Ponderosa Pine Forest Restoration Treatment Longevity:

Implications of Regeneration on Fire Hazard

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Background

- How did we get to the current situation?

The Problem

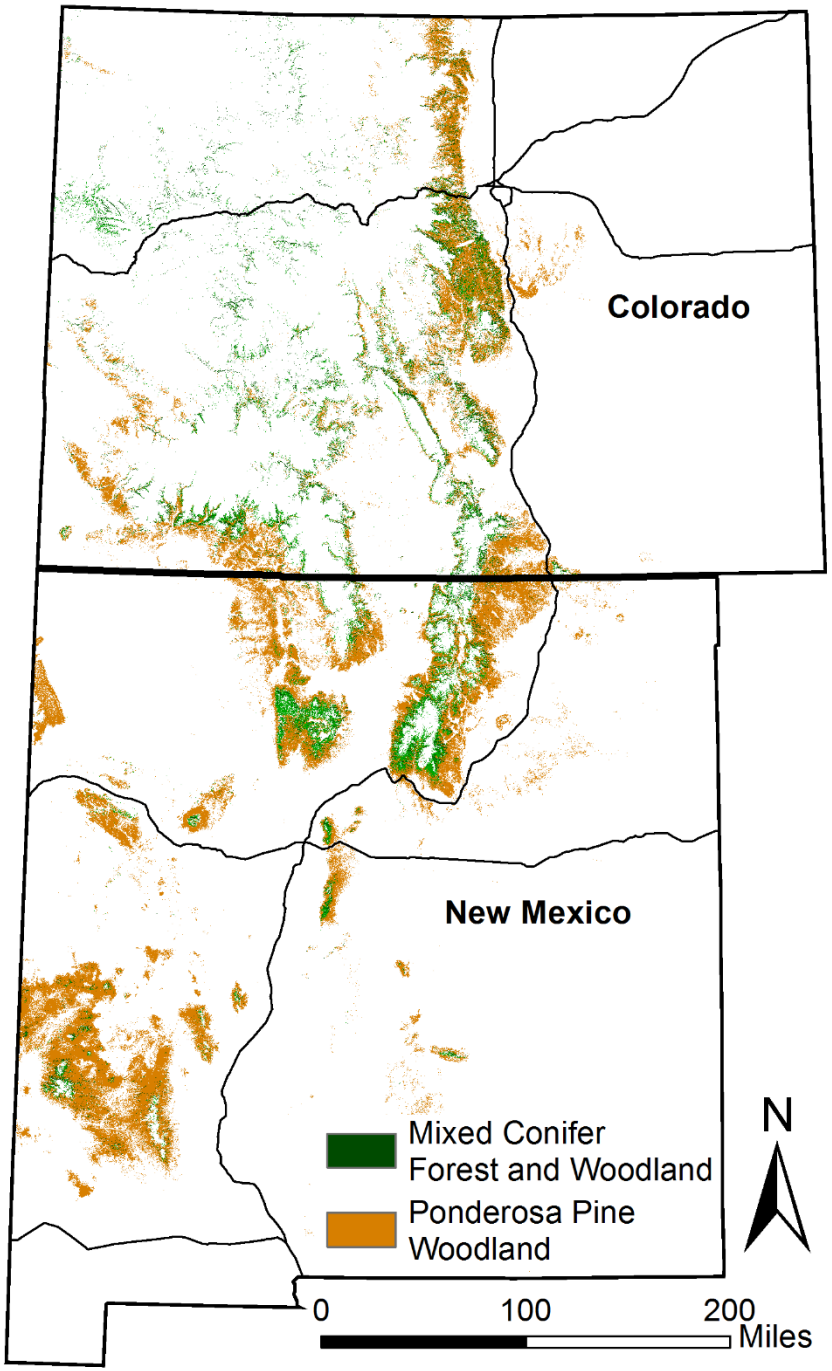
- Growth dynamics in restored forests

Assessing Treatment Longevity

- Evaluating fire hazard

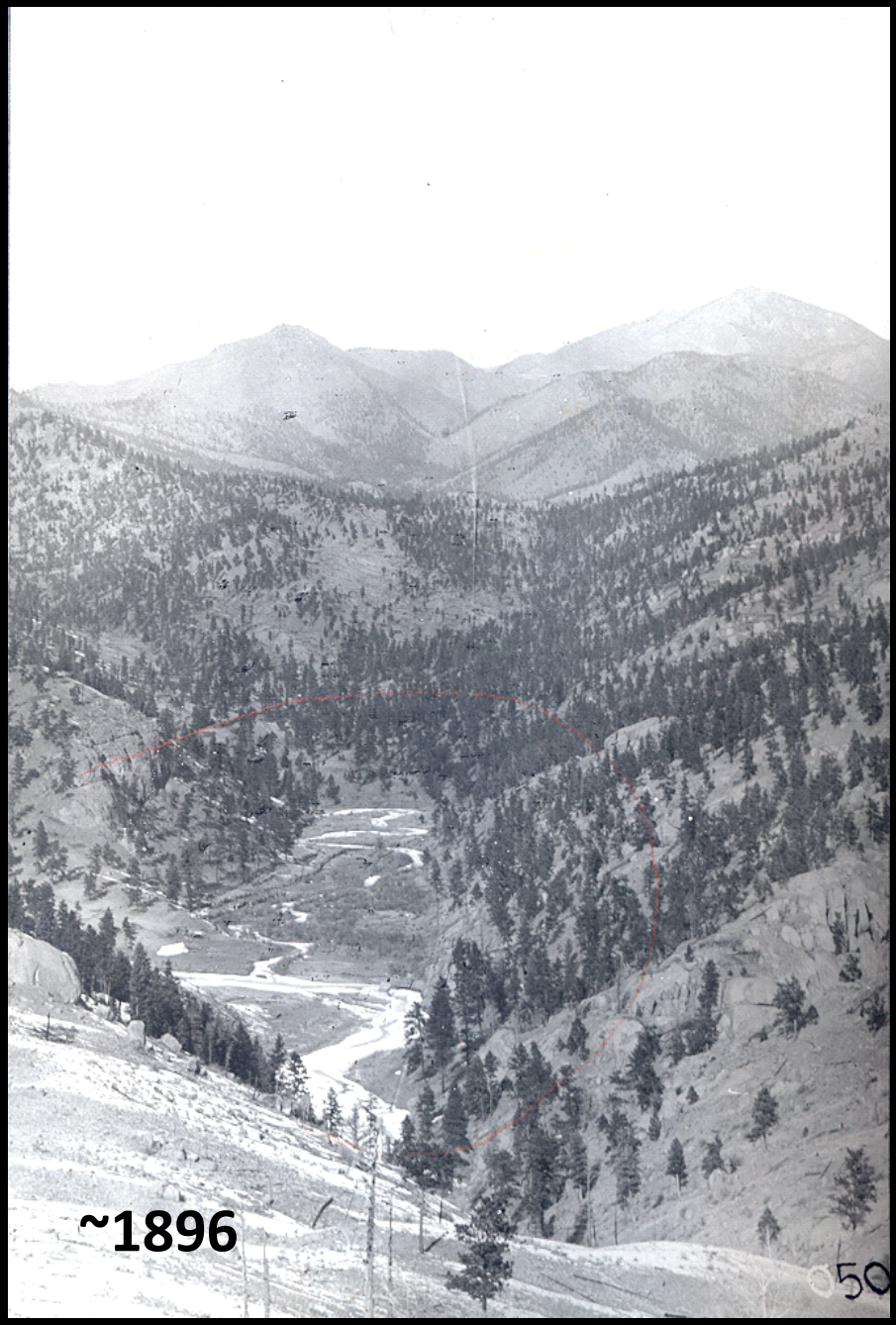
Results

- Complications and Implications



