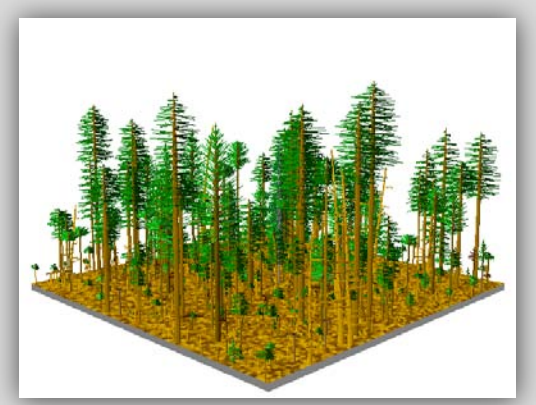
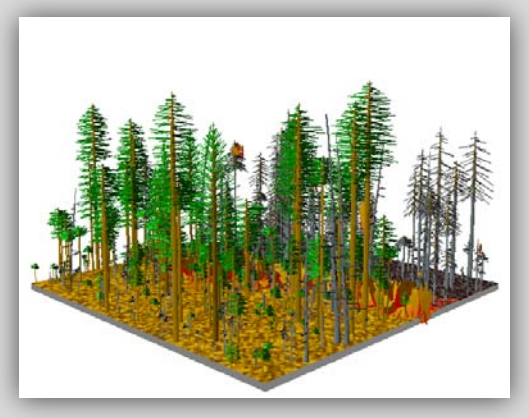
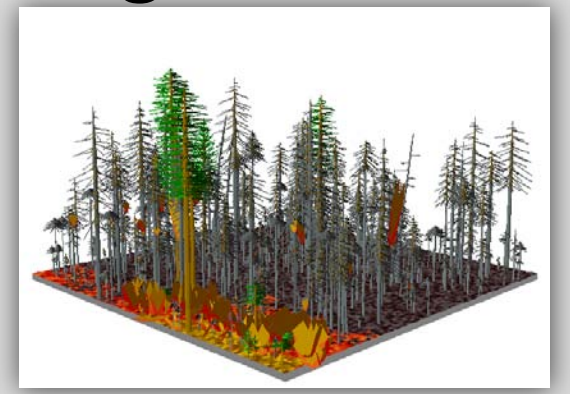
Meshing Climate Change Consideration with Forest Restoration Strategies

David L. Peterson, Jessica Halosky, Morris C. Johnson

Chapter 10: Managing and Adapting to Changing Fire Regimes in a Warmer Climate

in

The Landscape Ecology of Fire, Ecological Studies 213,

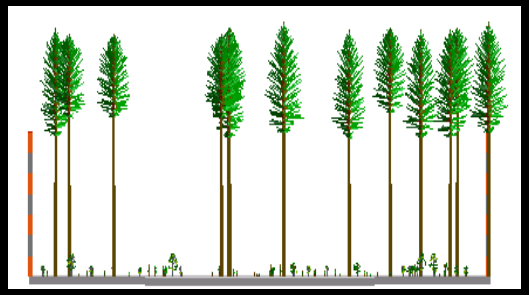
Edited by Don McKenzie, Carol Miller, and Don Falk

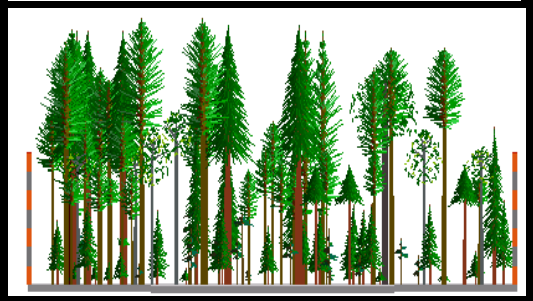
The Gates Millennium Scholars
Funded by a Grant from the Bill & Melinda Gates Foundation

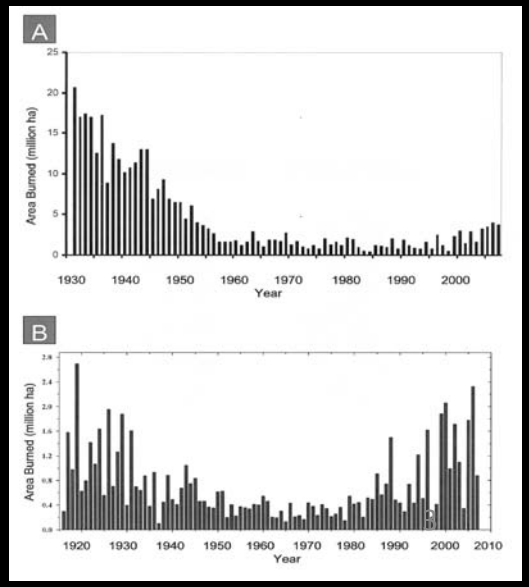
Well We Know That

Change in Dry Forest Heterogeneity

- Dry forests fuelbed characteristics
  - Encroachment of fire intolerant vegetation
  - Change vertical and horizontal fuel continuity
  - Increase canopy bulk density
  - Lower canopy base height
  - Increase probability of crown fires

