Sage-grouse conservation

Greater Sage-grouse habitat and demographic response to grazing by non-native ungulates

Topic: Sage-grouse conservation

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Within the Great Basin of the Western United States, management discussions regarding the impacts of grazing by livestock and feral horses on Greater Sage-grouse often focus on the negative habitat impacts, and how the sage-grouse populations will respond in turn. While the linkage between sage-grouse demographics and habitat is well documented, quantifying the direct impacts of non-native grazing on sage-grouse has been fraught with difficulties. These struggles include the logistical constraints and cost associated with monitoring multiple sage grouse populations across large landscapes, an adequate temporal span to detect responses, and grazing manipulations at a large enough spatial scale to affect grouse populations. We investigated the response of sage-grouse demographics, movements, and habitat to grazing of non-native ungulates in Northern Nevada and Southern Oregon. We failed to detect a difference in these metrics when grazing was analyzed at discrete treatment levels, however, we did find evidence for an effect when grazing was treated as a continuous measure of intensity. Grazing intensity during the breeding season of sage-grouse was estimated by integrating records of duration and number of livestock permitted on grazing allotments, and on the ground transect data targeting feces of both horses and livestock. Using Bayesian Hierarchal modeling to account for uncertainty in each component of our data, we found little evidence that sage-grouse are avoiding areas with high intensities of grazing by either horses or livestock. Likewise, there was little support for an effect of grazing on nest survival. We observed lower chick survival rates in areas that had higher grazing intensities of horses, livestock, and combinations both. We also found evidence for a negative effect of grazing on the habitat chicks were using during this time. These results suggest that high intensities of grazing during the breeding season of sage-grouse are negatively impacting populations, and may inform recommendations for issuing grazing permits and managing feral horses within the breeding range of sage-grouse.

Molecular Insights on Greater Sage-grouse Breeding Strategies in the Northwestern Great Basin

Topic: Sage-grouse conservation

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For sage-grouse, the annual breeding cycles begin on leks, areas where males produce visual and acoustic displays for females. Research using visual observations on leks suggests that a few males do most of the breeding. Intraspecific nest parasitism has also been documented in this species. Genetic analysis can reveal true parentage of resulting clutches. Using the vascularized membranes within eggshells, we extracted DNA from each egg. With the addition of adult samples, we verified maternity to determine nest parasitism, and paternity, to test for extra-pair copulations. We sampled the eggshell membranes of 350 eggs from 46 clutches from our study site in Northwestern Nevada. We used feathers collected from the incubating female as a unique genetic sample. We targeted 14 microsatellite loci developed for sage-grouse and one sex determination locus. These highly polymorphic loci are useful for parentage analyses as we can compare the alleles of the putative mother and each offspring. Using the program Cervus, we tested for matches and mismatches among each focal sample and the candidate parent. After matching the mother to her clutch, we compared the offspring genotypes to each other to determine paternity and nest parasitism. We reconstructed possible male genotypes and looked for matches among clutches to evaluate if a dominant male is doing most of the copulations, or if additional copulations are happening off of the lek. Multiple parentages in clutches may help maintain genetic diversity for the population. Females may also mate with multiple males to hedge their bets on male quality, and therefore the quality of offspring. These results provide important insights about sage grouse breeding behavior that observational studies cannot.

SYMPOSIUM: The Evolution of Forest Restoration Planning in the Central Sierra Nevada

Modeling human and natural disturbances under climate change

Topic: Natural areas management in light of climate change

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Between a history of fire suppression and changing climate, forests are moving outside of their historical range of variation. As fires are becoming more severe, forest managers are searching for strategies that can restore forest health and reduce fire risk. However, management activities are just one part of an integrated suite of disturbance vectors that shape forest conditions. To test this concept of the substitutability of disturbances, a disturbance return interval (DRI) was calculated that represented the average return time for any disturbance, human or natural, for any particular point, specifically to investigate the consequences of changing that interval on the proportion of high severity fire and the net sequestration of carbon on the landscape. In order to explore and quantify trade-offs between human and natural disturbances, we used management scenarios that were developed between forest managers and stakeholders in the Central Sierra Range of California. These scenarios were integrated into a mechanistic forest landscape model that accounted for climate change, harvesting, wildfire, and insect outbreaks. Our results suggest increasing the frequency of all disturbances on the landscape was found to reduce the percentage of high severity fire on landscape but not the total amount of wildfire in general. However, increasing the DRI reduced landscape carbon storage and sequestration, particularly in management strategies that emphasized prescribed fire over hand or mechanical fuel treatments.

