Fire History of Mixed-Conifer Riparian Areas & Forest Restoration on a Landscape Scale

Yosemite Valley after 62 & 95 years of fire suppression

1899

1961

1994

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Talk Outline

Part 1: Riparian fire history and forest structure

1) Background: Riparian fuels and forest management

2) Historic riparian fire regimes

3) Historic vs. current forest and fuel conditions

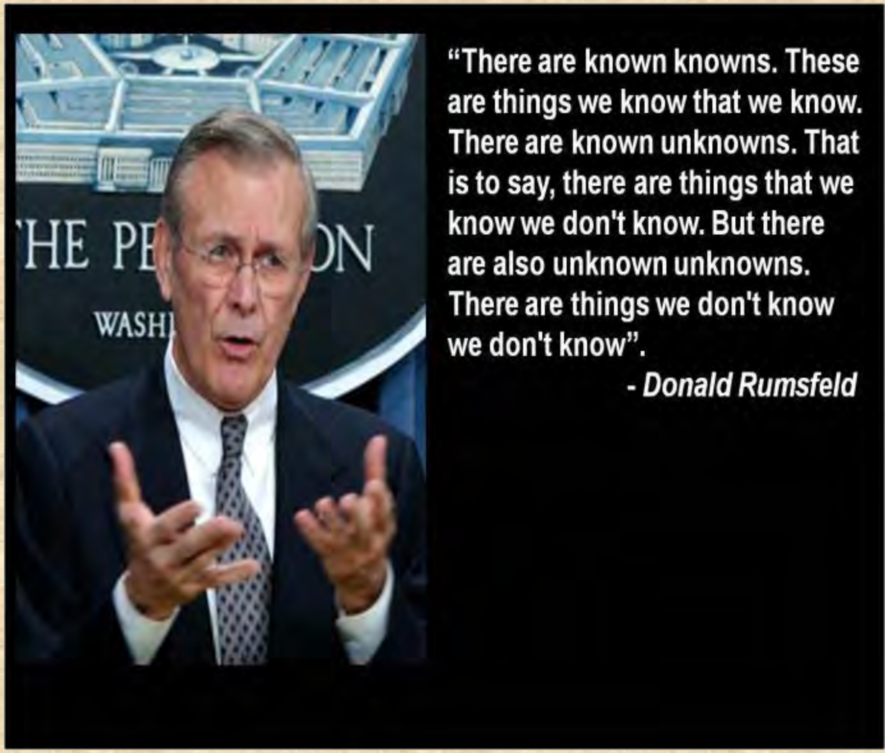
Part 2: Landscape Forest Restoration

4) Motivation for a new forest management strategy in Sierra Nevada

5) Four problems to overcome

6) Using topography as a template for forest management

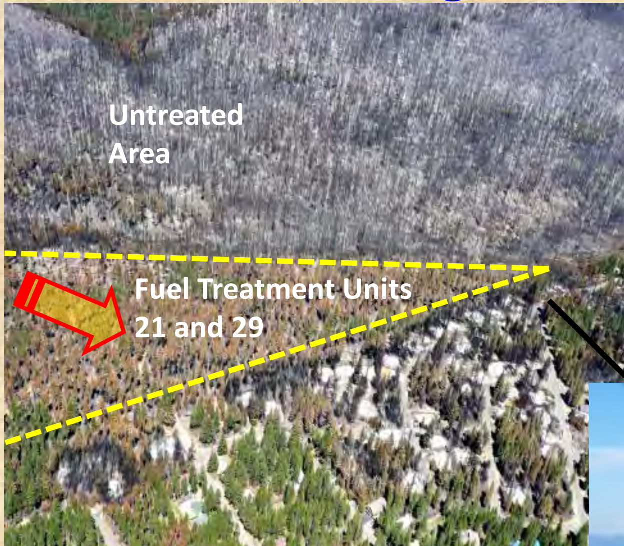
7) An application of the guidelines



1)Background: Riparian fuels and forest management

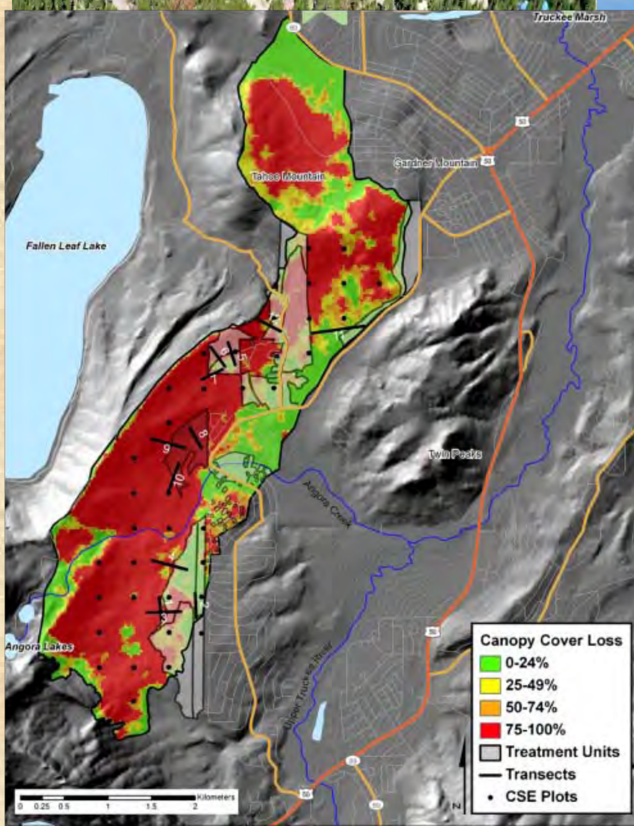
- Productive, mesic riparian forests can accumulate higher stem densities and fuel loads than upland forests, making them susceptible to high-severity fire.
- Zones of 150 and 300 ft on either side of intermittent and perennial streams limit management operations.
- Consequently fuels treatments applied to upland forests are often excluded from riparian areas due to concerns about degrading forest habitat and water quality.

