Forests in Flux: Are Sierra Nevada Forests Primed for Catastrophic Change?

Eastern Sierra Climate & Communities Resilience Project

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Outline

- Sierra Nevada forest ecosystems and fire
  - Historical vs. current conditions
- Stressors to forest ecosystems
- Restoration of forest landscapes

Sierra Nevada Forest Ecosystems

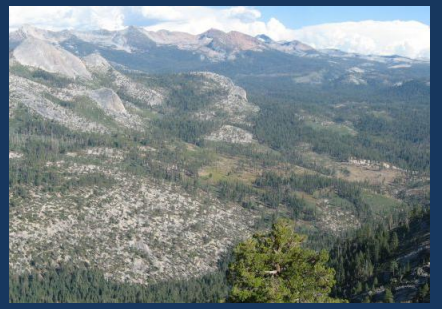
- Coniferous forests are fire-adapted
  - Historical frequent, low severity fire regime
    - Mean historical FRI: 10-15 years
    - Primarily low-moderate severity surface fires
      - Generally small (<1 acre) stand-replacing (high severity) patches

Sierra Nevada Forest Ecosystems

- Coniferous forests are fire-adapted
  - Historical frequent, low severity fire regime
    - Mean historical FRI: 10-15 years
    - Primarily low severity surface fires
      - Includes small (<1 acre) stand-replacing patches
  - Fires variable in size but generally small (<10-100 ac)
  - Includes lightning ignitions and cultural burning

Forest Structure and Composition

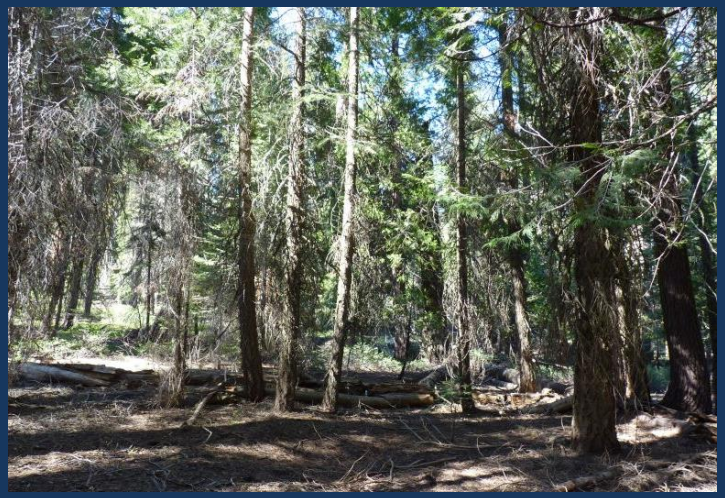
- Fire creates stand structural heterogeneity
  - Individual trees, tree clusters, and openings (ICO)
  - Reduces fuel loading & continuity
  - Promotes tree regeneration (esp. pines)
- Landscape scale heterogeneity



Century of Fire Exclusion

- Loss of forest ecosystem integrity & resilience
  - Increased densification & fuels
  - Structural homogenization

Fire exclusion



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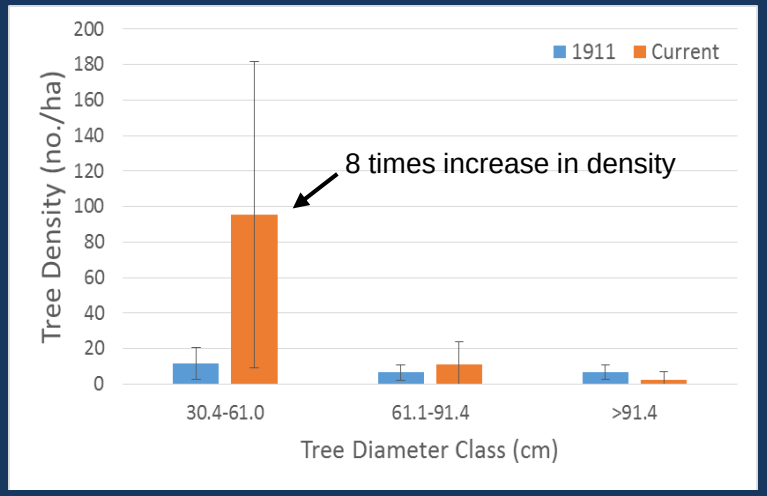