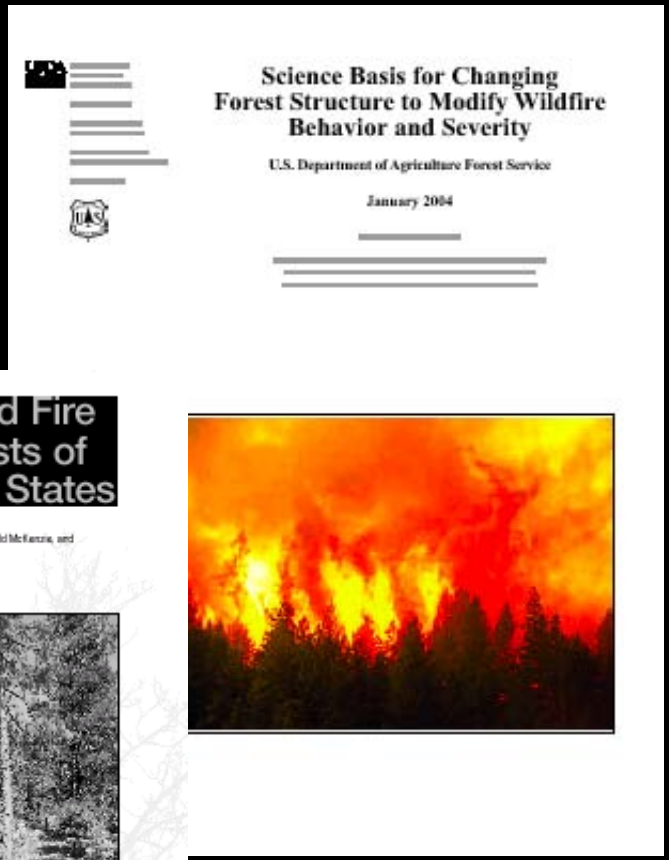


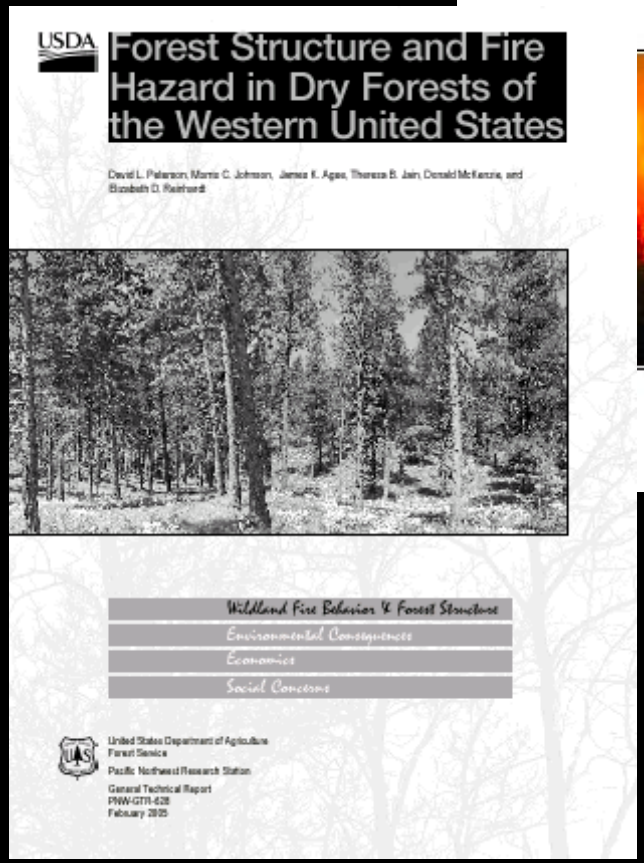




Why do fuels management

- Why do fuels management?
- Not to stop wildfires
- Scientific basis for fuel treatments
  - Quantitative guidelines for fuel treatments
- Principles Fire Safe Forest
  - Crown fire
  - Control surface fire behavior



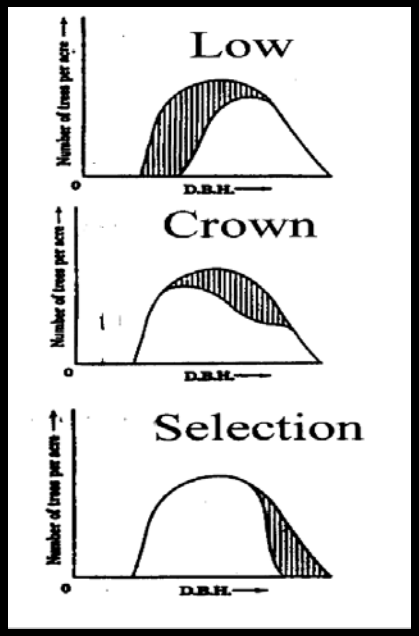


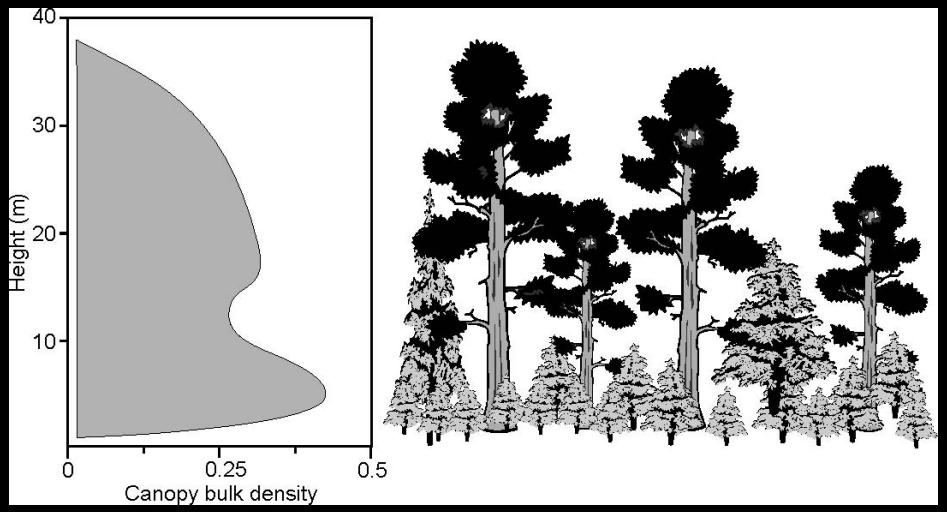
Principles of Fire Safe Forests

Principle	Effect	Advantage	Concerns
Principle #1 Reduce surface fuels	Reduces potential flame length	Control easier; less torching	Surface disturbance less with fire than other techniques
Principle #2 Increase height to live crown	Requires longer flame length to begin torching	Less torching	Opens understory; may allow surface wind to increase
Principle #3 Decrease crown density	Makes tree-to-tree crown fire less probable	Reduces crown fire potential	Surface wind may increase and surface fuels may be drier
Principle #4 Keep big trees of resistant species	Less mortality for same fire intensity	Generally restores historic structure	Less economical; may keep trees at risk of insect attack