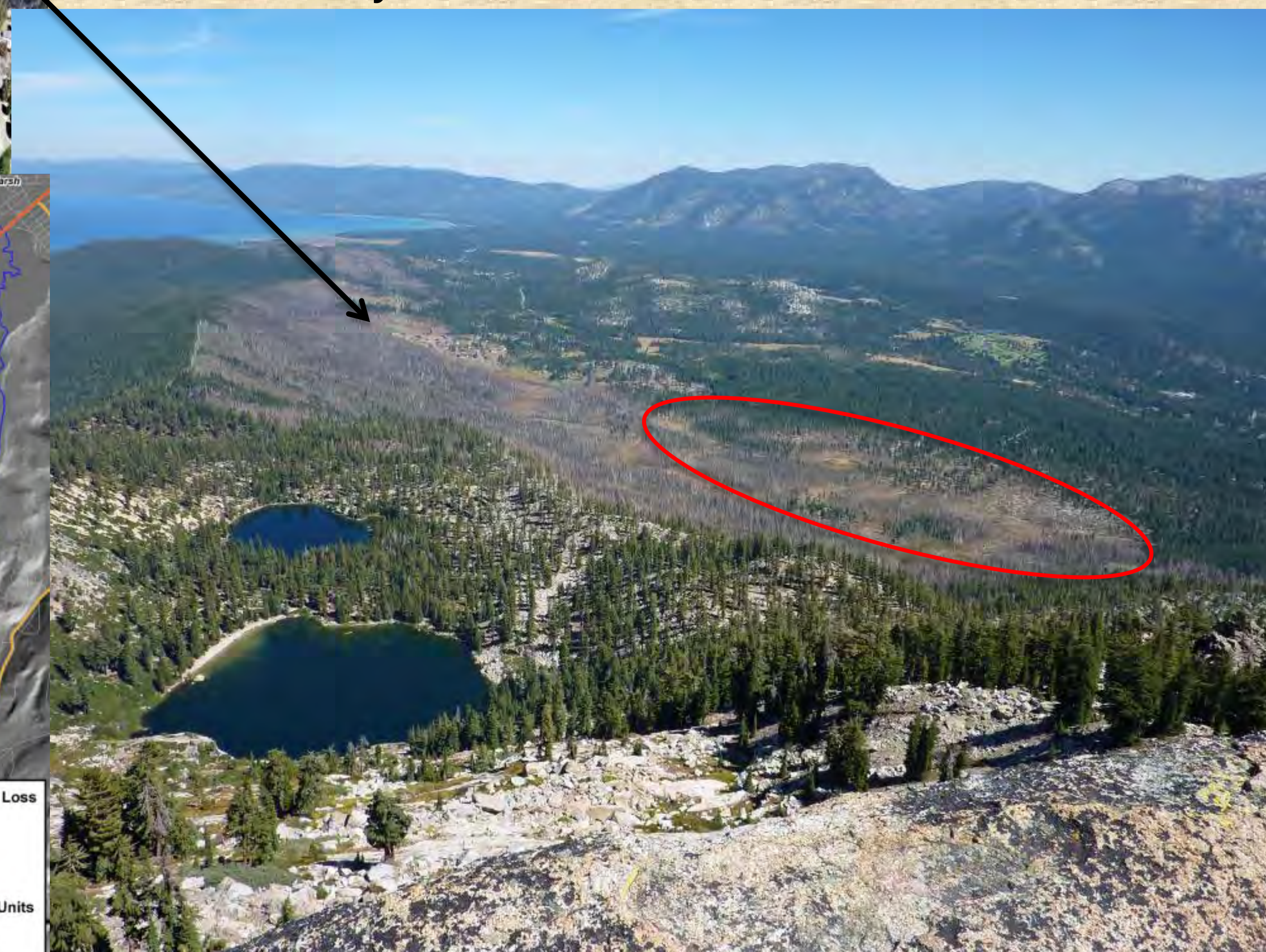
1)Background: Riparian fuels and forest management

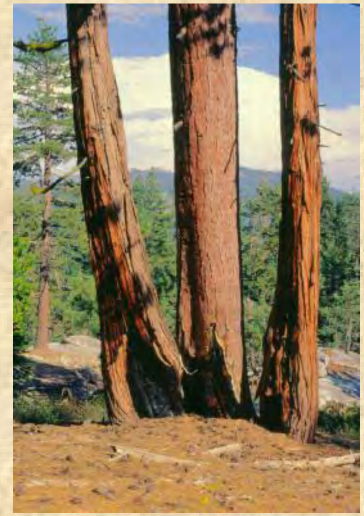


June 24, 2007:

- Fire rapidly wicks up the Angora Creek drainage burning through high fuel loads.
- Fuels treatments outside the riparian zone eventually aided in containment.





