Severity patterns and drivers of repeat fires along a fire interval gradient in the Klamath Mountains

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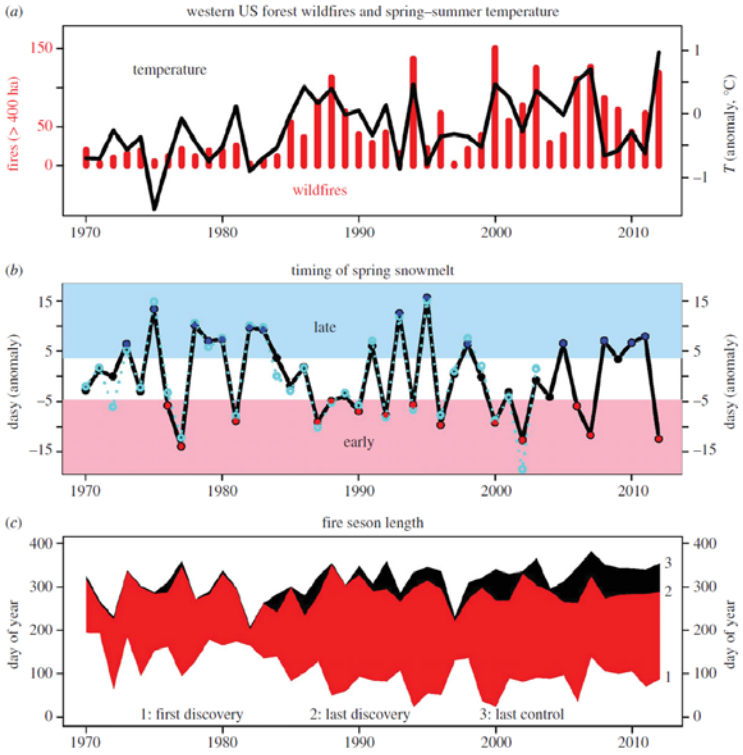
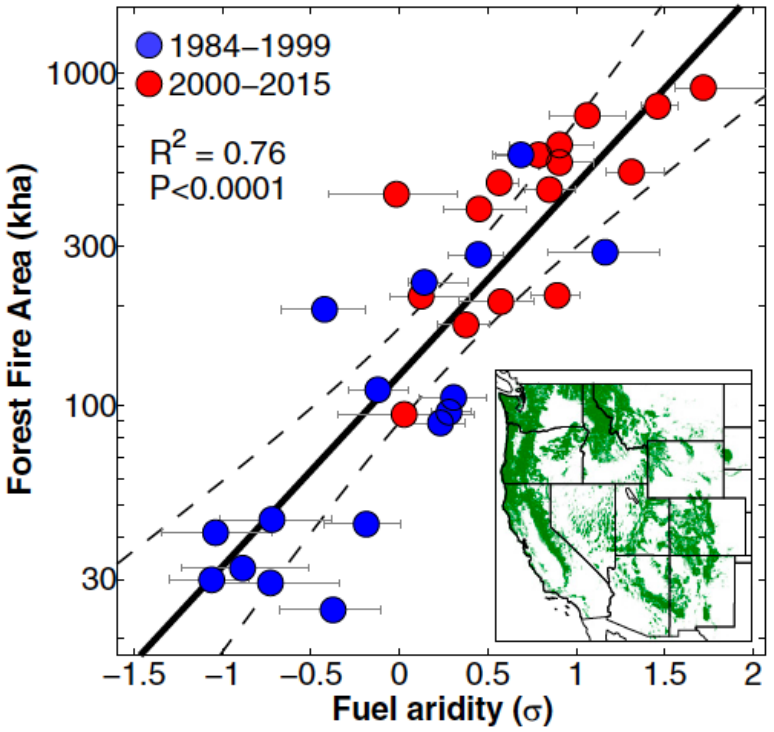
Photo credit: W. Harling

Recent Changes in Fire Activity

- Increasing frequency and size of wildfires
- Increasing fuel availability and expansion of the fire season

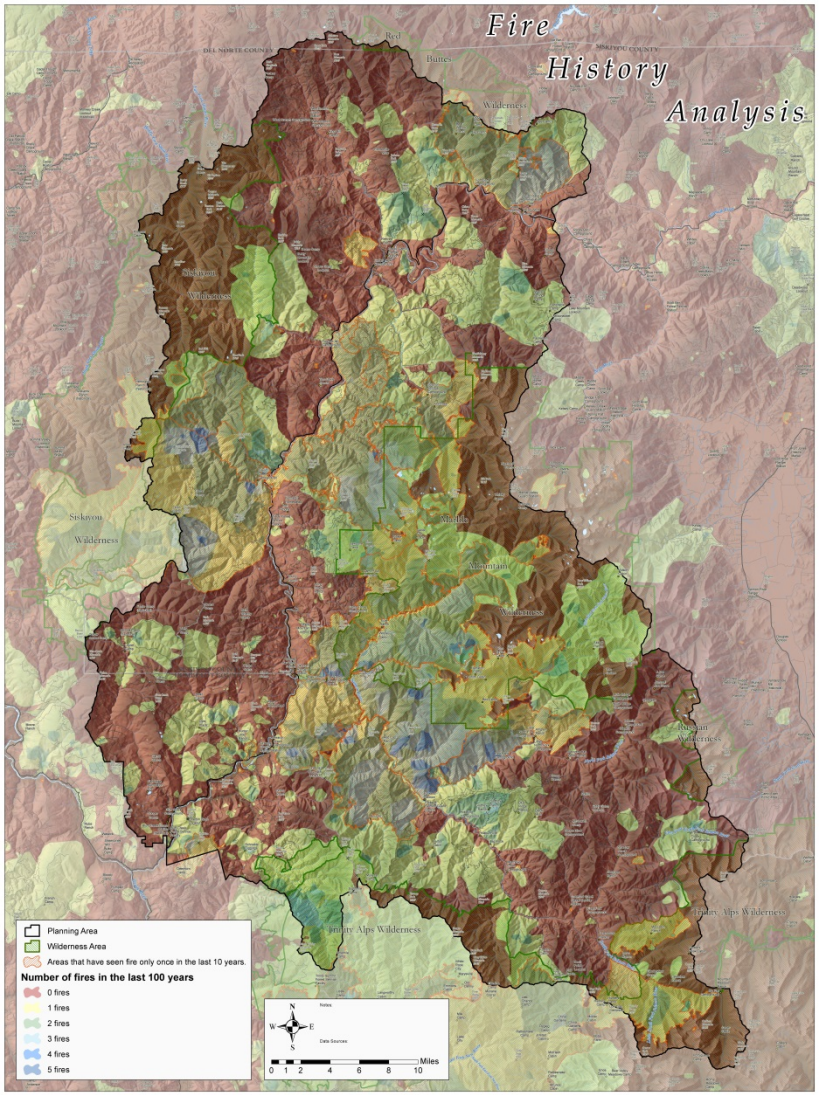


Westerling 2016



Abatzoglou and Williams 2016

Need for More Fire



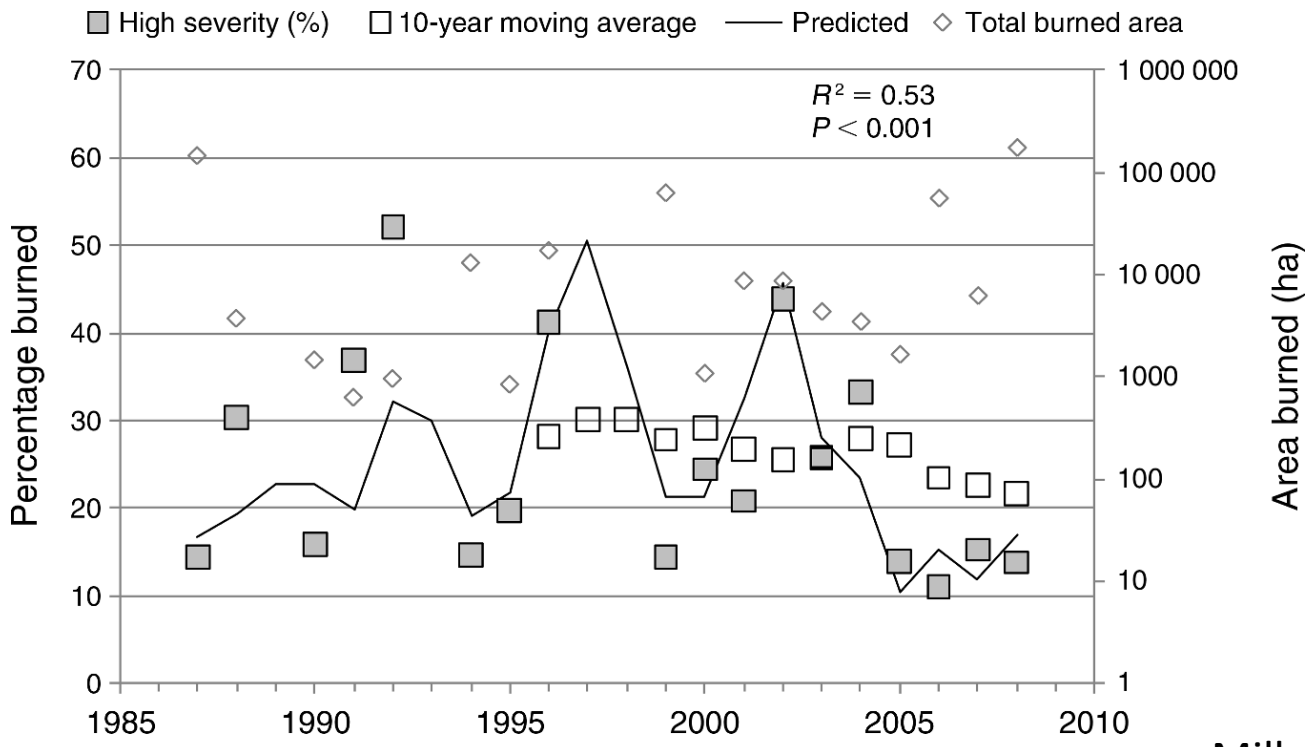
- Majority of fire-prone areas still in a fire deficit
- Increased recognition for the need of managed wildfire
- Need to assess and learn from the patterns and impacts of modern fires

