Framework for post-fire restoration in California's national forests

Presenter's Name: Marc Meyer
Presenter's Company/Employer: USDA Forest Service Pacific Southwest Region
Presenter's Title: Ecologist
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Symposium - select this if you are part of an organized session

Abstract:
Increasing extent and frequency of high severity wildfires and other large-scale disturbances pose a significant threat to California's ecosystems. This is apparent in forest, chaparral, and sagebrush steppe landscapes, where departure from natural fire regimes may result in large-scale alteration of terrestrial ecosystems and deterioration of the services they provide. Based on these trends and a broader consideration of sustainability, there is a growing need for a comprehensive and science-based approach to post-fire management. We propose a framework to guide the development of post-fire restoration strategies on the national forests in California. The framework is founded on a set of guiding principles and a flexible five-step process that leads to the development of restoration planning and projects. The restoration framework can inform future post-fire management, monitoring, and research in California's diverse ecosystems. Coauthors: Jonathan W. Long, Hugh D. Safford, Becky Estes, Kyle Merriam, Nicole Molinari, Shana Gross, Michelle Coppoletta, Sarah Sawyer, Ramona Butz, Amarina Wuenschel, Angela White, Brandon Collins, Malcolm North, Scott Conway, Michele Slaton, Clint Isbell, Dana Walsh, and Emma Underwood

Bandits, Birds, Burning, and Beliefs: The Story of Florida Scrub Jays at Jonathan Dickinson State Park

Presenter's Name: Rob Rossmanith
Presenter's Company/Employer: Florida Park Service
Presenter's Title: Park Biologist
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Individual Presentation

Abstract:
Jonathan Dickinson State Park (JDSP) is a 4,250 hectare property in south-eastern coastal Florida. JDSP is one of 175 state parks in the Florida Park Service system, which as an agency won its fourth National Gold Medal in 2019. JDSP annually welcomes 300,000 visitors and includes a rare ecosystem, Florida scrub. One of the inhabitants of Florida scrub is the Florida Scrub Jay, a Florida endemic bird that is Federally Threatened. The population of the bird, within JDSP, peaked in the early 1990s due to several wildfires in the 1970s and 1980s and then crashed in the early 2000s. Persistent use of prescribed fire and interpretation of these efforts to the public has created an accepting public outlook which supports the parks' prescribed burning. Due to prescribed fire in the scrub Florida Scrub Jays now thrive and are rebounding in numbers, which we know because of supervised citizen science. The park is a model for using prescribed fire in urban settings and in leveraging community efforts to monitor imperiled species.

Fire restoration and consequences for ecosystem management

Presenter's Name: John Williams
Presenter's Company/Employer: University of California, Davis
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Symposium - select this if you are part of an organized session

Abstract:
In the western United States and in many other fire-adapted landscapes, decades of fire suppression policies have left forests out of equilibrium with natural fire regimes. Reintroducing fire to these landscapes under controlled conditions offers a path to restoring affected ecosystems and to achieving a variety of ecological, conservation, land management and risk abatement objectives. This symposium will specifically address the use of prescribed fire within or bordering public lands and protected areas, and how these and related management actions can be leveraged for multiple benefits. Speakers will describe how they integrate mixed- or limited-severity burn objectives, fuels reduction, timber management, habitat protection and other goals into burn plans. They will also discuss how they control for the vagaries of conditions that add risk and uncertainty to their ability to burn. Additionally, in the panel discussion, speakers and participants will talk about navigating the constraints of weather, smoke, personnel shortages, and narrow burn windows, as well as how to deal with out-of-control burns, damage control and public relations. Finally, participants will be encouraged to share ideas on the use of creative approaches and collaborations with communities, NGOs, the private sector and multiple land management agencies to improve the probability of executing a successful burn.

Symposium Description:
This symposium will focus on how fire can be reintroduced to fire-adapted landscapes in the form of prescribed burns to achieve a variety of ecological, conservation, land management and risk abatement objectives. Talks may span agency, academic, and other land management perspectives, as well as the application of fire across a range of forest types. Speakers are encouraged to give real-life examples of how prescribed fire and other fuel mitigation activities can be used to meet multiple objectives while limiting risk and minimizing disturbance to and complaints from the inhabitants of surrounding areas.

Implications of changing fire regimes for Sierra Nevada bat and bird communities

Presenter's Name: Zack Steel
Presenter's Company/Employer: UC Berkeley
Presenter's Title: Postdoctoral Researcher
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Symposium - select this if you are part of an organized session

Abstract:
Managing ecosystems for multiple objectives and multiple taxa is challenging under any circumstance but especially given uncertainties surrounding how biological communities will respond to changing fire regimes. To inform conservation and management efforts we studied the response of bats and birds to fire-induced changes in habitat and landscape pattern. For the bat community we conducted acoustic surveys in and around three wildfire areas during 2014-2017 in conifer forests of California's Sierra Nevada. We tested effects of mean burn severity and its variation, or pyrodiversity, on bat occupancy and diversity using hierarchical models that account for imperfect detection. Of the 17 species that occur in the region, occupancy rates increased with severity for at least 7 and with pyrodiversity for 2. Species richness increased from 8 species in unburned areas to 11 species in moderate- to high-severity burned areas with high pyrodiversity. We contrast these results with studies of avian post-fire habitat relationships in the region. While many bats appear to benefit from wildfire, even high-severity wildfire, bird responses are more mixed. As wildfires continue to grow larger with more area at risk of type conversion from forest to sustained early successional habitat, some species will benefit in the short-term while others lose habitat. Managing for resilience requires understanding how altered disturbance regimes are affecting all components of an ecosystem. For fire-adapted systems, actions that encourage mixed-severity wildfire and pyrodiversity will likely benefit the most species across taxa by limiting habitat extremes such as overly dense, fire-suppressed forests and very large high-severity patches. Coauthors: Brent Campos Ryan Burnett Winifred Frick Alissa Fogg Jay Roberts Hugh Safford