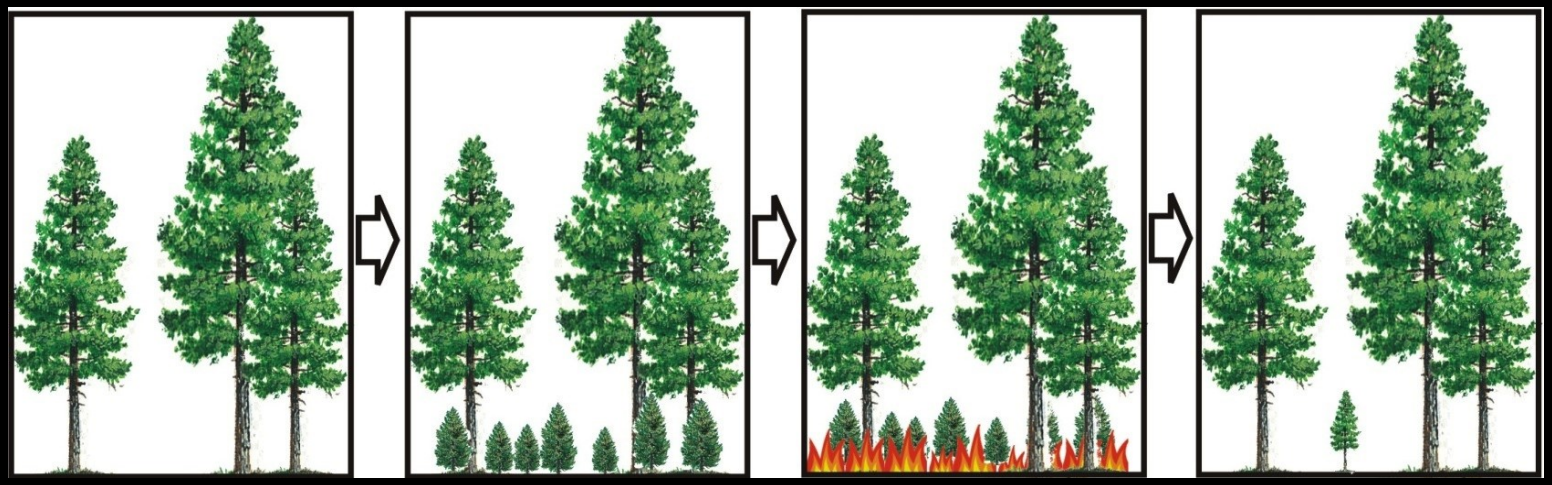
Background

~16 billion acres in southern Rocky Mountains



Images: Dr. Mike Battaglia, USFS Rocky Mountain Research Station

Historical mixed-severity fire regime



Current situation

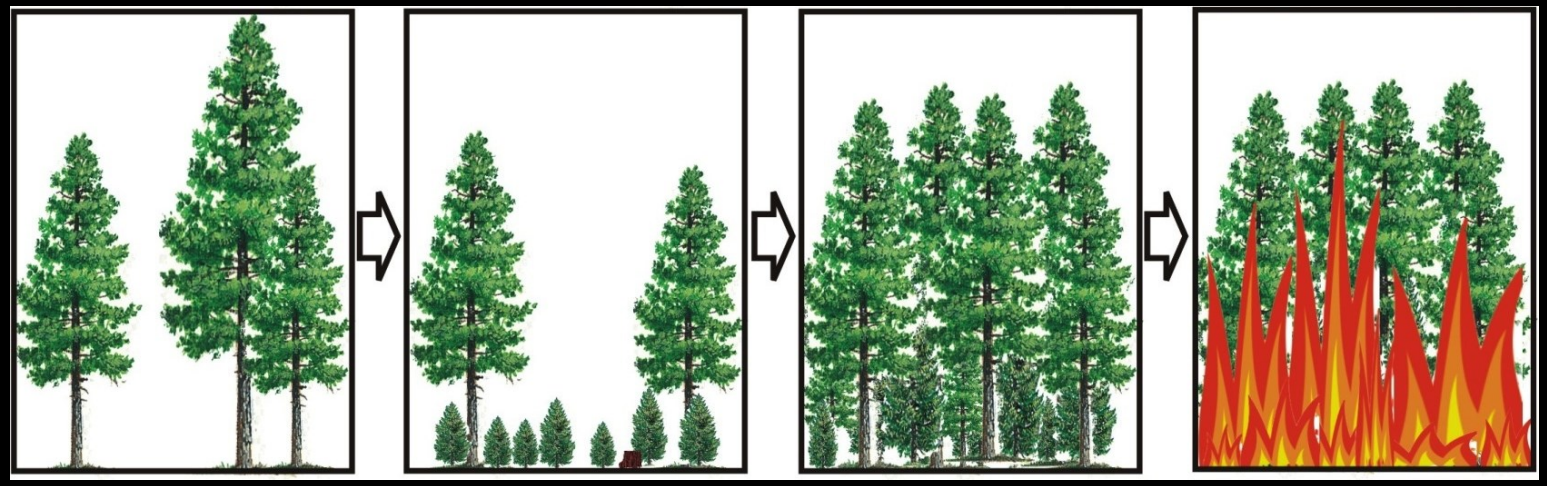


Image: Dr. Peter Brown, Rocky Mountain Tree-Ring Research

“Traditional” hazardous fuels mitigation

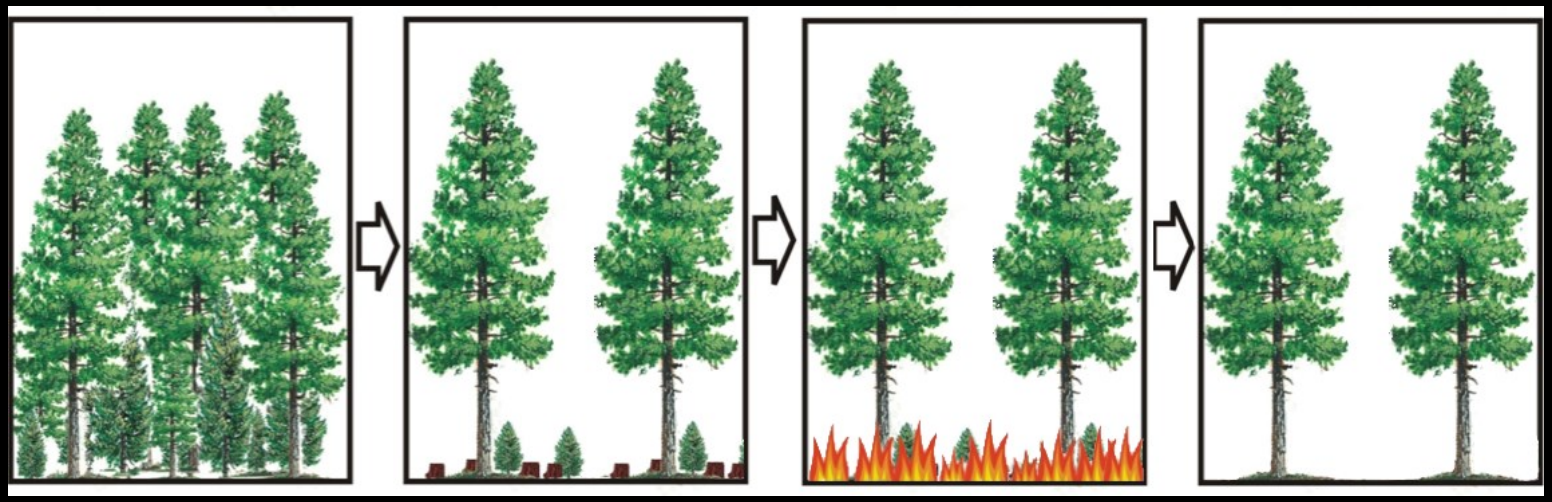
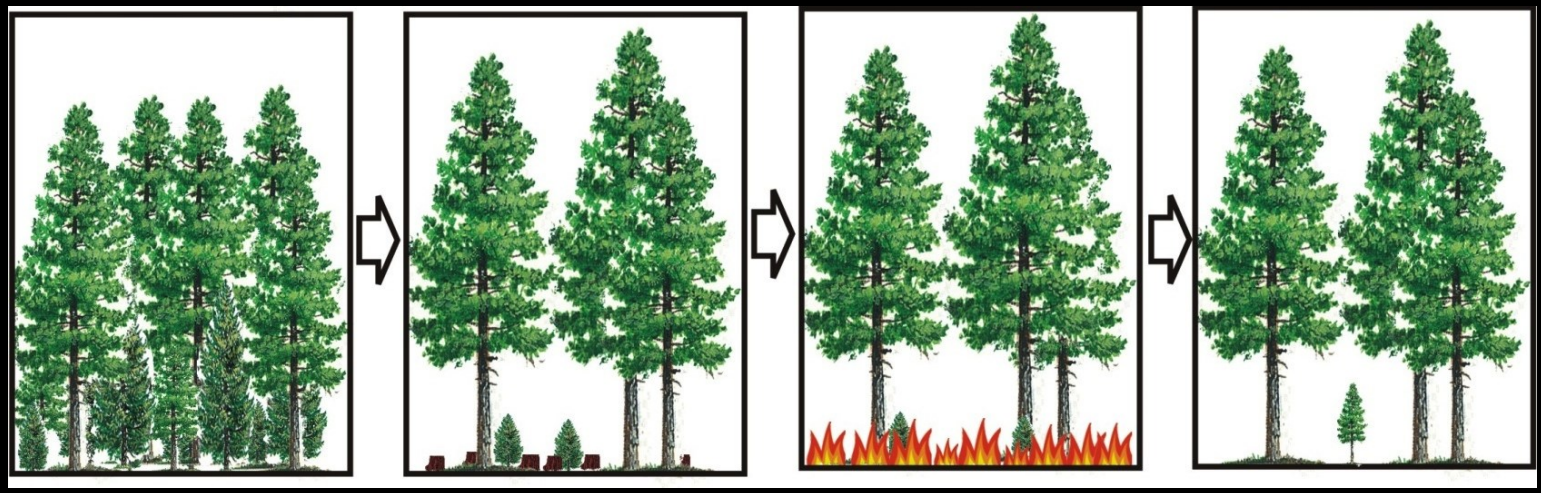


