

ORAL PRESENTATION ABSTRACTS

Thursday March 24 – Morning Plenary Session

Forest, People, Fire: Interactions, Dynamics and Adaptation in Fire-prone Landscapes of the eastern Cascades of Oregon

Tom Spies

Forests - Exploring alternative futures for fire-prone forest landscapes of the eastern Cascades

Fire-prone landscapes present many challenges for both managers and policy makers developing adaptive behaviors and institutions. We used a coupled-human and natural systems framework and an agent-based landscape model to examine how alternative management scenarios affect fire and metrics of ecosystem services in the eastern Cascades of Oregon. Our model incorporated existing models of vegetation succession and fire ignition and spread and was based on original empirical studies of landowner decision making. Our findings indicate that alternative management strategies can have variable effects on landscape outcomes over 50 years for fire, socio-economic and biodiversity metrics. For example, scenarios with federal restoration treatments had less high-severity fire than a scenario without treatment; exposure of homes in the wildland urban interface to fire was also slightly less with treatment than without. Treatments appeared to be more effective at reducing high-severity fire in years with more fire than in years with less fire. Under the current scenario, timber production could be maintained for at least 50 years on federal lands. Under an accelerated restoration scenario, timber production fell due to shortage of areas meeting current stand structure treatment targets. Tradeoffs between restoration outcomes (e.g. open forests with large fire-resistant trees) and habitat for species that require dense older forests were evident. For example, percent area of nesting habitat for northern spotted owls was somewhat less after 50 years under the restoration scenarios than under no management. However, the amount of resilient older forest structure and habitat for white-headed woodpeckers was higher after 50 years under active management. More carbon was stored on this landscape without management than with management, despite the occurrence of high-severity wildfire. We plan to use the model in collaborative settings to facilitate discussion and development of policies and practices for fire-prone landscapes.

Eric White and Jeff Kline, A. Paige Fischer, Susan Charnley, and Christine Olsen

People—human systems in complex fire-prone landscapes

Many fire-prone landscapes around the world are coupled human-natural systems (CHANS) where landscape outcomes are determined jointly from processes and events within linked human and natural subsystems that exist in those landscapes. The fire-prone landscape of central and southern Oregon is a CHANS, where the human subsystem includes private forest landowners and managers, homeowners, and policy makers. Actors within the human subsystem make decisions about forest management and homesites that affect natural resource conditions and wildfire behavior. Using results from social science research in the Forests, People, Fire project, we describe processes and decision-making within that human subsystem in the context of several complexities that are hallmarks of CHANS: spatial connections across places within the landscape, delayed responses in the natural system from human actions, and infrequent signals to individual actors about disturbance and conditions in the natural system. We describe the motivations of managers and landowners in central and southern Oregon, how those actors organize themselves into social networks that influence management in the fire-prone landscape, the factors that influence private landowner management decision making, and private forest landscape outcomes. We identify opportunities for managers and policy makers to better connect to, and coordinate with, landowner actors within this fire-prone landscape.

Ana Barros and Alan Ager, Michelle Day, Haiganoush Preisler, John Abatzoglou

Fire occurrence under climate change in central Oregon

In this work we modeled the effect of expected climate change in future area burned and wildfire severity on a 1.2 million study area in Central Oregon that includes the Deschutes National Forest, the Warm Springs tribal reservation, lands managed by private industrial owners and extensive wildland urban interface. We simulated fire occurrence using four alternative global circulation models (GCMs) – the CanESM2, CSIRO-Mk-3-6-0, HadGem2-ES and MIROC5 - and two representative concentration pathways (4.5 and 8.5). Wildfire was simulated using the minimum travel time algorithm implemented in a command line version of FlamMap, and linked to a spatiotemporal ignition model that predicted ignition location, ignition density and fire size as a function of the energy release component (ERC), and developed based on the historical spatiotemporal ignition pattern and fire size distribution. Future ERC was calculated based on meteorological variables obtained from the statistical downscaling of the four GCM's and emission scenarios. The agent based model Envision was used to illustrate how management can potentially mitigate climate change effects. Results highlighted expected changes in overall burned area and fire severity as a function of different GCM's, emission scenarios and forest management practices.

Restoration of Dry-forest Landscapes in the Pacific Northwest

Paul Hessburg

Restoring fire-prone Inland Pacific landscapes: Seven core principles

More than a century of forest and fire management of Inland Pacific landscapes has transformed their successional and disturbance dynamics. Regional connectivity of many terrestrial and aquatic habitats is fragmented, flows of some ecological and physical processes have been altered in space and time, and the frequency, size and intensity of many disturbances that configure these habitats have been altered. Current efforts to address these impacts yield a small footprint in comparison to wildfires and insect outbreaks. Moreover, many current projects emphasize thinning and fuels reduction within individual forest stands, while overlooking large-scale habitat connectivity and disturbance flow issues. We provide a framework for landscape restoration, offering seven principles. We discuss their implication for management, and illustrate their application with examples. Historical forests were spatially heterogeneous at multiple scales. Heterogeneity was the result of variability and interactions among native ecological patterns and processes, including successional and disturbance processes regulated by climatic and topographic drivers. Native flora and fauna were adapted to these conditions, which conferred a measure of resilience to variability in climate and recurrent contagious disturbances. To restore key characteristics of this resilience to current landscapes, planning and management are needed at ecoregion, local landscape, successional patch, and tree neighborhood scales. Restoration that works effectively across ownerships and allocations will require active thinking about landscapes as socio-ecological systems that provide services to people within the finite capacities of ecosystems. We focus attention on landscape-level prescriptions as foundational to restoration planning and execution.

