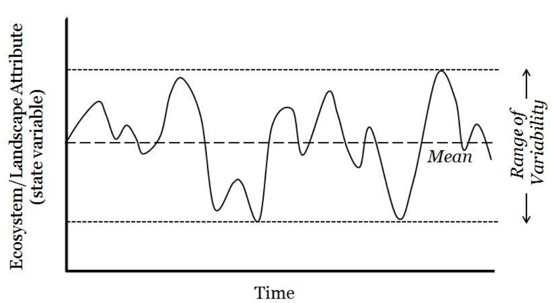
Departure from the Modeling Historical Range of Variability in the Upper Yuba River Watershed, Tahoe National Forest, California

ECOLOGY PROGRAM *PACIFIC SOUTHWEST REGION * US FOREST SERVICE

Why range of variability?

The 2012 Planning Rule directs us to use the range of variability concept, "Plan decisions affecting ecosystem diversity must provide for maintenance or restoration of the characteristics of ecosystem composition and structure within the range of variability that would be expected to occur under natural disturbance regimes of the current climatic period," (NFMA, 2012 Planning Rule 2015: 36 CFR § 219.2o(b)(1))

What is range of variability?



Conceptual diagram of the Range of Variability (ROV). Note, the ROV can be defined based on any percentile range and it could include the extremes as a reference point.

Project Overview

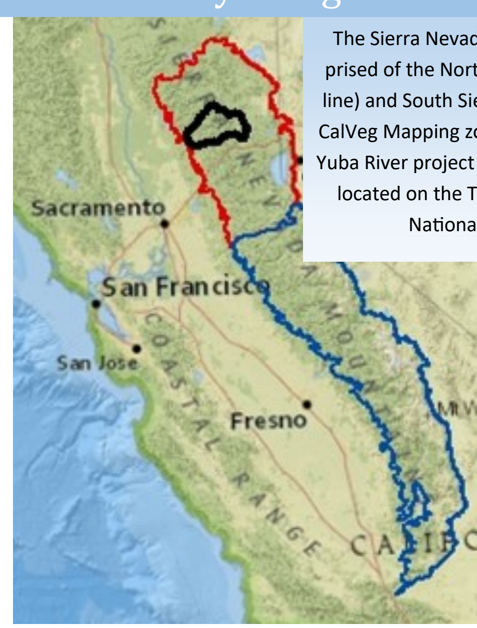
- The upper Yuba River watershed in northern California is a spatially and temporally dynamic mosaic of ecological systems;
- The Tahoe National Forest determined that to better guide restoration planning efforts that it was prudent to gain a better understanding of the natural range of variability

Citation: McGarigal, Kevin, Mallek, Maritza, Estes, Becky, Tierney, Marilyn, Walsh, Terri, Thane, Travis, Safford, Hugh, Cushman, Samuel A. 2018. Modeling historical range of variability and alternative management scenarios in the upper Yuba River watershed, Tahoe National Forest, California. Gen. Tech. Rep. RMRS-GTR-385. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Stations. 346 p.

Objectives

- Synthesize knowledge on disturbance and succession in the pre-Euro-American settlement period in the Upper Yuba River watershed;
- Quantify the Historic Range of Variability (HRV) and current departure of vegetation composition and structure in the Upper Yuba River watershed;
- Quantify the future range of variability (FRV) in landscape structure under a a wide range of alternative future land management scenarios.

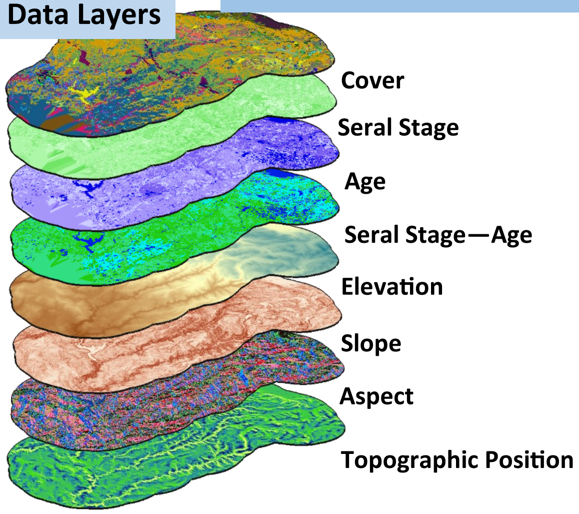
Study Design



The Sierra Nevada Ecoregion comprised of the North Sierran (red outline) and South Sierran (blue outline) CalVeg Mapping zones and the Upper Yuba River project area (black outline) located on the Tahoe and Plumas National Forests.