Image adapted from Dr. Peter Brown, Rocky Mountain Tree-Ring Research

“Groupy-clumpy” restoration



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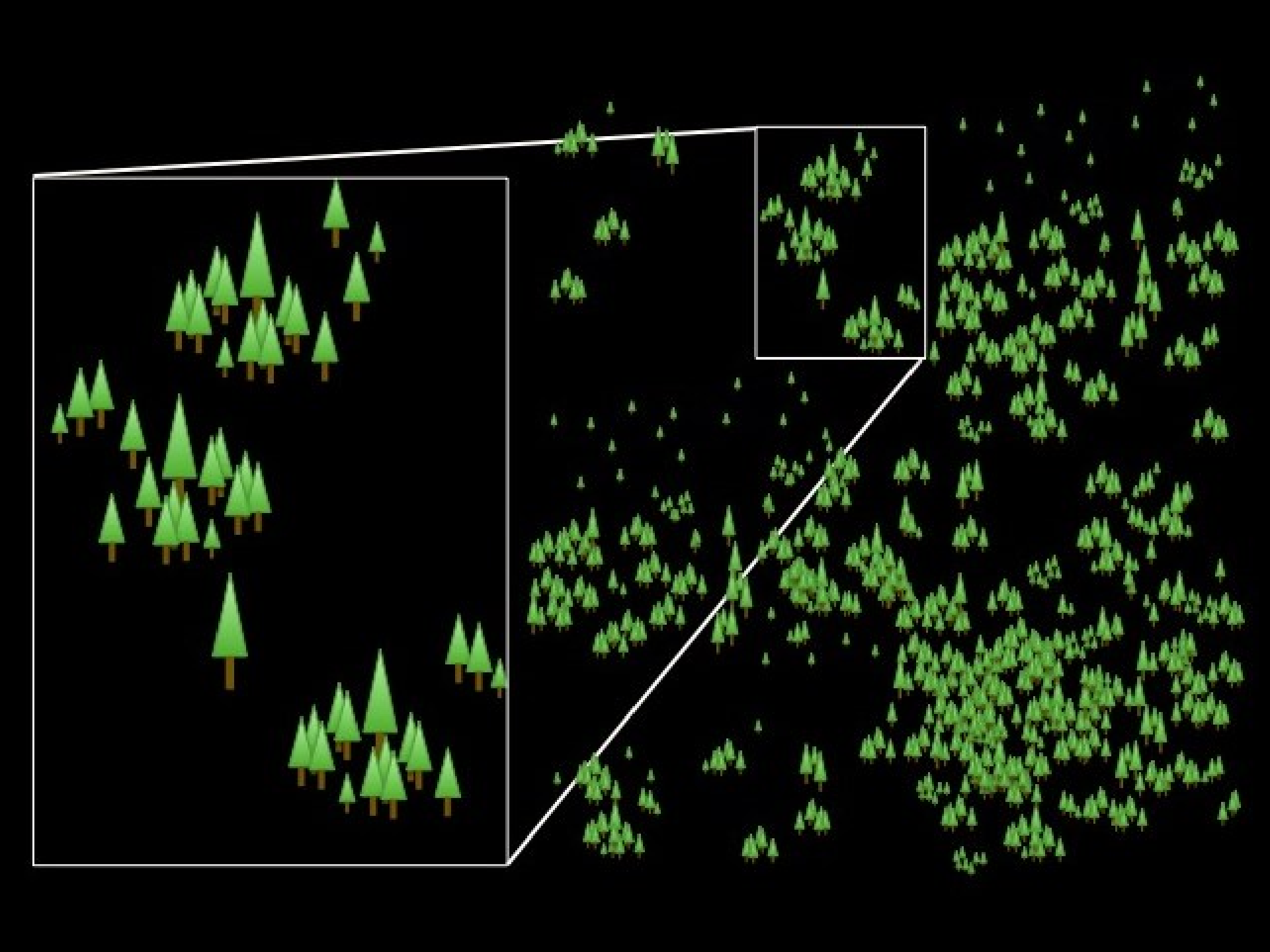