Ryan Haugo and Bill Gaines, James Begley, Jamie Robertson, Paul Hessburg, James D. Dickinson

Applying the principles of landscape restoration within the east Cascades, the Manastash-Taneum Resilient Landscape Project

Extensive efforts are being made across North America to restore the ecological patterns and processes of historically fire-dependent forested ecosystems. However, there is a growing recognition that a simple focus on stand-level forest management and uncoordinated terrestrial and aquatic restoration efforts will not lead to resilient ecosystems capable of continuing to provide critical habitat and ecosystem services in the face of a warming climate. The need for a landscape scale approach was recently crystalized in Hessburg et al.'s (2015) Restoring fire-prone landscapes: seven core principles. Here we describe the analytical foundation for applying these core principles within the Manastash-Taneum Large Landscape Restoration Project area. The project

encompasses ~40,000 ha in the central Washington Cascades with a mix of federal, state, and private ownership, and is focused on 1) improving watershed conditions and processes, 2) restoring aquatic habitats to support recovery of listed fish, 3) restoring patterns of vegetation and habitat successional patches, and 4) restoring inherent fire/disturbance regimes. Following the core principles, we have produced comprehensive “landscape prescriptions” using historical and future climate change analogue reference conditions, which provide the basis for land managers to effectively work across ownership boundaries while respecting individual landowner objectives.

Andrew Merschel and Tom Spies

Historical Fire Regimes across Dry to Moist Forest Ecotones in Central Oregon, and the Role of Landscape Context

Managers and the public have strong interest in restoration of structure and composition of mixed-conifer forests that is consistent with the historical fire regime of central Oregon. Generally, historical fire frequency is expected to decrease across the ecotonal transition from dry to moist forest, and moist forest environments are hypothesized to be less departed following fire exclusion. However, the magnitude of variation in fire regimes across mixed-conifer ecotones, and the controls on this variation are poorly understood. In particular the influence of surrounding topography and vegetation (landscape context), on dynamics at a local scale has not been effectively examined. We characterized historical fire regimes, stand dynamics, and current conditions across a 10,000 ha landscape that spans an annual precipitation gradient of 25-45 inches southwest of Bend, Oregon. Historically large spreading fires frequently burnt across dry-moist forest ecotones (CFI25=12.5, NFR=19), and fire intervals varied slightly with stand precipitation and composition (15-20 years in dry vs. moist stands). The spread of fire was historically limited by landscape context as mixed-conifer stands on buttes isolated by flats dominated by lodgepole pine often did not record large spreading fires, and burned in small isolated fire events. Mixed-conifer stands with an isolated landscape context had longer maximum fire free intervals (>70 years) than non-isolated stands (<30 years). Our results demonstrate that dry and moist mixed-conifer forests had similar fire regimes except where landscape context limited the spread of frequent fires. Forest development following fire exclusion demonstrates that moist mixed-conifer forest with a frequent fire landscape context is most departed.

Paul Anderson

Tree Vigor Responses to Restoration Thinning and Fuels Reduction at Lookout Mountain

A premise behind thinning as a means to enhance forest resilience is that decreasing overstory density reallocates limited site resources – water, nutrients, and light – to fewer trees, thus improving the vigor of individual trees and decreasing stand vulnerability to physical and biological stressors. Removal of understory vegetation as a means to decreasing fuels accumulation and fire hazard may also decrease demands on site resources. However, the duration of any overstory or understory treatment effects may be temporary as subsequent vegetation development reasserts resource demands. Experimental thinning and fuels reduction treatments in mature ponderosa pine stands at Pringle Falls Experimental Forest in central Oregon are being monitored for seasonal soil moisture depletion and individual tree water use. Early observations suggest that decreases in stand density and understory shrub removal have distinct effects on seasonal soil moisture depletion rates and related whole tree transpiration rates that should translate over time to increased vigor and growth. The influence of varying residual stand density and the persistence of these effects as understory shrubs reassert their influence will be the focus of monitoring into the future.

Thursday March 24 – Afternoon Session

Beyond the Sagebrush Rebellion: Contemporary Issues Impacting the Sage Steppe of Oregon

Lisa Ellsworth

Fire in the sagebrush steppe: 21st century challenges, successes, and opportunities

The sagebrush steppe is among the most endangered ecosystems in western North America due to land use change, invasive species, overgrazing, climate change, and altered fire regimes. Fire regimes have been significantly changed due to invasive species, fire suppression, negative perceptions of fire, and a changing climate. Declining habitat condition for wildlife species of concern have recently focused our attention to managing and restoring fire regimes in the sagebrush steppe, and we are currently in an era of great possibility for positively impacting the long term resilience of the sagebrush steppe with land management decisions. In the past several years, unprecedented collaborative efforts have been seen among resource managers, researchers, wildlife biologists, and agricultural producers to better understand and implement strategies for improving ecosystem function and habitat quality, restoring fire regimes, managing invasive species, maintaining broad-scale spatial and temporal heterogeneity, and increasing resilience to disturbance. In the coming decades, continued communication and collaboration among diverse stakeholders across the sagebrush sea will be critical to preserving and restoring these ecosystems while providing for resilient rural communities and economies.