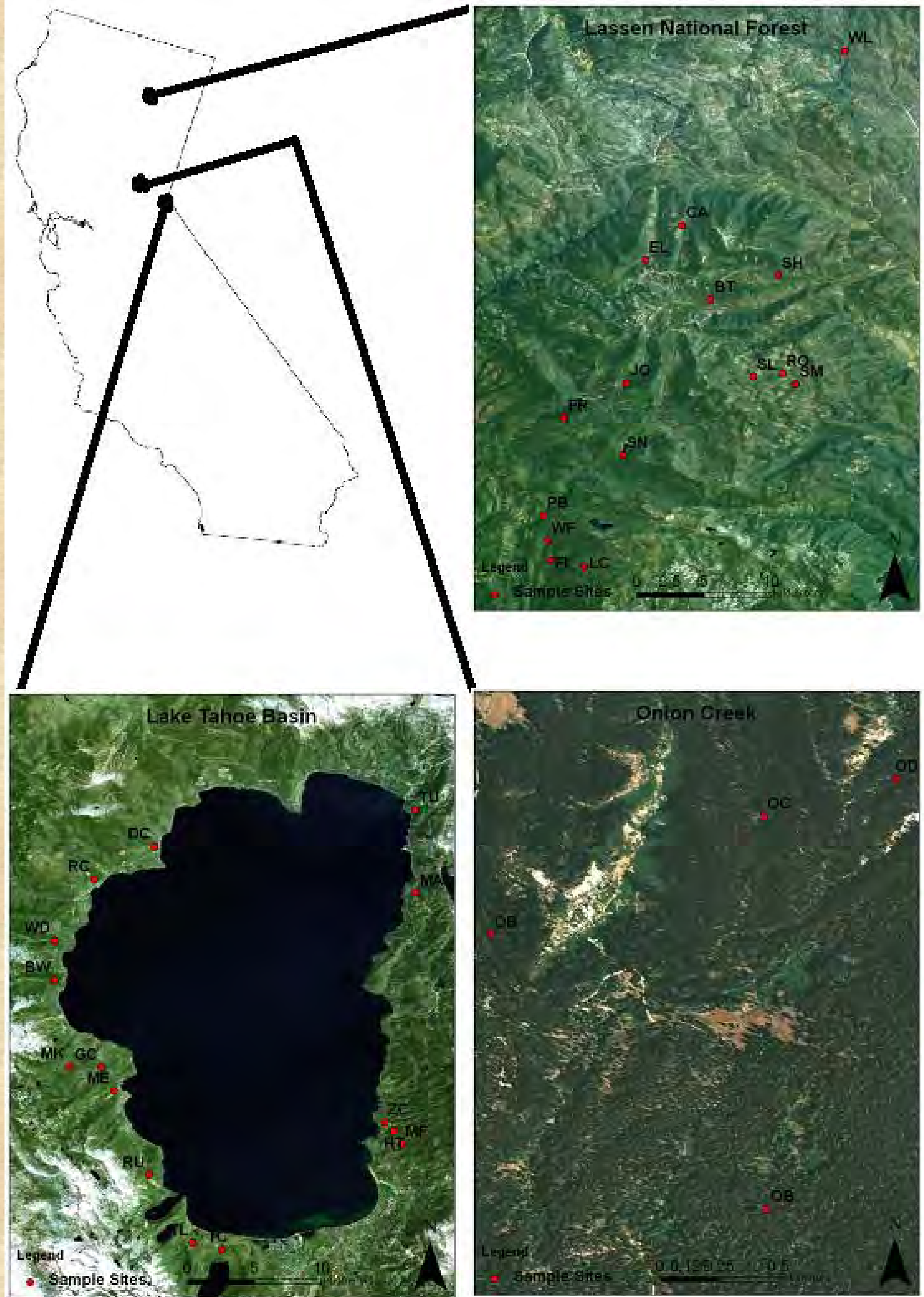


Objectives

- For adjacent coniferous riparian and upland forests compare historic fire regimes.
- If they have different fire regimes, identify site factors associated with that difference.
- Compare current and historic forest structure, fuel loads and potential fire behavior for adjacent riparian and upland forests.

Study Area

- 3 sample locations (Lassen, Tahoe, Onion Creek)
- Extensive logging and grazing began in 1850's
- 36 pairs of riparian/upland sites
- Sites chosen for long potential record of fire history, range of variability in forest/riparian characteristics



Field Methods

• Record forest, site and stream characteristics (ex. Precip regime, elevation, slope, aspect, stream order, riparian zone width, flow regime, bankfull width/depth, gradient, channel shape)

•Collect fire scar samples, age trees using increment cores, measure trees, snags, logs and fuels

• In the lab determine the date of the fires scars, and age the trees

• Using reconstruction methods, approximate the size and status (live or dead) of live trees immediate after the last fire.

Results

- 907 cross sections, 1631 fire scars, 760 events
- Period of record 1387-2009

Mean FRI		Riparian	Upland
C1 Any fire	Min	8.4	6.1
	Max	42.3	58.0
	Avg	16.6	16.9
C10 Wide spread	Min	10.0	10.0
	Max	86.5	56.3
	Avg	30.0	27.8

Table 1. Summary of mean FRI across all sites

Riparian areas that did have longer fire return intervals had wider, less incised streams

Van de Water, K. and M. North. 2010. Fire history of coniferous riparian forests in the Sierra Nevada. Forest Ecology and Management 260: 384-395.

Stand Structure, Fuels and Potential Fire Behavior*

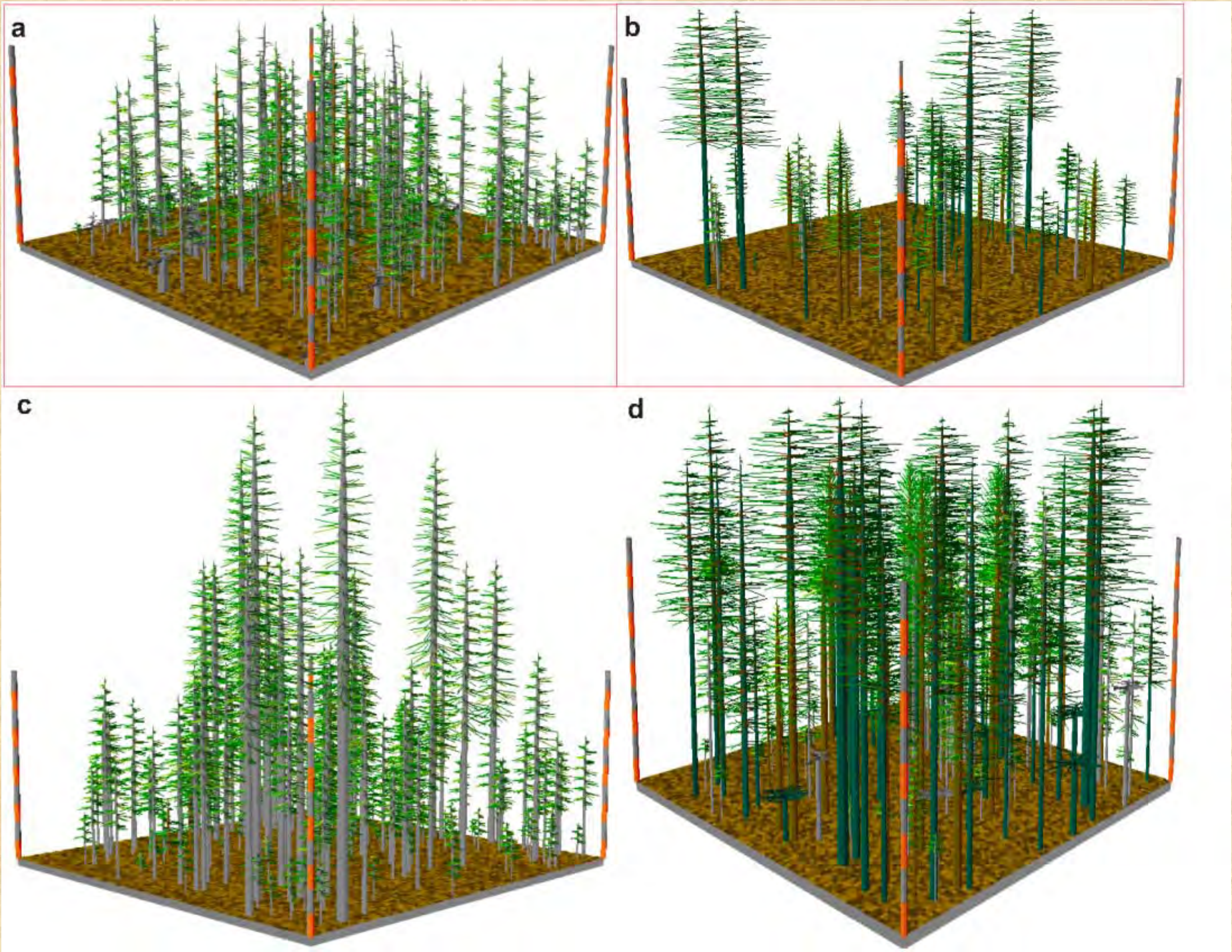
Values in the same row followed by a different letter are significantly different

ality (% BA) 30.6a

Key Results:

- Basal area, stems, and fuel loads have increased about 3 fold.
- Current torching and crowing index are ≤1/2 of reconstructed.
- Average diameter (QMD) and height to foliage (CBH) are equal or greater in current conditions??
  (rapid growth and pruning?)

*Van de Water, K and M. North. In press. Stand structure, fuel loads, and fire behavior in riparian and upland forests, Sierra Nevada Mountains, USA; a comparison of current and reconstructed conditions. Forest Ecology and Management



Stand visualization simulation of typical conditions for a) current riparian forest (Dollar Creek, 2009), and b) reconstructed riparian forest (West Branch Feather River, 1886). The corresponding stands, c) Dollar Creek riparian, reconstructed conditions in 1962, and d) West Branch Feather River, current conditions in 2009, are displayed for comparison. Ground area is approximately 2 ac.

