the fire regimes within the North American cold desert have been significantly altered relative to the historical period. Changes are commonly attributed to include: climate variation; fire suppression, agricultural and urban development; livestock grazing; increasing atmospheric CO_2 content; invasive species, particularly the annual grasses; and most recently climate change. It is widely thought that these factors, singly or in combination, have resulted in more numerous and larger wildfires. However, the effect of these factors on fire regimes has not been uniform across the region. For example, the influence of invasive annual grasses is more prevalent on parts of salt desert shrub and the more arid portions of the sagebrush steppe resulting in wildfires that are more common and larger in size. In contrast, wildfires in the more mesic portions of the sagebrush steppe have become less common, resulting in the encroachment of juniper, pine and other conifers. For all practical purposes, some of these factors, such as the annual grass introductions and climate change, are permanent alterations to cold desert landscapes leading to novel biotic communities and altered ranges of variability in the future. We will continue to have wildfires in this region, and in some years, the wildfires will be large to very large. Consequently some fire scientists are emphasizing the consideration of future fire regimes within the cold desert and other regions of the world. This will require knowledge of historical fire regimes and an understanding of how they are affected by current changing conditions. Land stewards must learn to manage for more resilient vegetation to more readily accommodate future fire regimes.

Bio: Steve joined the faculty at the College of Natural Resources, University of Idaho in 1978. His research has focused on the fire ecology of sagebrush steppe, western juniper and aspen woodlands, and canyon grasslands. He has also collaborated in fire research in maritime pine forests in Portugal and caldenal savannas in central Argentina. Steve's primary teaching responsibilities at the University of Idaho include Rangeland Ecology, Natural History of Western Rangelands, and Landscape Ecology.

SS14.2. Wildfire size effects on site and soil stability: wind erosion in cold-desert rangelands

***Presenter**: Germino, Matthew, US Geological Survey, Forest and Rangeland Ecosystem Science Center, Research Ecologist*
Additional Author(s):
Glenn, Nancy, Professor, Boise State University

Soil stability following fire is a major factor for rangeland ecology and post-fire rehabilitation and management practices. We will draw from preliminary and published studies conducted at plot-to-landscape scales to address how fire size relates to erosion risks, the extent of erosion that occurs, and the impacts of erosion on soil quality. Studies conducted across a number of wildfire sites in rangelands in the Northern Great Basin suggest that a critical threshold exists in the size of burn patches, above which extensive erosion can occur. Erosion from the largest "megafires" has been significant, causing several cm or more of soil to be redistributed or lost from sites and extensive dust plumes. In contrast, soils have resisted movement in spite of high wind shear on smaller wildfires. Previous literature suggests that appreciable changes in organic matter and soil carbon and nitrogen can result from wind erosion, where it has occurred extensively following wildfire. Wind erosion thus appears to be an emergent and potentially transforming outcome of the increased sizes of wildfires that have occurred in sagebrush-steppe, cold-desert rangelands. Continued development of models that can help predict when and where erosion is or is not likely will aid land managers in deciding where and when to apply soil and seeding treatments following fire.

Bio: Research Ecologist with the US Geological Survey, Forest

SS14.3. Effects of Large Fires on Sagebrush Obligate Species and Implications for Management

