Symposium Organizer: Kristen Wilson

NAC20 Program Topic: Natural areas management in light of climate change

Description: In the past fifteen years, forest restoration planning increased in spatial scale by twenty times in the Central Sierra Nevada. Coincidentally, science modeling studies at even larger spatial scales and across long temporal scales (1550-1850; 2018-2100) were developed to inform forest planning. These regional landscape studies provide a science foundation for planning at all smaller nested scales and for a conditions-based management approach. This symposium presents the evolution in forest planning with a focus on projects within the Tahoe Central Sierra Initiative, a 2.4 million-acre area. Incorporation of the science is being tested in the proposed North Yuba Project.

Registration

Presenter(s): Kristen Wilson and Patricia Manley

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

Abstract: 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.

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

Presenter: Becky Estes.

Co-authors: Kevin McGarigal, Scott Conway

Abstract: 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

Becky Estes, Pacific Southwest Region
Kevin McGarigal, LandEco Consulting
Scott Conway, Conway Conservation

Presentation Title: Modeling human and natural disturbances under climate change

Presenter: Charles Maxwell.

Co-authors: Kristen Wilson, Robert Scheller, Patricia Manley

Abstract: 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.

Presentation Title: North Yuba Project: a spatially explicit condition-based management approach

Presenters: Scott Conway, Andrew Salmon, Kristen Wilson

Abstract: 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.

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

Presenters: Patricia Manley and Nicholas Povak

Abstract: 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.