

The Climate Mitigation Benefit of Fire Prone Forests

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The Forest Carbon Sink

- Forests remove 3 billion tons annually
- Forest carbon sink has been increasing
 - Regrowth, fire suppression
- U.S. forests sequester 10% of human emissions

= Climate Mitigation Potential

Forest Carbon Accounting

- **Additionality:** forest practices that exceed the baseline expectation for carbon sequestration
- **Permanence:** the length of time the carbon must be sequestered

Additionality and Permanence

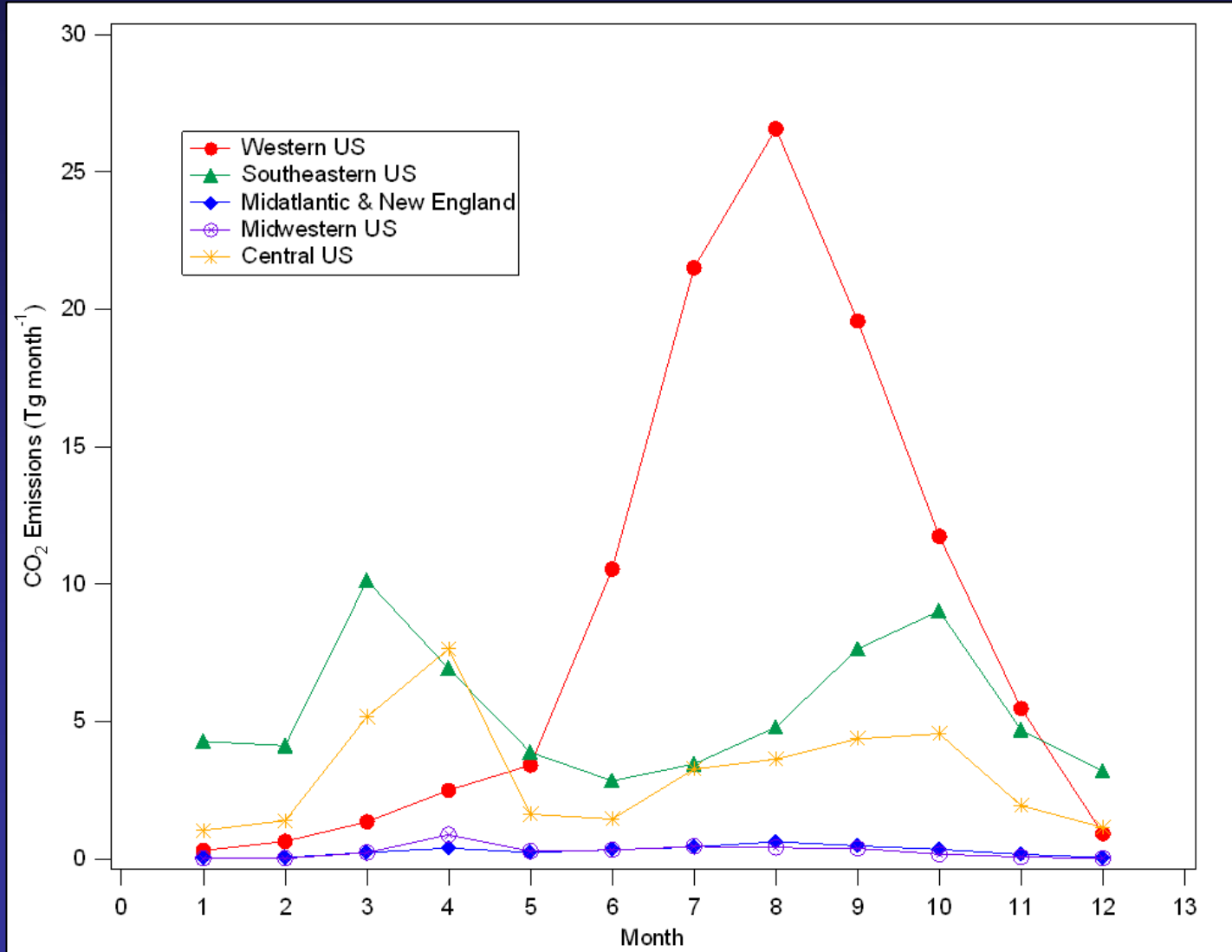


Photo: Rogue Valley IMC



Photo: U.S. Forest Service

Wildfires: A Large Source of Emissions



(Wiedinmyer and Neff 2007)