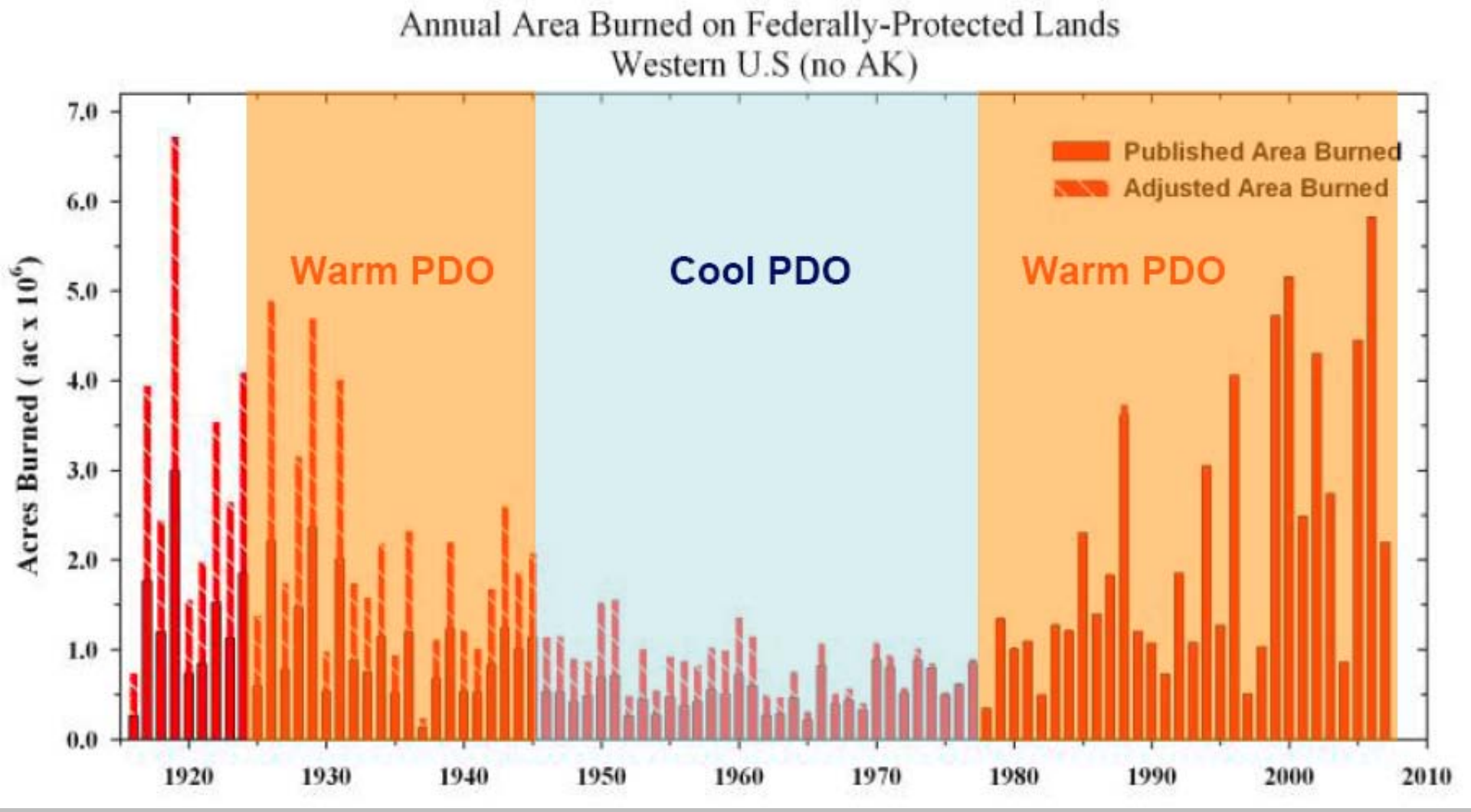
Agee, J. K., and C. N. Skinner. 2005. Basic principles of forest fuel reduction treatments. Forest Ecology and Management **211:83-96.**

Principles of Fire Safe Forests





Area burned – Western U.S., 1916 - 2007



Fire Suppression ⟶ Fire Exclusion ⟶ Fuel Accumulation

Climate Change and Fire

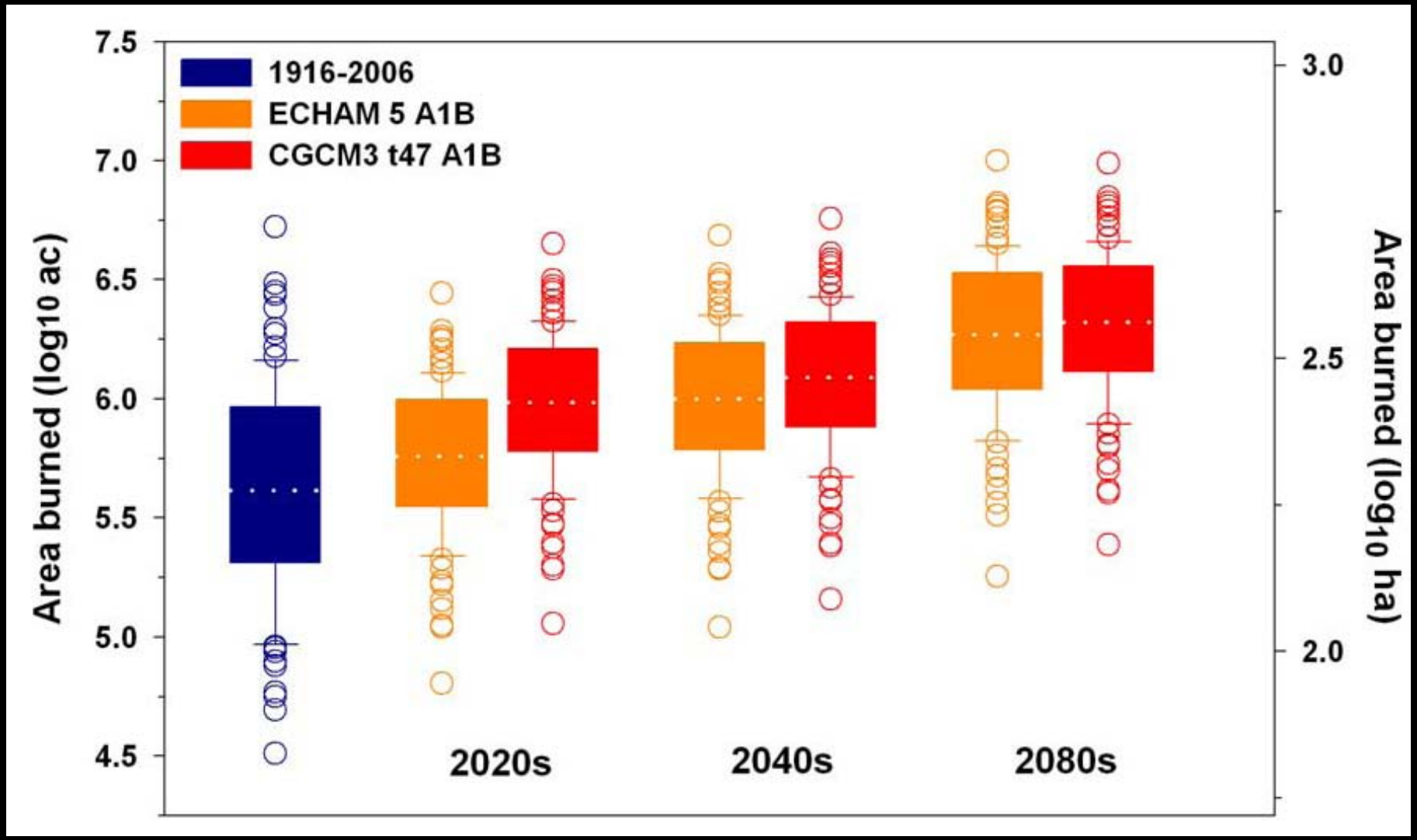
- Warmer and drier spring conditions =
  - early snowmelt
  - lower summer soil and fuel moisture
  - longer fire seasons
  - increased fire frequency and extent
- Fire intensity and severity may also increase