Source: Stephens et al. 2015

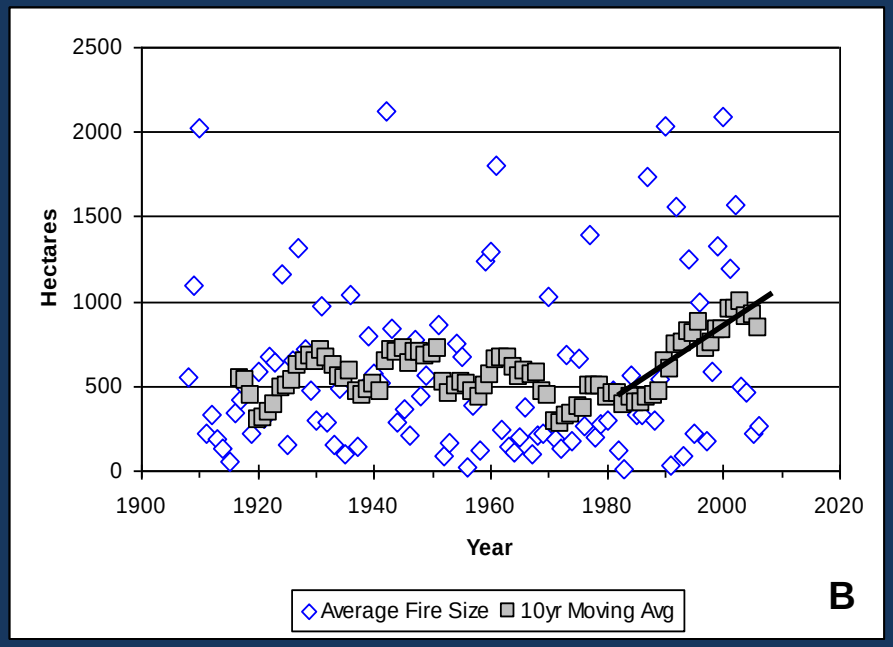
Century of Fire Exclusion

- Loss of forest ecosystem integrity & resilience
  - Increased densification & fuels
  - Structural homogenization
  - Increased susceptibility to stressors

Fire exclusion

Wildfires

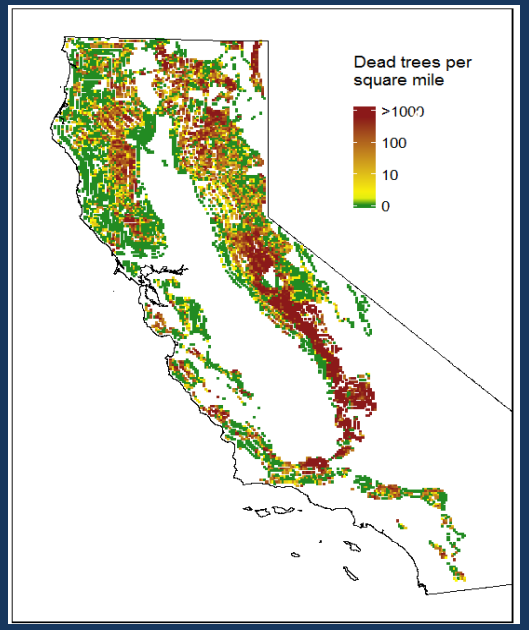
- Wildfire trends
  - Increasing size, frequency, and severity
  - “Megafires” more common
  - Increasing since 1980s