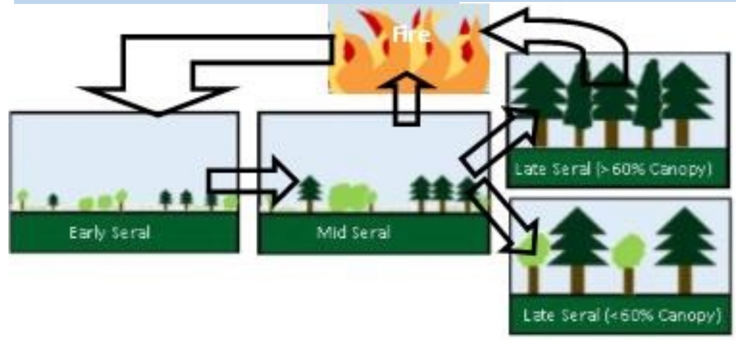
Study Design

Data Layers



A simulation modeling approach and a class of landscape change models generally referred to as landscape disturbance and succession models (LDSMs) to quantify the historical (ca. 1550–1850).and future range of variability

Disturbance and Succession Models



Management Scenarios

MS1: *No Treatment*
MS2: *Land Management Plan (“business as usual”)*
MS3: *Prescribed Fire Only*
MS4: *Land Management Plan with Moderate Intensity*
MS5: *Intensive Vegetation Treatments and Prescribed Fire (“SNC Scenario”)*
MS6: *Balanced Vegetation Management Treatments*
MS7: *Best Fit with NRV*

Data Outputs

Developmental stage -- in which the landscape was classified into none, early-, mid- or late-development classes pooled across cover types.

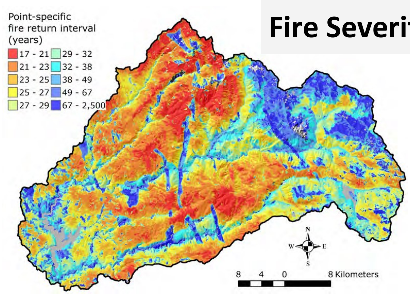
Canopy cover -- in which the landscape was classified into none, open (<40%), moderate (40-70%), or closed (>70%) canopy classes pooled across cover types

Seral stage -- in which the landscape was classified into 12 seral stage classes (mainly representing a combination of development stage and canopy cover for each cover type) pooled across cover types.

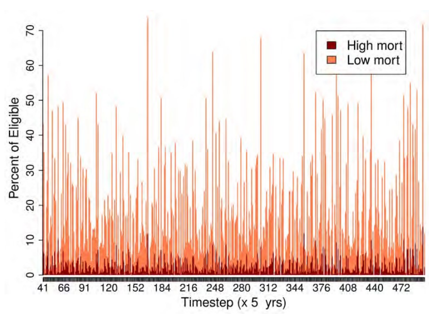
Cover-seral -- in which the landscape was classified into 151 unique combinations of cover type and seral stage.

Results

Fire Severity and Rotation



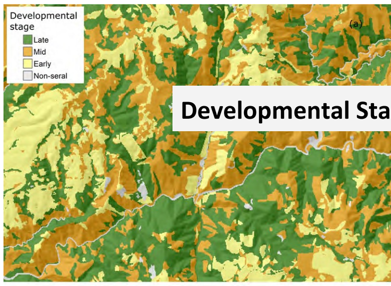
Simulated point-specific fire return interval for the historical range of variability (ca. 1550–1850).



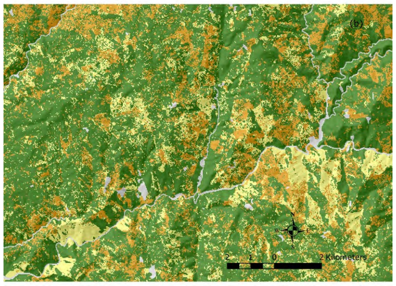
Landscape burned per 5-year timestep and the proportion of high– versus low-mortality vegetation response to wildfire (i.e., severity) for the simulated historical range of variability (circa 1550—1850) in the Upper Yuba River watershed project area.