Repeat Fires

- Areas that experience two or more fires that spatially overlap
- More repeat fires is ultimately desired
- Increased frequency may result in shorter fire return intervals than historical conditions
- Potential for altered fire severity patterns

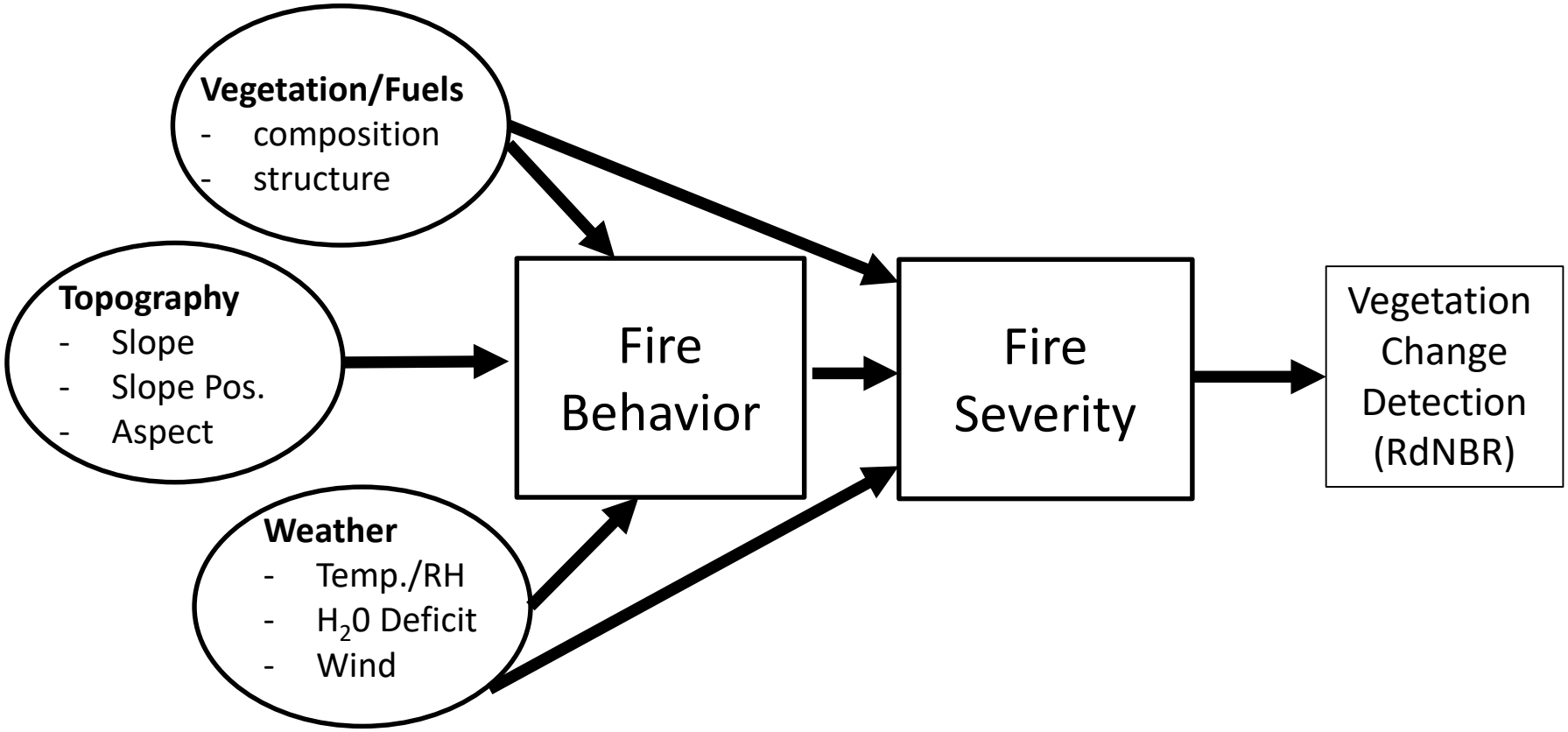
Modern Fire Severity

- Some concerns for increased high severity fire

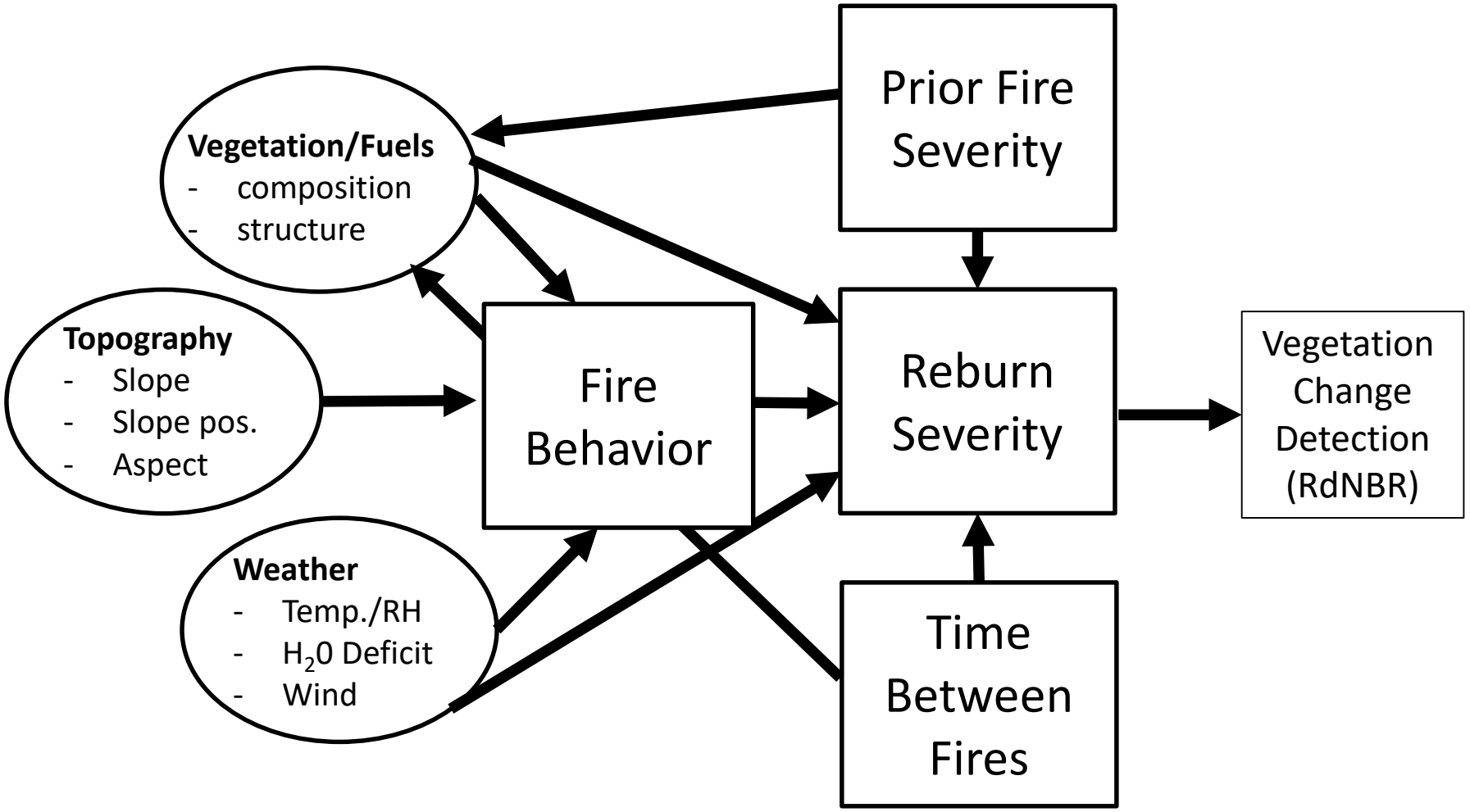


Miller et al. 2012

Controls of Fire Severity

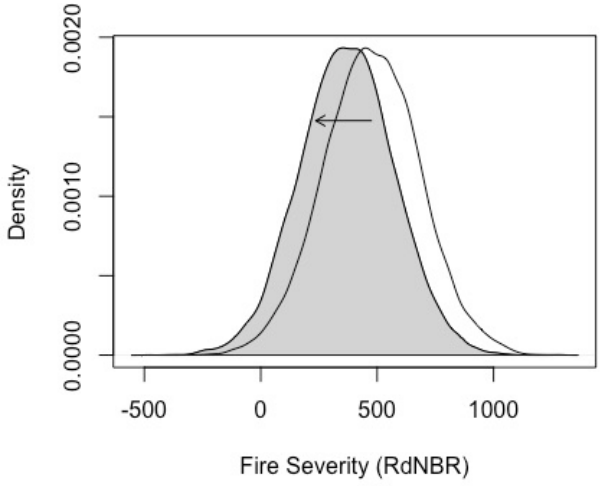


Controls of Reburn Severity

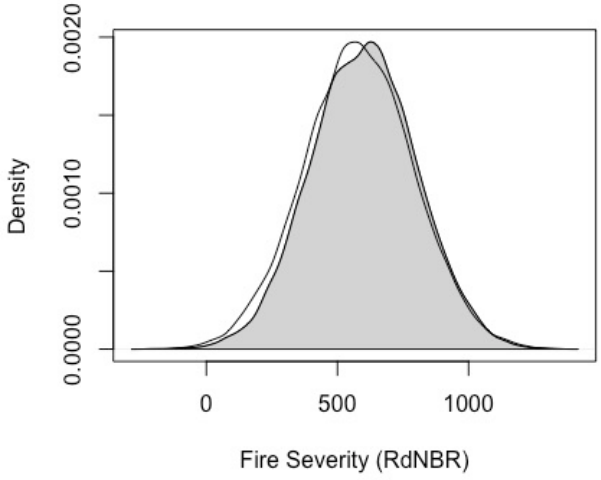


Patterns of Reburn Severity

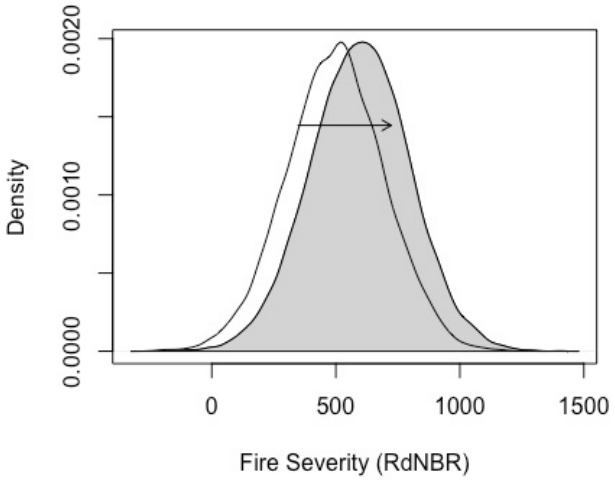
Decreasing



"Self-Regulating"



Increasing



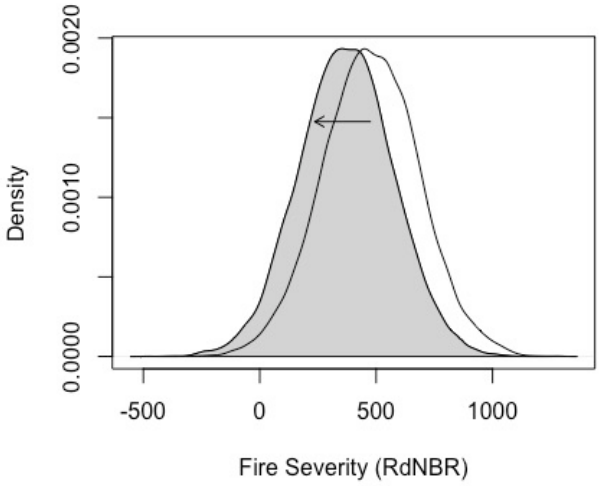
↓ Gila-Aldo Leopold Wilderness, New Mexico (13 fires, 3-12 yrs, 50,004 ha) – Holden et al. 2012