Christian Hagen and Lee Foster, Katie Dugger

Sage-Grouse in a Post-Wildfire Landscape: The High Price of Site Fidelity

Increased wildfire, coupled with expansion of invasive grasses, can alter sagebrush (*Artemisia* sp.) ecosystems and impact wildlife, especially greater sage-grouse (*Centrocercus urophasianus*) populations in the Great Basin. Wildfire activity is increasing across the range of sage-grouse, with the potential to destroy upwards of a million hectares of sagebrush habitat in a year. Because sage-grouse exhibit strong site fidelity and are a sagebrush obligate, they may be susceptible to population level declines in the event of large-scale habitat disturbance. We are investigating life history parameters and habitat selection of sage-grouse within the Holloway fire, which burned 187,000 hectares of sagebrush habitat in SE Oregon during August, 2012. We captured >66 female sage-grouse within the fire perimeter and fitted them with GPS transmitters during 2013 - 2015. We monitored the survival, reproductive effort, and habitat use of these birds for the first three years post-fire. We observed unusually low survival and reproductive rates, as well as unexpected patterns of nesting habitat selection. Nest success in 2013 and 2014 was 26% and 35%, respectively. Survival during the first year post-fire was 31%. On average 21% of nests were located in burnt habitat each year, however success of nests in burnt habitat increased from 20% to 83% between 2013 and 2014. Sage-Grouse are attempting to exist and reproduce within the fire degraded habitat, and preliminary evidence suggests that survival and reproductive effort is improving as habitat within the fire affected area regenerates.

Roger Rosentreter and Ann Marie DeBolt

Forbs: sage-grouse food or just another pretty weed?

There are hundreds of forbs native and non-native in the sagebrush steppe but which are valuable to sage grouse as food? Pre and post fire sampling for forbs can be a huge challenge. How can one categorize these vast number of species into some manageable categories for analysis and for management recommendations? Hundreds of forbs in the west are placed in both artificial and natural categories to make both field sampling and analysis reasonable for developing management trends and recommendations. A review of the literature and a knowledge of the plant chemistry is used to develop sage-grouse preferred plant categories.

Jesse Abrams and Emily Jane Davis, Katherine Wollstein, James Meacham, Alethea Steingisser, Lee Cerveny, Cassandra Moseley

When Two Worlds Collide: Rangeland Fire Protection Associations, Federal Agencies, and the Politics of Resilience

Wildfires in Great Basin rangelands have grown in size and intensity in recent years, raising concerns about impacts on native habitats, rare species such as the greater sage-grouse, and the livelihoods of ranching families. Rangeland Fire Protection Associations (RFPAs), self-organized volunteer wildfire response teams made up of ranchers and other local community members, have emerged as a model of early rangeland

wildfire response and have been formally sanctioned in Oregon, Idaho, and Nevada. With equipment and training from their respective states, RFPAs are positioned to contribute effort, local knowledge, and quick-response capacity to complement wildland fire suppression professionals from agencies such as the BLM. However, the largely informal approach to fire response typical of RFPAs stands in contrast to the highly formalized structure of federal agencies, setting up the opportunity for conflicts on the fireline and off. RFPA members see their lack of bureaucratic restrictions as an asset that allows them to be effective in fire response; for federal agency managers, this lack of adherence to bureaucratic standards can appear as an unacceptable risk. Is there room to accommodate flexible, informal organizations within a highly bureaucratized federal wildfire response system? What are the roles of state-level policies and agencies in mediating the conflict between national and local entities? In this talk we will introduce the RFPA model, describe conflicts that have arisen in their operations, discuss possible models for resolving these conflicts, and consider possibilities for maintaining the advantages of flexibility and informality while still providing for safety and accountability.

Rick Miller and Jeanne Chambers, Dave Board

Fire & Climate: Past, Present, and Future

Dramatic climate changes over the past 20,000 years since glacial maximum have had significant impacts on vegetation, soils, hydrology, and fire in the semi-arid Intermountain West. However, surprisingly Pleistocene vegetation was largely dominated by plants species present in the region today. The resilience of semi-arid Intermountain West is largely attributed to the highly variable topography, allowing species to stay within their moisture and temperature ranges by simply moving up or down in elevation and/or changing aspects. Major fire periods during the past 20,000 years were often associated with the transition of long term (centuries) wet cool-wet to warm-dry periods. The onset of Eurasian settlement in the late 1800s was followed by a dramatic decline in fire, frequently attributed to the reduction of fine fuels by grazing and fire suppression. The combination of the wet period between 1905 and 1917 and the reduction of fire that occurred throughout the Intermountain West is thought to largely have attributed to the expansion of pinyon and juniper woodlands. The combination of warming temperatures, longer fire seasons, expansion of exotic species, and the continued maturity of trees that established during the peak period of woodland expansion and infill in the early 1900s is likely attributing to the increasing size in fires since the 1980s. The large fires of today in semi-arid systems are often associated with 1-3 wet years preceding the fire, allowing for the accumulation of fine fuels. Although, vegetation and landscapes in the semi-arid Intermountain West have proven to be resilient throughout millennia to changes in climate and fire regimes, the introduction and rapid expansion of exotic plant species have significantly reduced the resilience of this region to future climate change, fire, and other disturbances.

Friday March 25 – Morning Session

Hazardous Fuels Treatments in the Inland PNW

John D Bailey and Christopher Dunn

Recent trends in wildland fires and fuels treatments in the Pacific Northwest

Wildfire spatial extent and associated fire intensity has become unprecedented recently in the PNW, as with much of the inland West, and is likely to continue or worsen into the near future with projected climate change. Larger fires with higher percentages of stand-replacement are clearly linked to issues around: 1) fuel abundance and continuity in the landscape; 2) longer fire seasons and more extreme fire weather; and 3) how these interact to reduce the likelihood of early suppression and containment. Growing interests in fuel treatments, and in the context of active management and collaboration across ownerships, continues to be met by misguided preservation notions/actions that perpetuate the problem – preservation of high-biomass multi-story older forests for recreational and wildlife habitat, which also is good habitat for wildfire; preservation of high-biomass riparian buffers, which serve as fuel-rich conduits for wildfire; preservation of

undisturbed scenic vistas, which burn as uniformly as they look; and finally reflex suppression, which preserves a fuel-rich landscape until conditions are such that suppression is impossible. All the while more humans move out and into the wildlands. This is a pathological cycle that must be broken by thoughtful, active treatment combined with a more realistic understanding of and relationship with fire. The pace of scale of designed and subsidized fuel treatments has been consistently insufficient to make a difference in most areas, either with mechanical treatments or prescribed burning or both. A more comprehensive approach encompassing vastly larger areas and tied to broad, active land management and inevitable wildfires would serve the forestry profession well at this critical junction. Indeed, large “box-and-burn” (PODs) approaches that blend prescribed fire and suppression strategies and restoration of resilient landscapes may be the only way to break out of the current pathology.