Source: Miller et al. 2009

Insect Outbreaks

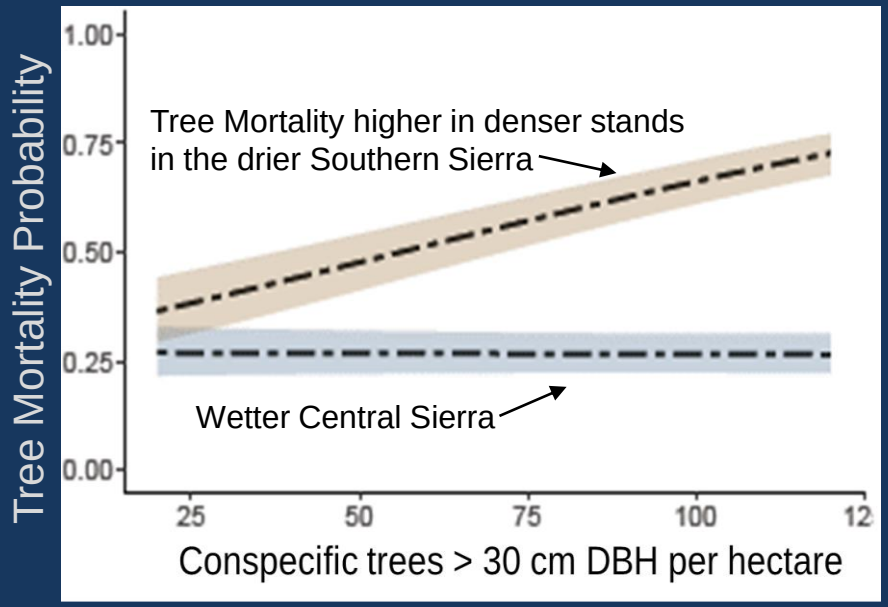
- Trends and patterns
  - Increasing outbreak frequency and severity
  - Associated with droughts (e.g., 2012-2016)
    - Highest in drier Southern Sierra Nevada



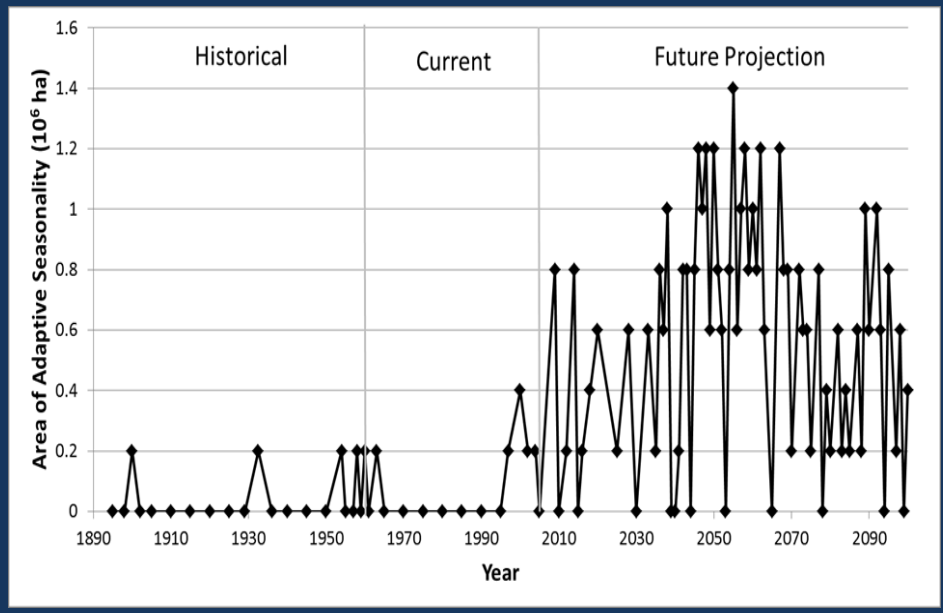
Source: Young et al. 2015

Insect Outbreaks

- Trends and patterns (cont.)
  - Highest in dense stands
    - Also during extreme drought
  - Increasing with warming trends