Gila-Aldo Leopold Wilderness, New Mexico (50,0004 ha) – Parks et al. 2014
Frank-Church River of No Return Wilderness, Idaho (91,671 ha) – Parks et al. 2014

↔ Northern Sierra Nevada, California (4 fires, 1-11 yrs, 36,423 ha) – Coppoletta et al. 2015

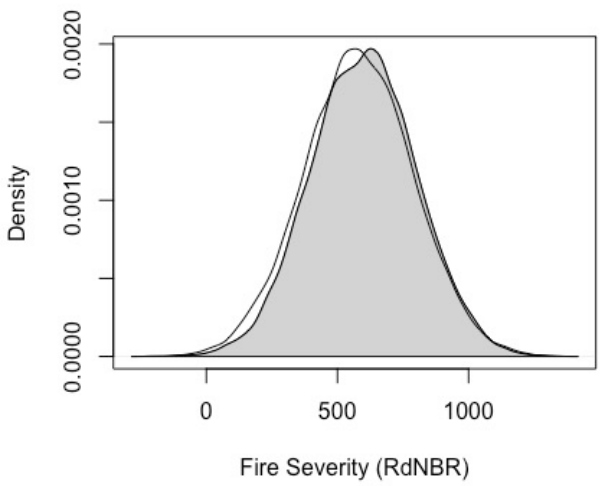
↑ Iillouette Creek Basin, Yosemite NP, California (9 fires w/ 2+, 8,000 ha) – van Wagtendonk et al. 2012
Northern Rocky Mountains (204 fires, 0-23 yrs, 138,061 ha) – Harvey et al. 2016

Patterns of Reburn Severity

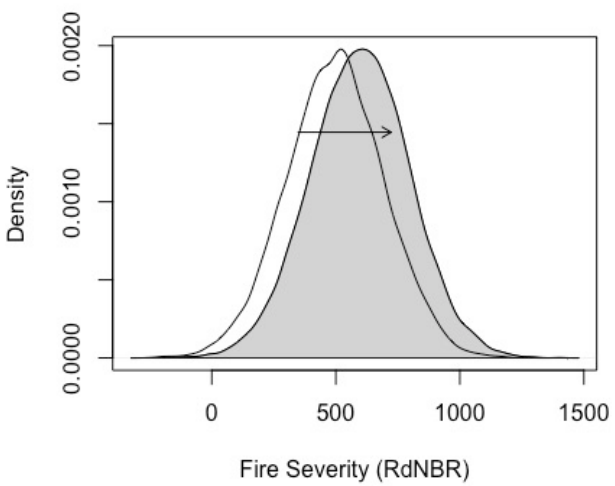
Decreasing



"Self-Regulating"



Increasing



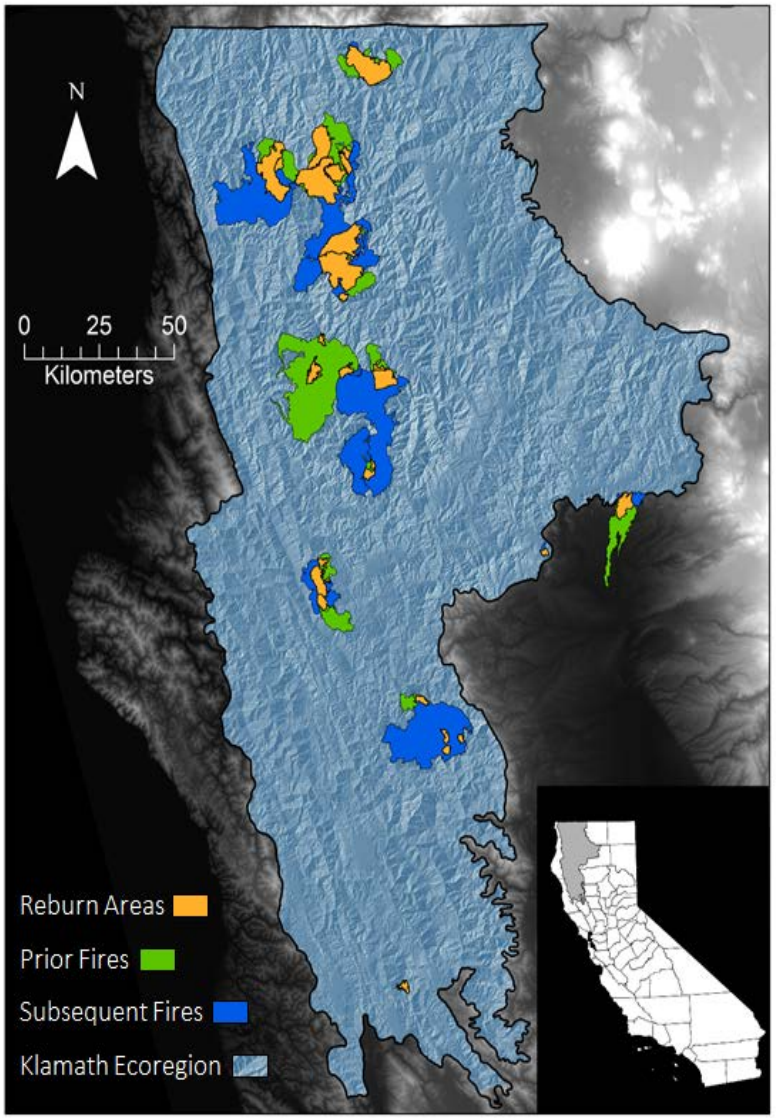
- Changes in reburn severity must consider multiple drivers across different temporal and spatial scales
- Need to interpret change with vegetation type, fire regime, and desired future conditions