North Yuba Project: a spatially explicit condition based management approach

Topic: Natural areas management in light of climate change

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The North Yuba Project's planning approach synthesizes ecological, economic, and social data to inform complex forest restoration decision-making across a 275,000-acre landscape. In conjunction with a nine-entity collaborative, a risk assessment and spatially explicit condition-based restoration framework informed by historical, current, and future scenario modeling is being developed to establish a multi-decade treatment design.

Priority-setting for restoration was informed through the quantitative valuation of strategic areas, resources, and assets aggregated with disturbance modeling outputs. With the objective of increasing ecosystem resiliency through improved forest structure and function, a spatially explicit condition-based framework was developed addressing the landscape's dynamic needs over time. Leveraging the modeling outputs from LDsim and Landis, restoration plans and silvicultural treatments were developed based on historical, contemporary, and future conditions. As environmental conditions change, this flexible condition-based approach will provide land managers with an adaptable scientifically-informed suite of options to draw upon in both the present as well as when the future inevitably changes conditions.

Tahoe Central Sierra Initiative: Ecosystem Management Decision Support Tool to guide a Blueprint for Restoration

Topic: Collaborative approaches to conservation - public/private partnerships

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The Tahoe Central Sierra Initiative (TCSI) is developing and demonstrating innovative planning, investment, and governance tools across a 1 million hectare landscape, which can also be adapted to forested landscapes throughout the Sierra Nevada region. Specifically, the TCSI will provide information and tools needed for effectively restoring region-wide forest health and resilience by: 1) defining the desired outcomes for the Sierra Nevada in terms of ecosystem resilience from ecological, social, and economic perspectives; 2) assessing current conditions of the TCSI landscape; and 3) identifying the types, locations, and timing of treatments that can transition the landscape toward a more resilient, healthy, and diverse condition. TCSI was structured to address eight pillars of resilience that represent the range of desired landscape outcomes and social benefits that motivate resilience restoration investments: forest resilience, fire dynamics, carbon sequestration, biodiversity conservation, water reliability, air quality, fire-adapted communities, and economic diversity and social well-being. To meet evaluate means by which to achieve desired outcomes, we developed a variety of spatially explicit data on current and future conditions associated with eight pillars. Current conditions were represented by spatially explicit high resolution maps of 25 metrics that spanned the eight pillars of resilience. Future conditions were derived from Landis II model outputs that accounted for climate change, including forest structure and composition, fire dynamics, and beetle mortality, and from secondary models of biodiversity, wood supply, and snow accumulation and melt dynamics based on Landis outputs. Future landscape dynamics were interpreted in terms of the conditions that landscape units tended to support, the stability of conditions in landscape units, and a rating of the ability of landscape units to provide benefits associated with the eight pillars of resilience. These data were integrated into the Ecosystem Management Decision Support (EMDS) Tool synthesize system dynamics and constraints and identify where management activities can have the greatest positive impact on resilience. EMDS is a state-of-the-art modeling framework for decision support of environmental analysis and planning at multiple geographic scales. The system integrates geographic information system data, logic-based reasoning for environmental assessment, and multi-criteria decision analysis for strategic planning to provide explicit, practical decision support for strategic and tactical planning as well as adaptive management. The EMDS model of the TCSI landscape provides a range of management options and opportunities to move the landscape toward achieving desired outcomes that reflect where in the landscape various benefits and outcomes are most readily accomplished and maintained.

Tahoe Central Sierra Initiative: Modeling Historic Range of Variability to inform restoration planning