Controls on plant-soil feedbacks of herbaceous community following fire in the Ruby Mountains, NV, USA

Presenter's Name: Katherine Strain
Presenter's Company/Employer: University of Nevada, Reno
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Poster Presentation

Abstract:
Erin J. Hanan, University of Nevada, Reno As larger and more frequent fires continue to shape landscapes in the Great Basin and across the western United States, it is increasingly important to understand how fire influences ecosystem processes such as carbon and nitrogen retention, streamflow, and water quality. Studies that couple carbon and nitrogen dynamics with vegetation recovery following fire can help us identify when and under what circumstances wildfires are changing the structure and function of Great Basin plant communities, ecosystems and watersheds. To examine how burn severity and soil moisture influences the composition of recovering herbaceous species and soil biogeochemical dynamics, we sampled vegetation and soils from burned and unburned plots following a wildfire that burned a portion of Lamoille Canyon Recreation area outside of Elko, NV, USA. We quantified the cover, presence, and biomass of herbaceous species and analyzed foliar carbon and nitrogen content at the peak of the first postfire growing season and the following year. We also collected mineral soil and forest floor samples (where present) and measured their carbon and nitrogen content, microbial biomass, pH and net mineralization and nitrification rates. Preliminary data show that in the first year post-fire, herbaceous species composition differs between burned and unburned plots and that soil microbial biomass is negatively associated with burn severity. These results, though preliminary, contribute to our understanding of how fire influences herbaceous community dynamics and soil biogeochemical dynamics in Eastern Nevada. Future work will involve continued sampling of vegetation, soils and forest floor. We will also use our results to inform an ecohydrological model that we will use to examine possible effects of changing climate, plant invasion, and fire regimes on ecosystem processes.

Following fire with fire: fire as a key restoration tool in areas affected by California's largest wildfire

Presenter's Name: Gabrielle Bohlman
Presenter's Company/Employer: USDA Forest Service
Presenter's Title: Ecologist
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Symposium - select this if you are part of an organized session

Abstract:
During the summer of 2018, the Ranch Fire burned over 410,000 acres in the northern California Coast Ranges, about 288,000 of which are on the Mendocino National Forest. The Ranch Fire was the largest fire in California history. The fire burned with varying intensity, leaving a mosaic of burn patterns on the landscape that ranged from unburned islands to large areas where tree canopies were completely consumed. In order to help managers with the task of restoring this post-fire landscape, I used the US Forest Service Region 5 Post-fire Restoration Framework to develop a restoration strategy for yellow pine and mixed conifer forests within the fire perimeter. The resulting strategy identifies the use of prescribed fire and managed wildfire as a key tool for restoring large portions of the Ranch Fire footprint. This talk will provide a brief overview of the development of the Ranch Fire post-fire restoration strategy followed by specific examples for how the Forest plans to use fire in their restoration efforts.

Springs Fire Case Study: The importance of prescribed burn monitoring for reaching long-term ecological goals.

Presenter's Name: Ashley Grupenhoff
Presenter's Company/Employer: UC Davis
Presenter's Title: Graduate Student
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Symposium - select this if you are part of an organized session

Abstract:
In late July of 2019, the Inyo National Forest contacted the California prescribed-burning monitoring team (PBMT) about the potential for deployment to the Springs Fire NE of Mammoth Lakes, which was being managed for resource benefit. The PBMT is a joint effort by CalFire and the Safford lab at the University of California-Davis and is intended to produce a database of ecosystem conditions and fire behavior resulting from prescribed burning and to help California tie these findings to climate change adaptation, carbon capture, and environmental sustainability objectives. The PBMT worked on the ground with fire-suppression and burn teams tasked with managing the fire to sample forest and fuels conditions immediately before, and immediately after fire passage. The focus was on areas within the predicted final fire perimeter that had been treated with prescribed fire in previous years. High levels of cooperation between the PBMT and fire management personnel on the ground led to important learning on both sides (e.g., fire crews received informal training in fuels and forest structure measurement, and PBMT staff with red cards received informal training in firing techniques). Plot data were fed to the air quality monitoring team working on the fire which resulted in more accurate and credible air quality predictions. Additionally, a terrestrial LiDAR sampling effort was undertaken by a team from the University of Nevada-Reno to better quantify preburn fuels. Finally, after follow up sampling this season (2020 and continuing for a few years thereafter), the Inyo National Forest will receive a report as to the effectiveness of prescribed fire treatments in reducing fire severity, conserving forest carbon, and outcomes on ecosystem condition due to subsequent fire. The Springs Fire provided an outstanding and, to this point, unique opportunity to conduct real-time collaboration between scientists and managers. We hope to use lessons-learned from the Springs Fire to make this sort of science-management collaboration more likely in the future. I will present the outcomes of this collaboration, including initial data, to demonstrate the importance of on the ground monitoring before, during, and after burning events.