Objectives

- Examine temporal patterns of area burned and reburn severity in repeat fires
  - Patterns by year (1996-2012)
  - Patterns along fire interval gradient (2-25 yr)

- Determine the relative importance of factors that influence reburn severity at different scales

Repeat Fires in the Klamath Mountains in California

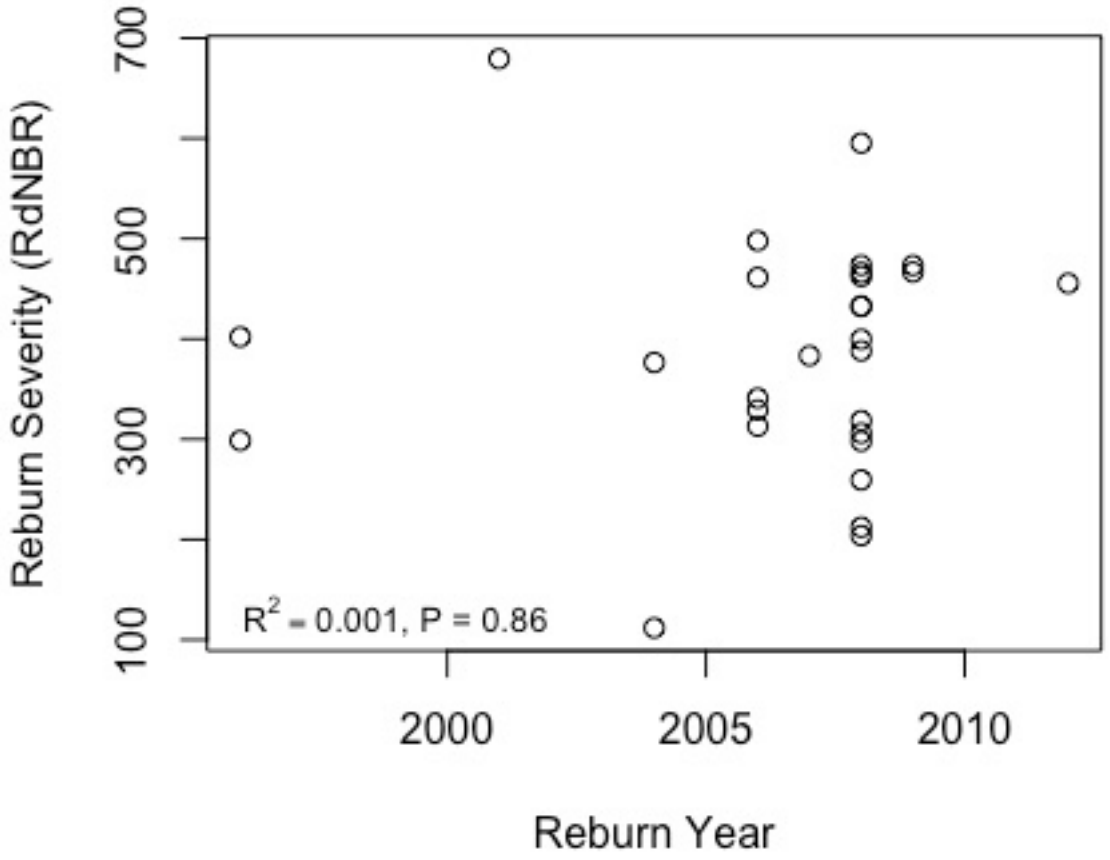


- 28 repeat fires between 1996 and 2012
- Wildfires only
- Total area = 79,112 ha (195,490 acres)
- Reburn Area: 397 – 11,818 ha
- Elevation: 194-2,221 m
- Time between repeat fires ranged from 2 to 25 years
- Historical Fire Return Interval
  - median 12-19 yr

Taylor and Skinner 1998

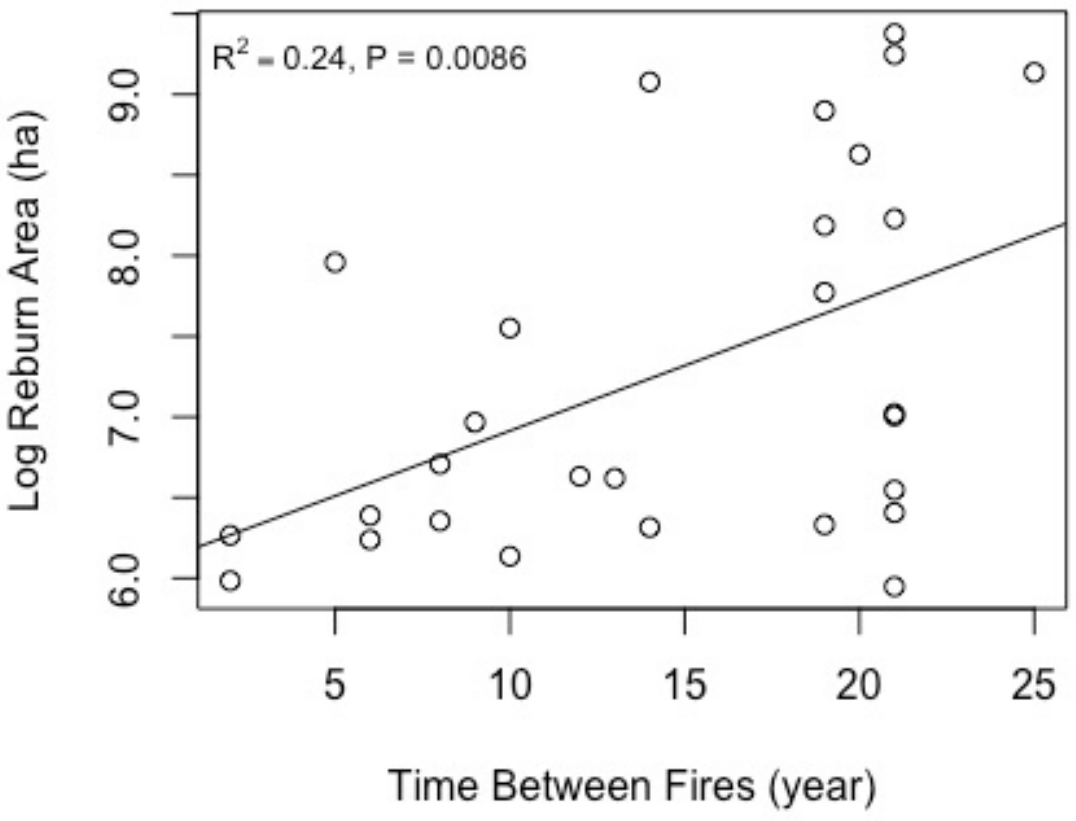
Annual Reburn Patterns

- No observed annual trend with reburn area (R^2 = 0.08, P = 0.14)
- No observed annual trend with reburn severity (R^2 = 0.001, P = 0.86)