Topic: Natural areas management in light of climate change

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The Tahoe Central Sierra Initiative (TCSI) spans 2.4 million acres covering a range of forest types in the Sierra Nevada in California. The landscape is dynamic, developing as a result of complex natural and human land use history driven largely by disturbance. Fire is the dominant disturbance driving vegetation succession, in which cycles of fire and recovery occur variably over large extents and long periods producing a constantly shifting mosaic of ecosystem conditions. It is generally believed that prior to Euro-American settlement in the mid-1800s, the TCSI landscape was in a dynamic equilibrium with a stable shifting mosaic of vegetation conditions that was highly resilient to permanent change. To understand this dynamism, TCSI felt it was important to develop a quantitative assessment of the historical (ca. 1550–1850) range of variability (HRV) in landscape structure that can be used as a restoration planning tool to: 1) define a reference to evaluate the current landscape 2) develop a framework for deriving desired future conditions and 3) create a monitoring tool to measure restoration success. To simulate disturbance and succession processes representative of the HRV period within the project area, we developed a landscape disturbance-succession model using fine scale LIDAR data in the LDSIM framework and simulated the dynamics in vegetation driven by wildfire during the historical reference period At the landscape scale, the historical reference period was best characterized as a shifting mosaic of vegetation types and conditions that was subject to a remarkably high wildfire disturbance rate. We quantified the range of variability in composition and configuration of the landscape mosaic and compared the results to the current landscape to quantify departure. Current conditions compared to the simulated HRV showed departures in both composition and structure. For example, HRV was characterized by more late seral forests and smaller and more distributed openings than our current conditions. These outputs can define the reason for change and help prioritize where to do treatments. HRV can also be expressed using a biophysical unit framework that defines departure from HRV at a stand scale providing quantitative estimates that can be built into project level silvicultural prescriptions (gap size, seral stage). The HRV departure estimates will ultimately be used to help guide large landscape scale projects in TCSI such as the one underway in

The Evolution of Forest Restoration Planning in the Central Sierra Nevada

Topic: Natural areas management in light of climate change

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Patricia Manley
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Efforts to restore forests are increasing in pace and scale to improve forest resilience to climate change. Although forest management to achieve desired conditions has been practiced for at least a century, arguably several centuries in the Sierra Nevada, the complexity of the environmental context and the planning processes have increased significantly, creating a need to retool restoration planning approaches. We describe four projects that illustrate recent adaptations in forest restoration planning to broader spatial and temporal scales and to include climate change impacts. An early restoration effort that was designed and implemented over a 15-year period from 2005 to present at the Sagehen Creek Field Station and Experimental Forest, tested a then novel approach to restoration on National Forest System lands. The Sagehen Project created openings or gaps in the forest and thinned out small diameter trees over a 4,000-ha landscape. A more recent project, French Meadows Project, was designed and began implementation over only 3 years. The project tackled multiple land ownerships, and similarly complex silvicultural prescriptions over a 11,000-ha landscape. Both projects took a static view of current fire risk, departure of vegetation from historic conditions, and evaluation of assets at risk from fire. They qualitatively addressed climate change but did not quantify the projected influence of climate change. The Lake Tahoe West Restoration Partnership marked a transition in forest restoration planning. The planning scale increased again to a 24,000-ha landscape ranging from urban to wilderness. The partnership adopted a dynamic view of landscape conditions over 100 years across a large set of ecological and social outcomes modeled under future climates to inform a restoration strategy. The Tahoe Central Sierra Initiative (TCSI) builds on the Lake Tahoe West project by taking another leap to a 1-M ha regional landscape. TCSI also incorporates dynamic modeling over 90 years to inform forest restoration management inputs, and to support planning efforts at all scales within the regional landscape. Broader spatial and temporal scales of analysis along with quantitative evaluation of climate change as a driver of forest health across diverse land ownerships characterize the recent evolution of forest restoration planning.

SYMPOSIUM: Managing for Drought in California Ecosystems

Droughts and Drought Impacts in California: An Overview

Topic: Natural areas management in light of climate change

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Drought is a basic feature to California's climate. Moreover, droughts have been an important influence on California's ecosystems for millennia. Over the past century, the state has experienced several extreme drought events; but in the past 5 decades there has been a notable increase in drought frequency and severity. A notable hallmark of this was the 2012-2016 drought, which based on tree ring records, was the most severe in >1000 years. Droughts like this one can contribute to wide-spread ecological and economic impacts that touch many different industries and sectors. In California the most recent severe drought facilitated wide-spread mortality of trees and shrubs in forests and woodlands, was blamed for poor rangeland condition and leading to agricultural and forestry industry impacts.

In this presentation we will examine how historical drought has differentially shaped California's natural ecosystems. We will also consider what is expected with future climate change especially in regard to extreme climate events like drought and heat waves. Mindful that the future climate change will bring increased frequency and severity of drought; attention will be given to how ecosystem components may be impacted directly and indirectly. We will conceptually introduce how management strategies and approaches can work to prepare forest and associated ecosystems with greater adaptive capacity in the face of future impactful drought events. Such considerations are of value so context-specific management strategies can be considered preemptively with the goal to ameliorate the impacts brought from climate change. Finally, some treatment will be given to what climate mediated impacts could mean for various societal and industry interests if management efforts are not prioritized preemptively.