It's now or never: the narrowing window of opportunity for maintaining fire resilience in a restored old-growth stand

Presenter's Name: Michelle Coppoletta
Presenter's Company/Employer: USDA Forest Service Region 5 Ecology Program
Presenter's Title: Ecologist
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Symposium - select this if you are part of an organized session

Abstract:
The restoration of forest structure, which was historically created and maintained by frequent fire, has become a central tenet of forest management on public lands. However, information about vegetation and fuel succession in restored stands, as well as the influence of these variables on the longevity of fire resilience, is currently incomplete or lacking. The Beaver Creek Pinery in the Ishi Wilderness of California is frequently cited as a contemporary example of a heterogeneous wildfire-resilient forest with structural attributes that are characteristic of historical frequent-fire ponderosa pine forests. We examined stand-level and landscape-scale changes in forest structure, species composition, and surface fuels in this contemporary reference site by revisiting plots that were established following a 1994 wildfire. We then used this data in forest growth models to project future changes in stand structure over time and evaluate potential fire behavior and fire effects under different fire weather scenarios. In the 22-year absence of fire, the Beaver Creek Pinery experienced substantial infilling of canopy gaps, declines in oak regeneration, and increases in the size and density of tree clusters. Despite these changes, forest conditions are currently considered within the historical range of variability for these forest types and are predicted to be resilient to wildfire in the near-term. However, our modeling of future stand conditions and potential fire risk also suggests that this resilience may be short-lived, with crown fire becoming the predominant behavior in as few as ten years. As vegetation and fuels develop, the effectiveness of prescribed burning at maintaining and restoring desired conditions, will also diminish. Burning in the next 10-20 years, under controlled conditions, will likely be the most effective strategy for reducing surface fuels and small trees, and for maintaining the unique structural heterogeneity of this ecologically significant reference stand. (Co-authors: Michelle Coppoletta, USDA Forest Service Region 5 Ecology Program; Eric Knapp, USDA Forest Service Pacific Southwest Research Station; Natalie C. Pawlikowski, USDA Forest Service Pacific Northwest Research Station; Alan H. Taylor, The Pennsylvania State University)

Estimating the Impacts of Wildfire on Ecosystem Services in Southern California

Presenter's Name: Emma Underwood
Presenter's Company/Employer: University of California, Davis
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Individual Presentation

Abstract:
Emma C. Underwood, University of Davis, California, USA and Hugh D. Safford, USDA Forest Service Pacific Southwest Region, California, USA Chaparral-type shrublands characterize the world's Mediterranean-type climate regions. In southern California they are the most extensive ecosystem and dominate the four southern USDA Forest Service National Forests. Wildfire is a natural disturbance in California's shrublands and critical for its healthy functioning. However, a rise in anthropogenic ignitions has resulted in increased fire frequency, which is having disastrous effects on property and human lives and incurring millions of dollars in suppression costs. Less obvious, though, are the intangible environmental impacts of wildfires â€“ the consequences on the provision of ecosystem services to the millions of people who live in close proximity. We developed a web mapping tool to quantify fire impacts on six ecosystem services: carbon storage, water runoff and groundwater recharge, sediment erosion, recreation, and biodiversity. The removal of vegetation increases water runoff, recharge and sediment erosion post-fire, and decreases carbon storage immediately after. Moreover, frequent short-interval fire is causing the type-conversion of native shrubs to invasive annual grasses. Quantifying the impacts of wildfire on ecosystem services in addition to routine fire suppression expenses is increasingly recognized as an important component of natural resource management on public lands in southern California. In addition, assessing areas of high ecosystem service provision can help prioritize areas for post-fire management activities, such as stabilizing slopes in areas of high erosion risk, thereby helping to ensure their long-term provision.

Retrospective analysis of burn windows in the Lake Tahoe Basin

Presenter's Name: Randy Striplin
Presenter's Company/Employer: USFS R5
Presenter's Title: Regional Fuels Planner
Co-Presenter's Name: Stephanie McAfee
Co-Presenter's Company/Employer: University of Nevada, Reno
Co-Presenter's Title: Associate Professor, Nevada State Climatologist
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Symposium - select this if you are part of an organized session

Abstract:
Prescribed fire is an essential ecosystem management tool in the Sierra Nevada, but it is relatively underused because of the number of conditions that need to co-occur to burn. Assessing the likelihood of burn windows -- days on which weather is in prescription, air quality regulators permit burning, and sufficient personnel and other resources are available -- is useful for managers planning and implementing a prescribed fire program. To assess burn window patterns in the Lake Tahoe Basin, this study evaluated the daily occurrence and co-occurrence of 1) burn permits granted by the California Air Resources Board, 2) weather within burn plan prescription at local RAWS stations, and 3) local or National Preparedness level less than 3 from 1999-2019. Burn windows were most frequent in the spring and autumn and far less common during the summer or winter. There was considerable interannual variation, even in months when burn windows were relative common. At least part of this interannual variability was due to changes in air quality permitting standards in 2008 that allowed burning under a wider range of conditions. This case study demonstrates how simple planning tools developed from readily available data can be used to identify underutilized burn windows, evaluate regulatory and resource changes that could increase burning opportunities, and provide insight into the research needed to confidently take exploit winter and early spring burn windows that may become more common as temperatures rise.

Effects of plant functional groups determine 10-year sagebrush recovery following fuels treatments, A regional study.