Management Implications

- Most riparian and upland forests had similar fire regimes
- However higher elevation riparian forest, bordering wide, less incised streams had longer fire return intervals and may act as a buffer to fire movement except during extreme droughts.
- Reconstructions suggest historic fuels and forest structure may not have significantly differed between many riparian and upland forests.
- However under current conditions, modeled fire severity is much greater in riparian forests, suggesting forest habitat and ecosystem function may be more severely impacted by wildfire than in upland forests.

Part 2: Landscape Forest Restoration

4) Motivation for a new forest management strategy in Sierra Nevada

2008 wildfire

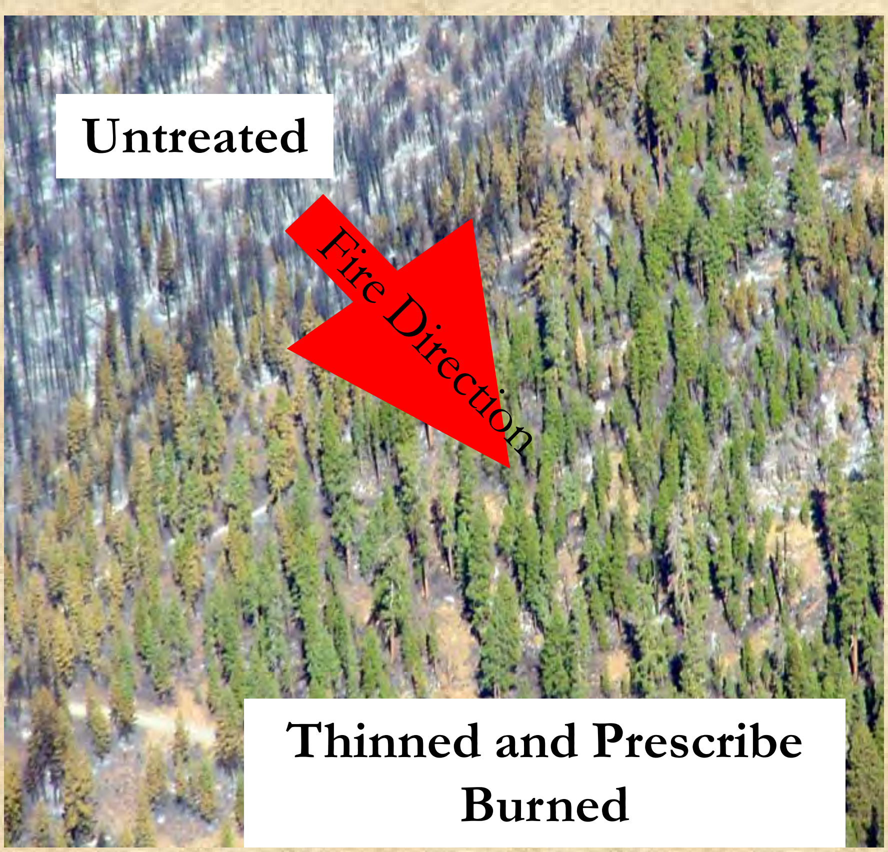
Sept. 22 1900 fire plume in the San Gabriel Mountains, Los Angeles County (taken 25 miles from the fire).

- Before 1800, almost 5 million ac of California burned each year, of which about 1.2 million ac was forest*
- Research suggests fire was one of the most important processes shaping these ecosystems
- For 1950-1999 average annual total burned by wildfire was 250,000 ac
- Area annually treated in CA for fuels reduction (about 50,000 ac)

*Source: Stephens et al. 2007. Forest Ecol. & Man. 251: 205–216

Compelling evidence that fuels treatments, which reduce ladder and **surface fuels**, can be highly effective

Skinner et al. 2005. 25th Veg. Proceedings; Raymond and Peterson 2005 CJFR 35:2981; Safford et al. 2009 Forest Ecol. Man. 258:773; Pritchard et al. 2010. CJFR 40:1615



Cone Wildfire, N. Calif.

Sugarloaf Fire: Treated (above) and Untreated (below) forest within 200 m.

Why are Fuels Treatments Stalled? 4 Problems: 1) Economics

- Almost 50% of the US Forest Service's budget is used for fire fighting and training, leaving little for preventive measures like fuels treatments.

- The large-scale fuels treatments which are needed will never occur unless most of them can 'pay for themselves'.

- Thinning merchantable trees, however, rarely affects potential wildfire intensity, and can create the perception and problems associated with 'getting the cut out'.

- The most effective fuels treatments reduce surface and ladder fuels—As a service contract (i.e., when no commericial timber is removed) costs are often $800-2,500/ac

Problems: 2) Wildlife Habitat

- Fuels treatments are repeatedly stalled due to litigation
- A recent analysis found one of the most common reasons was the lack of sufficient provisions for threatened and endangered species (TES) habitat
- One of the perceived conflicts is the association of some TES with forest conditions that have high surface and ladder fuel loads and high canopy cover.

Recent newspaper cover story, northern goshawk and California spotted owl

Problems: 3) Climate Change Uncertainty

• If climate is changing, is forest management that mimics historic conditions misguided?

• Managers have often used pre-European conditions to develop structural targets (i.e., 8 pine trees/ac >30") to assess forest treatments.

• Now what do you measure restoration against?

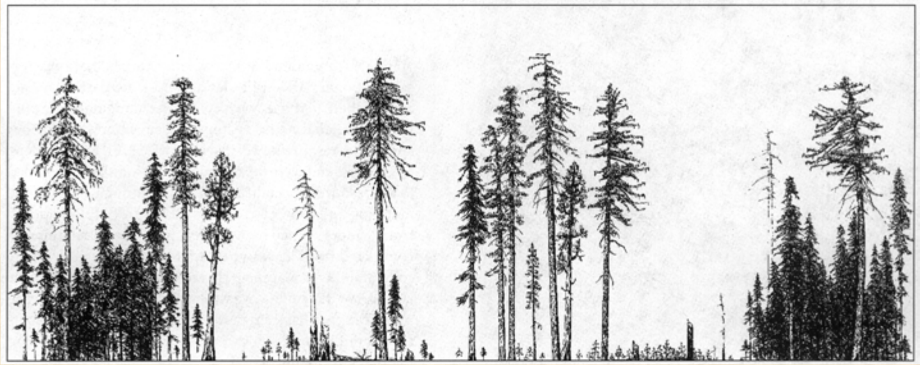
Another problem caused by forest loss from warming

Problems: 4) Increasing forest heterogeneity

- Under changing climate conditions and inevitable fire events, forest resiliency is more likely retained with variable forest and fuel conditions

- Management which applies the same treatment across the landscape will also reduce habitat heterogeneity

- The problem has been to identify where and how forest conditions should vary



Forest structure in an active-fire stand structure (Yosemite)

A 'tidy' German forest

At the landscape level, how do you balance fuels treatment, forest restoration and provision of wildlife habitat?