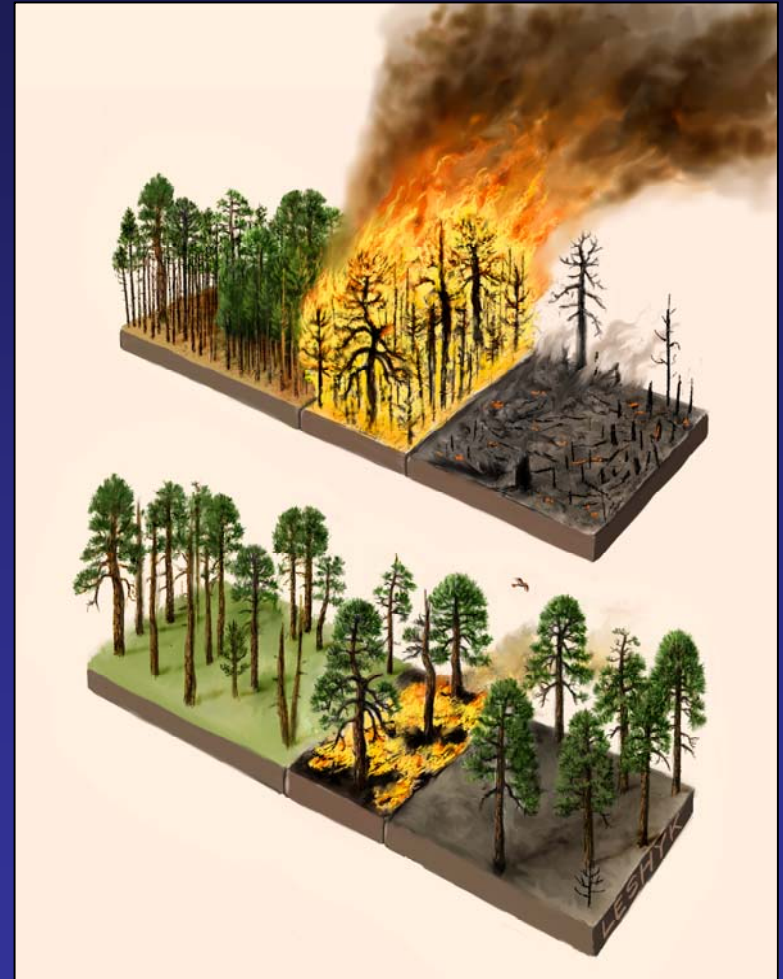
Permanence?



Photo: Arizona Division of Emergency Management

Management & C Accounting

- California AB32
- Thinning = stock loss
- Wildfire emissions are written off the books