***Presenter**: Beck, Jeffrey, University of Wyoming, Associate Professor*

Sagebrush (Artemisia spp.) communities provide habitat for approximately 250 species of mammals, birds, and herpetofauna. At least 7 of these vertebrate species are commonly considered sagebrush-obligates, depending on sagebrush communities for resources, including Brewer's sparrow (Spizella breweri), greater sage-grouse (Centrocercus urophasianus), pronghorn (Antilocapra americana), pygmy rabbit (Brachylagus idahoensis), sagebrush lizard (Sceloporus graciosus), sagebrush sparrow (Artemisiospiza nevadensis), and sage thrasher (Oreoscoptes montanus). Concerns over habitat loss from landscape-scale disturbance, particularly large wildfires have led to petitions to list greater and Gunnison (C. minimus) sage-grouse, and the pygmy rabbit under the Endangered Species Act of 1973. Big sagebrush (A. tridentata) forms most of the habitat used by these iconic wildlife species; however, the distribution of big sagebrush has declined by more than 50% since settlement, and much of what remains is fragmented and degraded by anthropogenic disturbance and invasive species such as cheatgrass (Bromus tectorum). Big sagebrush habitats are dominated by Wyoming big sagebrush (A. t. wyomingensis) at lower elevations and mountain big sagebrush (A. t. vaseyana) at higher elevations. Fine fuel accumulation by cheatgrass in Wyoming big sagebrush has promoted extensive and more frequent wildfires in lower elevation sagebrush, whereas the lack of fire in mountain big sagebrush has promoted encroachment of conifers, which has led to less frequent, but more catastrophic fires in higher elevation sagebrush. Big sagebrush is not a root-sprouting shrub; consequently, fire eliminates or creates patchy sagebrush habitat following burning. Large fires thus pose a significant risk to the habitats on which sagebrush obligate species depend. Although historic, low-intensity, infrequent fires killed encroaching conifers and created mosaic or patchiness within sagebrush communities, the size, intensity, and frequency of recent large fires has led to large-scale loss of sagebrush suitable for obligate wildlife species. Decrease in shrub-mediated structural characteristics, changes in herbaceous understory, and loss of large continuous patches of sagebrush are primary concerns for the effects of large fires on restoration of sagebrush wildlife habitats. In addition to reducing the size and frequency of fire in sagebrush systems, scientists and practitioners should consider ways to assist in controlling invasive species (especially cheatgrass and encroaching conifers) and develop effective methods to reestablish big sagebrush and native perennial herbaceous plants to restore habitat for sagebrush-obligate vertebrate species.

Bio: Dr. Jeff Beck is an Associate Professor of wildlife habitat restoration ecology in the Department of Ecosystem Science and Management at the University of Wyoming. His research focuses on restoring the functionality and structure of wildlife habitats in disturbed rangeland systems, particularly sagebrush habitats. The work that Dr. Beck and his students conduct seeks to link habitat conditions with population processes, specifically through: 1) Understanding the direct and indirect impacts of anthropogenic and natural disturbances on vertebrate species, and 2) Evaluating the efficacy of mitigation techniques and conservation practices in sagebrush habitats.

SS14.4. A strategic landscape approach to managing invasive species and wildfire – melding ecological and conservation considerations

***Presenter**: Chambers, Jeanne, US Forest Service, RMRS, Research Ecologist*
Additional Author(s):
Pyke, David, Research Ecologist, USGS
Maestis, Jeremy, State Habitat Biologist, NRCS
Pellent, Mike, Ecologist, BLM
Boyd, Chad, Rangeland Scientist, ARS

Espinosa, Shawn, Upland Game Biologist, NDOW

Large wild fires in cold desert shrublands are placing many sagebrush-obligate species like Greater sage-grouse at risk. Progressive invasion and spread of annual grasses is resulting in more frequent and larger fires at low to mid elevations, and expansion of pinyon pine and/or juniper is resulting in more severe fires at mid to high elevations. Management objectives for these ecosystems include increasing the resilience of native ecosystems to fire and enhancing their resistance to invasive species, specifically, maintaining landscape cover of sagebrush to support sage-grouse populations, increasing perennial herbaceous species which facilitate recovery, and decreasing abundance and spread of invasive annuals. A Western Association of Fish and Wildlife Agencies working group has developed an approach to assist managers in prioritizing management activities at landscape scales. The approach is based on our current understanding of (1) ecosystem attributes that determine resilience to fire and resistance to invasion over the environmental gradients that characterize these landscapes and (2) habitat requirements of sage-grouse populations. A sage-grouse habitat matrix has been developed which shows that as resilience and resistance go from high to low, recovery after fire is progressively limited by decreases in sagebrush regeneration and abundance of perennial grasses and forbs and the risk of annual invasives is increased. Also, as sagebrush cover increases across large landscapes, the capacity of an area to provide habitat for sage-grouse increases. The sage-grouse habitat matrix provides a tool for prioritizing sagebrush habitat management based on maintaining or increasing resilience and resistance by protecting areas of high conservation value, preventing loss of ecological integrity in areas with declining ecological conditions, and restoring disturbed, degraded or invaded areas. A case study is used to illustrate the use of this approach and application of these concepts at local/site scales.