PSW-GTR-220 attempts to summarize science in 5 areas to develop management recommendations and silvicultural guidelines:

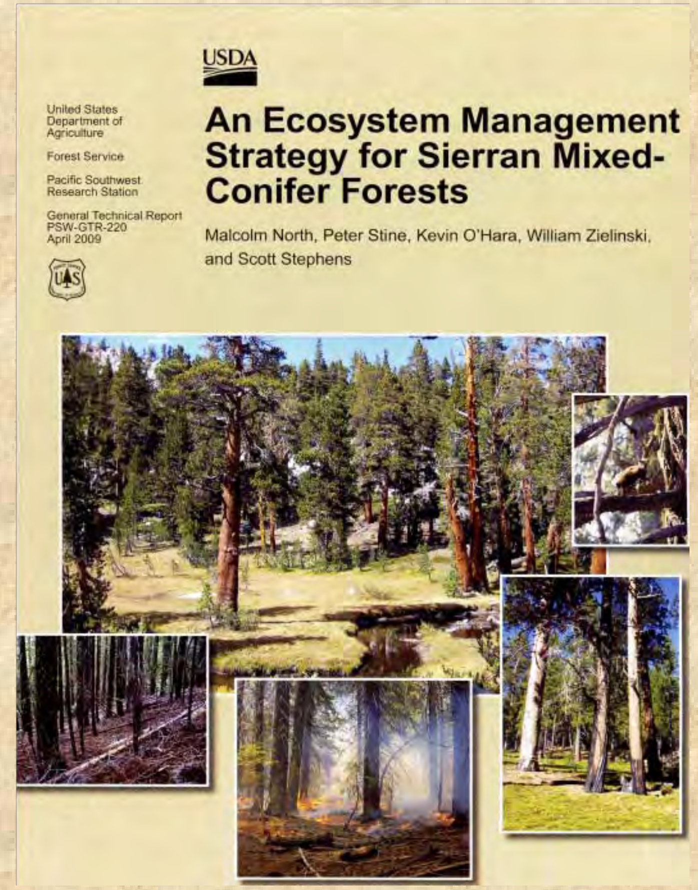
1) Fuel Dynamics

2) Ecological Role of Fire

3) Climate Change

4) Sensitive Wildlife Habitat

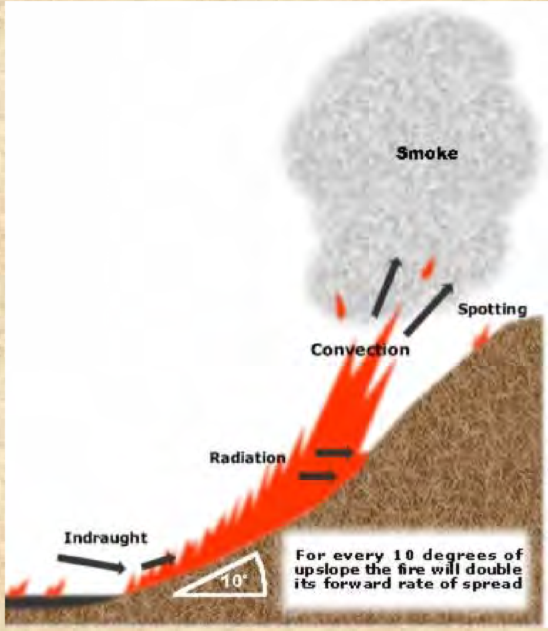
5)Forest Heterogeneity and Resilience



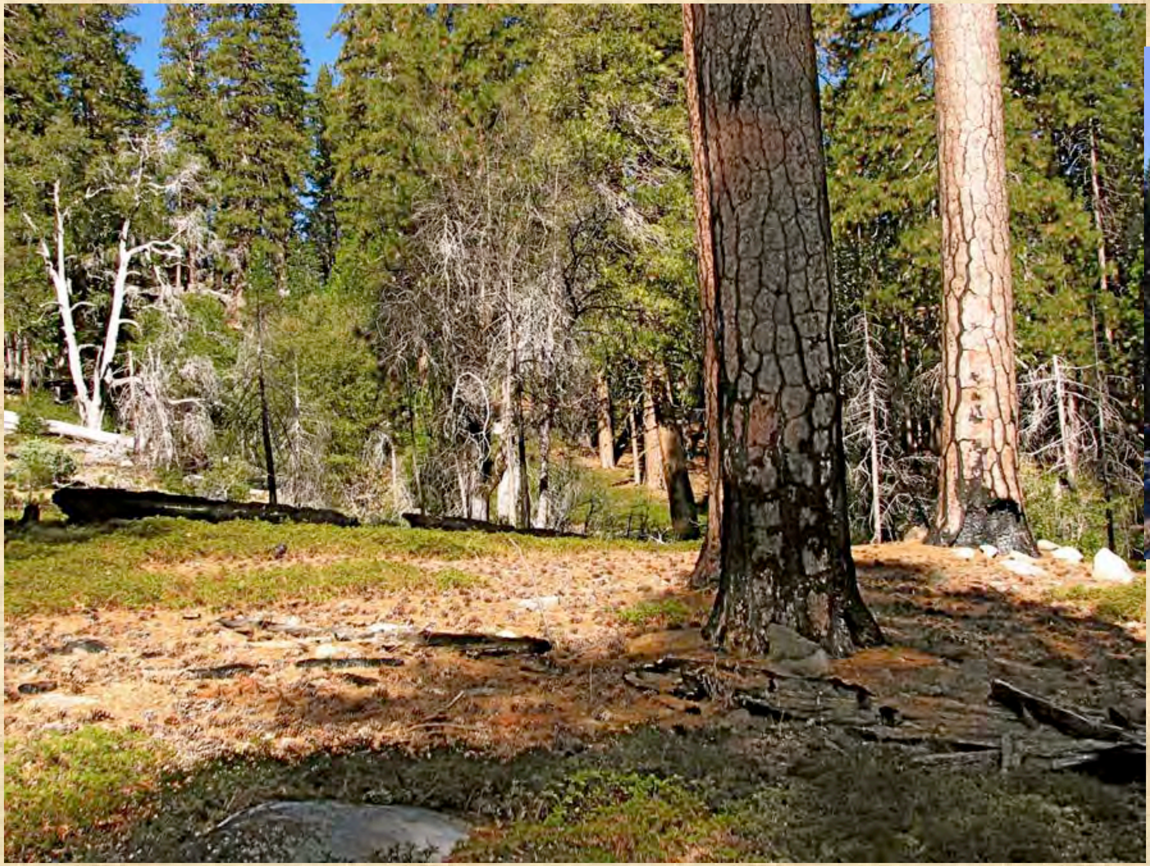
6) Using topography as a template for forest management