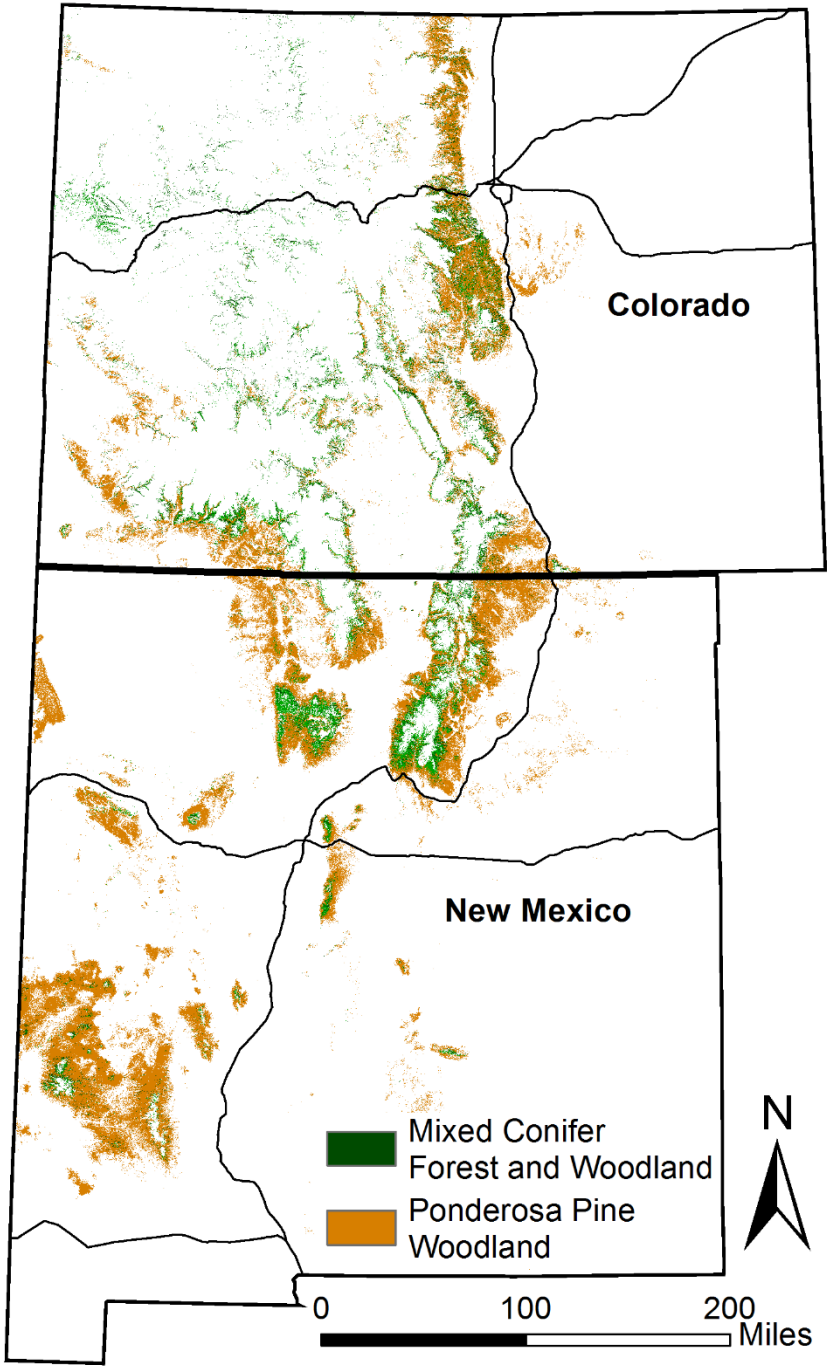

Collaborative Forest Landscape Restoration Program

5 – CFLRP Projects in southern Rocky Mountain ponderosa pine systems

Targeting 2.1 million hectares for treatment

Intended to increase horizontal heterogeneity

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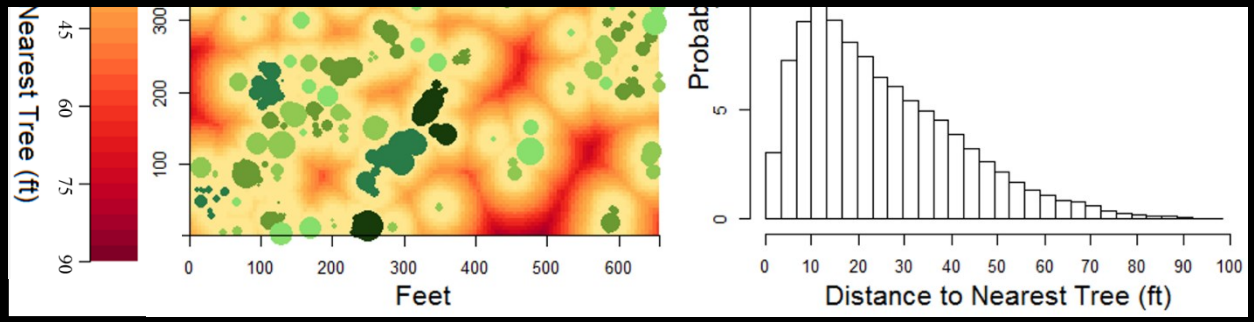
Fine-Scale Forest Structure

Fine-Scale Forest Structure

- Restoration treatments enhance stand structural variability.
- It is speculated that these stands create micro-site conditions conducive to explosive regeneration.

The impact of regeneration on the length of time a treatment is able to reduce fire hazard is unknown.

Objective: Assess the effects of regeneration magnitude and timing across a range of ponderosa pine site productivities on the longevity of fuel hazard reduction in restoration treatments.



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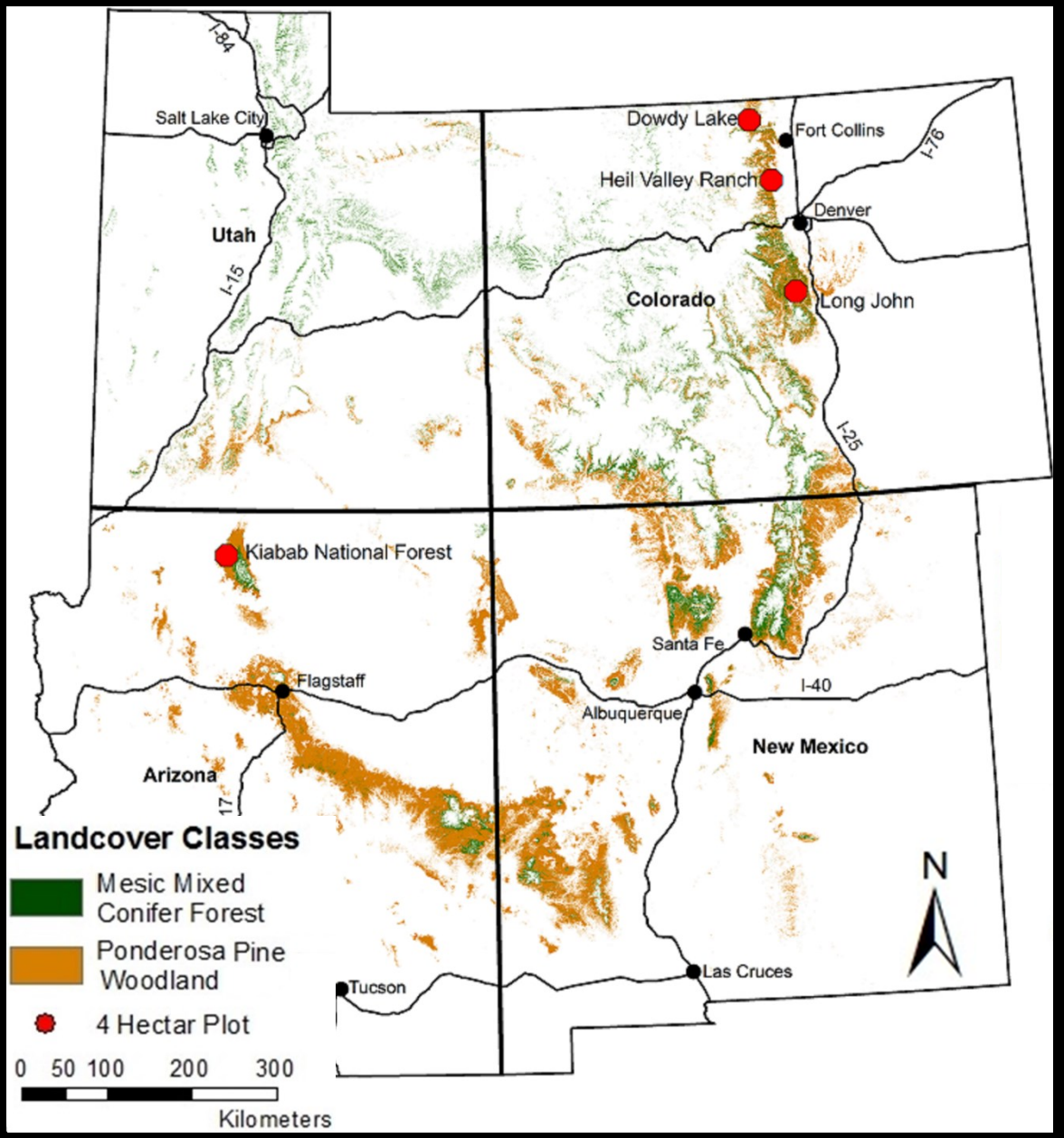
Simulated Stands

Reference Stands

- 4 – 10 acre ponderosa pine dominated sites were stem-mapped.
- Represented a range of site index (35, 55, 75, 95 ft) at base age 100 years.