Presenter's Name: David Board
Presenter's Company/Employer: USDA Forest Service, Rocky Mountain Research Station
Presenter's Title: Ecologist/Data Analyst
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Poster Presentation

Abstract:
Many sagebrush ecosystems in western North America are at risk of developing invasive grass-fire cycles prompting management aimed at increasing resilience to wildfire and resistance to invasive annual grasses. Managers implement large-scale fuel treatments to reduce fire risk by decreasing woody fuels and increase recovery potential by promoting native perennial herbaceous species that recover after fire. Responses to these treatments are variable and little is known about long term effects on recovery of keystone sagebrush species. The Sagebrush Treatment Evaluation Project (SageSTEP) was established to evaluate effectiveness of woody fuels treatments (prescribed fire, mechanical, herbicides) in sagebrush ecosystems and now has long-term (10 yr) data on treatment effects. We used path analyses to evaluate effects of community interactions on sagebrush cover and density for sites exhibiting pinyon - juniper expansion and cheatgrass invasion. We included 6 discrete time-steps ÃƒÂ¢Ã¢â€šÂ¬' pretreatment and 1, 2, 3, 6 and 10 years after treatment. We asked two questions. (1) How did cover of the dominant plant functional groups influence post-treatment sagebrush population dynamics over time? (2) How did population responses to treatment differ on relatively cool and moist pinyon and juniper expansion sites and warm and dry sagebrush sites exhibiting cheatgrass invasion? Preliminary results indicate that in controls sagebrush cover and density was consistent over the ten years while annual grass cover increased for both expansion sites and invasion sites. Density and cover of sagebrush in fire treatments at expansion site types increased slowly over the ten years after the initial reduction. Sites with the highest residual sagebrush cover recovered best. Pretreatment sagebrush cover negatively affected perennial native grasses, which negatively affected on cheatgrass, indirectly linking pretreatment sagebrush cover to post-treatment cheatgrass invasion. Mechanical treatment of expansion sites had little impact on sagebrush density and cover. Mowing treatments in the invaded sites reduced sagebrush cover and density neither of which recovered from the treatment over the ten years. Initial analyses of big sagebrush sites exhibiting cheatgrass invasion indicated that tebuthiuron application gradually reduced sagebrush density over time. Competitive interactions among sagebrush, perennial native grasses, and cheatgrass changed following treatment. Effects of sagebrush cover were reduced and effects of perennial native grasses on cheatgrass became apparent. Management implications are that adequate residual sagebrush cover post-treatment will increase sagebrush recovery, while adequate perennial native grass cover will reduce cheatgrass.

The heat is on. Cheatgrass engineered habitats are thermally unsuitable for shrub dependent Great Basin Reptiles

Presenter's Name: Gareth Blakemore
Presenter's Company/Employer: McGinley and Associates, Inc.
Presenter's Title: Lead Biologist
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Individual Presentation

Abstract:
Co-authors: Chris R. Feldman - University of Nevada, Reno; Chris M. Gienger - Austin Peay State University. The altered structure and function of cheatgrass (Bromus tectorum) engineered habitats have been implicated in biodiversity reductions throughout the Great Basin. Yet, an understanding of the mechanisms driving these losses is still lacking. Design and implementation of conservation plans requires an understanding of these local scale mechanisms. We have quantified significant declines in reptile abundance and diversity across cheatgrass dominated landscapes in the northwestern Great Basin Desert. We examined a likely mechanism behind these declines: that the state change from Great Basin sagebrush habitat to cheatgrass dominated landscapes has substantially altered the thermal regimes required by desert lizards. We deployed arrays of operative temperature models across NW Nevada to quantify the thermal regimes of both native-shrub and cheatgrass-invaded habitat types. These data were analyzed using several indices of habitat thermal quality and compared against published values of the thermal tolerances for a common and well-studied lizard species of the region, the western fence lizard (Sceloporus occidentalis). As a whole, cheatgrass habitat is significantly warmer than shrub habitat and represents a landscape in which S. occidentalis is likely to be thermally stressed. In particular, there are fewer optimal thermal patches and a significant reduction in the amount of activity S. occidentalis may achieve in cheatgrass habitat. The loss of shrub cover in cheatgrass landscapes represents a substantially increased risk of thermally induced death for this species. Our data show that cheatgrass habitat is thermally unsuitable for at least one species (Sceloporus occidentalis) and suggest that the altered thermal regime of cheatgrass engineered habitats is a mechanism driving the declines in Great Basin reptile biodiversity.

Fire severity and productivity influence diversity patterns in

Presenter's Name: Emily Brodie
Presenter's Company/Employer: UC Davis Graduate Group in Ecology
Presenter's Title: Graduate Student
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Symposium - select this if you are part of an organized session

Abstract:
In subalpine forests of the North American Mediterranean climate zone, climate-fueled changes in snowpack and growing season are contributing to larger and more frequent fire events. Changing fire regimes have resulted in biodiversity declines in lower elevation mixed conifer forests, which have low resilience to large patches of high severity fire. However, the risk of high severity fire to diversity in Mediterranean-type subalpine systems is uncertain. The influence of disturbance severity on species diversity is expected to depend in part on ecosystem productivity, but this theory has not been adequately tested in the context of fire and forest ecosystems. This study aims to help elucidate the effect of productivity on the species richness-fire severity relationship as well as to understand the effect of fire severity on species richness in Mediterranean-type subalpine forests. To answer these questions, we sampled understory richness in plots spanning a wide range of fire severity and across 13 fires in California's subalpine forest. In general, post-fire species richness increased with fire severity and decreased with productivity. The interaction between fire severity and productivity was also significant, with species richness increasing more across the fire severity spectrum in high productivity plots than in low productivity plots. Further, high severity plots had 3 times as many unique species as unburned plots and 2 times as many as low severity plots, suggesting that increased richness in high severity plots is driven by flora that can take advantage of the post-fire environment. Accordingly, the number of species with the classic colonizer traits of short lifespan and long-distance dispersal ability increased significantly with fire severity. Our results suggest that ecosystem productivity is an important predictor of the richness-fire severity relationship and that the projection of potentially higher fire severity in high elevation forests may be neutral to positive for species richness.