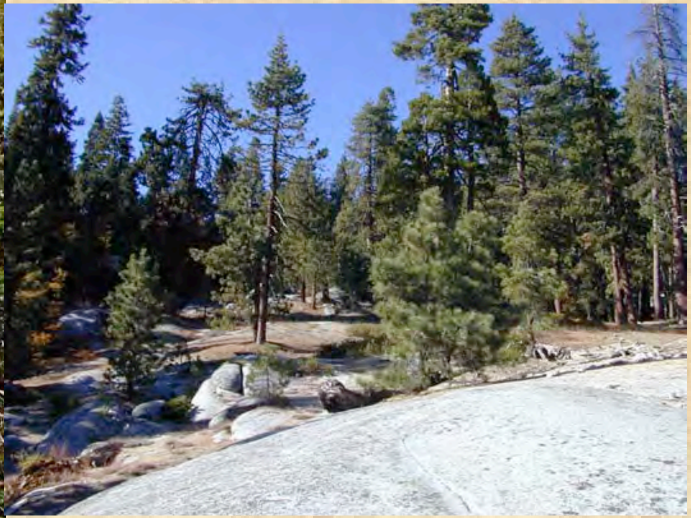
• Active fire regimes likely produced forest heterogeneity as fire intensity and extent was affected by topography.

• Different fuels reduction and resulting forest structure could be produced using micro- and macro- topography as a guide.



Proposed Strategy: Using Topography
Stand Level



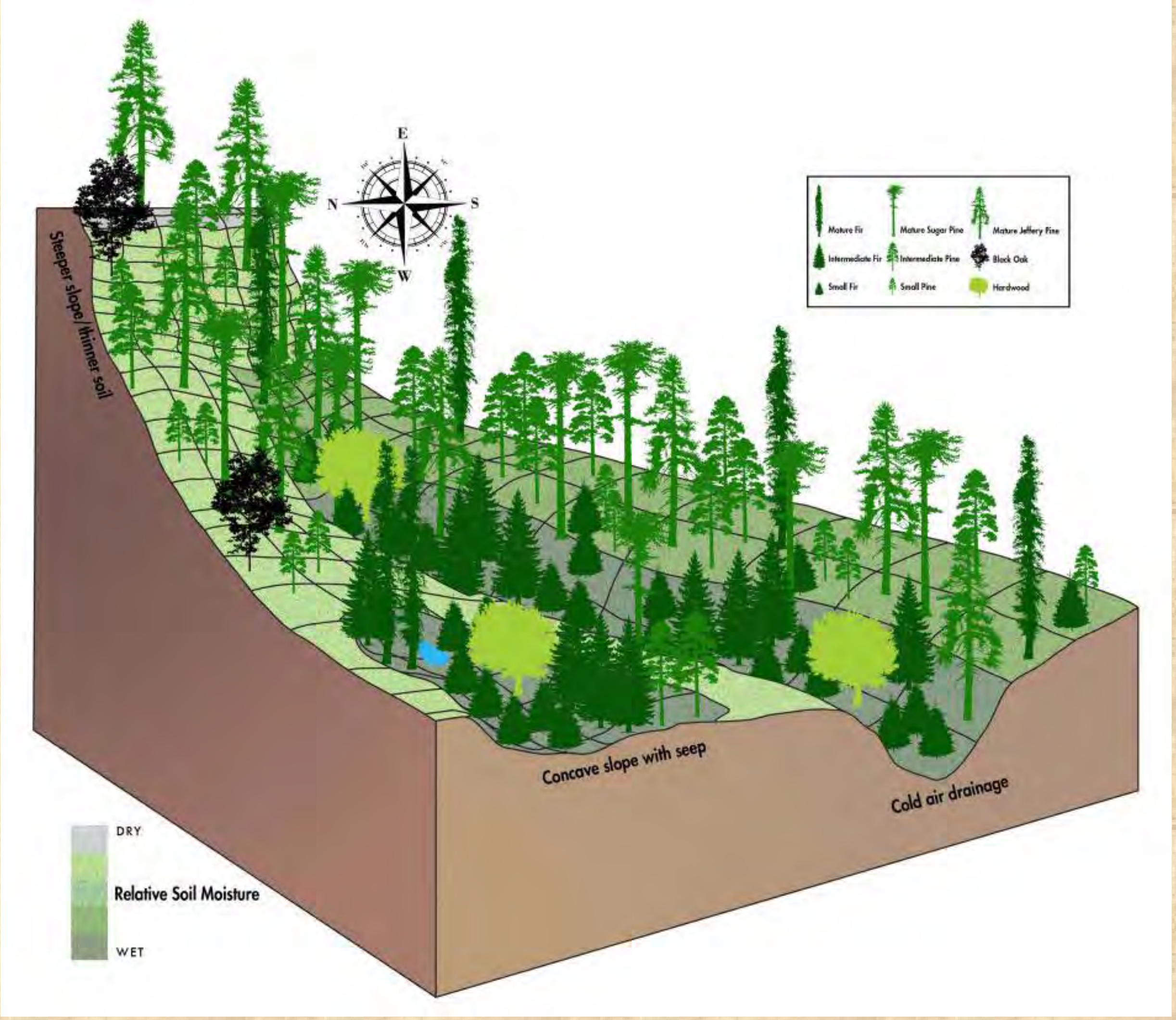


Low density of pine on upper slope shallow soils

Active-fire stand structure in Aspen Valley, Yosemite NP: Note dense group of hardwoods in drainage

Proposed Strategy: Using Topography

Stand-level schematic of how forest structure and composition would vary by small-scale topography after treatment. Cold air drainages and concave areas would have high stem densities, more fir and hardwoods and could provide TES habitat. With increasing slope, stem density decreases and species composition becomes dominated by pines