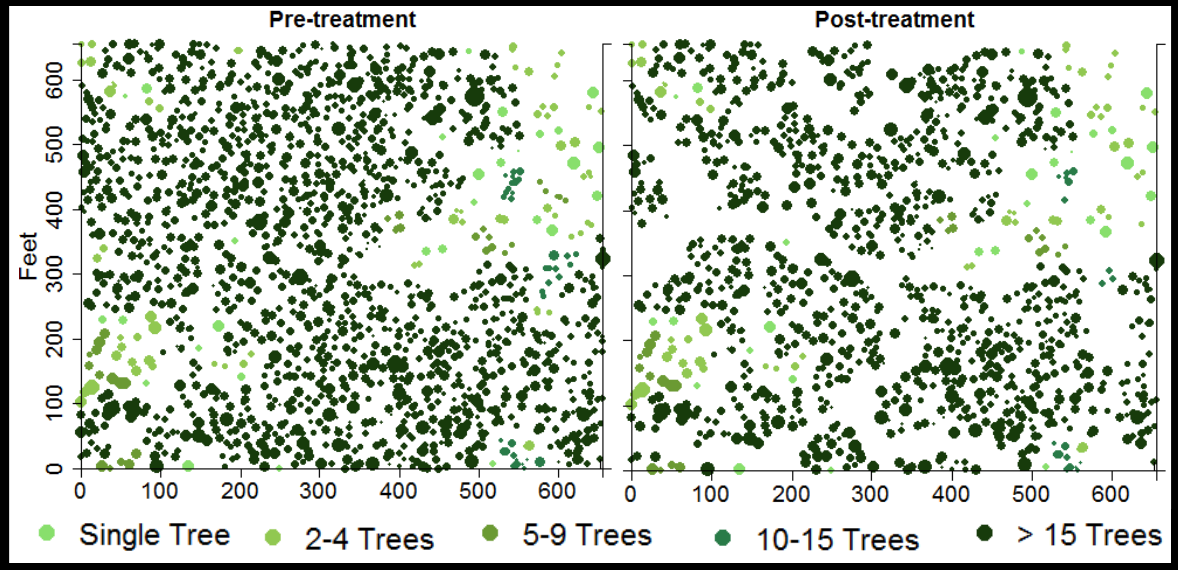


Simulated Stands

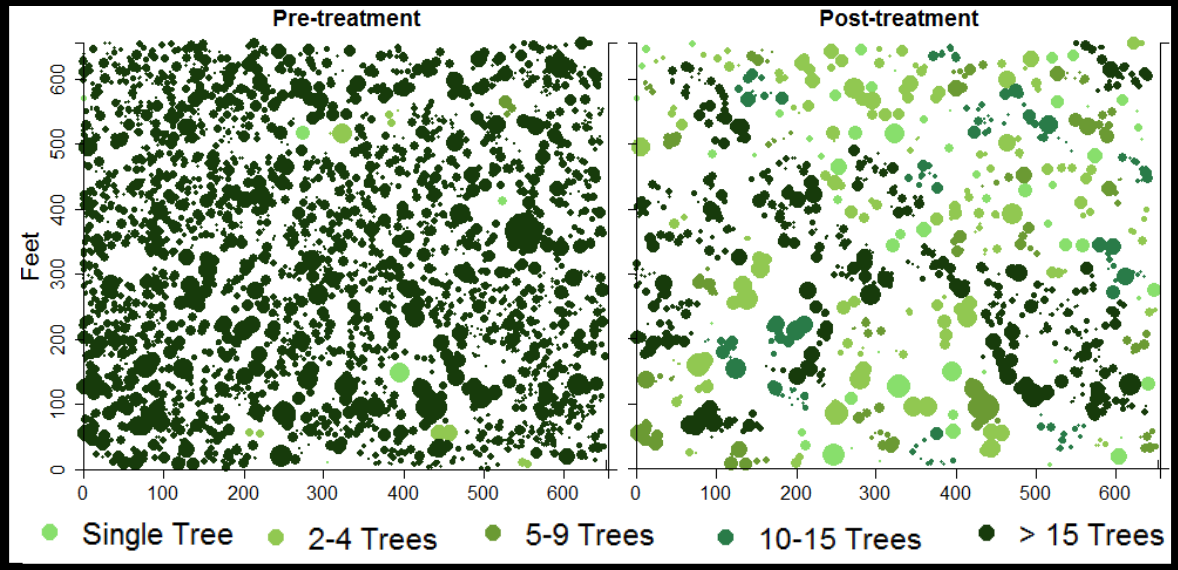
Reference Stands

- 4 – 10 acre ponderosa pine dominated sites were stem-mapped.
- Represented a range of site index (35, 55, 75, 95 ft) at base age 100 years.
- Each was treated with a spatially explicit restoration treatment.
- Stands were simulated using FVS-FFE at a 5 year cycle for 100 years.

Site Index 35



Site Index 75



* Trees scaled to measured crown width

Regeneration Scenarios

All regen was initiated using the FVS Partial Establishment Model default setting.

Density

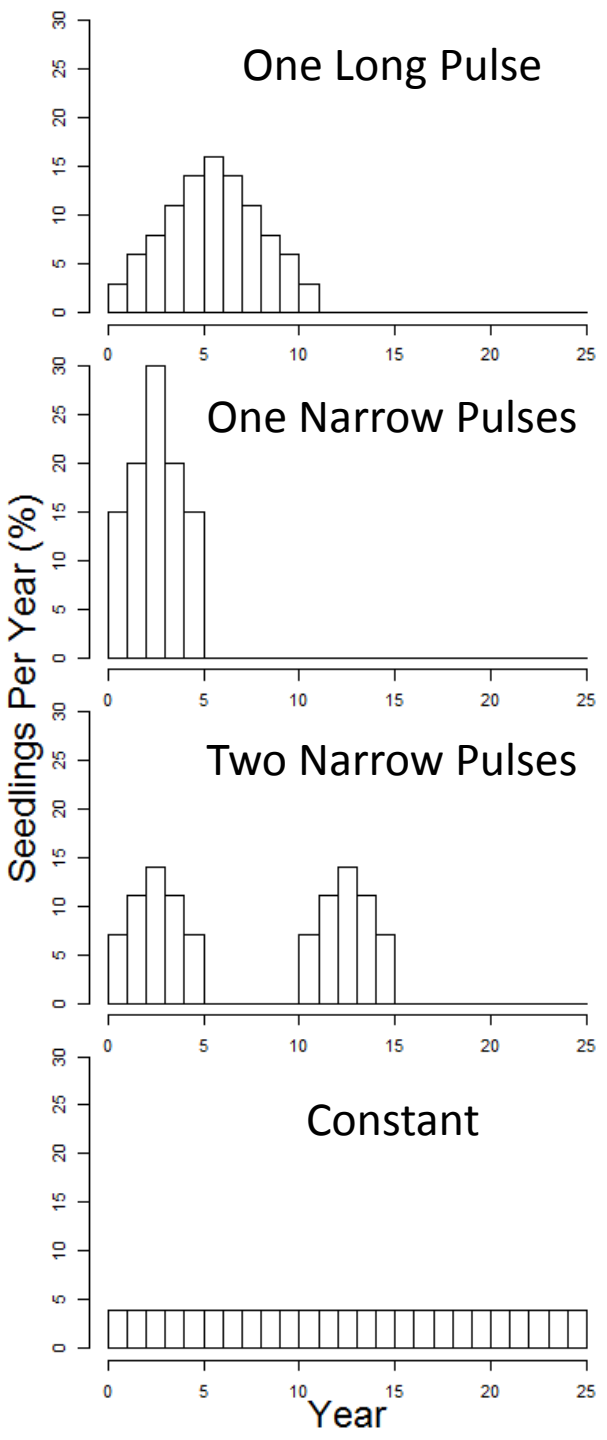
- 5 levels of seedlings ha^{-1}
  - 124, 371, 618, 1,235, 2,470 seedlings ha^{-1}

Temporal Rate

- 4 rates

$$4(site\ index) \times 5(density) \times 4(rates)$$

$$= 80\ simulations$$



Evaluating Fire Hazard

Fire hazard was modeled as the wind speed need to initiation passive (Torching) and active (Crowning) crown fire activity.