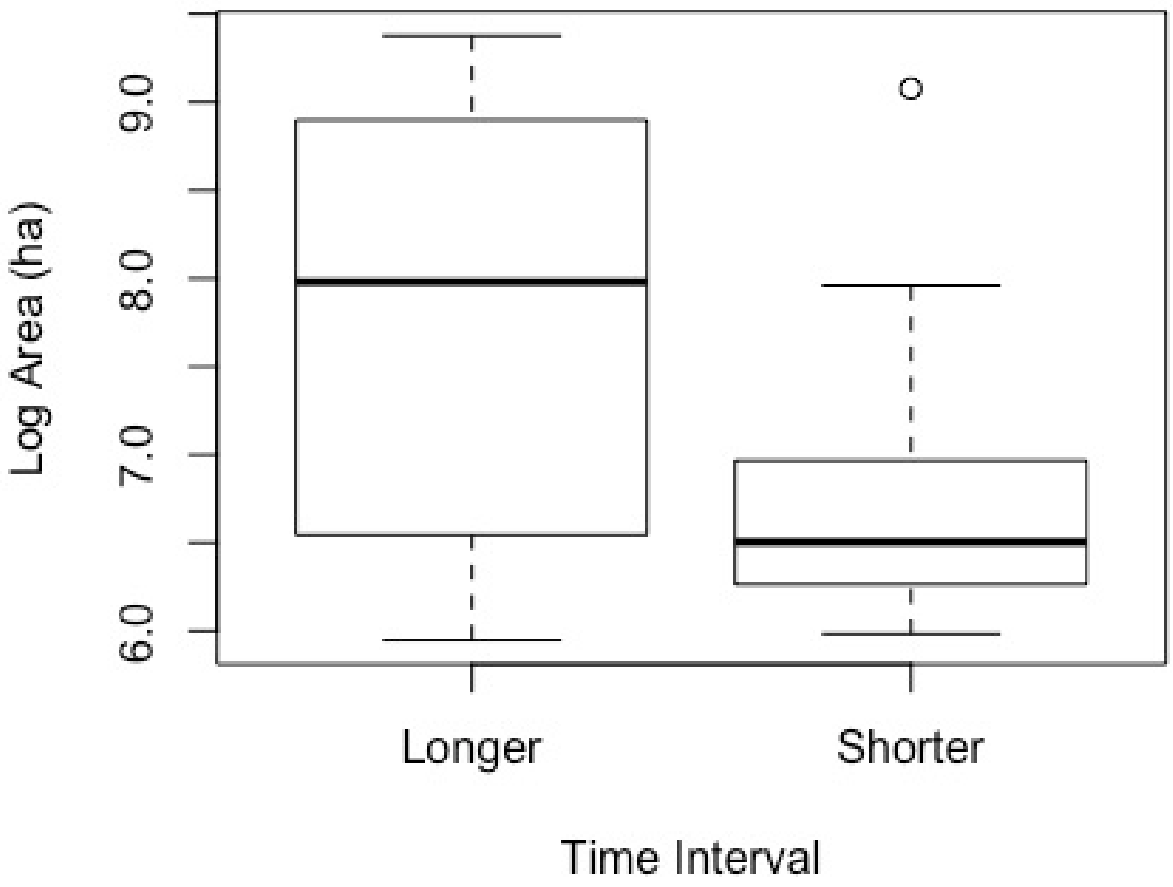
Time Between Fire Patterns

- Reburn area increased with time between fires (R^2 = 0.24, P = 0.009)
- No pattern observed with reburn severity (R^2 = 0.028, P = 0.397)



Time Between Fire Patterns

- Smaller reburn area with shorter interval repeat fires (F = 5.9, P = 0.02)