Bio: Jeanne Chambers is a research ecologist with Rocky Mountain Research Station, US Forest Service, located in Reno, NV. She has a Master's Degree in Range Science and a PhD in Biology/Ecology from Utah State University. Her research interests include global change processes, disturbance/restoration ecology, and invasive species. Her current work focuses on arid and semi-arid shrublands, woodlands and riparian ecosystems.

SS14.5. Use of Terrestrial Laser Scanning to Model Fuel Characteristics in Shrub-Steppe

***Presenter**: Anderson, Kyle, Idaho State University, Research Assistant*
Additional Author(s):
Glenn, Nancy F., Boise State University
Spaete, Lucas P., Boise State University
Shinneman, Douglas J., US Geological Survey, Forest and Rangeland Ecosystem Science Center
Arkle, Robert S., US Geological Survey, Forest and Rangeland Ecosystem Science Center
Pilliod, David S., US Geological Survey, Forest and Rangeland Ecosystem Science Center
McIlroy, Susan K., US Geological Survey, Forest and Rangeland Ecosystem Science Center

Invasion by non-native plants, climate change, and other factors are altering ecosystem processes in sagebrush steppe shrublands of the western U.S., with notable effects on vegetation composition, fuels structure, and fire regimes (i.e. increased frequency and severity of wildfires). In particularly arid regions, wildfires are contributing to a conversion of native shrublands to communities dominated by fire-prone invasives (notably cheatgrass, Bromus tectorum) via a positive feedback loop, which can result in long-term degradation of burned areas. Efficient methods of vegetation inventory over large areas are essential to understand and manage changes in vegetation conditions and to anticipate future wildfires. However, the application of remote sensing information from aerial or satellite platforms to shrub-steppe ecosystems is limited by spectral signal mixing and coarseness of data relative to low-stature vegetation. Terrestrial laser scanning (TLS) technology provides rapid collection of high-resolution structural information at ranges up to hundreds of meters, offering an opportunity to efficiently record vegetation characteristics in large swaths. We tested the ability of a variety of TLS-derived indices to predict vegetation biomass in shrub-steppe plots in southwestern Idaho, using systematic destructive biomass sampling data for model training and validation. Preliminary results suggest that TLS is an effective standalone tool for shrubland vegetation inventory, while future applications include collecting training data for interpretation of coarser remote sensing information and providing accurate simulations of fuel beds for spatially explicit wildfire models.

Bio: Kyle is an MS student with research interests in remote sensing, ecology, and land management.

SS14.6. Assessing fuel loads across successional and invasion gradients in degraded sagebrush landscape

***Presenter**: Shinneman, PhD, Douglas, U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Research Fire Ecologist*
Additional Author(s):
Robert Arkle, Ecologist, U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center
David Pilliod, Research Ecologist, U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center
Susan McIlroy, Ecologist, U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center
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Sagebrush shrublands in the Great Basin are highly influenced by non-native plants that alter successional trajectories, creating novel and dynamic fuel conditions. Often, non-native annual species, especially cheatgrass (Bromus tectorum), gain footholds in post-fire environments, suppress native species, and promote subsequent wildfires. This process promotes further non-native species dominance, increased fire risk, and degradation of shrubland communities. Moreover, fuel quantities are highly variable through space and time under these conditions, hindering attempts by land managers to predict and control fire and restore native communities. The goal of this study was to develop an approach to better quantify and predict fuel loads and the effects of fuels manipulations in Great Basin sagebrush communities. Using the Morley Nelson Snake River Birds of Prey National Conservation Area (NCA) in southern Idaho as a study area, we addressed three primary research questions: 1) How do fuel loads change along successional/invasion gradients in current or former sagebrush ecological sites? 2) How do fuel reduction treatments influence fuels in invaded areas formerly dominated by sagebrush? 3) What are the fine-scale spatial patterns of fuels across the landscape, and how can high-resolution, remotely-sensed imagery be used to develop spatially-explicit, predictive models of these fuels loadings. After two years, we have sampled more than 2,500 field plots distributed throughout the NCA. Preliminary predictive models indicate that, as expected, fuel loads vary across successional gradients, with higher fine fuel loadings in invaded versus intact sagebrush communities. However, fuel loads also varied depending on non-native species composition, with annual forbs (e.g., tumble mustard, Russian thistle) contributing significantly to fine fuel loads relative to sites dominated by cheatgrass alone. In addition, the contribution of non-native species varied between years, suggesting precipitation influences species-specific contributions to fine-fuels. Our predictive fuel models are currently being coupled to LiDAR and other remotely sensed data, so that we can develop spatially-explicit fuel maps for the study area over time. Ultimately, this approach should contribute to a better understanding of spatial and temporal variability of fuels across invasion and succession gradients in sage-steppe landscapes, and will improve fuel-reduction strategies and enhance fuel models used to predict fire behavior.