How much will area burned increase with climate change?

Analysis of wildfire data since 1916 for the 11 contiguous Western states shows that *for a 4 F increase* that *annual area burned will be 2-3 times higher*.

McKenzie et al. (2004), *Conservation Biology* 18:890-902

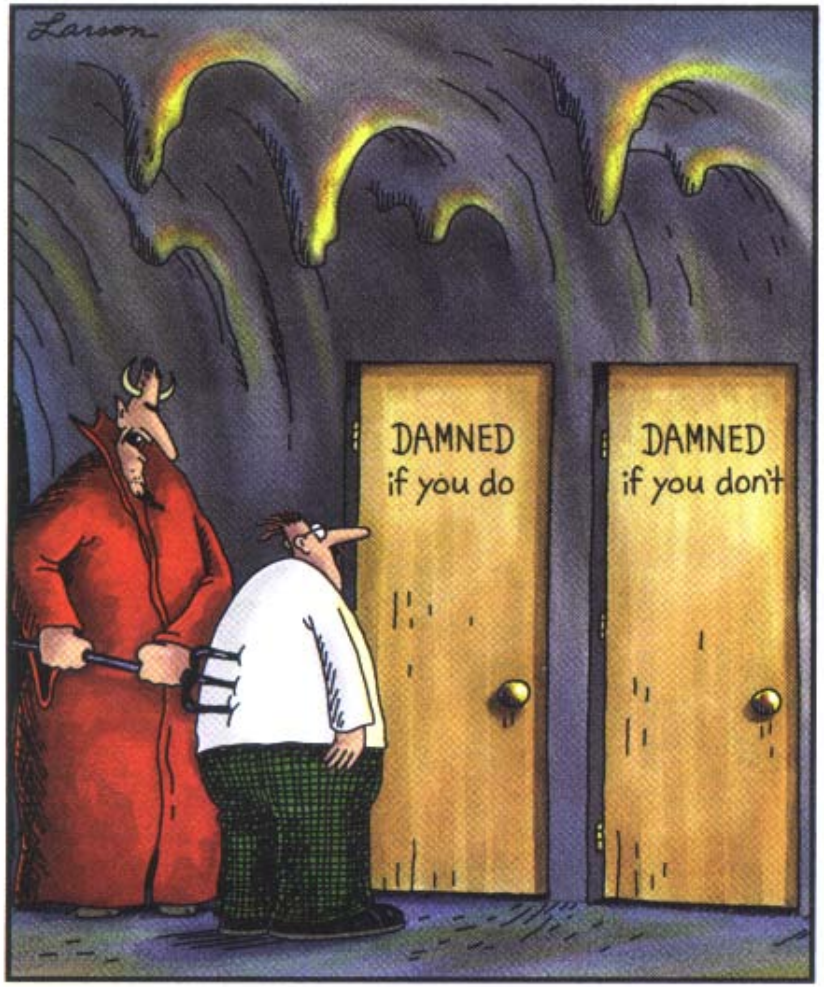
Projected changes in area burned in the PNW



Littell et al. 2010

Adaptations to Climate Change

- So what should be done about these probable changes
- We don't know exactly what to do – there's so much uncertainty in the future.
- There will likely be a lot of good outcomes and a lot of bad outcomes, so you're damned if you do and damned if you don't.
- But being proactive will likely lead to more good outcomes than bad.



"C'mon, c'mon—it's either one or the other."

Adaptation strategy #1

Increase landscape diversity

Thin forest stands to create lower density, and diverse stand structures and species assemblages that reduce fire hazard and increase resilience to wildfire.