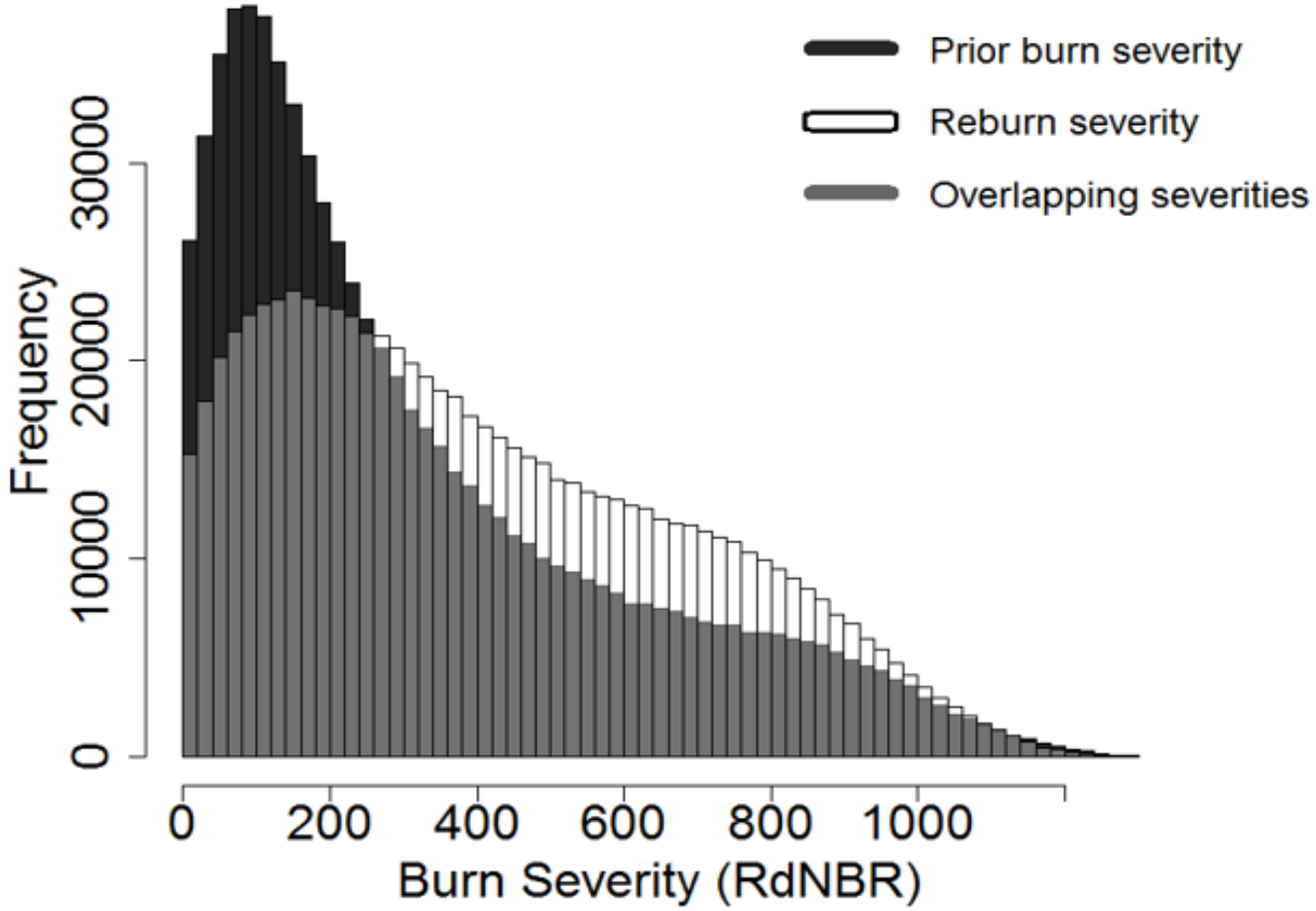


Shorter Interval
mean = 1466 ha

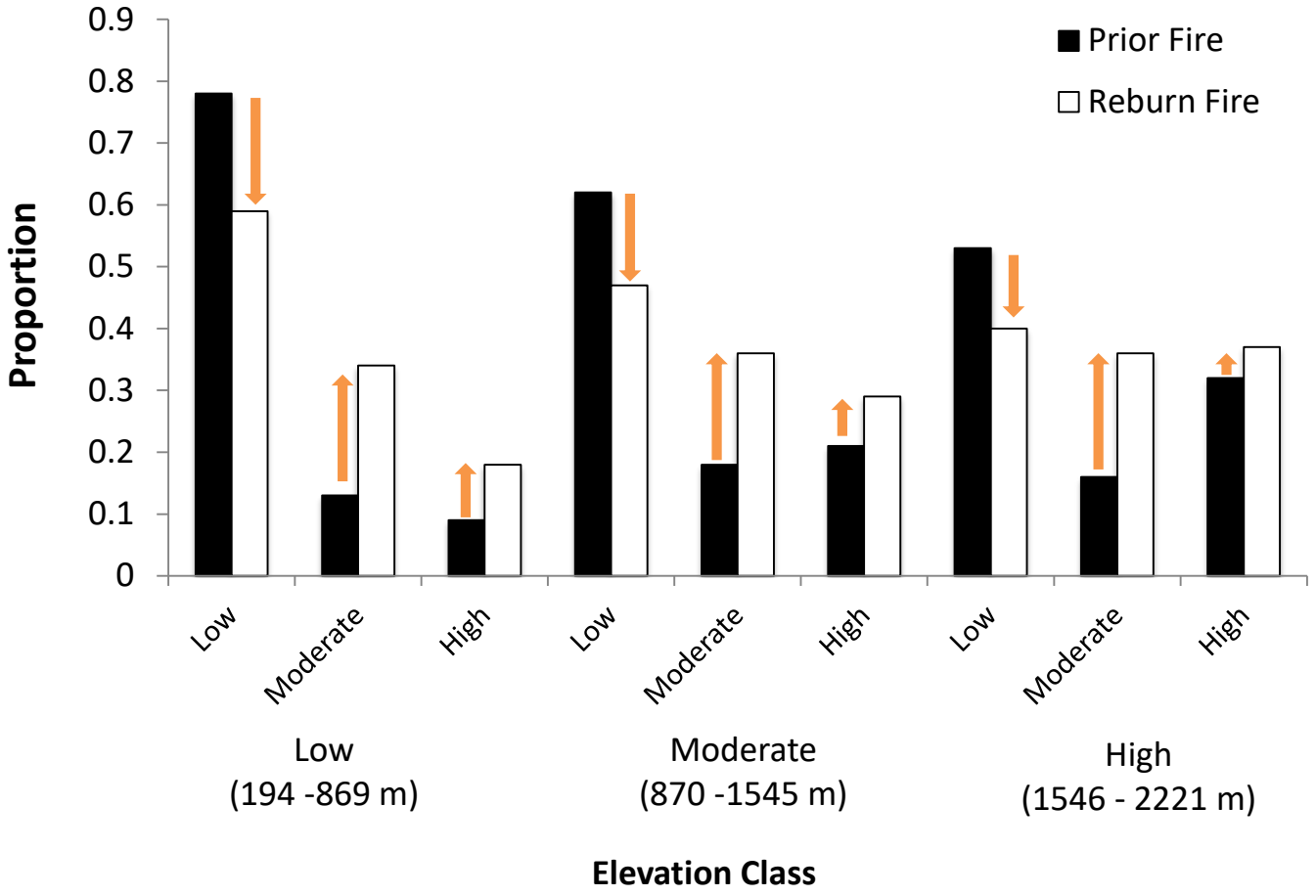
Longer Interval
mean = 4185 ha

Prior and Reburn Severity Trends

All 28 repeat fires combined



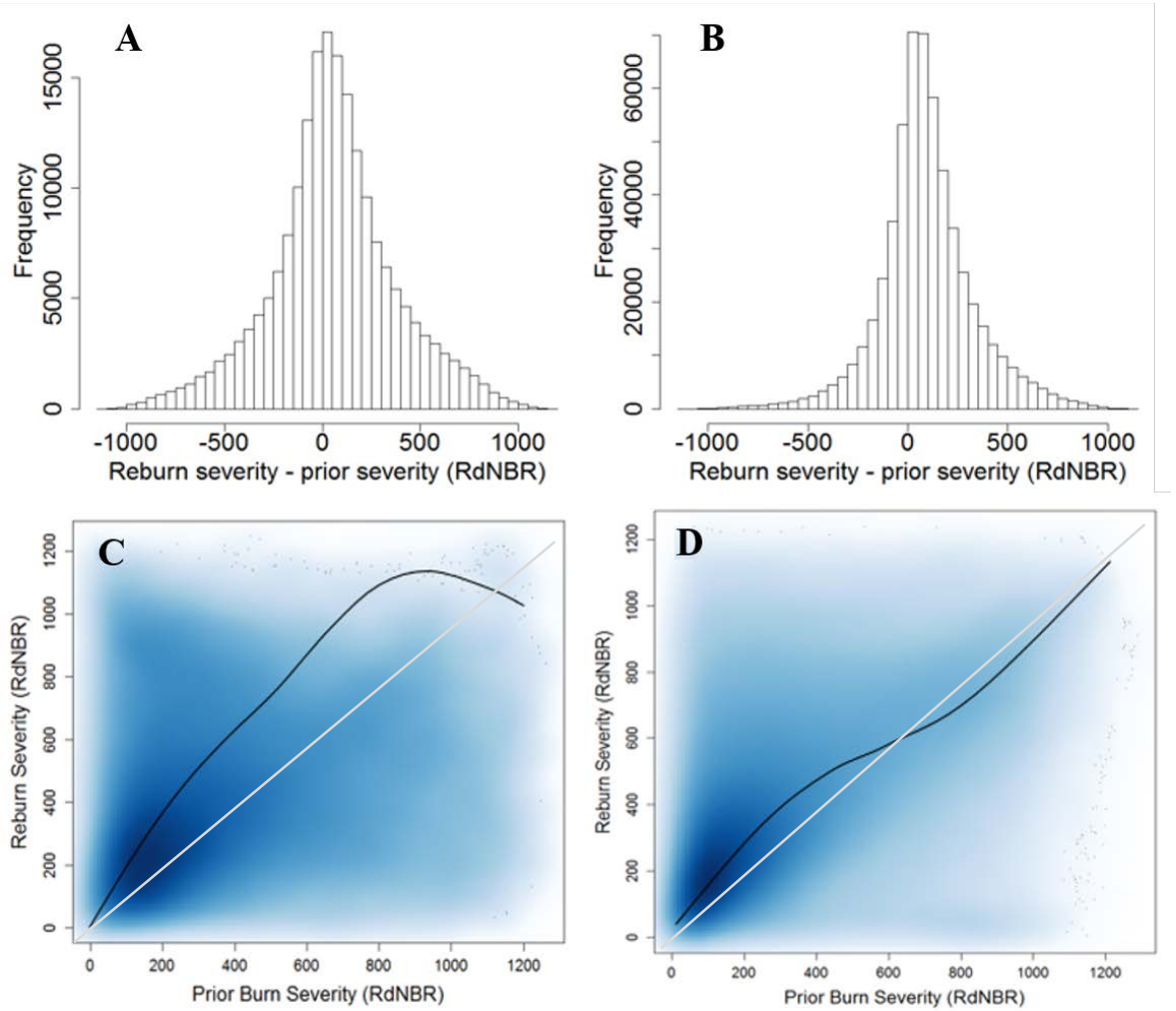
Fire Severity by Elevation



Severity patterns with fire interval classes