Bio: Douglas J. Shinneman is a Research Fire Ecologist with the U.S. Geological Survey - Forest and Rangeland Ecosystem Science Center (Boise, ID). Doug received a B.S. from Michigan State University, and an M.A. in Geography and Ph.D. in Botany (2006) from the University of Wyoming. He worked for the Nature Conservancy and U.S. Forest Service Northern Research Station as a post-doctoral Ecologist before coming to USGS. His research investigates how plant communities and disturbances regimes are influenced by land use, nonnative species, and climate, with projects in aspen woodlands, Rocky Mountain forests, boreal forests, pinyon-juniper woodlands, and sagebrush shrublands.

SS14.7. SageSTEP: Short-term Vegetation Responses to Fuels Treatments in Sagebrush Ecosystems

***Presenter**: Schupp, PhD, Eugene, Utah State University, Professor*
Additional Author(s):
Chambers, Jeanne, Plant Ecologist, USDA Forest Service
Davis, Lee, Research Associate, Utah State University
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Sagebrush communities in the Great Basin are extremely threatened by cheatgrass invasion at lower elevations and by woodland encroachment at higher elevations. One of the major issues is wildfire and much effort is devoted to fuels reductions projects that might also be useful for restoration of more resilient ecosystems. However, managers need improved information about the responses of these ecosystems to different fuels reduction/restoration treatments. In 2006 the Sagebrush Steppe Treatment Evaluation Project (SageSTEP), a partnership with scientists and managers, began the implementation of treatments on 21 replicates of study plots spread across western Utah, northern Nevada, southern Idaho, northeastern California, and eastern Oregon and Washington, including seven replicates representing sagebrush/cheatgrass and 14 replicates representing sagebrush/woodland conditions. In sagebrush/cheatgrass sites we evaluated mechanical (mowing), chemical (tebuthiuron and imazapic), and prescribed fire treatments. In sagebrush woodland sites we evaluated mechanical (cut and drop, mastication [Utah only]) and prescribed fire treatments. The overall project considers responses of fuels, wildlife, hydrology, and more, but in this talk we highlight some of the important vegetation responses to these treatments over the first 3-4 years post-treatment.

Bio: Gene Schupp is a Professor of Plant and Restoration Ecology in the Department of Wildland Resources and the Ecology Center at Utah State University. He works in the Great Basin, Colorado

Plateau, and southern Spain. His research focus is primarily on factors that limit recruitment of new plants in arid and semi-arid environments.

SS14.8. Effectiveness of Current Postfire Seeding Practices in Cold Desert Ecosystems – Implications for Future Restoration Projects

***Presenter**: Beyers, PhD, Jan, USDA Forest Service, Pacific Southwest Research Station, Research Ecologist*
Additional Author(s):
Pyke, David A., PhD, Research Ecologist, U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center