Proposed Strategy: Using Topography
Landscape Level

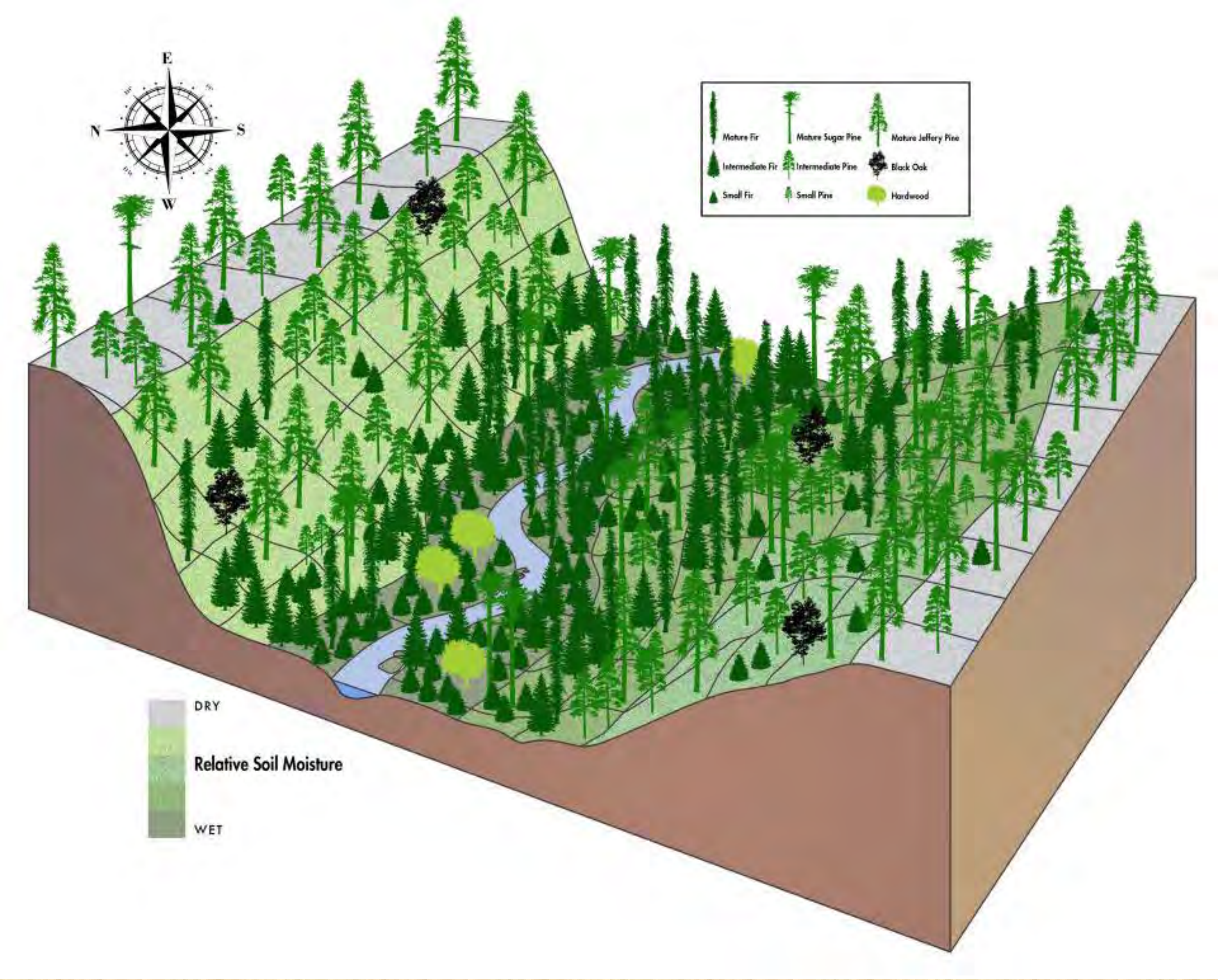
Main influences on fire intensity:

- Slope position
- Slope steepness
- Aspect

Topography's influence on burn intensity producing different forest structures and fuel loads.
Moonlight fire, Lassen NF

Proposed Strategy: Using Topography

Landscape schematic of variable forest conditions produced by management treatments that vary by topographic factors such as slope, aspect, and slope position. Ridgetops have the lowest stem density and highest percentage of pine in contrast to riparian areas. Midslope forest density and composition varies with aspect: density and fir composition increase on more northern aspects and flatter slope angles. Riparian forest provide high canopy cover movement corridors.



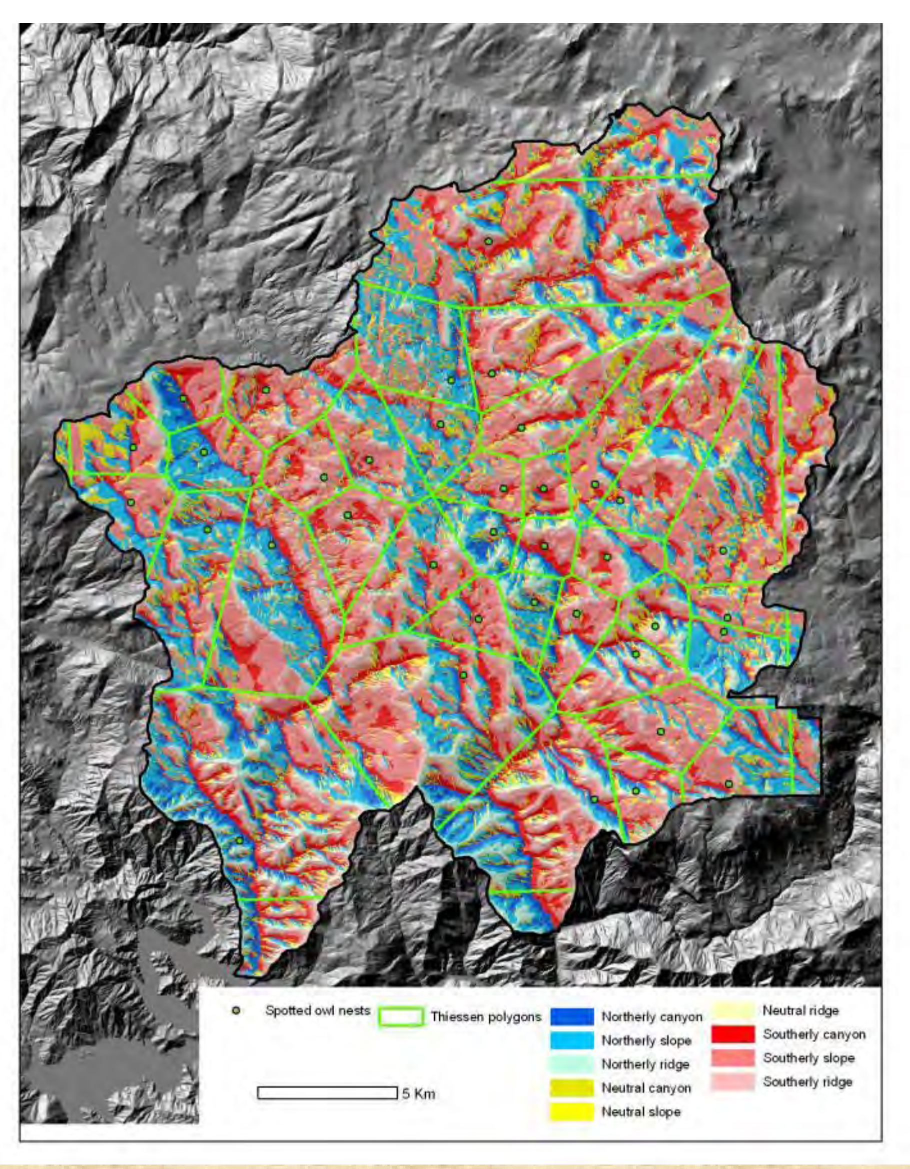
Economics: Justification for thinning merchantable ($\geq$ 20") trees

Criteria (based on ecosystem restoration):