Longevity was defined as time to return to within 10% of pre-treatment Torching and Crowning Indices.

- Due to concerns with FVS-FFE's modeling of crown fires, we utilized the Crown Fire Initiation and Spread model (CFIS; Cruz et al., 2004, 2005).
- CFIS Parameters
  - 4% fine dead fuel moisture (FVS's assumed severe fire weather condition)
  - SFC – Surface Fuel Consumption (litter, 1-Hour, shrub, and herbaceous fuels from FVS)
  - CBD – Canopy Bulk Density (derived from FVS)
  - FSG – Fuel Stratum Gap (the distance from the top of the surface fuelbed to the lower limit of the aerial fuel stratum constituted by the ladder and live canopy fuels that can sustain vertical fire propagation

Evaluating Fire Hazard

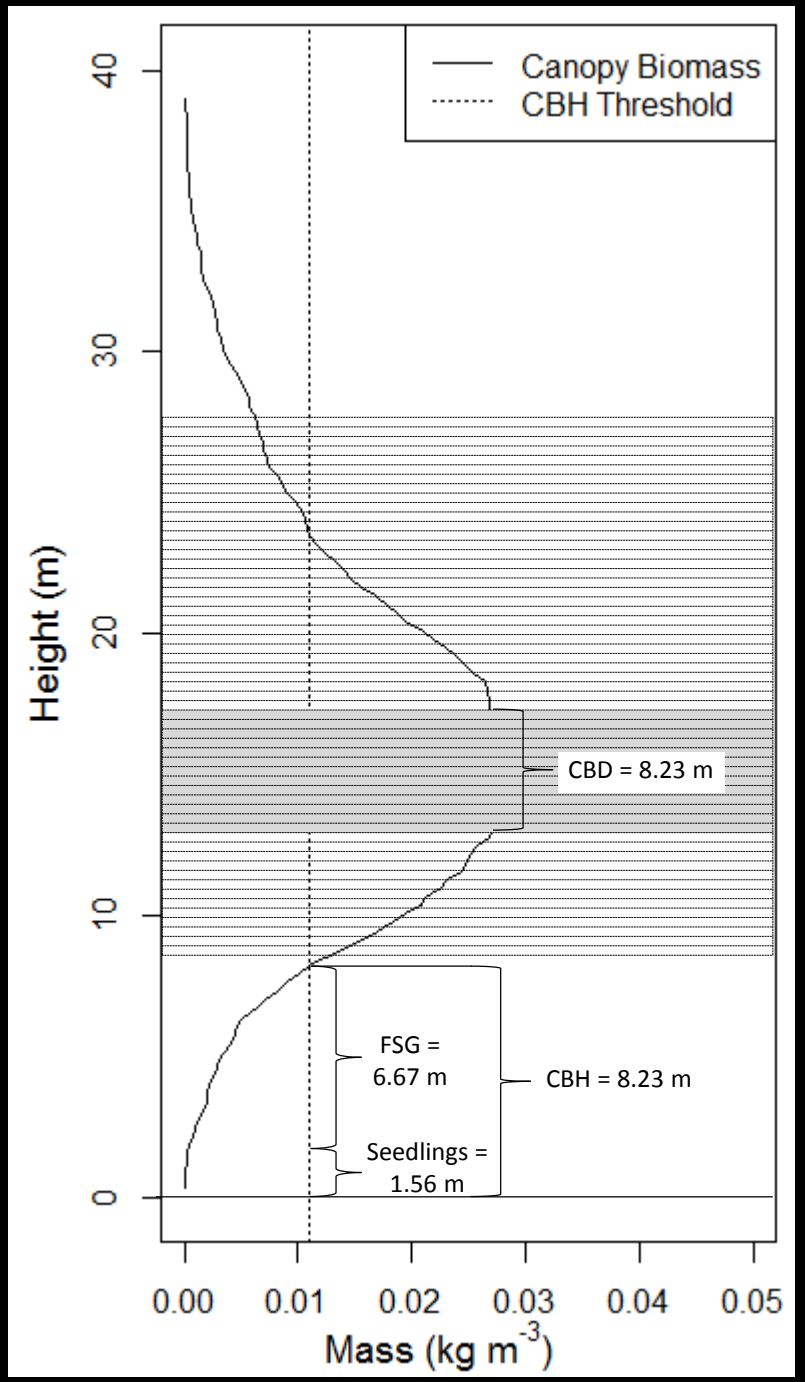
Canopy Bulk Density

- Calculated in FVS-FFE as the maximum 4 m running mean of 0.3 m canopy biomass slices.

Fuel Stratum Gap

- Distance between surface fuelbed and aerial fuel stratum constituted by the ladder and live canopy fuels that can sustain vertical fire propagation.
- Calculated by subtracting surface veg height from FVS-FFE estimated CBH (unless CBH was less than 1.83 m (6 ft), then FSG was set equal to CBH).

$$CBH - surface\ fuel\ height = FSG$$



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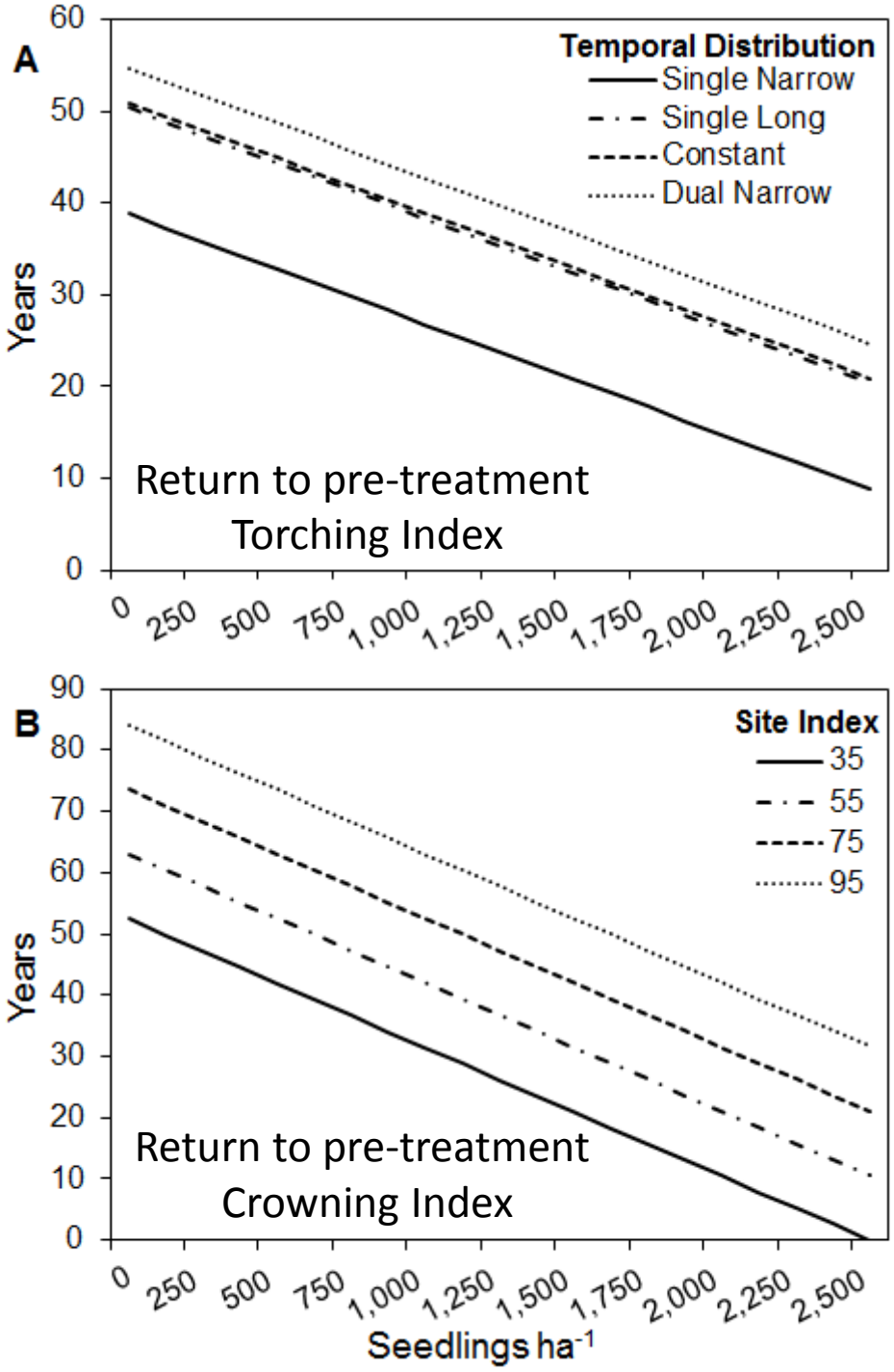
Results