Adaptation strategy #2

Increase resilience at large spatial scales

Implement thinning and surface fuel treatments across large portions of landscapes where wildfires may occur

Orient the location of treatments to modify fire severity and fire spread

Focus the spatial scale of treatments on units of hundreds to thousands of acres

Adaptation strategy #3

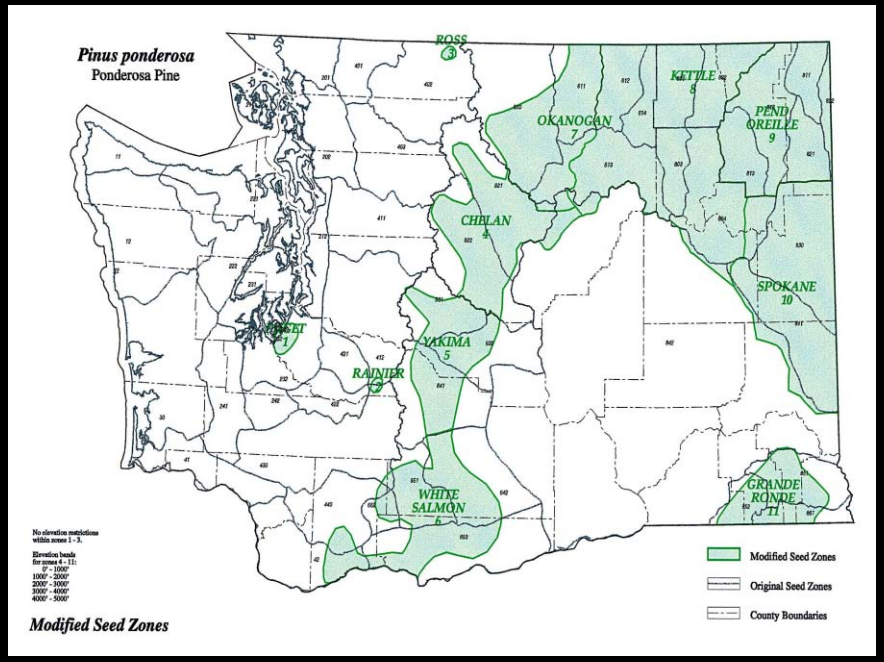
Maintain biological diversity

Modify genetic guidelines

Experiment with mixed species, mixed genotypes

Assist colonization, establish neo-native species

Identify species, populations, and communities that are sensitive to increased disturbance



Adaptation strategy #4

Plan for post-disturbance management

Treat fire and other ecological disturbance as normal, periodic occurrences

Incorporate fire management options directly in general planning process

Adaptation strategy #5

Implement early detection / rapid response

Eliminate or control exotic species

Monitor post-disturbance conditions, reduce fire-enhancing species (e.g., cheatgrass)

Adaptation strategy #6

Collaborate with a variety of partners

Develop mutual plans for fire and fuels management with adjacent landowners to ensure consistency and effectiveness across large landscapes

Adaptation strategy #7

Promote education and awareness about climate change

Facilitate discussion among management staff regarding the effects of a warmer climate on fire and interactions among multiple resources

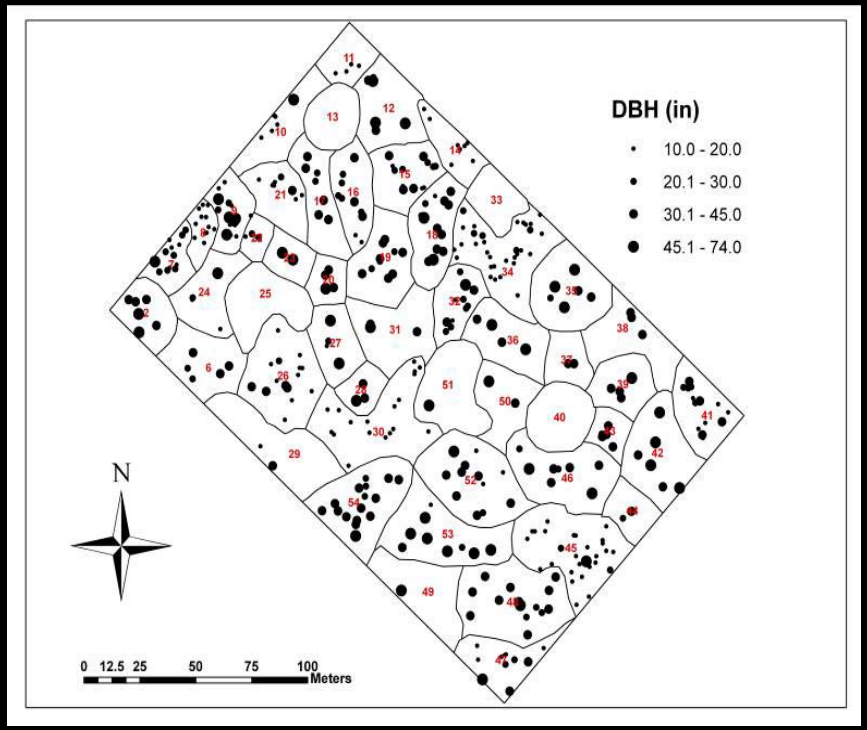
Educate local residents about how a warmer climate will increase fire frequency and how fuel reduction can protect property