- Species: preferentially remove shade-tolerant, fire sensitive species (firs and cedar)
- Mid to upper slope topographic position where fire probably maintained lower large tree densities
- Ladder fuel trees: larger trees can still ladder fire if their canopy extends close to the ground
- Reduce drought stress and beetle mortality in leave trees

White fir 20-30" dbh with ladder fuel potential

7) An application of the guidelines
Where are TES Located? Spotted Owl Nests



	Canyon	Slope	Ridge
Northerly	3	5	1
Neutral	1	2	0
Southerly	11*	12	2

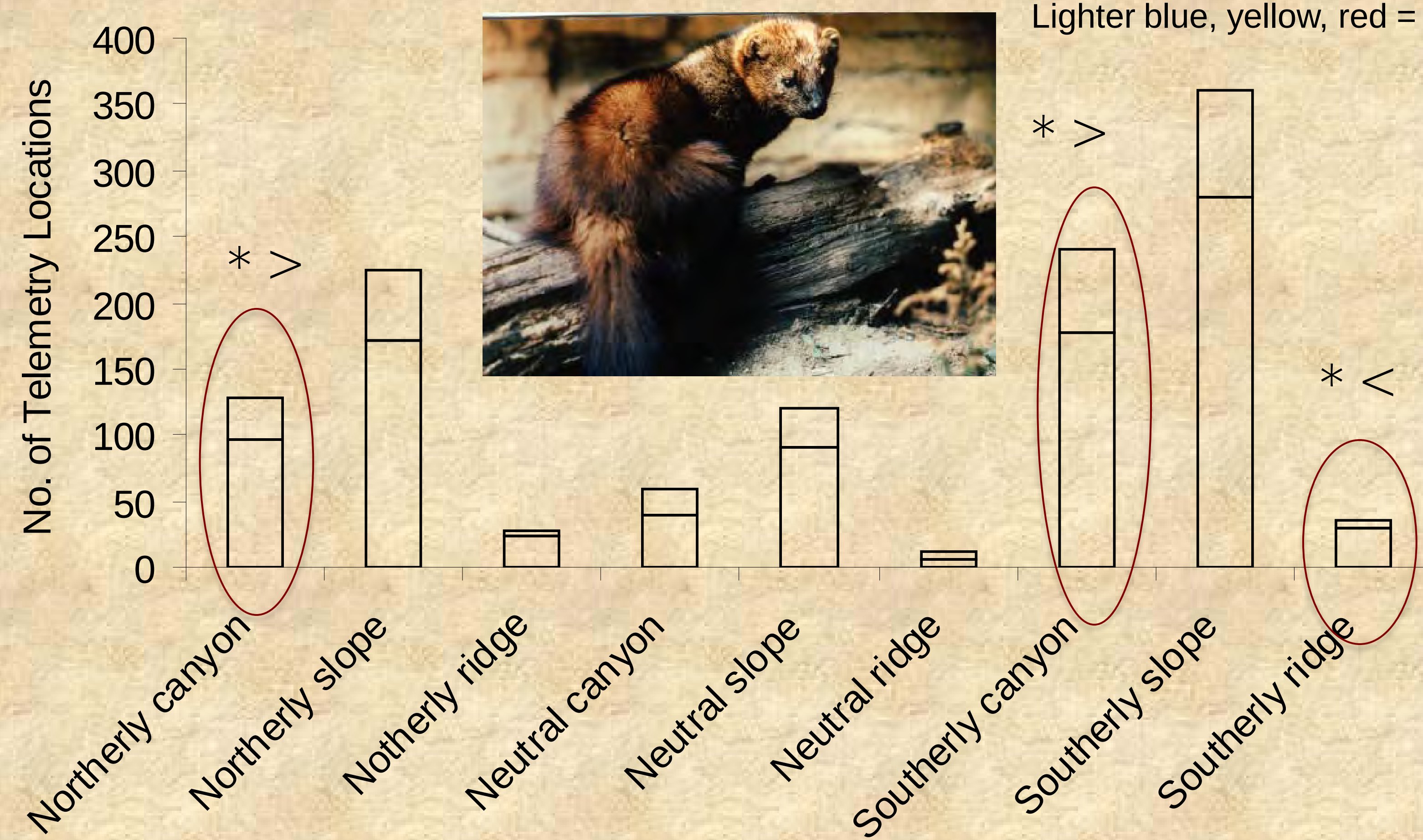
(* > expected)

Underwood, E.C., J.H. Viers, J.F. Quinn, and M. North. 2010. Using topography to meet wildlife and fuels treatment objectives in fire-suppressed landscapes. Journal of Environmental Management 46: 809-819.

Number of Pacific fisher telemetry locations recorded in each topographic category

(n=1209)

Darker blue, yellow, red = Female
Lighter blue, yellow, red = Male



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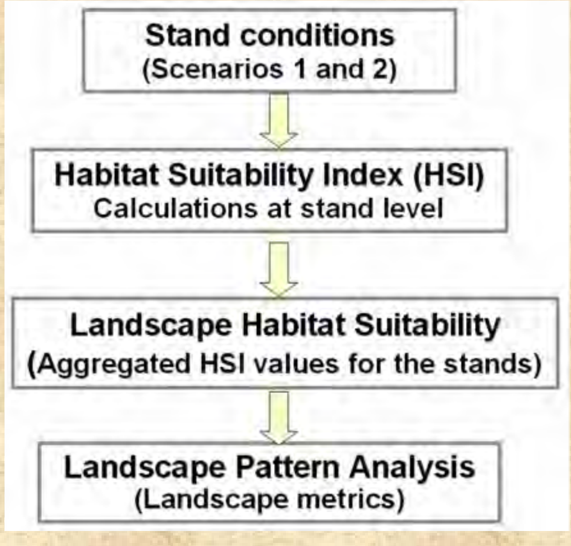
Research's Role: Provide a Science-Based Concept for Multiple Objective Management in Fire-Dependent Landscapes

• Scientist's "Failure to communicate"—forest managers sometimes use science to articulate their objectives

• But the reductionist nature of science doesn't usually provide a synthetic concept to use.

•Research may help by providing a conceptual model of how different forest and fuel conditions might knit the landscape together.

• For stakeholders, this approach can help with **transparency and verification**



Traditional FRAGSTATS method of calculating habitat in a landscape that does not provide a concept of TES habitat allocation or how the pieces might function together

Conclusions:

- In fire-prone forests, the risks of carefully considered active management are lower than the risks of inaction.

The 2007 Moonlight Fire

- The best means of providing sensitive species habitat in fuels treated landscapes may be to produce the variable, resilient forest structure that these species evolved with.

- This can only happen IF there's common ground allowing fuels treatments to be widely implemented AND be economically viable.

Prescribed fire at Blodgett Experimental Forest

- "Trust but verify": In the absence of upper diameter limits, Sierran environmentalists want a landscape plan for where sensitive species habitat should be located & what criteria are used for tree thinning.