Management Implications

- *The disturbance rate resulted in a fire rotation period (FRP), or the time required to burn a cumulative area equal to the project area of 29 years;*
- *The percentage of high-mortality fire (>75 percent canopy mortality) varied over time from a low of about 2 percent to a high of 24 percent, but averaged around 13 percent per timestep;*
- *Historically, wildfire was a dominant driver of the landscape dynamics and any major deviation such as fire suppression is likely to have major ecological consequences;*
- *In order to restore the historical landscape structure and function some level of prescribed fire or wildfire for resource benefit will be necessary.*

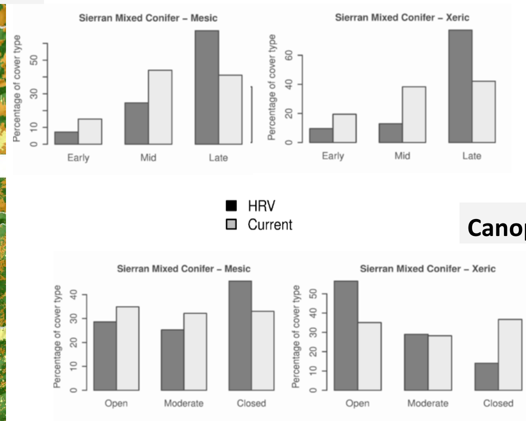


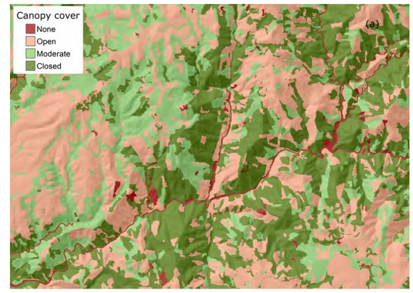
Developmental Stage



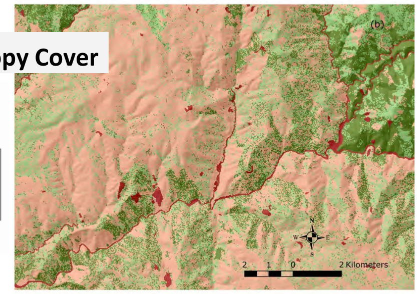
Results[1]

Example—Sierra Mixed Conifer (SMC)



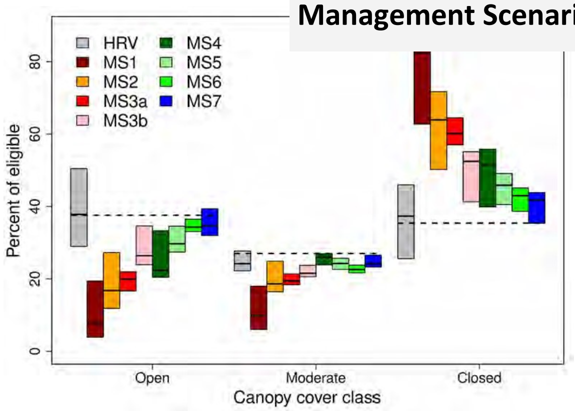


Canopy Cover



- Early seral habitat is more common in the current landscape as compared to HRV in SMC habitat both mesic and xeric;
- Late seral habitat in SMC mesic and xeric habitat is lacking as most of this forest type is in the mid seral stage which made up very little of the landscape during the HRV period;
- Open and moderate canopy conditions were only slightly higher in the current condition of SMC mesic whereas closed canopy conditions were lacking in the current condition as compared to HRV;
- In SMC Xeric open canopy was much greater In HRV than in current conditions and has transitioned to closed canopy forests;
- Fine scale variability is common in the HRV period driven by the frequent occurrence of fire.

Management Scenarios



Management Implications

- *In SMC xeric and mesic, allowing early and mid seral conditions to succeed to late-development would take decades however focused management could hasten this process*
  - ⇒ *Reducing fuels with the intention of reintroducing fire*
  - ⇒ *Use appropriate silviculture techniques to promote transition from mid seral to late seral*
- *Transition open canopy SMC mesic forest to closed and transition SMC xeric closed forest to open canopy forests.*
- The No Treatment (MS1) and the Current LMP (MS2) failed to move the current landscape closer to HRV and resulted in a more homogenous landscape;
- The prescribed fire only treatments used much greater treatment intensity (MS3b) than the scenarios with mechanical treatments in addition to prescribed fire (MS4-MS7) and, despite this, were generally not as effective in approximating the HRV as the latter;
- The scenarios that had a range of treatments (MS6-MS7) were the most successful at emulating HRV often better than those that treated more of the landscape.

Management Implications

- *Currently, we treat on average about 1 percent of the TNF forest landscape under current direction. The lower intensity scenarios (MS6—MS7) treated about 4 times as much of the landscape and the higher intensity scenarios treated about 7 times as much so we must plan on increasing the area we treat;*
- *If we are to use prescribed fire as a tool, we need to assume more canopy mortality of up to or more than 15 percent to move the landscape closer to HRV;*
- *The scenarios do show that management can be successful at shifting the landscape closer to NRV but we must realize that this would require more intensive and large landscape treatment (e.g., managed lighting ignitions).*

[1] This is one example of results that can be extracted from the current research. Data are available for the most common vegetation types in the study area.