Ecosystem impacts of managed wildfire in Yosemite National Park

Presenter's Name: Scott Stephens
Presenter's Company/Employer: UC Berkeley
Presenter's Title: Professor of Fire Science
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Symposium - select this if you are part of an organized session

Abstract:
Since implementing policies to allow wildfires to burn the Illilouette Creek basin over 45 years ago, land managers have allowed fire regimes to return to a near natural state. Over the last 20 years we have done research examining the factors impacting fire severity, the proportions of landscape burned at different severities, how realistic our understanding of fire history is based on fire scar reconstruction, how vegetation states have been changed by a functioning fire regime, and how > 40 fires impacted the mountain hydrology of this 15,000 ha watershed. These questions, and their subsequent answers, are critical to furthering our understanding of how fire historically shaped the landscape and how it could continue to do so today. The Illilouette Creek basin provides hope for how upper montane forests in the Sierra Nevada could be managed into the future.

Wildfire effects on belowground carbon and nitrogen cycling and microbial biomass in the Sierra Nevada

Presenter's Name: Mary Brady
Presenter's Company/Employer: University of Nevada, Reno
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Individual Presentation

Abstract:
Coauthors: Erin Hanan, Jessica Miesel, Matthew Dickinson, Jonathan Greenberg, Carol Ewell, Laura Wade Fire is a key factor regulating carbon (C) and nitrogen (N) retention in soils of the Sierra Nevada. As fire regimes shift in response to climate change and management, it is vital to understand how belowground C and N cycling will respond. However, studying fire is challenging. Fire timing and location are difficult to predict and as a result, researchers must often rely on space-for-time substitutions to evaluate fire effects. Unfortunately, these substitutions make teasing apart fire effects from other drivers challenging. To eliminate such problems, many studies have focused on prescribed fire, which enables researchers to conduct pre- and post-fire measurements at a known location. However, prescribed fires differ from unplanned fires (hereafter called wildfires) in their severity, heterogeneity, and spatial scale. Thus, to understand the effects of wildfire on soils, we need to incorporate location specific pre- and post-fire sampling. Here, we collected soil samples in the path of advancing wildfires in the Sierra Nevada and then resampled the sites immediately post-fire, one month, and six months later. Additionally, because some of our sampling sites did not burn, we were able to examine the role of wildfire alongside seasonal processes that influence soil dynamics. We analyzed the forest floor and mineral soil for N mineralization and nitrification rates, pH, microbial biomass, and total C and N. Preliminary results show pronounced spikes in pH following fire for both mineral soil and forest floor. The magnitude of these spikes increased with fire severity and were larger in the forest floor than in mineral soil (i.e., 4 and 0.7 pH unit increases, respectively, in the high severity plot). Our results also suggest that microbial responses vary with fire severity: microbial biomass was higher in mineral soils that burned at high severity while plots that burned at low severity had similar mineral soil microbial biomass to unburned plots one month post fire. Forest floor microbial biomass however, was lowest in the high severity fire plots. Preliminary results also indicate different biomass response to spring thawing with larger increases in areas that did not burn. Our current work seeks to link soil temperature measurements from wildfires with belowground biogeochemical fluxes to quantify the effects of fire energy. These measurements are crucial for projecting how carbon and nitrogen retention will respond to future fire and climate conditions.

Prescribed burn monitoring in California forests

Presenter's Name: John Williams
Presenter's Company/Employer: University of California, Davis
Co-Presenter's Name: Joe Restaino
Co-Presenter's Company/Employer: CalFIRE
Co-Presenter's Title: Senior Environmental Scientist, FRAP
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Symposium - select this if you are part of an organized session

Abstract:
After a century of fire suppression, there is a growing understanding that fire plays a natural and necessary part in many California ecosystems. Even with interest on behalf of government agencies, NGOs and academic researchers, there is a lot to be learned about the art and science of reintroducing fire to fire-adapted landscapes. Given the backlog in forested areas that are long past their historic fire return intervals, how do we prioritize where, when, and how much to burn? How should we apply controlled fire to reduce the risk of catastrophic fire, while managing the inherent risks of conducting prescribed burns and the negative effects of the smoke they create? What are the impacts of prescribed fire on different forest types with respect to tree density, timber productivity, species composition, wildlife habitat and forest heterogeneity? How frequently, how many times, and at what severity do we need to burn before we start seeing a return to pre-suppression forest conditions and the ecosystem service benefits that come with restored fire regimes? These are some of the questions that CalFIRE and researchers from UC Davis are trying to answer in a multi-year prescribed burn monitoring partnership. Working together, these two institutions are leveraging resources and drawing on a broad joint network of land managers to identify sites on private, state and federal forested lands where they are setting up a system of permanent burn monitoring plots. So far, field teams have put in pre- and post-fire plots in multiple sites across the Sierra Nevada, with plans to extend the plot network elsewhere across the State. In this talk, we describe the goals, design and progress of this partnership, and discuss its role in raising awareness about and the application of prescribed fire as a management tool for risk abatement and ecological benefit.