Nicole M Vaillant and Elizabeth D Reinhardt

An evaluation of the Forest Service hazardous fuels treatment program– Are we treating enough in the right places?

It is commonly accepted that wildfire suppression has resulted in uncharacteristic fuel accumulations, and that this in turn is one of the causes of a growing wildfire management problem which is becoming more expensive and wildfire impacts greater and more often negative. Fuel treatment strategies typically fall within two overarching land management objectives: 1) creating/maintaining resilient landscapes and 2) reducing wildfire hazard. We used LANDFIRE data to evaluate the spatial extent of mechanical treatments, prescribed fire, and wildfire occurrence within National Forest System lands from 2008 to 2012 with respect to their historic disturbance rates and current wildfire hazard in order to evaluate the extent to which management of these lands is correcting this situation. Over the period assessed less than 1% of the total area was treated annually with an equal amount burned by wildfire. Areas that historically burned frequently require active management with repeated entry to promote resiliency in the absence of wildfire. These frequent fire areas are the most departed based on comparison to historic rates. To reduce wildfire hazard, treatments should prioritize areas with the highest hazard first; however, this is not the case. In the lowest hazard categories almost twice as much area was treated with mechanical treatments or prescribed fire as was burned by wildfire. The opposite was true for the highest hazard classes where wildfire accounted for two-thirds of the impact each year. The current scale and pace of treatment implementation is not sufficient to compensate for current fire suppression activity, let alone address the known backlog. The Agency should aspire to: 1) design treatments that create conditions conducive to naturally ignited fires burning under desired conditions while fulfilling an ecological role; and 2) place treatments targeted to reduce hazard while providing options for firefighting to protect highly valued resources and assets.

Ali Dean

Lessons learned from fifteen years of monitoring fire effects in Central Oregon

The fire effects monitoring program in COFMS began in 2001. Long-term monitoring has yielded insight into processes of ecological change and resilience. We have learned that observations and apparent trends from 1-year monitoring are often not predictive of the 5-year or longer-term site condition. Landscapes need time to restore equilibrium, and more data points provide more accurate conclusions. Our program is shifting from initiating lots of new plots to expanding our follow-up with specific projects and targeting new monitoring where it will fill knowledge gaps. Synthesizing long-term data from multiple projects is allowing us to approach broader questions such as, Are we losing old-growth trees at a faster rate due to Rx fire? How do invasive annuals respond to different kinds of disturbance? How do our treatments affect wildfire behavior and subsequent recovery?

Alissa Cordner

Waiting for the Next Big One: Catastrophic Wildfire and Other Motivators of Improved Wildfire Risk Management

The inland Pacific Northwest, like most regions of the United States, faces increasing fire severity due to a complex combination of ecological, climate-related, and social factors. Wildfire risk management strategies will need to change in the future because of the increasing economic and social costs of wildfire suppression and the heightened threats to many communities. What motivates changes in wildfire risk management, both for communities potentially threatened or impacted by future wildfires, and for the state and federal agencies charged with wildfire suppression and risk mitigation? This presentation draws on ongoing qualitative research with wildfire managers in Central Oregon, including interviews, ethnographic observations, and analysis of wildfire publications and documents. Communities and residents respond to acute triggers, such as wildfires that directly threaten homes, and chronic triggers, such as increased awareness of drought and heavy fuel conditions. Wildfire agencies have tended to enact risk management changes affecting firefighter safety in the aftermath of fatalities, and changes affecting public safety in the aftermath of record-breaking fire seasons. This presentation will address the implications and limitations of these modes of response. In particular, the “new normal” of intense fire season severity suggests that new motivations for enhancing wildfire risk management must be found.

Smoke Management and Fire Severity

Roger Ottmar

Smoke Management and Rx Fire: fuel bed components that contribute to smoldering smoke and evening intrusions

Land managers are reducing fire hazard and restoring landscapes near Bend and Prineville, Oregon, by increasing the area they treat with prescribed fire. However, smoke from prescribed fires (especially smoke from evening smoldering that can be entrained into the night time drainage flows) may intrude into these towns resulting in exceedances of background PM_{2.5}. These nighttime impact and intrusions are often caused from the smoldering and low buoyant smoke generated from specific fuel bed components including rotten stumps and logs, litter and duff accumulations around larger trees, and pockets of deeper duff. This presentation discusses a retrospective study to determine the contribution of important fuel components to the smoldering smoke and how that may have contributed to smoke intrusion events from the West Bend and Glaze Meadows prescribed burns in the spring of 2014. For smoke managers, it may no longer be enough to base burn plans on the total amount of forest fuels, fuel consumption, and total smoke produced on site. Rather, a more detailed understanding of the timing of consumption and smoke production during periods of weak atmospheric dispersal may better help manage downwind smoke effects in communities near prescribed fires. Furthermore, plans may need to be in place to (1) limit the ignition of fuel bed components that have the potential of long-term smoldering, (2) initiate mop-up on fuel bed components that ignited and have the potential to continue to burn into the evening hours, and (3) develop better weather forecasting tools to capture downwind drainage flows. A large smoke study called the Fire and Smoke Model Evaluation Experiment (FASMEE) is to provide observational data necessary to evaluate and advance operationally used fire and smoke modeling systems and should improve land managers ability to manage smoke impacts.