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Managing Drought-Prone Chaparral Landscapes

Topic: Natural areas management in light of climate change

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Beginning in 2012 California experienced one of the most intense droughts in history. The duration of the drought varied throughout the state. In the Sierra Nevada it lasted three years and was a factor in massive mortality of trees in mid-elevation conifer forests. In southern California the drought continued through most of 2018 and resulted in massive dieback of chaparral shrublands. There is good reason to believe this dieback was a major factor contributing to the size of the 2017 Thomas Fire and the 2018 Woolsey Fire, the largest fires in the region in recent history. This presents a significant management challenge because dead woody fuels likely contribute to extreme fires, and in this climate these fuels decompose slowly, plus future climate change is predicted to increase the incidence of severe droughts.

Our work has used remote sensing methods (Landsat NDVI) for detecting and verifying vegetation dieback in southern California shrubland landscapes, and then relating these to fire severity patterns in the 2018 Woolsey and 2017 Thomas fires (using Monitoring Trends in Burn Severity, MTBS data). This provides insight into relationships between severe drought, vegetation dieback and subsequent fire severity, and to what extent this information could be used to inform land and fire management activities in the region.

Management options must consider the wildland-urban interface risks associated with prescription burning on this landscape, thus making this obvious management option for dealing with drought an unlikely strategy. Future focus must deal with drought impacts by concentrating on the urban environment and considering the 5 P's of 1) people as the primary problem, 2) prevention of fire ignitions during extreme wind events, 3) planning future developments, 4) p rotection of structures by home-hardening, and 5) predicting capacity for fire trajectories during extreme wind-driven fire events.

Managing Effects of Drought and Facilitating Recovery in California Oak –dominated Forests and Woodlands

Topic: Natural areas management in light of climate change

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Oaks have many adaptations, including drought tolerance and resprouting abilities that afford them increased resilience to drought and associated natural disturbances. Shifts toward increased dominance of oaks are expected in many parts of California based upon projections of increased warming and drought. Such trends have become evident during the recent, widespread drought event that killed many pines and other conifers in the southern Sierra Nevada. Drought and fire-induced mortality are natural regulatory processes that may restore more sustainable forest conditions by reducing densities of oaks and competing conifers, especially if that mortality tends to kill smaller trees and trees in poorer soils, at low elevations, on south-facing slopes. However, mortality events could be degradative where they kill mature trees and inhibit regeneration. For example, in southern California, the combination of drought, wildfire, and expanding insect pests like the goldspotted oak borer may lead to reductions among some oak species. Meanwhile, sudden oak death is a novel stressor in northern California coastal forests. A goal for managing resilience throughout the state is to conserve mature oaks that provide ecosystem services such as acorn production and habitat for wildlife. That goal can be advanced by thinning overly dense oak stands, remove competing conifers, reducing fuels, and supporting use of fire, including cultural burning directed by tribes and informed by traditional knowledge. Treatments also need to create openings for regeneration to ensure sustainable conditions over the long-term. Several recent synthesis reports have proposed and developed these strategies, including the recent General Technical Report on management for drought in the US, a report on restoring California black oak for tribal values, and the 4th California Climate Change Assessment. Reducing competition for water by non-native annual grasses may also be important strategies in grazed woodlands and in urban forests. More active efforts to plant young oaks and water mature trees may be also appropriate in intensively managed areas. Meanwhile, in more remote locations, managing naturally ignited fires and using prescribed burns will be important strategies for resilience. However, managers and the public may want to help inventory and safeguard especially old and large legacy trees that have disproportionate ecological and social value to minimize potential losses from combined stressors.

Managing Effects of Drought and Facilitating Recovery in California: Coast Redwood Forests

Topic: Natural areas management in light of climate change

Ramona Butz
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Within the redwood forests of northern California, annual water use by large redwoods is high, and the greatest demands for water occur during summer months when rain is sparse. Summer fog serves an important role in ameliorating water deficits. During drought, redwood forests continue to tap fog as a water source, and deep, loamy forest soils slowly release the water captured from winter rains. Coast redwoods tend to be poor regulators of water use, making them sensitive to ambient humidity and the presence or absence of cloud cover. During prolonged drought, decreased canopy water content and fog drip can lead to decreased germination and survival rates of seedlings, and reduced radial growth, limited foliar water uptake, and even death in mature trees.