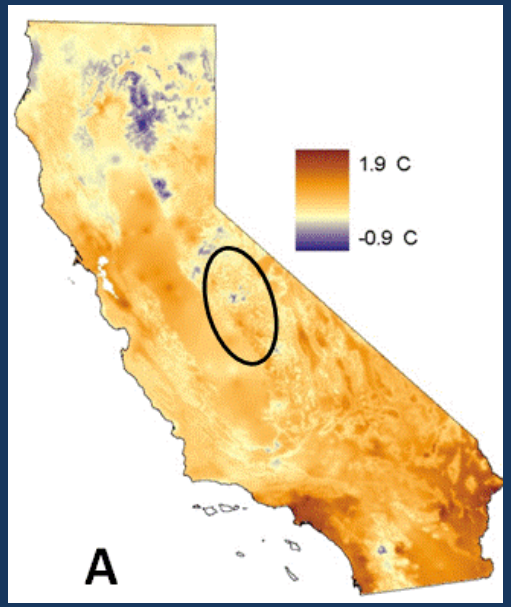
Source: Restaino et al. 2019



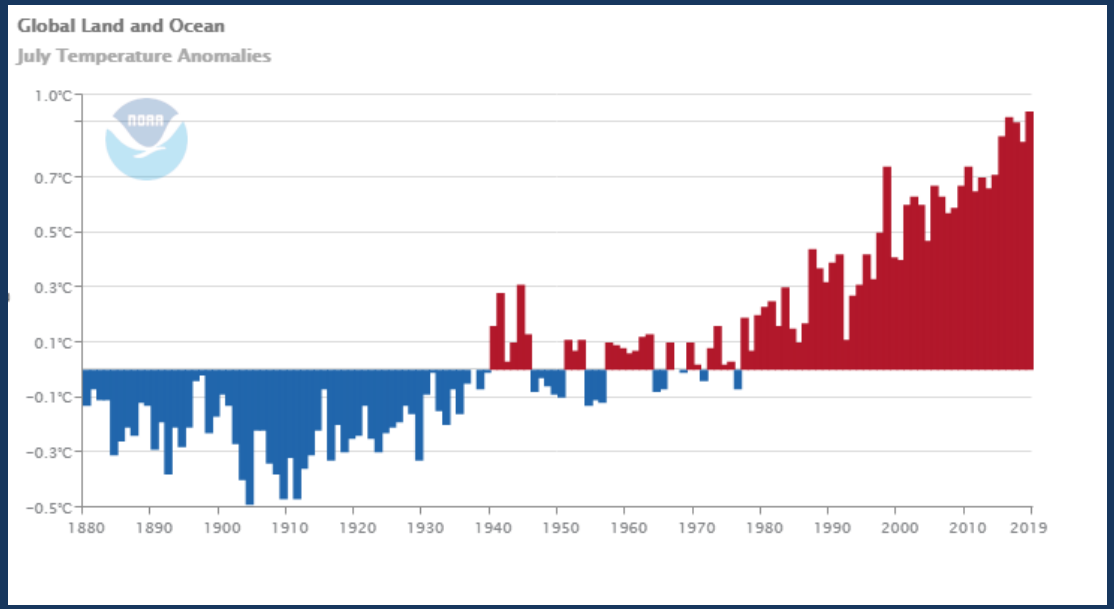
Source: Hicke et al. 2006

Climate Change

- Temperatures rising
- Precipitation more variable
  - Snowpack declining
- Extreme droughts more common



Source: Dobrowski et al. 2015

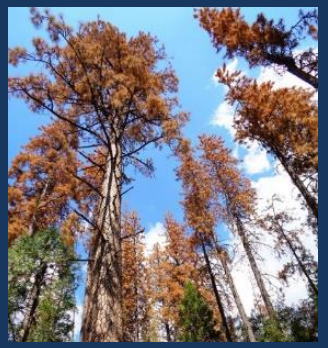


Source: NOAA 2019

Interacting Stressors

Uncharacteristic Wildfires

Forest ecosystems



Climate change

Insect outbreaks

Source:

Primed for Catastrophic Change

- Densified forests + stressors = major forest loss
- Large stand-replacing patches
  - Conifer regeneration failure
  - Permanent loss of forest ecosystem resilience

Forest Management Approach

- Restore forest structure and function
  - Reduce stand densities and fuels
  - Enhance structural heterogeneity
    - Variable tree spacing
    - ICO pattern

Restoration

Restoration Approaches

- Reintroduction of natural fire regimes
  - Prescribed fire
  - Wildfire managed for resource objectives
- Ecological forestry

Ecological Forestry

- Focused on ecological restoration objectives
  - Removal of small trees & retention of large trees
  - Creation of ICO pattern (heterogeneity)
  - Ideally followed with prescribed fire

Eastern Sierra Climate & Communities Resilience Project

- Represents ideal landscape for planning landscape-scale forest restoration
  - Many valued resources and assets
  - High wildfire and insect outbreak risk
  - High potential for forest restoration
  - Robust community partnerships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