Climate and Fire

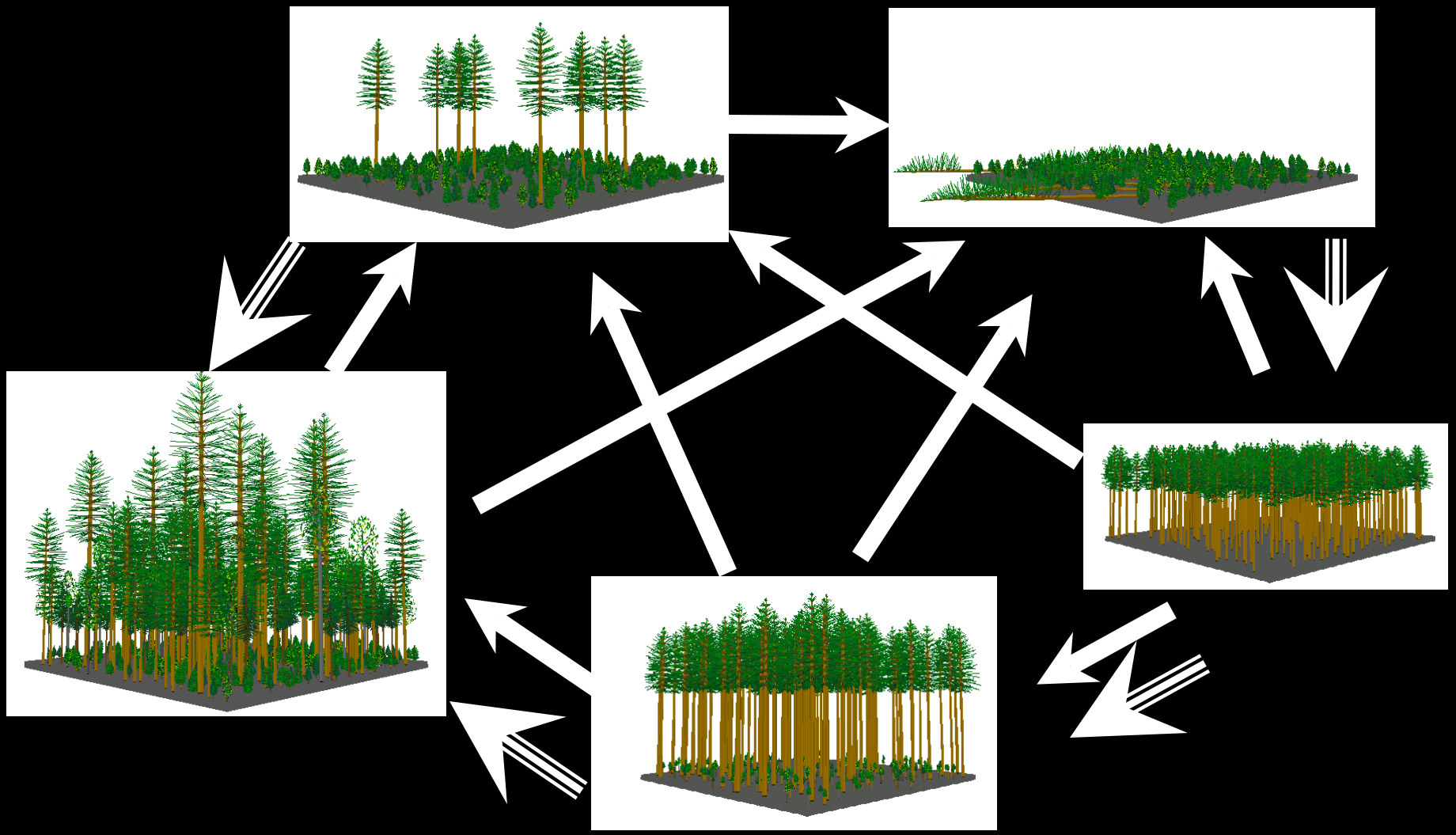
- Climate may have implication on design of fuel treatments
- Adaptation
- Fuel treatment guidelines may need to be adjusted to retain either more or fewer stems per acre
- Managers weigh tradeoffs

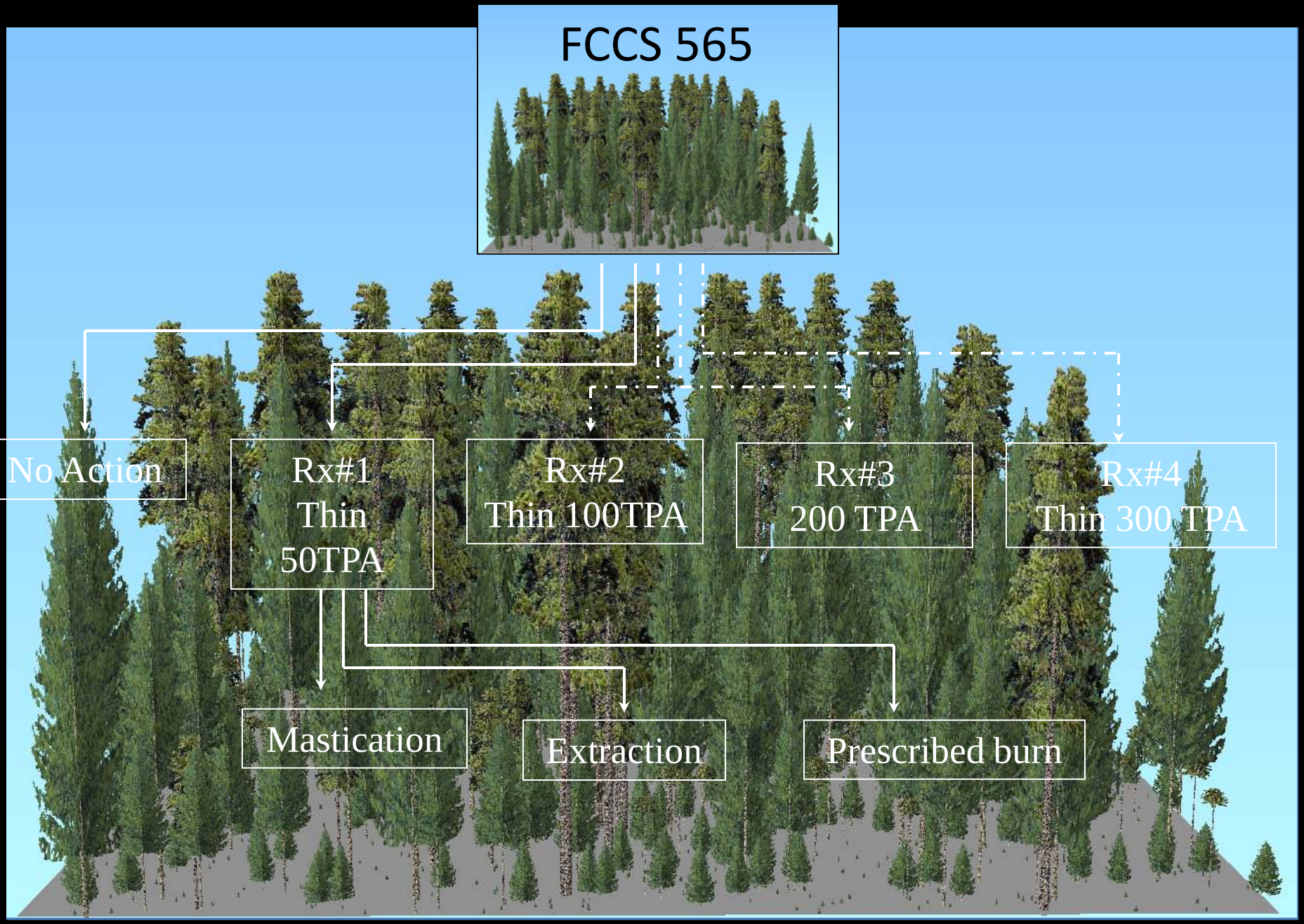
Adaptation strategy #1

- Increase landscape diversity
- Thin forest stands to create lower density, and diverse stand structures and species assemblages that reduce fire hazard and increase resilience to wildfire
  - Gaming approach
  - Scenario building