Shorter Interval (2-14 y)

Longer Interval (19-25 y)

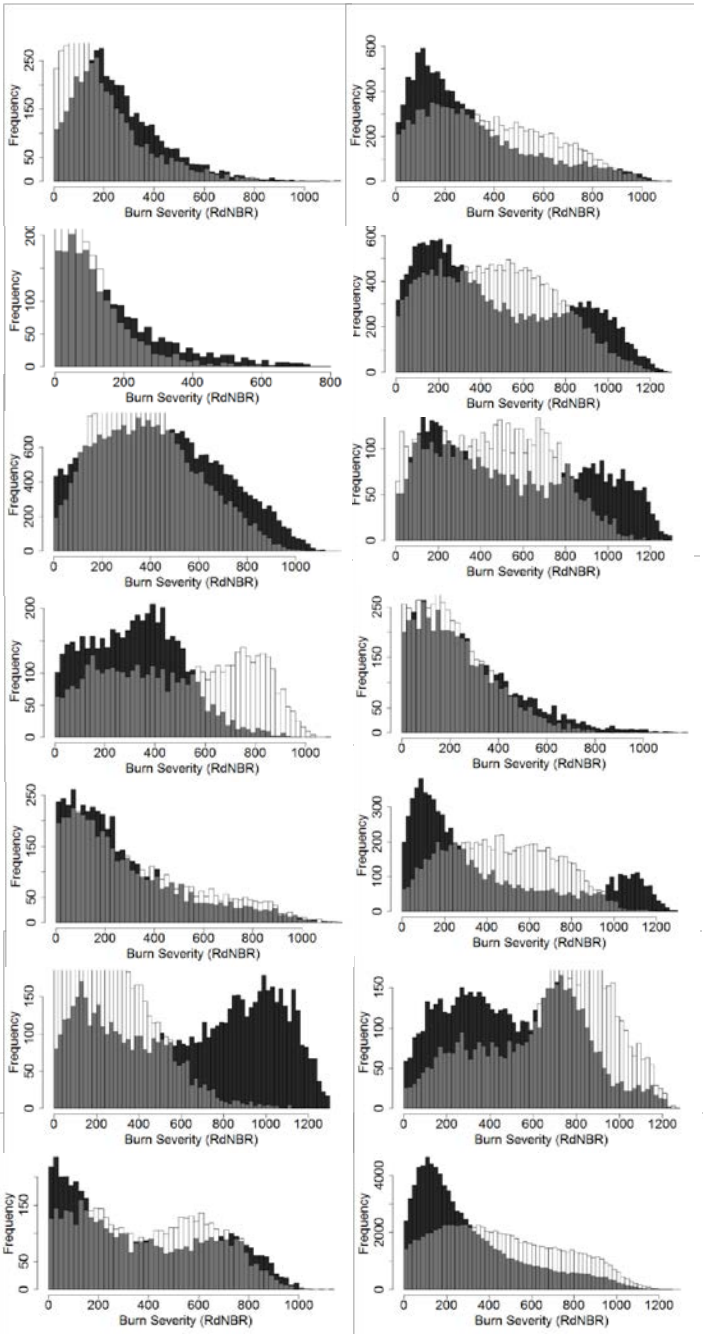


Shorter Interval
29.8% increase

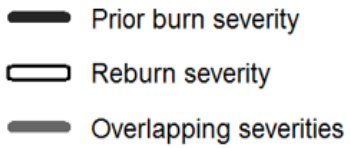
Longer Interval
14.3% increase

Shorter Interval (2-14 y)

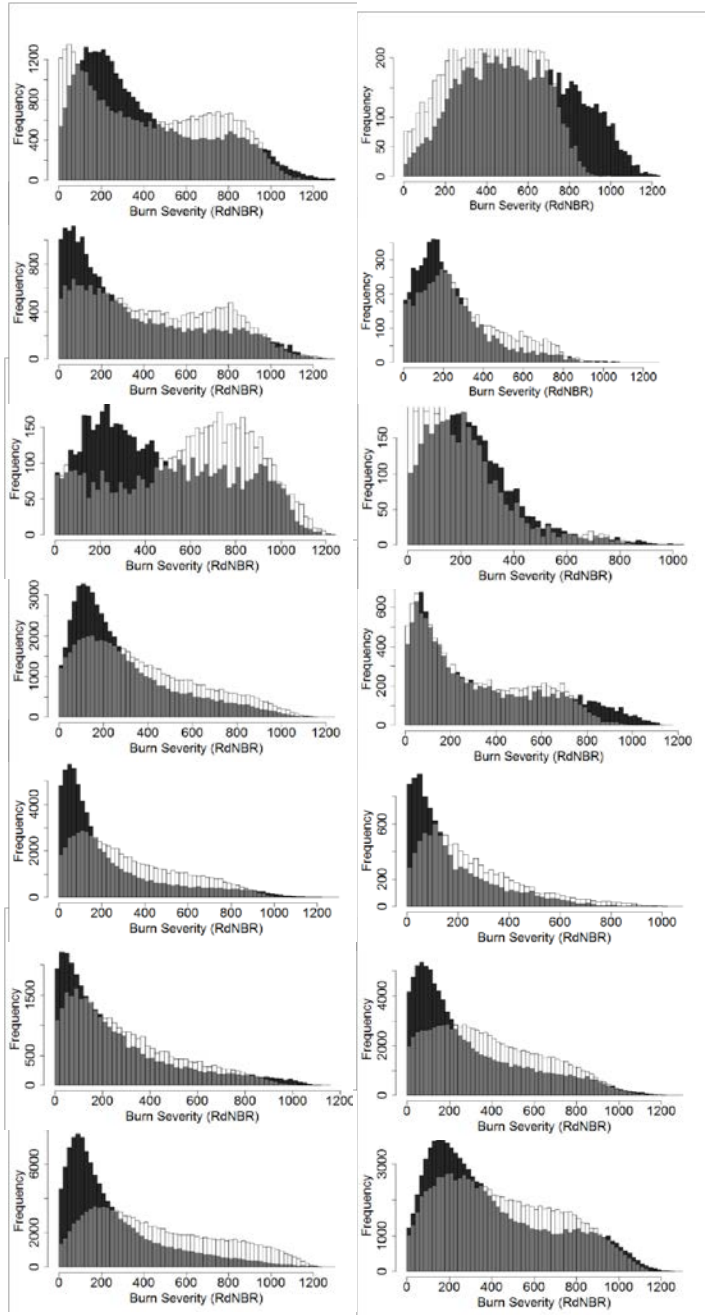
Longer Interval (19-25 y)