Susan O’Neill and Miriam Rorig, Colton Miller, Rick Graw, Sim Larkin

Understanding Smoke Transport from Prescribed Burning in the Wildland Urban Interface of Bend, Oregon

The Bend, Oregon area is an example of where the needs for fire to mitigate the chance of large wildfires protecting public health, and promote forest health, are balanced with the need to keep the air clean in a community. The Forest Service Region 6 Air Program and the FS Pacific Northwest (PNW) Research Station AirFire Team are collaborating with land managers on the Deschutes National Forest to gain a better understanding of meteorological conditions that can transport smoke into Bend, Oregon. The goal is to increase the pace and scale of forest restoration burning while protecting air quality in Bend and surrounding communities. We conducted two field campaigns deploying up to twelve weather stations (which measure wind speed and direction, temperature, and RH), and three portable air quality particulate monitors (E-

Samplers, which measure PM2.5 or particulate matter less than 2.5 micrometers in diameter, and wind speed and direction) from Sisters, Oregon down through Bend to Sunriver, Oregon. Two automated cameras were also deployed at wildfire lookout points. Instruments were deployed for the Fall 2014 prescribed burn season, five weather stations remained in-place over the Winter when pile burning occurred, and the remaining instruments (E-Samplers and cameras) were re-deployed for the Spring 2015 Rx burn season. We also simulated dispersion from prescribed fires at spatial resolutions of 4km and 1km. During the Spring of 2015, a number of smoke intrusions occurred in Bend and were measured at the PM2.5 samplers. Hourly PM2.5 concentrations reached over 350 micrograms/m³ on May 29, 2015, most likely due to overnight smoldering of large woody fuels and basal accumulations. We present a detailed analysis of the measured wind conditions and spatial distribution of the smoke for the Spring 2015 smoke intrusions into Bend, Oregon.

Michelle Agne and Travis Woolley

Post-mountain pine beetle lodgepole pine forests: assessing fire and cumulative disturbance effects in the Pole Creek Fire

Recent large scale mountain pine beetle (MPB) outbreaks have created concern regarding their influence on fuel loadings and subsequent fire behavior and have prompted a desire to understand synergistic effects of multiple disturbances on the landscape. However, most research on this topic has been derived from fire behavior models rather than direct observation or post-fire monitoring. The 2012 Pole Creek Fire provides a unique opportunity for comparison with previous findings, as the fire partially overlapped gray stage (8-15 years post-MPB epidemic) lodgepole pine forests. One year post-fire, we established 52 plots, stratified by fire and MPB severity, for the measurement of post-fire structure and fire effects. We examined the combined effects of MPB and fire disturbances on stand structure, and investigated the influence of previous MPB severity and fire weather on subsequent fire severity and cumulative disturbance severity. Fire severity metrics from all vertical strata decreased with increased MPB severity under extreme burning conditions, following expected trends for crown fire severity, but not surface fire severity. High severity crown fire was common despite hypothesized low canopy fuel loadings during the gray stage, indicating the importance of understanding variable mortality density of MPB outbreaks. Cumulative disturbance severity metrics were not consistently related to MPB severity. Although long-term studies are needed to understand ecosystem recovery trajectories over time, there was no indication that a loss of ecosystem resilience occurred as a result of two sequential disturbances in this landscape.

Bryce Kellogg and Nicole Vaillant, Crystal Kolden, Brian Wing, Luigi Boschetti, Alistair Smith

Can Satellite Derived Temperature Data Improve Estimates of Burn Severity?

Recent studies report that the size and severity of wildland fires in the Western United States has expanded in recent years. Observations of long term trends in fire size and severity necessarily rely heavily on remotely sensed data. Current satellite derived indices of burn severity are insensitive to the magnitude of biomass loss, making comparisons of burn severity across space and time difficult. Several satellite sensors are capable of measuring the temperature or Fire Radiative Power (FRP) of biomass combustion. MODIS derived FRP measurements are used by programs such as GFAS (Global Fire Assimilation System) to estimate biomass emissions globally. GFAS emission estimates are compared to LiDAR-derived change in biomass for the Pole Creek Fire to evaluate the potential incorporation of this data into severity estimates. LiDAR-derived biomass is also compared with the differenced normalized burn ratio (dNBR) to illustrate the limitations of this commonly used measure.

Gordie Reeves and Rebecca Flitcroft

Fish and Wildfire: A New Perspective

Contrary to the perception that fire in riparian and upslope areas have negative impacts on native fish, short-term effects of fire on aquatic communities are transitory unless those systems are already seriously impaired by habitat loss, fragmentation, or other effects and may be positive over time. Recent studies suggest that

native salmonids are adapted to natural disturbance regimes wildfire and subsequent hillslope failures and erosion can help create productive habitats over the long-term. Thus, fish may be affected as much or more by long-term fire suppression and the response to fire (halt erosion) than by fire itself. This will be illustrated by recent work on the effect of fire on spring Chinook Salmon in the Wenatchee River, Washington and results of other studies. There are several regulatory, administrative, and social issues that challenge this new perspective of fire and fish and will need to be addressed if this new perspective and associated actions, such as setting broader goals for fire management which may lead to less fire suppression in some situations, are to be accepted and implemented.