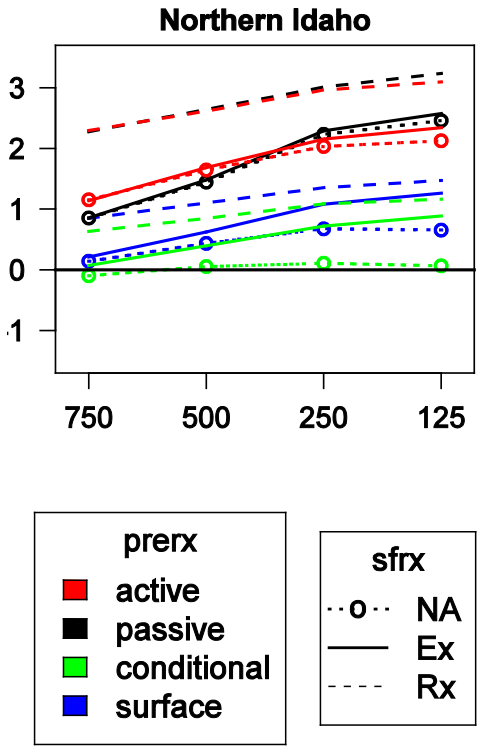


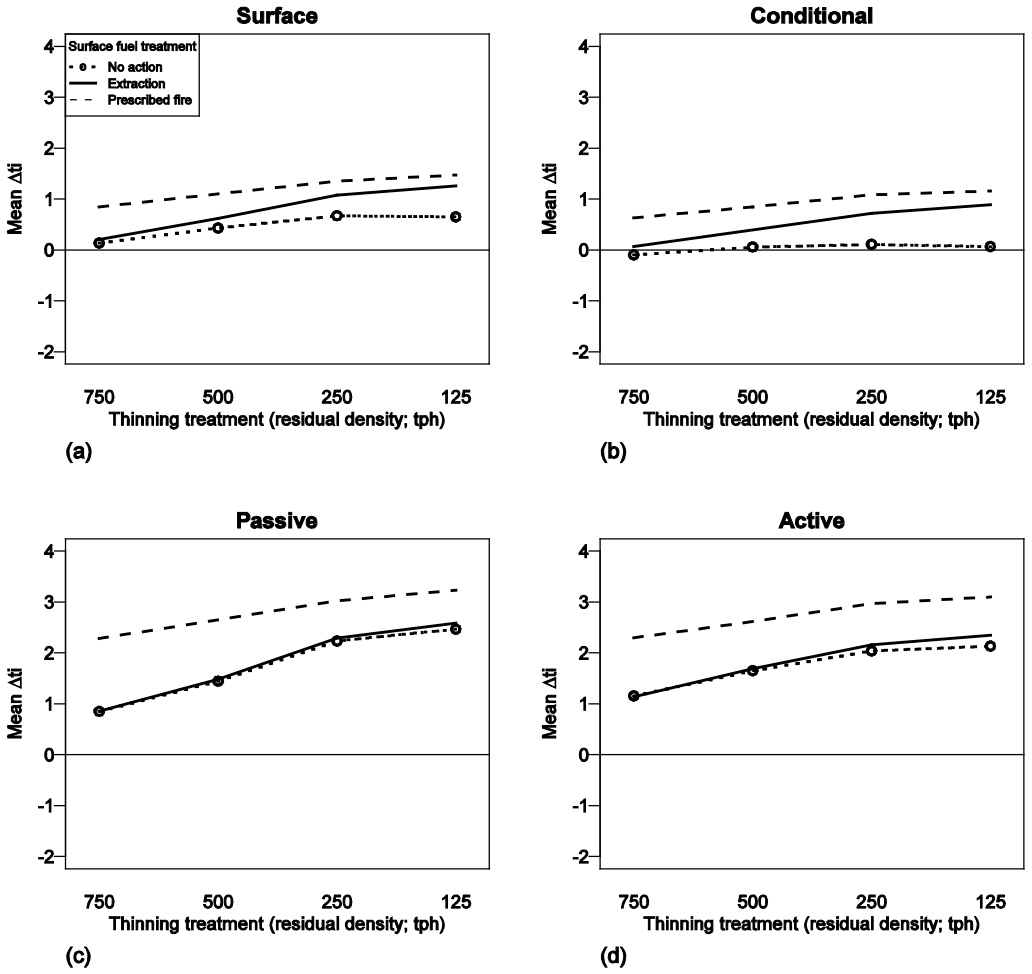
Multiple Silvicultural Pathways




FCCS 565
No Action
Rx#1
Thin
50TPA
Rx#2
Thin 100TPA
Rx#3
200 TPA
Rx#4
Thin 300 TPA
Mastication
Extraction
Prescribed burn

Treatment Matrix





Johnson, M.C., Kennedy, M.C., Peterson, D.L. 2011. Simulating fuel treatment effects in dry forests of the western United States: testing the principles of a fire-safe forest. Canadian Journal of Forest Research 41(6): 1018-1030.

Scaling up to Landscape Levels

"Where no man has gone before…."