Although mature redwood forests are generally fairly drought tolerant, the effects of drought events of increased intensity and duration can be minimized through a number of management strategies. The loss of redwood trees to natural disturbances (e.g., wildfire, windthrow, floods, severe drought), extensive timber harvest, or other land-use practices converts forests to more open habitats reducing fog capture, thus altering the hydrological balance and creating more drought-prone conditions. Drought mitigation in coast redwood forests includes: (1) reduction of competing vegetation, such as Douglas-fir (Pseudotsuga menziesii), through prescribed burning and mechanical thinning, (2) reduction of practices that create forest structures that are too open, thereby losing their ability to capture moisture from fog, (3) minimization of soil disturbance, (4) reduction of road densities, (5) creation of small gaps for light availability for regenerating seedlings, and (6) protection of old-growth reserves.

Managing for Drought in California Ecosystems

Topic: Natural areas management in light of climate change

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We propose a symposium related to managing for drought in California that corresponds to a recent chapter in the USDA Forest Service-produced General Technical Report 'Drought Impacts on U.S. Forests and Rangelands: Translating Science into Management Responses'. This symposium will contain an overview of the topic, four additional presentations related to drought management in widespread California ecosystems (montane forests, redwood forests, oak woodlands, chaparral and coastal sage scrub, and grasslands) and conclude with a facilitated discussion. Presentations are germane to the conference topic 'Natural areas management in light of climate change' given that global climate models project severe droughts will become the norm in California.

Drought presents significant challenges for natural resource managers in California, and future droughts will likely exert even greater impacts. Managers can intervene by altering plant structure and composition, increasing annual water yield, and conducting public outreach and education regarding water conservation. Due to strong environmental gradients in California, drought management should be tailored to individual ecosystems. For example, in forests and woodlands, drought management focuses on the use of mechanical thinning and prescribed burning both to decrease stand densities and to promote the growth and vigor of desirable tree species. In chaparral, frequent disturbances are stressors, so soil disturbances need to be limited as much as possible to reduce the spread of nonnative annuals that promote wildfires. Invasive plants are also an important problem in grasslands, where they should be removed and replaced with native grasses and forbs. In grasslands, prescribed fire may be useful to manage nonnative species and increase perennial plant cover to make grasslands more drought-resilient.

By including a diverse group of presenters, experts in their respective ecosystems, this symposium will flesh out the fuller story of drought management across California, and convey specific, actionable, science-driven management options for each ecosystem as well as touch on commonalities across ecosystems. An overview will provide context on the recent 2012-2016 drought relative to historic droughts in California, and serve to convey the need to manage for future drought. Our symposium will act as a much needed forum for delivery of recently-published knowledge to practitioners.

Managing the Effects of Drought and Facilitating Recovery from Drought in California's Montane and Subalpine Forests

Topic: Natural areas management in light of climate change

Christopher Fettig
Pacific Southwest Research Station

In montane and subalpine forests of California, recent droughts have contributed to widespread bark beetle outbreaks, extensive tree mortality, reduced tree growth, and increased wildfire hazard, all of which in turn affect biogeochemical cycling and hydrologic processes. Reducing forest densities will increase the resilience of montane and subalpine forests to drought and other disturbances exacerbated by drought. The main tools are mechanical thinning and fire, the latter consisting of prescribed fires or wildfires that are allowed to burn under appropriate weather conditions (i.e., managed wildfire). Facilitating recovery and restoration of drought-impacted forests requires a flexible approach. For small patches of tree mortality (e.g.,

The montane and subalpine forests of California provide immeasurable ecological goods and services, many of which warrant special protection and management considerations. In this presentation, several USDA Forest Service and California Department of Forestry & Fire Protection publications will be reviewed that guide thinking about managing forest structure to emulate the 'natural' heterogeneity of forests, to minimize the undesirable impacts of drought, and to facilitate recovery from drought. Key elements include: (1) increasing the pace and scale of thinning, prescribed burning and managed wildfire, (2) rebuilding the forest products industry in California to facilitate adequate biomass removals, (3) improving forest structure for wildlife habitat, (4) restoring ecologically-sensitive areas (e.g., meadows), (5) facilitating legislative and administrative reforms that act as barriers to project implementation, and (6) implementing monitoring and adaptive management.