Torching Index Longevity

- Predicted by density and rate
  - Longevity reduced 5 years for every 420 seedling ha^{-1}
  - Single Narrow Pulse 13 years earlier

Crowning Index Longevity

- Predicted by density and site index
  - Longevity reduced 5 years for every 240 seedlings ha^{-1}
  - Longevity increased 10.5 years for each 20 unit increase in site index



Complications

However, the site index effect was counter to what we hypothesized.

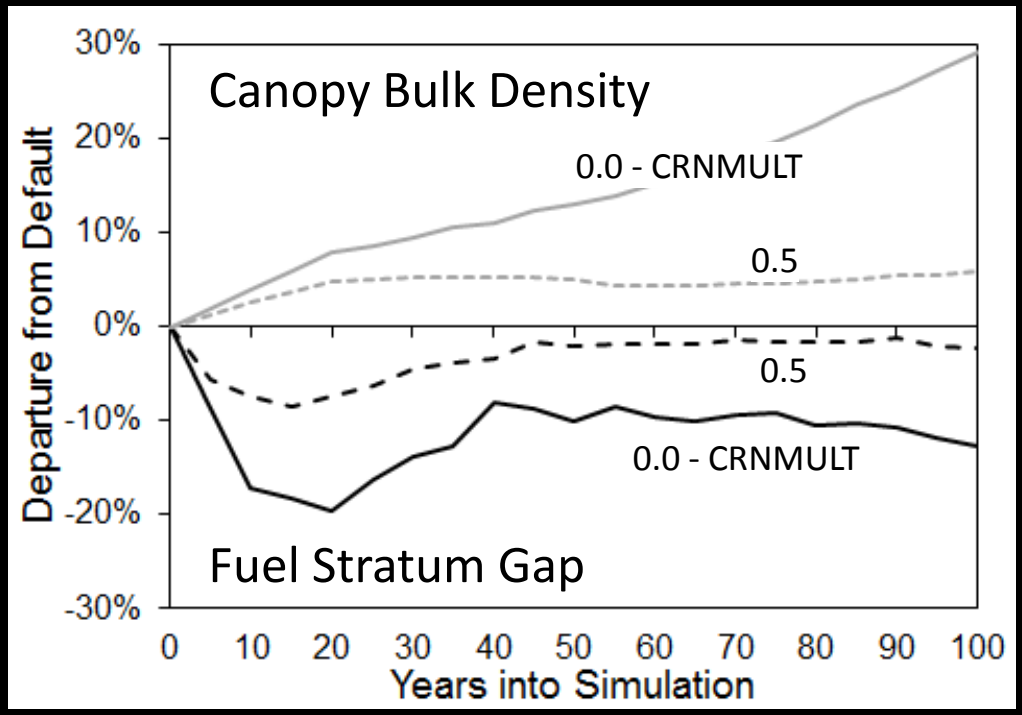
- We believed remnant trees would in-grow faster on more productive sites.

To understand this we looked at the effect of the FVS CRNMULT Keyword.

- Were the Default is to accept the simulated crown ratio or multiply it by the specified value.

We compared 0.5 and 0.0 against the Default crown ratio change.

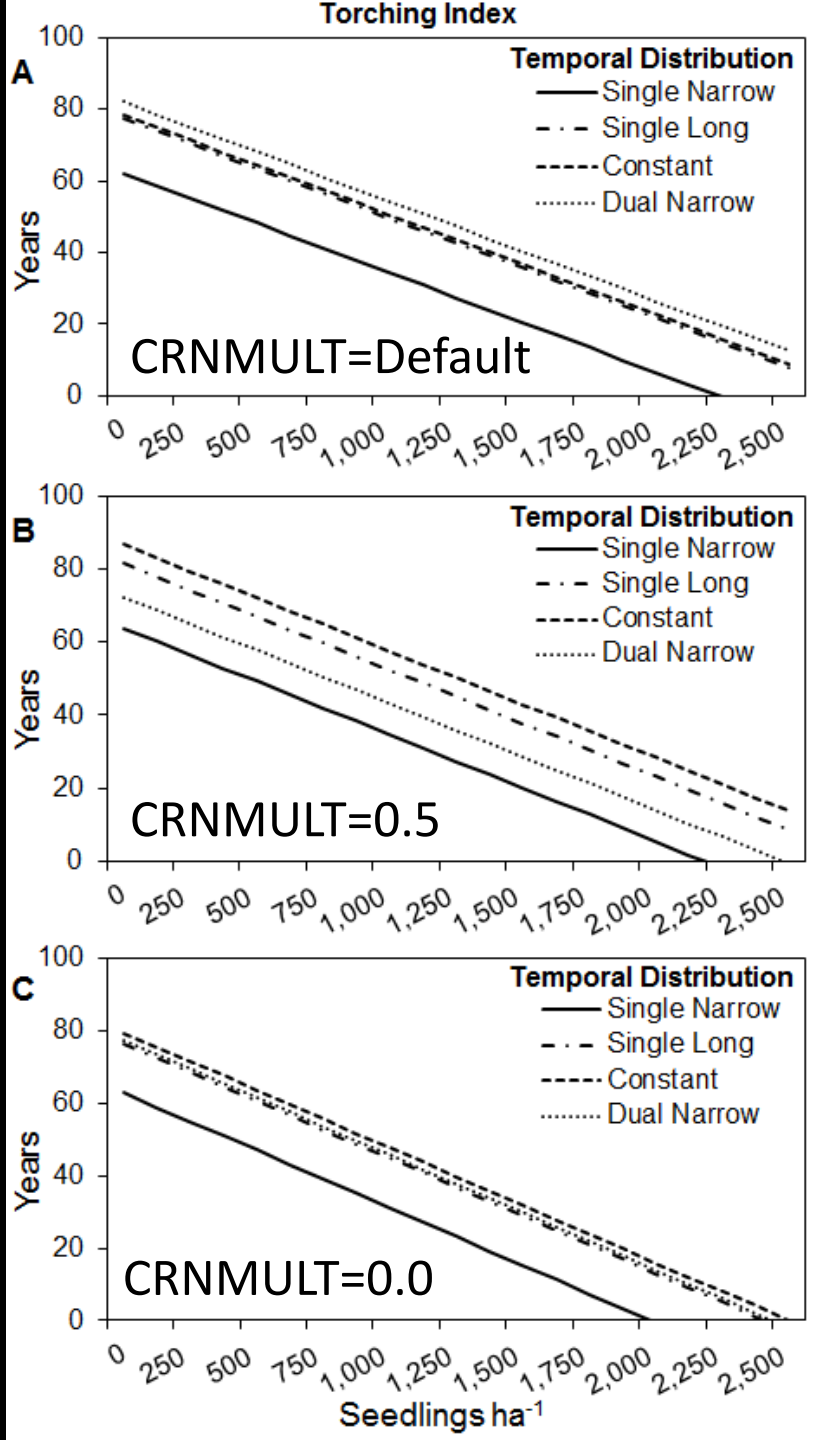
- Led to increased CBD and decreased FSG.