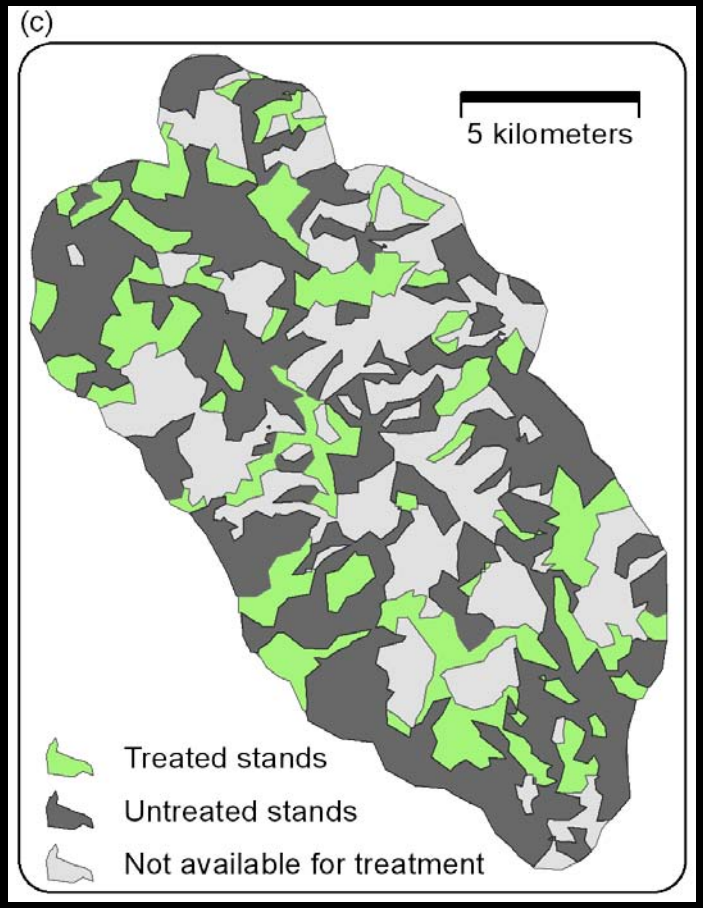
Slide credit: James Agee

How Much Is Enough?

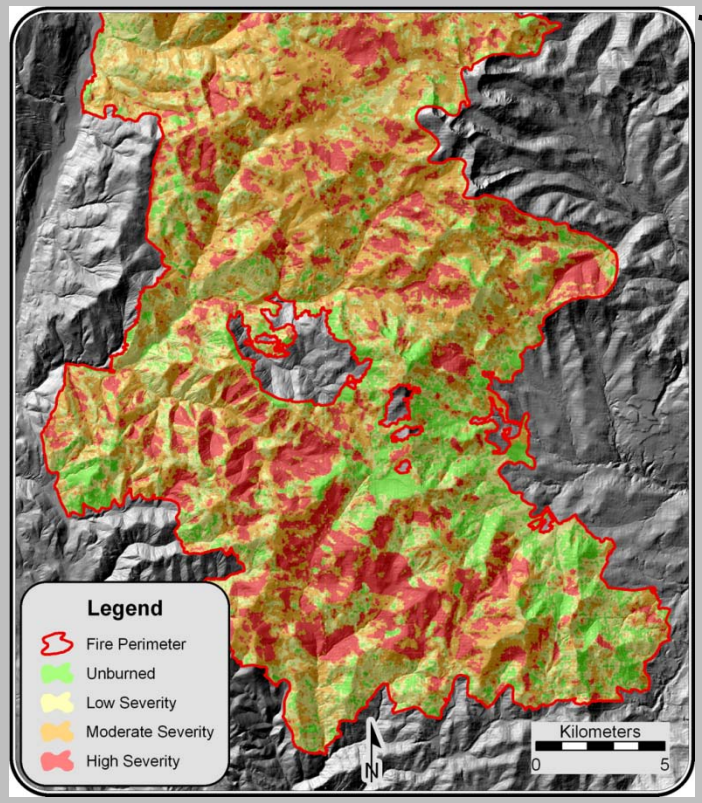
- What proportion of a landscape needs to be treated?
  - FlamMap, ArcFuels
- Will this vary by how and where the treatments are placed on the landscape?
- Great questions!
- Use wildfires to treat the landscape…use of ~~wildland fire~~…

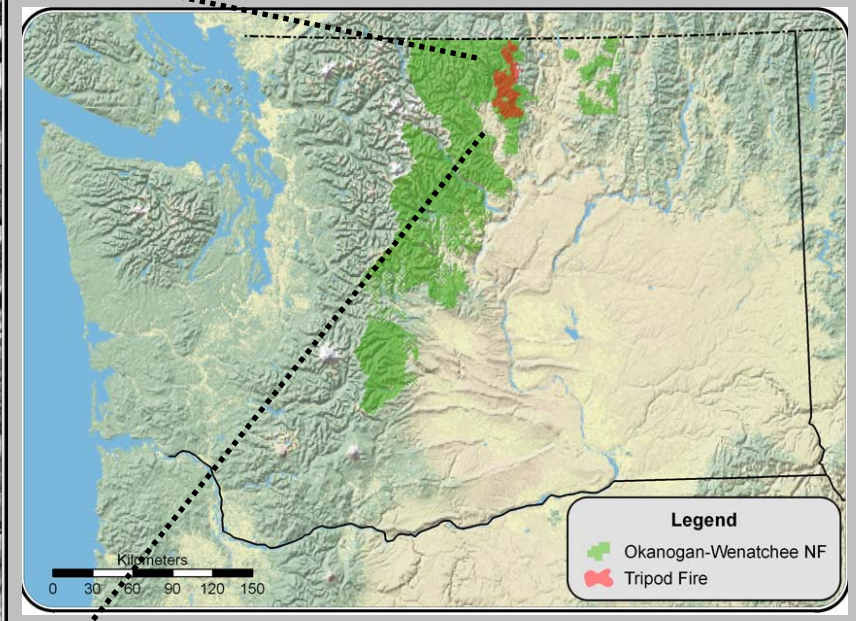
Adaptation strategy #2

- Increase resilience at large spatial scales
- Implement thinning and surface fuel treatments across larger portions of landscape where wildfires may occur
- Orient the location of treatments to modify fire severity and fire spread



Graph credit: Kennedy et al. 2007


Legend
Fire Perimeter
Unburned
Low Severity
Moderate Severity
High Severity
N
Kilometers
0
5


Kilometers
0 30 60 90 120 150
Legend
Okanogan-Wenatchee NF
Tripod Fire

Summary

- Current warming tending in northern latitudes will lead to increased area burned by wildfire
- Will this vary by how and where the treatments are placed on the landscape?
- Warmer and drier climate will reduce the effectiveness of fuel treatments
- Develop and incorporate adaptation strategies