Symposium Description:
This symposium will focus on how fire can be reintroduced to fire-adapted landscapes in the form of prescribed burns and use of natural ignited wildfires to achieve a variety of ecological, conservation, land management and risk abatement objectives. Talks will span agency, academic, and other land management perspectives, as well as the application of fire across a range of ecosystem types. Speakers will give real-life examples of how fire and can be used to meet multiple objectives while limiting risk and minimizing disturbance to and complaints from the inhabitants of surrounding areas.

Linking wildland fuel characteristics to smoke emissions: Development of a compact smoke measurement instrument

Presenter's Name: Kellen Nelson
Presenter's Company/Employer: University of Nevada-Reno
Presenter's Title: Postdoctoral Scholar
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Symposium - select this if you are part of an organized session

Abstract:
Coauthors: Adam Watts, Jayne Boehmler, Vera Samburova, Andrey Khlystov, Hans MoosmÃ¼ller, Eric Wilcox (Desert Research Institute, Reno, NV). Smoke emissions from wildland fire can result in poor air quality that threatens human health and therefore requires planning to mitigate effects from prescribed burning and monitoring to inform air resource managers during periods of active burning. To better understand how smoke emissions vary with fuelbed characteristics and environmental conditions, we developed and tested a compact instrument package that integrates direct air sampling with air quality and meteorology sensing, suitable for in situ data collection within burn units and as a payload on multi-rotor small unmanned aircraft systems (sUASs). The instrument employs co-located sensors to collect temporal profiles of carbon dioxide, carbon monoxide, and particulate matter with a microcontroller-based system that includes independent data logging, power systems, radio telemetry, and a global positioning system. Sensor data facilitates precise remote canister collection of air samples suitable for laboratory analysis of volatile organic compounds (VOCs) and other major and trace gases. The sensing system was tested at the Sycan Marsh Preserve, OR during controlled burns in a ponderosa pine/western juniper (Pinus ponderosa/Juniperus occidentalis) forest type with a sagebrush/bitterbrush (Artemisia tridentata/Purshia tridentata) shrub understory. The sensing device was hung at 8-m height to monitor the temporal profile of gas concentrations as a head fire passed under the device. Calibrated carbon monoxide concentrations in the smoke plume rose to 197 ppm and carbon dioxide concentrations rose to 6330 ppm. Modified combustion efficiency estimates ranged from 0.84 to 1.00, similar to other studies that observed flaming combustion in senescent grass and pine litter fuel types. The canister sampling system was tested onboard a sUAS at the Tall Timbers Research Station, FL during controlled burns in a longleaf pine-wiregrass (Pinus palustris/Aristida beyrichiana) forest type. We collected five canister samples for VOC determination by remotely triggering the valve system from outside the burn perimeter. Prefire ambient samples contained total VOC concentrations of 0.8 to 1.8 ppbv, whereas samples collected during active burning contained 7.3 to 24.3 ppbv. Six VOCs (i.e., iso-pentane, benzene, 1-butene + isobutene, 1,3-butadiene, toluene, and styrene) accounted for ~71% and 15 VOCs accounting for ~90% of total VOCs observed in the smoke plume. Understanding how fuel characteristics influence smoke composition and production is critical for fire and fuels management applications used to reduce contemporary heightened fuel loadings and to restore historic ecosystem composition, structure, and function.

Key planning tools for the Lake Tahoe West Restoration Partnership: Resilience Assessment and Restoration Strategy

Presenter's Name: Shana Gross
Presenter's Company/Employer: USFS
Presenter's Title: Ecologist
Presenter's Email: shana.gross@usda.gov
Co-Presenter's Name: Sarah Di Vittorio
Co-Presenter's Company/Employer: National Forest Foundation
Co-Presenter's Title: Northern California Program Manager
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Symposium - select this if you are part of an organized session

Abstract:
The Lake Tahoe West Restoration Partnership (LTW) is a multi-agency, collaborative effort to increase the resilience of the forests, watersheds, recreational opportunities, and communities on Lake Tahoe's west shore. Lake Tahoe West's resilience-based approach emphasizes scaling up and accelerating restoration efforts to address a large landscape and all land ownerships, planning for a dynamic and changing future, and addressing a comprehensive set of landscape values. Through an iterative process, with manager, stakeholder and scientist input, ecological and social landscape values and services, and primary disturbances that are important to understand the current state of resilience of the west shore were identified and evaluated in a Landscape Resilience Assessment (LRA). The LRA used quantitative and spatially-explicit data to compare current conditions to historic and/or contemporary reference conditions to determine which portions of the landscape and which landscape values and services are the least resilient to disturbances. The LRA results indicated that much of the Lake Tahoe Basin's west shore is likely not resilient to a variety of disturbances. The LRA, combined with computer modeling and expertise to better understand risks and likely outcomes of different treatment approaches, provided the foundation for development of a science-based Landscape Restoration Strategy (LRS). The LRS guides watershed and forest restoration approaches on the west shore over the next two decades to increase social-ecological resilience. The LRA and LRS are foundational products that support landscape level planning. They reflect an extraordinary amount of collaboration and consensus building among agencies, scientists, and stakeholders. This talk will discuss how the LRA and LRS were developed, focusing on key components of the methods, and how the results were translated into actionable management projects.