7 of 14 Decreasing
Range: -367 to +171

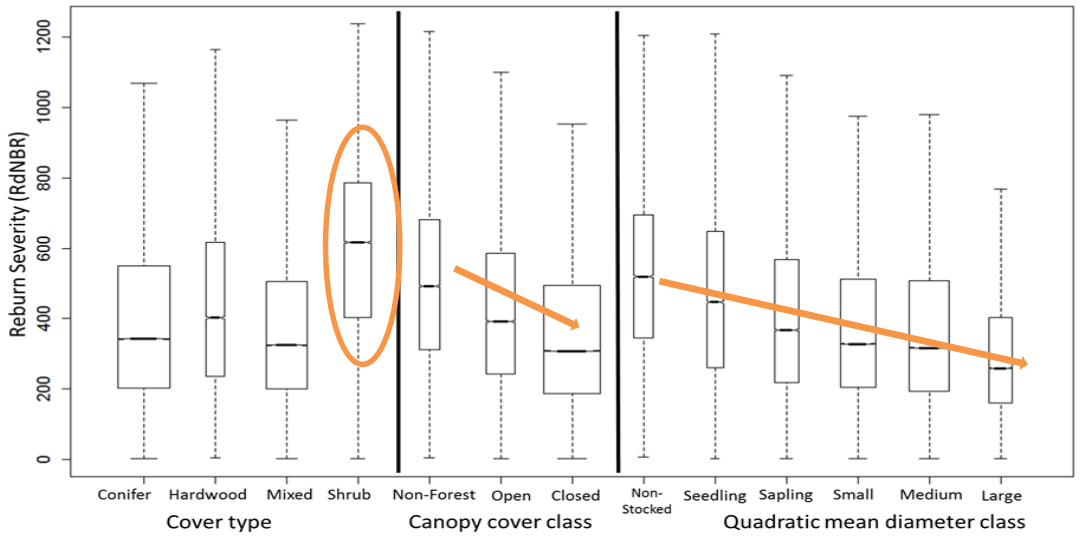


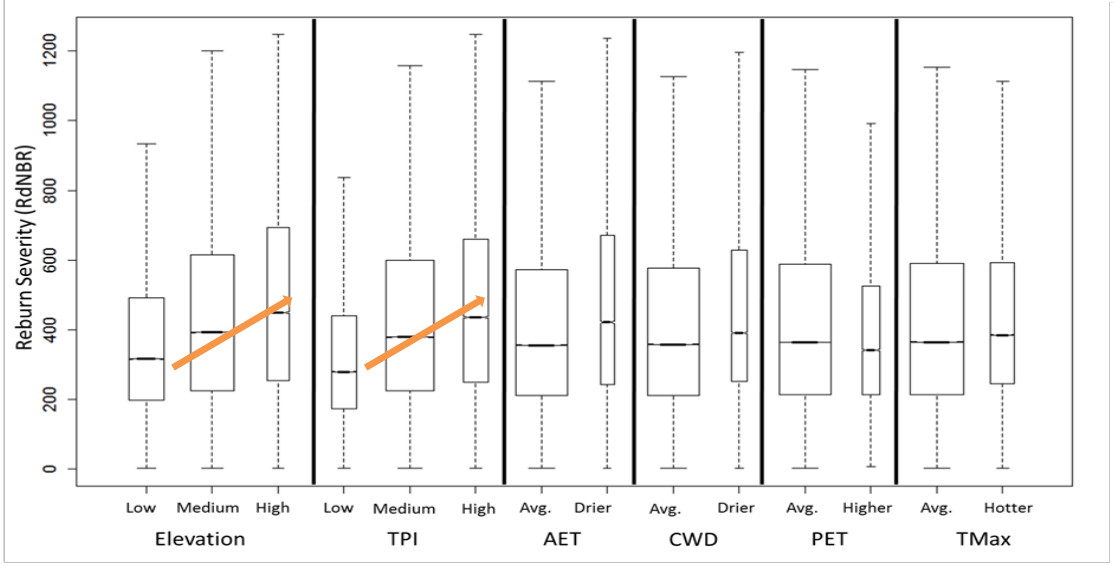
11 of 14 Increasing
Range: -129 to +201



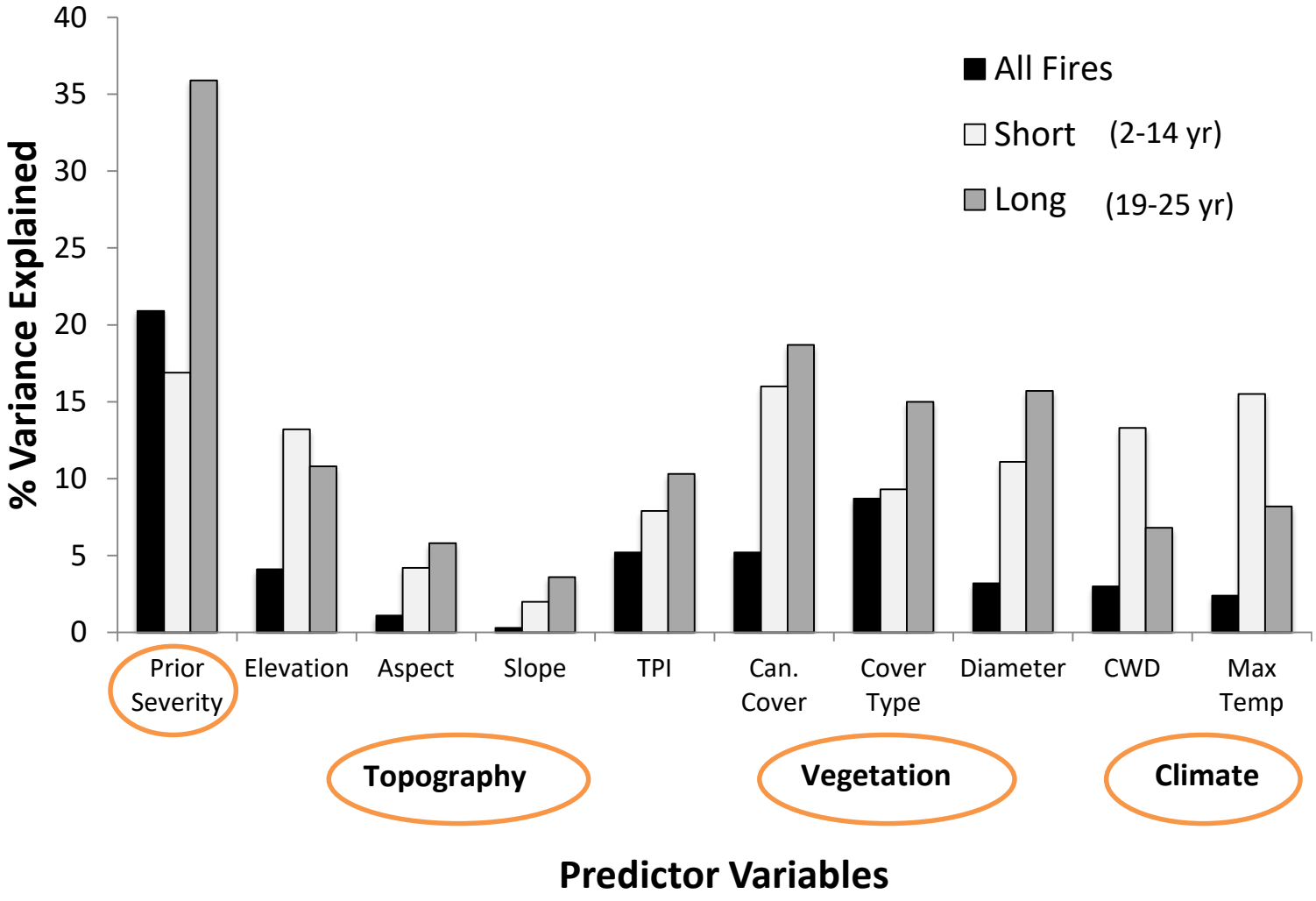
Controls of Reburn Severity

All 28 repeat fires combined





Reburn Severity Model Comparison

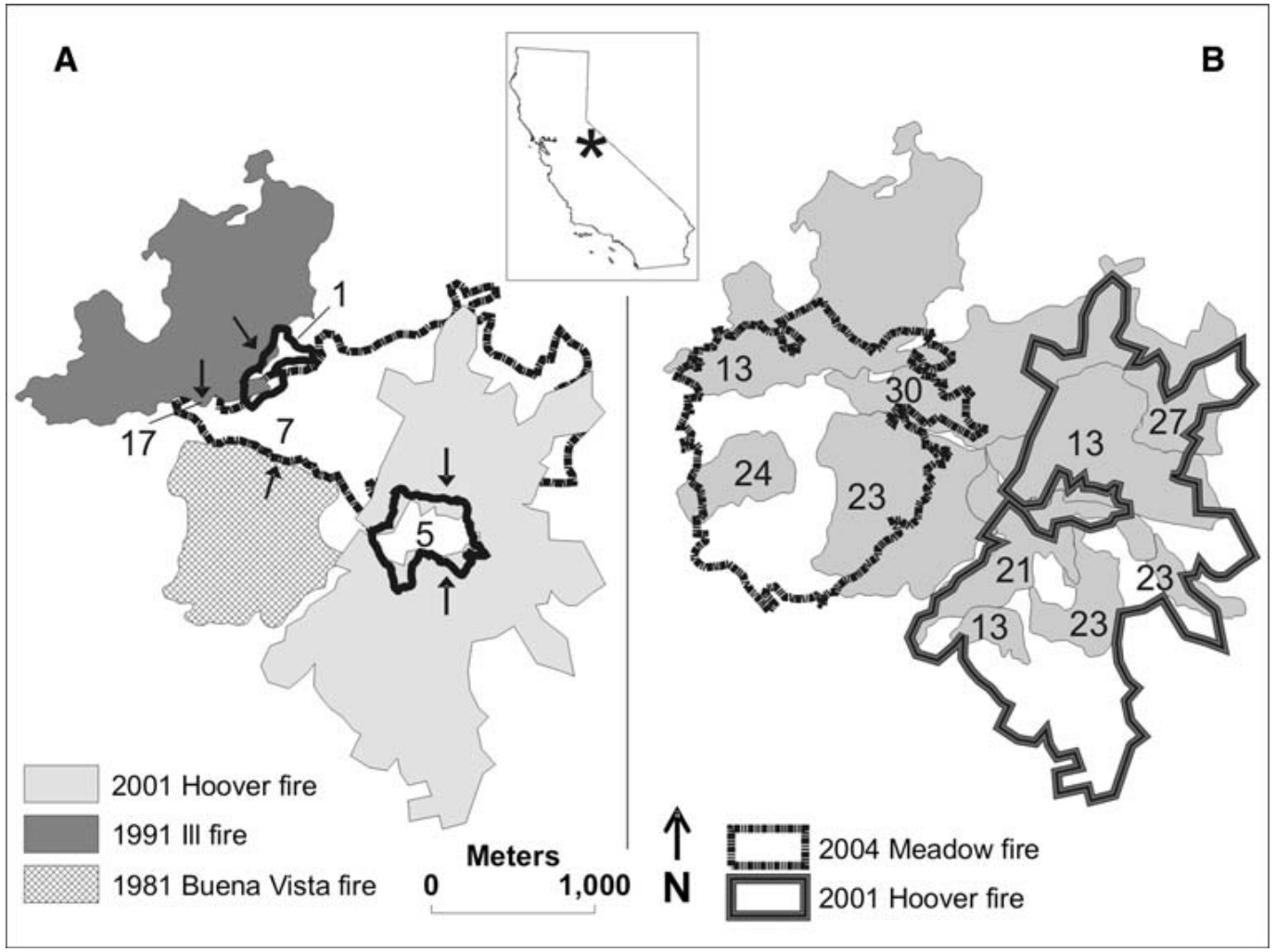


Summary and Implications

- No pattern of increased reburn severity or area over time

- Shorter interval repeat fires smaller and maybe self-limiting
  - but will depend on fire weather
  - potential to inform Rx fire and managed wildfire treatments locations

Summary and Implications

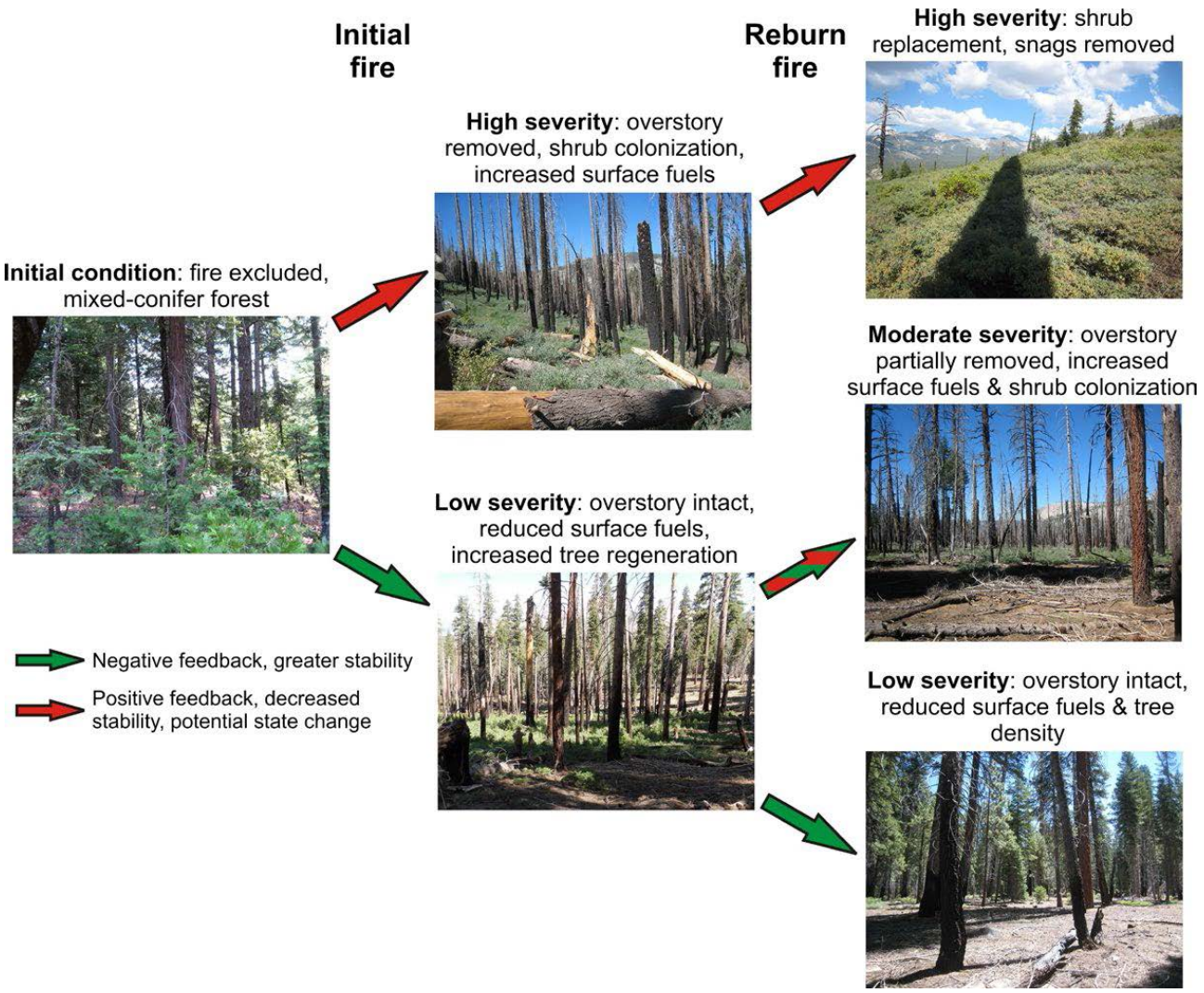


Collins et al. 2009

Summary and Implications

- Prior and reburn severity positively related
  - Self-regulating?
  - Shorter interval>Longer Interval
- Modest increases in reburn severity
  - Shift to more moderate severity
- Multiple potential interpretations for modest increases in reburn severity
  - Need for increased severity? (Huffmann et al. 2017)
  - Increased shrub/open forest representation

Implications



Coppoletta et al. 2016

Summary of Findings

- Reburn severity is a complex result of multiple factors
  - Prior fire severity (longer > shorter interval)
  - Vegetation factors (longer > shorter interval)
  - Climatic factors (shorter > longer interval)
  - Topography factors lowest impact (no change with fire interval)

Summary and Implications

- Repeat fires still represents a small fraction of area burned

- Reburn severity is a complex result of multiple factors across temporal and spatial scales
  - Improves understanding and model development
  - Difficult to make concrete management suggestions

Future Research Needs

- Need for field-based observations to examine post-repeat fire vegetation and fuel changes
- Assess severity patch-sizes and heterogeneity
- Set clear and measureable desired conditions that can be used to interpret the impacts of repeat fires

Acknowledgements

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Apologies:

This presentation did not have enough fire photos