Complications

Torching Index Longevity

- CRNMULT had no impact



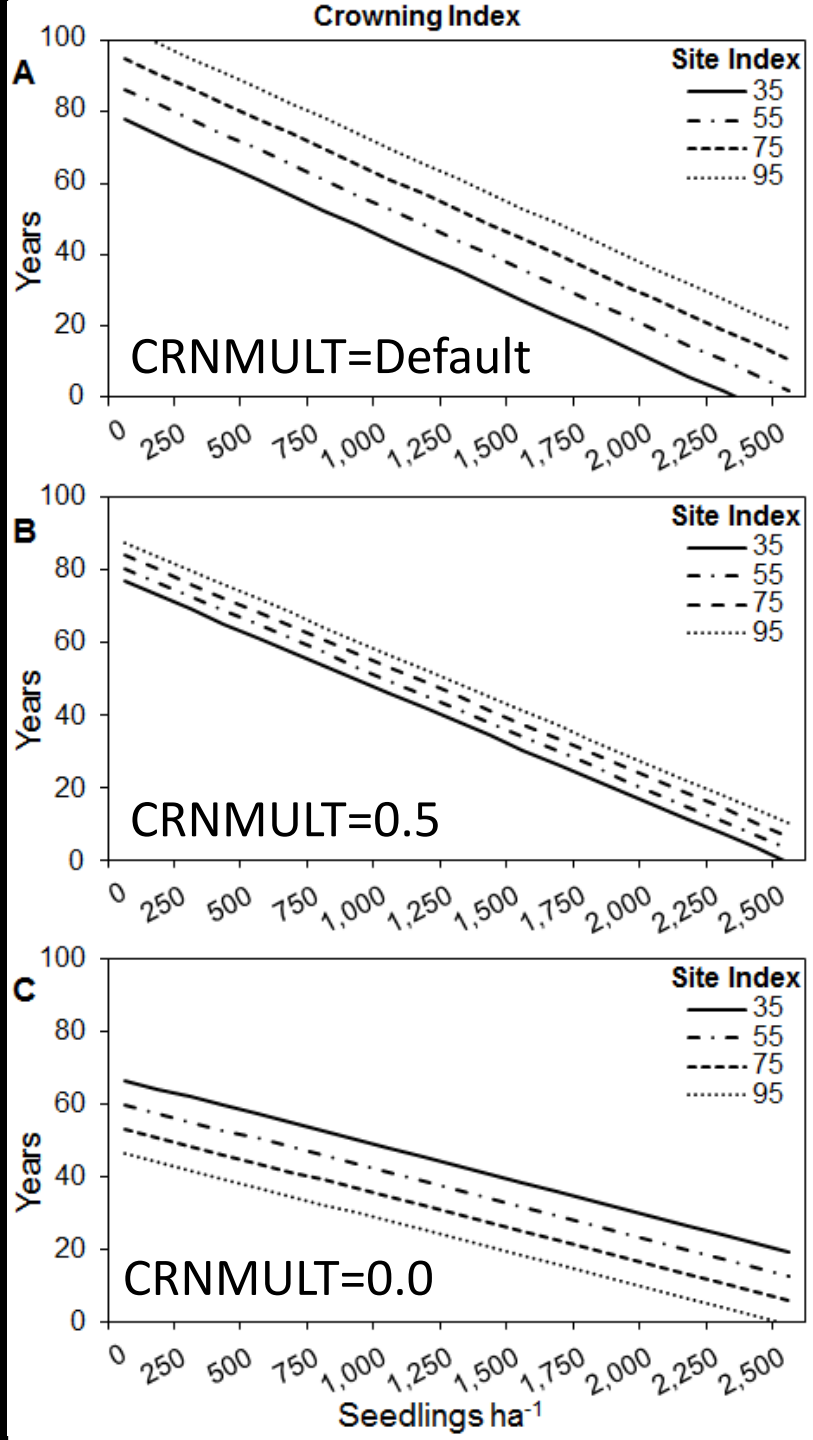
Complications

Torching Index Longevity

- CRNMULT had no impact

Crowning Index Longevity

- CRNMULT caused the influence of site index to flip
  - Default - increased longevity with increased site index
  - 0.5 - site index has no significant effect
  - 0.0 - increased longevity with decreased site index
  - We have no way of being certain which scenario is correct



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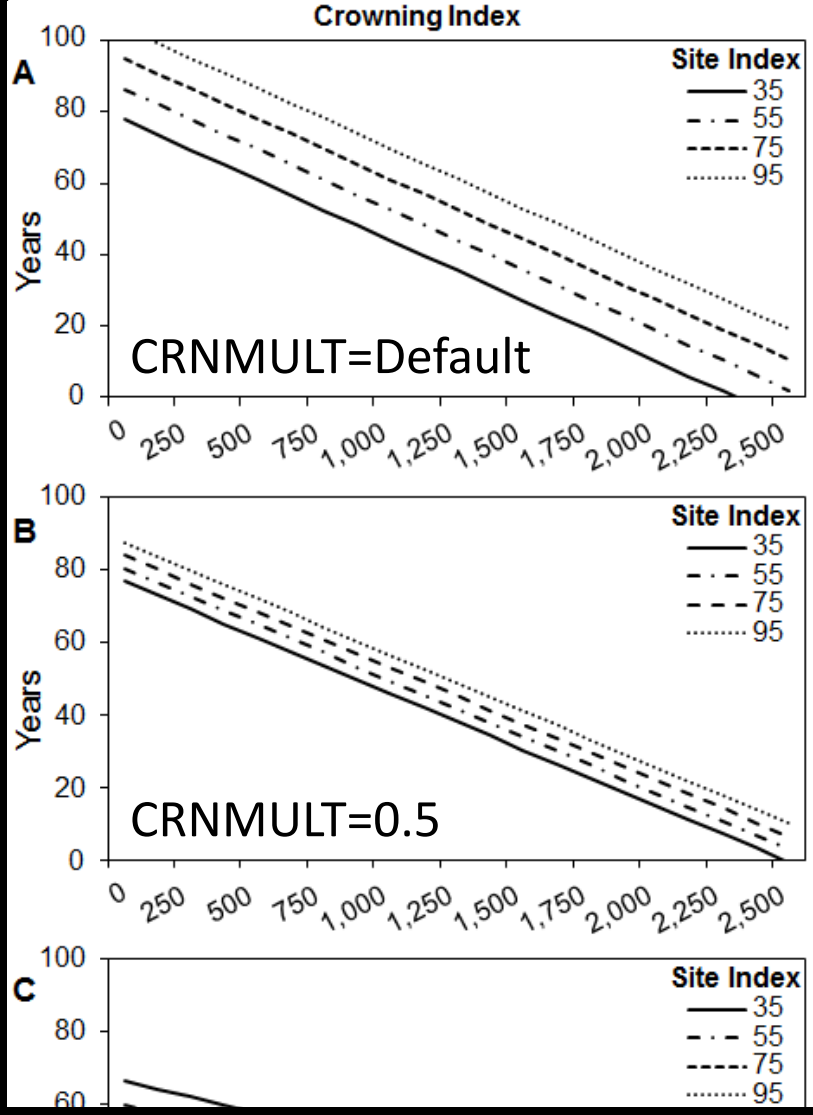

FVS's crown dynamics modeling seems feasible for assessing Torching but may require additional research to model Crowning in spatially heterogeneous restored ponderosa pine systems.

Acknowledgements

We need to thank:

- The Joint Fire Sciences Program and Rocky Mountain Research Station for funding this endeavor.
- Regional Foresters for helping us select treatment sites
- The diligent gr
for the long ho

Questions?