Leveraging monitoring, modeling, and messaging to minimize smoke impacts during fire restoration

Presenter's Name: Leland Tarnay
Presenter's Company/Employer: USDA Forest Service, Pacific Southwest Region (Region 5)
Presenter's Title: Ecologist
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Symposium - select this if you are part of an organized session

Abstract:
Smoke from wildland fire, if unmanaged, can have substantial impacts on air quality and public health. Historically, the way such impacts have been avoided, especially during prescribed fire, has been to minimize acres burned to a level that nearly assures no impacts to air quality beyond the local area. However, minimizing acres rather than impacts also potentially minimizes the scale at which subsequent fire will be slowed or suppressed, especially for those projects which have the purpose of creating, or building on landscape-scale fire mosaics. We discuss the current smoke management framework and toolbox used in California, and review case studies selected from over two decades of smoke monitoring where that toolbox has been used. We show how wildfires (and Rx fires), proactively managed to moderate spread rates and severity patterns, rarely create the regional-scale impacts we've seen from the latest megafires and likely result in daily emissions rates that the airshed can readily disperse. Thus, a strategy for managing spread rate (actively or passively, as appropriate) such that dispersion and emissions are well-matched, and messaging to warn people where and when any smoke still does occur appears to be one of the most promising ways to increase the pace and scale of the fire effects that reinforce resilient forests. In this way, healthier forests can lead to healthier air.

Increasing Prescribed Fire Capacity and Quality in a Changing World

Presenter's Name: Sasha Ernst
Presenter's Company/Employer: Florida Park Service
Presenter's Title: Fire Management Coordinator
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Individual Presentation

Abstract:
The Florida Park Service (FPS) is a four-time National Gold Medal winning state park system consisting of 175 state parks, trails, and historic sites spanning nearly 800,000 acres. The FPS mission to provide resource-based recreation while preserving, interpreting, and restoring natural and cultural resources in Florida is quite a challenge to meet while also hosting over 30 million visitors in 2019. Florida is a major tourism destination, has a booming housing market and economy, and has an ever-increasing resident population of over 20 million people. Many state parks are in, or near, the wildland-urban interface providing significant challenges for engaging community support, smoke management, and ensuring public safety. Despite these challenges, records for total acreage burned have been set in the past three years, and last year was the FPS's most successful prescribed fire season ever resulting in 96,417 total acres burned. FPS is accomplishing on-average an approximately three-year fire return interval while actively managing nearly 300,000 acres of fire-dependent natural communities. We are increasing capacity (burning more acres) and focusing on quality (meeting ecological objectives) by optimizing cooperation, effective prescriptions, and implementation window management. I will explore some of the strategies, successes, and failures of FPS burning efforts in order to share lessons learned and contribute to initiatives to help other land managers realize our common goal of maximizing prescribed fire to promote healthy, fire-maintained natural communities.

Modeling social-ecological systems as part of the Lake Tahoe West Restoration Partnership

Presenter's Name: Jonathan Long
Presenter's Company/Employer: USDA Forest Service Pacific Southwest Research Station
Co-Presenter's Name: Patricia Manley
Co-Presenter's Company/Employer: USDA Forest Service Pacific Southwest Research Station
Co-Presenter's Title: Program Manager, Conservation of Biodiversity
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Symposium - select this if you are part of an organized session

Abstract:
Jonathan W. Long, Patricia Manley, Charles Maxwell, Robert Scheller Collaborations between scientists and land managers are increasingly important to guide large landscape restoration efforts. Efforts to promote social-ecological system resilience depend upon scientific frameworks for evaluating how different potential management strategies will influence ecological and social indicators across broad spatial and temporal scales. These efforts involve collectively identifying indicators and thresholds that reflect desired future outcomes and then projecting how different management strategies will perform given changes in future climates. As part of the Lake Tahoe West Restoration Partnership, a science team worked with resource managers and stakeholders to model future forest ecosystem dynamics in response to five management scenarios over 100 years across a 60,000 acre landscape in the Lake Tahoe basin of California and Nevada. Forest growth and fire dynamics were modeled using the LANDIS-II landscape platform, on which we based additional modeling to evaluate changes in wildlife habitat, water, and economics. We evaluated how the different management strategies would affect outcomes important to stakeholders, including abundance of old trees, wildlife habitat, fine sediment, water quantity, implementation costs, fire characteristics and threats, air quality, cultural resource quality, and carbon sequestration. The scenarios spanned a wide range of management inputs, from wildfire-suppression only, fuels reduction near communities, moderate and extensive restorative thinning and/or prescribed burning, all under different future climates. The team found that moderate and extensive thinning or burning treatments would promote overall objectives better than no treatment or community protection only, with the exception of carbon sequestration and treatment costs. Over the long-term, more treatment would reduce the wildfire threat to communities, the risk of unnaturally large patches of high intensity burns, and days of extreme emission of smoke into downwind communities. More extensive treatments were projected to increase water yield and promote the growth and occurrence of pine and aspen trees. The modeling considered how increased treatments, especially burning, might promote cultural resources important to the Washoe Tribe, who consider Lake Tahoe the center of their ancestral home. Ramping up the amount of prescribed burning, however, would pose risks to water and air quality, which could be mitigated with careful planning. Managers and stakeholders used the findings of this integrated modeling effort to inform the design of a landscape restoration strategy that balanced risks and benefits based on a robust scientific foundation.