Friday March 25 – Afternoon Session

Improving the Safety and Efficiency of Large Fire Management

Tim Sexton

Planning for Wildfire Management in the Twenty-first Century

All of our actions on federal land should be based on Land and Resource Management Plan Goals and Objectives and should support movement of the landscape conditions toward (or prevent movement away from) the desired conditions described in the Land and Resource Management Plan. Most federal land management plans give little attention to wildfire and its effects on desired conditions. Firefighter and public safety are often mentioned, but the impacts from fire at various levels of severity and from fire exclusion are usually not well addressed. Consequently, it is often very difficult to devise strategies and tactics that are clearly linked to LRMP objectives. One must interpret the plan to determine how response to a fire might support or be detrimental to LMP goals and objectives. It is often much easier to put the fire. Further, it is also perceived that there is less “risk” involved in keeping a fire small than in managing it for an extended period of time over a larger area. On a large percentage of federally managed lands the cumulative effect of these wildfire response actions has been to allow the landscape conditions to move farther away from LRMP desired conditions and to allow wildfire risk to increase. We can change the paradigm of “hit ‘em hard and keep ‘em small” but it will take a lot of effort. We need to improve how Land Management Plans address wildfire, adopt spatial fire planning, and provide training to agency administrators and fire managers on comprehensive risk management. We also need to engage our partners and the public in conversations about the need for fire on the landscape and how carefully managing some wildfires can be a key component of a robust wildland fire risk management program.

Jennifer Anderson

A Novel Application of Wildfire Risk Assessments in Land Management Plans (LMPs)

Recent updates in USFS policy and guidance require the designation of strategic fire management areas through spatial fire planning (SFP). Strategic fire management areas spatially depict fire-related LMP direction in SFP and guides implementation through the use of Wildland Fire Decision Support System (WFDSS). Under the 2012 Planning Rule, we use a risk-based approach in the Pacific Southwest Region (Region 5) to generate strategic fire management areas for the three Early Adopter forests in the Southern Sierra Nevada. This approach will also be completed for eight additional forests in the northern Sierra Nevada, four forests in the mid-coastal region in northwest California, and four southern California forests. We propose a six-step cycle of risk-based fire management that facilitates bringing a landscape closer to desired conditions, as outlined within the LMPs. The cycle consists of the following steps: 1) fire modeling, 2) asset and resource characterization, 3) effects analysis, 4) continuum analysis, 5) SFP integration, and 6) desired condition evaluation. Using a quantitative approach, this risk cycle uses location of risk and the likelihood of fire ignition, fire spread and intensity to assist managers in determining where wildfires are likely to have positive or negative outcomes on highly valued resource and assets. Using a continuum of actions ranging from full suppression to managing fires to meet protection and resource objectives, this spatially-explicit risk based

approach will allow fire managers to more effectively achieve desired conditions for a more resilient landscape.

William Aney

Making Long Term Fire Analyses Relevant to Decision Makers

Long Term Fire Assessments can be useful and effective if they are able to influence the decisions being made over the life of a fire. This presentation will cover the lessons that one long term fire analyst has learned over the past 10 years as he has strived to make long term assessments relevant to line officers, fire managers, and IMTs. The presentation draws from a number of long term assessments from the Pacific Northwest over this decade to illustrate the key points. An effective long term assessment is timely, focused on the questions that inform the decisions to be made, and supports the public's confidence in our ability to manage fires. We recognize that we need more "good fire" on the landscape, and less likelihood that a "good fire" becomes a "bad fire". Long term fire assessments are a critical part of achieving this goal, because having a solid plan is essential. As the plan is implemented over the course of a fire season, fire managers need to remain diligent to ensure that decisions are still supported by the long term plan.

Chris Dunn

How do we develop optimal incident management strategies for a new large-fire management paradigm?

Wildfire extent and intensity have increased in recent decades as the legacy of historical management interacts with a rapidly changing climate. These trends stimulated management focused on fuels reduction and forest restoration. However, landscapes are not being treated broadly enough to influence them, and costs incurred by highly-valued resources and assets and agency budgets continue to increase. Researchers and managers alike are turning towards large-fire management to expand the 'right kind of fire in the right place' as a pathway to achieve ecological and economic objectives. This requires a shift in land, resource and fire management objectives and adaptation of this complex system to a new fire management paradigm. We present challenges and opportunities for achieving this transition, including pre-suppression planning and large-fire incident management. We then propose a new dynamic, multi-response model of large fire management that considers uncertainty in land management objectives, environmental conditions and suppression resource availability, efficiency and effectiveness. This model identifies optimal management strategies that reduce impacts to HVRAs while limiting firefighter exposure to hazards, but requires improved data and modeling capacity. Integration of expert knowledge with this analytical approach will also help fire management organizations more effectively adapt to the new fire management paradigm.

Brenda Hallmark

Case study - 2015 Corner Creek Fire: Fuels treatment effectiveness and invasive species

The Corner Creek fire was ignited by lightning on June 29th, 2015 on the Ochoco National Forest. Initial efforts to control the fire were hampered by unseasonably hot, dry and windy weather conditions with daytime temperatures reaching 100 degrees and relative humidities at or near single digits. This extreme weather resulted in aggressive fire behavior making control efforts more hazardous and often ineffective. The fire continued to spread until weather conditions moderated allowing firefighters opportunities to control the fire's progression. Containment efforts were aided by utilizing previously treated areas where thinning and/or prescribed fire had occurred. However, increases in invasive plant species in historically barren sites that previously acted as barriers to fire spread negated some advantages of fuels treatments allowing the fire to quickly spread around treated areas in newly established grasses. This discussion will examine the types of fuels treatments that have occurred in this area over the past decade, the effects of these treatments on fire behavior and suppression efforts, and how invasive plants hindered suppression efforts on the Corner Creek fire.