Invasive annual grasses alter fire regimes in shrubland ecosystems of the western U.S.A., increasing fire frequency and extent compared to historical conditions. Substantial money is expended annually for post-wildfire stabilization and rehabilitation of cold desert shrublands. Major objectives are to (1) stabilize soils against wind and water erosion, (2) control the spread of invasive non-native species, especially annual grasses, and (3) restore critical habitat for wildlife, such as the greater sage-grouse. Seeding is the most common postfire treatment, using native or non-native perennial grasses, annual or perennial forbs, and/or shrubs. Recent analyses of published literature, agency monitoring reports, and field evaluations found that the success of meeting the second objective, controlling invasive species, is climate related, but the type of rehabilitation treatment may influence the project's success. Successful establishment from aerial seeding increased with greater precipitation and elevation, whereas drill seeding resulted in generally higher success with less dependence on environmental conditions. Native species establishment was better when aggressive non-native species were not included in the seeding mix, but total plant cover was higher with use of non-natives under favorable precipitation conditions. This implies that native-only seed mixes should be used where restoration of native vegetation is a high priority, and success will be better at higher, wetter sites. Climate change scenarios for the western U.S.A. indicate warmer, drier environments in the future, suggesting that more intensive restoration methods may be needed at lower and drier sites, including invasive plant control and repeated intervention (re-seeding). Addition research on rehabilitation success should aid in providing better predictive models not only of locations where rehabilitation and restoration will succeed, but also provide better predictions of species to use for success.

Bio: Jan L. Beyers has been a research plant ecologist with the Forest Service's Pacific Southwest Research Station since 1991. She holds a bachelor's degree in Environmental Studies-Biology from Whitman College and a PhD in Botany from Duke University. Her research focuses on the effectiveness of postfire emergency watershed stabilization treatments, ranging from grass seeding to aerial hydromulch, and on fire ecology of chaparral and related plant communities. The use of native plant materials for stabilization and restoration is a long-standing interest; new research examines methods for restoring chaparral and other shrubs in sites degraded by non-native annual grass invasion.

SS14.9. Managing Invasive Species and Wildfire – Social and Political Considerations in the Public Land States

***Presenter**: Brunson, Mark, Department of Environment & Society, Utah State University, Professor and Department Head*

Additional Author(s):

Large wildfires in the western U.S. often are linked to non-native plant invasions. Where fires have burned it is difficult to avoid exotic plant invasions. And where invasive plants are dominant there is often increased risk of wildfires. This is both an ecological problem and a social one, as the conditions that make the fire/invasion cycle difficult to break are due partly to interactions between societal beliefs and political processes. In this presentation I describe research in the Intermountain West designed to help fire and fuels managers understand these interactions.
Pre-emptive restoration – the use of practices that can reduce fuel loads and invasive plant cover to enhance resistance and resilience to wildfire – is often promoted as a way to reduce risk of catastrophic wildfire. However, despite much managerial and research interest, pre-emptive restoration projects remain rare. One reason (perhaps second only to inadequate agency resources) is that restoration projects are often difficult to shepherd through environmental review processes due to local public and/or interest group opposition. Two factors that exacerbate public opposition are a lack of trust in federal government, and changing demographics of affected publics.

The growth of low-density subdivisions near western public lands affects not only the pattern and frequency of wildfire and plant invasions but also prevailing public opinion toward management options, and thereby agencies' capacity to use those options in a changing political environment. A study of small-acreage owners in Utah found that landowners who had owned their property for less than 10 years were equally likely to have taken steps to reduce fuel hazard but less likely to have controlled non-native plants. New residents were also more concerned about scenic impacts of practices.
A separate study in the Great Basin showed that beliefs about the acceptability of practices such as prescribed burning, juniper control, or herbicide application were influenced less by knowledge about those practices or wildfire risks than by people's trust in the agencies' ability to use the practice effectively. In an era when trust in federal government is especially low, this poses a risk to efforts to increase use of pre-emptive restoration. However, methods do exist to build trust locally, and agencies would be well-advised to use them.

Bio: Mark Brunson is a professor and department head of Environment and Society at Utah State University. He is an environmental scientist who applies methods from both the social and ecological sciences to understand the complex dynamics of human-environment interactions. Current studies investigate how social and institutional factors interact with biological invasions and climate to influence the success of restoration projects following wildfire; how soil-disturbing activities such as recreation travel affect plant fitness and invasion susceptibility; and how cultural and economic factors interact with environmental factors to influence perceptions of wildfire risk and willingness to take steps to reduce risk.