Symposium Description:
The symposium will discuss science findings to inform management as part of the Lake Tahoe West Restoration Partnership, which involved co-production of scientific research into effects

of different management strategies to promote social and ecological resilience. This symposium will include an introductory presentation on the assessment and final strategy (Gross), followed by an overview of the core modeling of social and ecological important indicators (above), results from vegetation and wildlife habitat modeling, results from snow modeling (Krough and Harpold), and lessons learned (DiVittorio), followed by a panel discussion. The symposium will address several conference topics.

Applications of fire behavior modeling to strategic land management at project to landscapes in the Sierra Nevada, CA

Presenter's Name: Edward Smith
Presenter's Company/Employer: The Nature Conservancy
Presenter's Title: Forest Ecologist & Fire Manager
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Symposium - select this if you are part of an organized session

Abstract:
Frequent-fire, dry conifer forests throughout the world are fire-starved and altered in structure, composition, and ecological function due to successful fire suppression activities for over a century in many locations. Re-introduction or restoration of fire regimes to fire-adapted forests is a key process toward improving conditions for wildlife habitat, watershed function and safety for human communities, but re-introducing fire can be difficult due to terrain, accumulated forest fuels, and activity costs, especially in a hotter, drier climate. There are millions of acres throughout the western USA in need of forest fuel removal through mechanical harvest of surface and ladder vegetation or re-introduction of prescribed fire, or both, but the cost of these treatments in both social goodwill as well as operational complexity is prohibitive. Using fire behavior modeling such as FLAMMAP and fire simulation modeler (FSIM) can provide planners and managers with tools to help prioritize areas for restorative treatments by disclosing where fire is more or less likely to occur, and when it does occur, the intensity of its behavior. This analysis can be used at the landscape scale to select which areas are in need of mechanical harvest or prescribed fire or both, to inform where investments are more likely to have a beneficial outcome. We employed fire behavior modeling on the French Meadows Project west of Lake Tahoe in the Sierra Nevada of California both to select areas for treatment, and also to disclose the potential reduction in fire intensity with and without treatment for environmental clearance documentation in the production of an Environmental Assessment for the Tahoe National Forest across 10,000 hectares. The project decision was signed in December 2018 and implementation began in summer of 2019. We also used fire behavior modeling across the 1-million-hectare landscape referred to as the Tahoe Central Sierra Initiative (TCSI) to prioritize large areas that could be restored, and to identify project areas that will be analyzed under subsequent environmental review. We are also using seasonally extracted fire behavior model outputs to identify areas within the Tahoe National Forest that are more suitable for the opportunity to utilize lightning-ignited wildfires for resource benefit. Fire behavior models have proven to be valuable tools for planning ecological restoration treatment projects and strategic plans in the Sierra Nevada. Broad application across large landscapes and project areas can help accelerate the implementation of projects to return fire to ecosystems that have co-evolved with fire.

Recent bark beetle outbreaks influence wildfire severity in mixed-conifer forests of the Sierra Nevada, California, USA

Presenter's Name: Rebecca Wayman
Presenter's Company/Employer: University of California, Davis
Presenter's Title: Associate Specialist
Topic: Managing fire regimes in a changing world (good fire/bad fire)
Proposal Type: Symposium - select this if you are part of an organized session

Abstract:
Rebecca B. Wayman and Hugh D. Safford. In temperate forests, elevated frequency of drought related disturbances will likely increase the incidence of interactions between disturbances such as bark beetle epidemics and wildfires. Ecosystem management relies on sound information from analogous forest types, yet our understanding of the influence of recent drought and insect-induced tree mortality on wildfire severity has largely lacked information from forests historically experiencing frequent fire. A recent unprecedented tree mortality event in California's Sierra Nevada provides an opportunity to examine this disturbance interaction in historically frequent-fire forests, filling an important gap in a body of evidence drawn largely from forests adapted to severe, infrequent fire. Using field data collected within areas of recent tree mortality that subsequently burned in wildfire, we examined whether and under what conditions wildfire severity relates to severity of pre-fire tree mortality in Sierra Nevada mixed-conifer forests. We collected data on 180 plots within the 2015 Rough Fire and 2016 Cedar Fire footprints. Our analyses identified pre-fire tree mortality as influential to all measures of wildfire severity (basal area killed by fire, RdNBR, and canopy torch) on the Cedar Fire and to two of three measures on the Rough Fire. Factors such as fire weather and topographic position also strongly influenced wildfire severity. On the Cedar Fire, the influence of pre-fire mortality on wildfire severity was greater under milder weather conditions. All measures of fire severity increased as pre-fire mortality increased up to pre-fire mortality levels of approximately 30-40%; further increases did not result in greater fire severity. The interacting disturbances shifted a pine dominated system to a cedar/pine/fir dominated system, while the pre-disturbance fir/cedar system retained its species dominance. Managers of historically frequent-fire forests will benefit from utilizing this information when prioritizing fuels reduction treatments in areas of recent tree mortality, as it is the first empirical study to document a relationship between pre-fire mortality and subsequent wildfire severity in these systems. This study contributes to a growing body of evidence that the influence of pre-fire tree mortality on wildfire severity in temperate coniferous forests may depend on other conditions capable of driving extreme wildfire behavior, such as weather.