Alex Robertson**Case Study- 2015 Corner Creek Fire: Operation Planning and Implementation**

The Corner Cr. fire was started on the eastern end of the Black Canyon Wilderness by lightning on June 29, 2015 on the Ochoco National Forest approximately 11 miles south of Dayville, OR. Because of the fire's growth potential and expected negative consequences should it reach surrounding private lands, communities, and sage-grouse habitat, the management response was to extinguish the fire before it could impact those surrounding values. Initial efforts to control the fire were hampered by unseasonably hot and dry weather with daytime temperatures reaching 100 degrees Fahrenheit and relative humidity at or near single digits. Such extreme weather resulted in aggressive fire behavior that made control efforts more hazardous and often ineffective. In these conditions, the fire continued to surge past control lines to the south for over a week, forcing firefighters to concentrate efforts on holding the fire west of the South Fork of the John Day River. By July 5th, the weather eased slightly allowing firefighters opportunities to finally control the fire's southern progression. The fire burned around 4,000 acres with the Black Canyon Wilderness. The Ochoco National Forest Supervisor along with the Incident Management Team had to decide on a long term strategy for the wilderness portion of the fire. The issues were; early in the fire season with a long summer ahead, potential draw down of Type 1 crews and aviation resources that were needed to safely operate in the wilderness, and the need to restore fire into portions of the wilderness that were currently well outside of the historic fire return interval. These discussions led us to deciding on a non-traditional strategy of preparing the road system around the wilderness and burning the interior portion. In my presentation I will discuss the strategy and the outcome for the Corner Creek Fire.

POSTER ABSTRACTS**Thursday March 24****Kayla Johnston, Andrew Merschel, John Bailey, and Rob Pabst****Historical Patterns of Stand Development in Ponderosa Forests during Natural Fire Regimes**

There is strong interest in restoring the spatial pattern and development processes in ponderosa pine forests following a century of fire exclusion in central Oregon. Restoration of relatively fine-scale (10s of acres) stand structure requires an understanding of the controls on tree establishment and the process behind formation of clumps, gaps, and individuals. Our 4ha study area in the Metolius Research Natural Area has already been stem mapped providing an opportunity to investigate the historical development of fine-scale structure in ponderosa pine forest. Specifically we examine 1) the relationship between historical tree establishment and fire and climate, 2) the temporal development over time of clumps, gaps, and individuals, 3) recruitment and longevity of snags and logs, and 4) patterns of establishment following fire exclusion. To date all live and dead trees >10 cm have been precisely mapped, we've completed a preliminary reconstruction of fire frequency (MFI~12years), and we've developed a multi-century ring-width chronology. Results can help guide prescriptions designed to reintroduce fire as a process and restore appropriate stand structure in similar ponderosa pine forests of Oregon.

Benjamin Hart, Jane E. Smith, and Daniel L. Luoma**Fuel treatments of Ponderosa pine (*Pinus ponderosa*) in the Blue Mountains of eastern Oregon: A mycorrhizal perspective**

Severe wildfires are an increasing risk as the western United States becomes hotter and dryer for longer periods annually due to the changing climate. Reduction of historically uncharacteristic woody fuels that drive large, severe forest fires is an increasing priority for forest managers. Traditionally, fuel reduction has been achieved with mechanized thinning for removing over-crowded trees and low-intensity prescribed fire to reduce woody fuels near the forest floor. However, the long-term impact of these fuel reduction treatments is

poorly understood with respect to ectomycorrhizal fungi (EMF). We quantified EMF biodiversity and abundance associated with ponderosa pine (*Pinus ponderosa*) in four randomly assigned replications of restoration treatments (thinned, burned, thinned and burned, and untreated), applied over a decade ago in the Blue Mountains of Oregon. The belowground community composition and structure of EMF at the site were characterized using molecular methods. Preliminary results indicate that species richness and abundance were similar across treatment types, and that fire effects on community composition were smaller than anticipated. Our results provide evidence that a 10+ year interval allows EMF to disseminate and re-colonize areas from which they have been removed or reduced by disturbance treatments. Knowledge of the long-term impacts of forest restoration treatments on EMF will aid in understanding the outcomes of desired management to produce stands with large-tree retention and low fuel loads.

Amanda Stamper and John Bailey

Oregon's Prescribed Fire Council: working in the future with prescribed burning and managed wildfire

As a member of the national network of prescribed fire councils, our focus in Oregon is first and foremost on the use of management-ignited fires that meet pre-planned landowner objectives. There is broad agreement within both the management and scientific communities on the effectiveness and unique benefits of prescribed burning across a wide range of Pacific Northwest ecosystems. These ecological benefits cannot be fully achieved through other, non-fire-based management approaches; restoration of cultural burning practices and fire regimes is included within this scope. We also acknowledge the very real and growing challenges facing fire and fuels managers in Oregon, particularly on federal lands, where fire seasons are increasingly long and resultant wildfires are increasingly severe, with little reprieve or optimism in sight relative to wildfire risks, budgets and personnel. Annual treatments to reduce wildfire hazard/risk account for only a small percentage of the area that needs attention and do not even compensate for continued growth of biomass/fuel. We therefore conclude that it is not feasible to fully address wildfire hazard in many areas outside of the wildland-urban interface or to significantly reduce wildfire risk across landscapes with mechanical treatments and/or manager-ignited prescribed fires. Many areas are too steep or remote for mechanical treatments, in designated wilderness or other reserved lands (where fire is the only tool for maintaining ecological health), or economically unfeasible to treat given current fiber markets and infrastructure; similarly, air quality management constraints, liability and personnel requirements frequently limit manager-ignited prescribed burning. Consequently, we recognize the need to define and market "beneficial fire" more broadly, and to regard both prescribed fire and managed wildfire as important tools for bringing fire-adapted and fire-dependent ecosystems in Oregon into a more resilient condition. This redefined relationship with fire and resultant resilient landscapes will further serve to reduce the stress on fire management systems and our larger society over time relative to current realities.

Tim Ingalsbee

A 'Leopoldian' Fire Ethic to Inspire Ecological Fire Management

Firefighters United for Safety, Ethics, and Ecology (FUSEE) is a national nonprofit organization promoting safe, ethical, ecological wildland fire management. FUSEE members include current, former, and retired wildland firefighters; fire managers, scientists, and educators; forest conservationists; and other concerned citizens who support FUSEE's vision and mission. FUSEE's primary mission is to provide public education and policy advocacy in support of the emerging paradigm that seeks to holistically manage wildland fire for social and ecological benefits instead of simply "fighting" it across the landscape. We seek to enable fire management workers to perform their duties with the highest professional, ethical, and environmental standards. Our long-term goal is the creation of fire-compatible communities of workers and citizens able to work safely and live sustainably with wildland fire. Inspired by Aldo Leopold's "Land Ethic," FUSEE advocates for a new "Fire Ethic" in fire management policies and practices: "A thing is right when it contributes to the safety of firefighters and the public, ethical use of public resources, environmental protection of fire-affected landscapes, and ecological restoration of fire-dependent ecosystems. It is wrong when it tends otherwise." This poster will display some

of FUSEE's philosophy, research, education, and advocacy projects. Elaboration of some key FUSEE concepts will be featured, including: the FUSEE triad of safety, ethics and ecology; re-identifying firefighters as fire rangers; promoting community fire preparation; creating fire-compatible communities, restoring fire-permeable landscapes, and the fire ethic for ecological fire management.

Kat Morici and John Bailey

Fuel Treatment Longevity in the Blue Mountains of Oregon

Fuel treatments are designed to reduce extreme fire behavior, promote resilient forest structure, and facilitate fire control efforts. Repeated treatments are needed to maintain desired conditions, and longevity is likely to vary with forest type and treatment approach. The Blue Mountains Fire and Fire Surrogate study site in northeastern Oregon was a prime candidate for re-measurement of existing fuel treatments in ponderosa pine and dry mixed conifer forest. In 1998, sixteen units were assigned to four treatment groups: mechanical thin, prescribed burn, both thin and burn, and control. Thinning took place in 1998, and prescribed burning in 2000. The primary research question is: How does fuel loading and understory vegetation composition vary between fuel treatments, measured 15-17 years post-treatment, in the Blue Mountains of northeastern Oregon? Treatment longevity can be examined by comparing pre- and post-treatment fuel loading and understory vegetation. My hypotheses are: 1) fuel reduction effects persist, but fuel loading is higher now than directly after treatment; 2) prescribed fire increases cover of grass and forbs; 3) shrubs are more prevalent in untreated units; and 4) invasive plant species cover is correlated with treatment intensity. Quantifying persistent changes in fuel loading and understory vegetation aids in the planning of future fuels treatments, along with scheduling maintenance of existing treated areas.

Kevin Credo and John Bailey

Trajectories of fire hazard and Pacific marten habitat following fuel treatment in Lassen National Forest

Forest managers are challenged to restore resilience in forests with an elevated risk of stand-replacing fire by using mechanical treatments and prescribed fire. However, implementation of such treatments can be constrained by mandates to conserve sensitive wildlife species. On federal forestlands in the Sierra Nevada, the Pacific marten (*Martes caurina*) is a Management Indicator Species for late-seral, closed-canopy forests. The distribution of this forest carnivore is already fragmented due to management history and land use changes. Martens avoid simplified stands created by some management activities, but the long-term comparative risk to this species of increased wildfire versus fuel reduction treatments is not clear. This research will examine the trajectories of crown fire potential and Pacific marten habitat over a 30-year period following fuel treatment in Lassen National Forest. I will simulate the effects of treatments at two scales: on representative stands selected by vegetation type and management history, and on sub-watersheds randomly selected from those with documented marten occupancy. Four treatment scenarios will be implemented at each scale: no treatment; prescribed underburn only; light thin from below with underburn; and heavy thin from below with underburn. Additionally, at the sub-watershed level 0 to 70% treatment of each unit will be simulated at 10% increments, and growth will be simulated with and without a large fire after 5 years. I hypothesize that enduring changes in crown fire potential will correspond to an extended period of marten exclusion. Light thinning from below may represent a balance between marten use and reduced fire hazard, but this effect will be short-lived. At the sub-watershed scale, I expect that 30% or more of the planning unit needs to be treated in order to significantly reduce fire behavior. In scenarios with fire after 5 years, this will translate into a long-term benefit for marten habitat.

Dana Skelly and E. Clark, S. Bush, B. A. Myers, K. Rappelyea, J. Offutt, K. Percy, T. Boyce

Innovations and Lessons Learned in Post Fire Fuels Treatment Effectiveness Assessments, Malheur National Forest, Canyon Creek Complex

The 2015 Canyon Creek Complex burned over 110,000 acres in the heart of Grant County, Oregon. Most of this fire occurred on the Malheur National Forest. While more than half of the forest acres burned were

designated as wilderness, the remaining 41,000 acres were in the Wildland Urban Interface and tested over 11,000 treated acres. Most of these treatments represented the earliest projects collaborated on by the Malheur and Blue Mountain Forest Partners (BMFP). Thorough assessments of the treatments were critical for adaptive management as well as to honor these early collaborative efforts. To complete this work, combined with extensive Burned Area Emergency Response (BAER) work and the existing “Green Tree” program, new efficiencies were developed both in terms of technological application, integration across disciplines, and transparent dialogues. We also learned valuable lessons in terms of data reporting that will inform future projects. In this presentation we give an overview of these innovations.



Photo by: Maret Pajutee