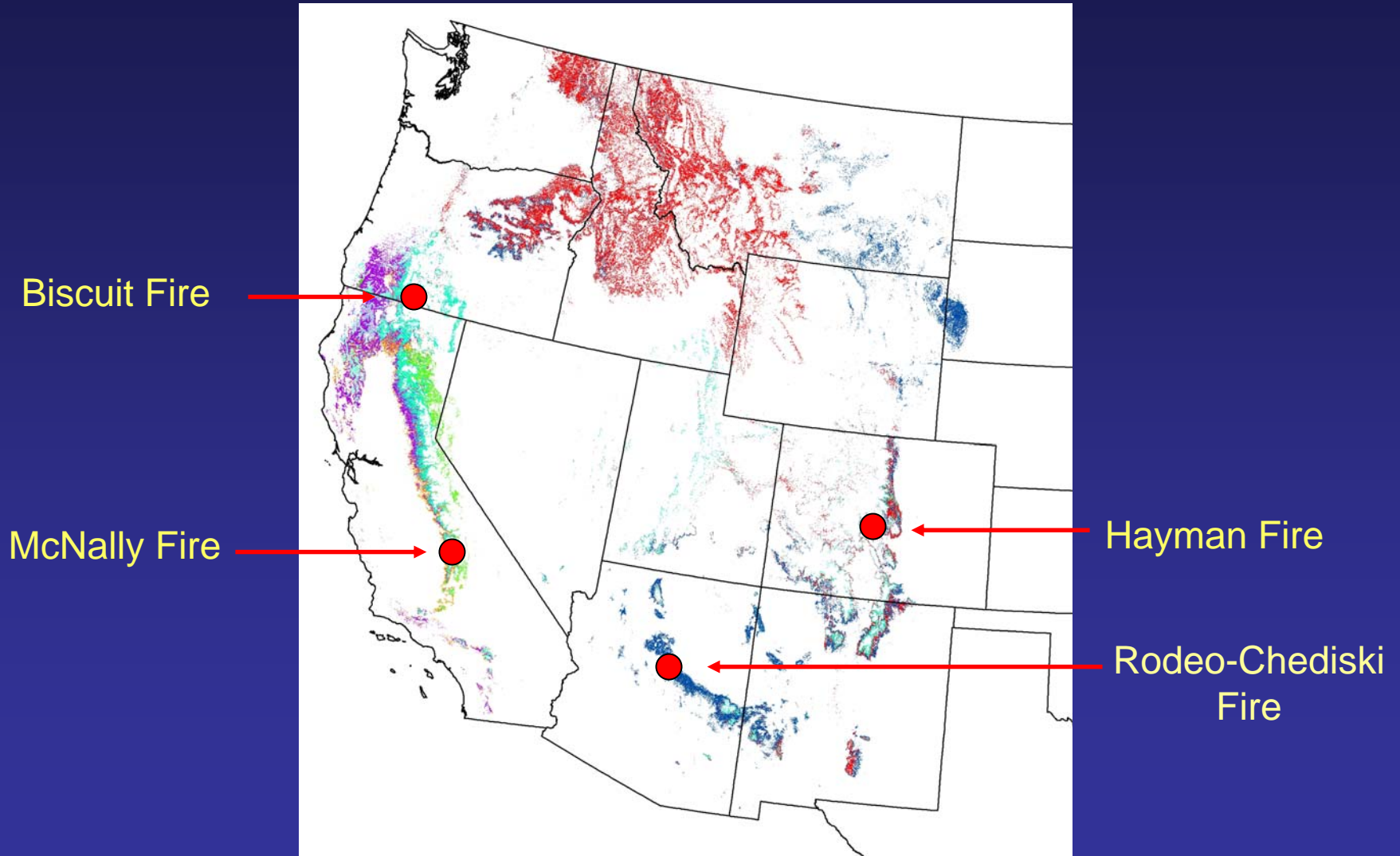


Hurteau, Koch, and Hungate (2008)

Hypothesis:

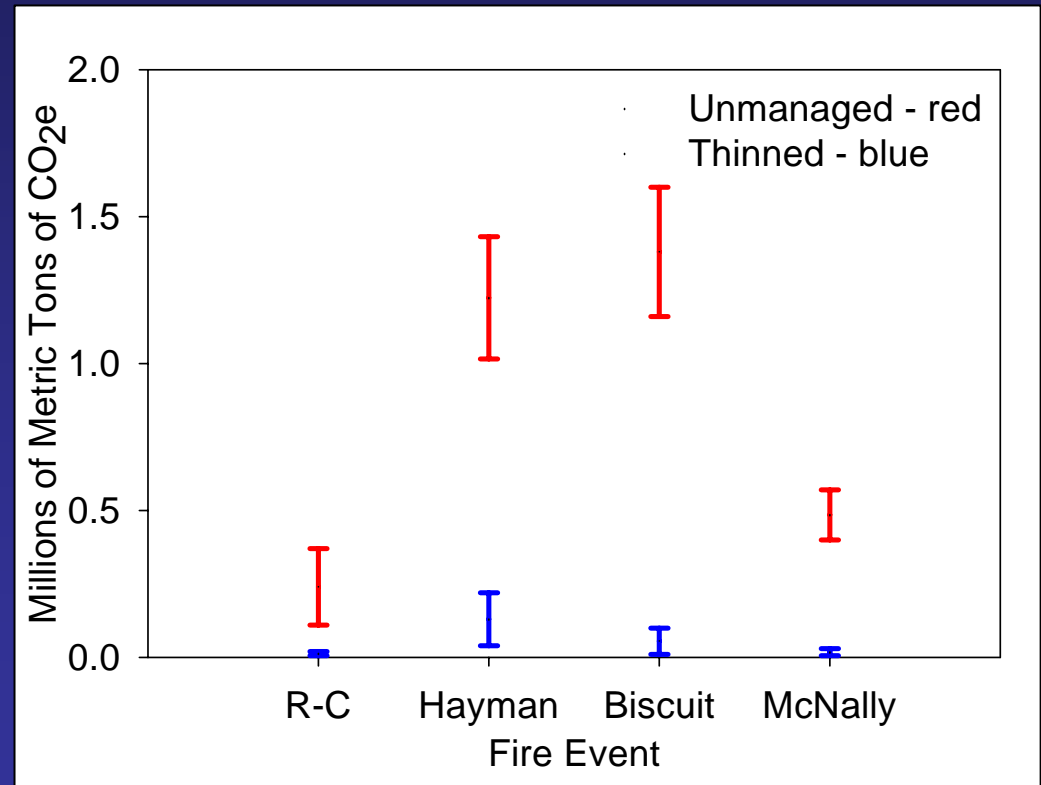
Forest thinning makes forests
more resistant to stand
replacing fire resulting in a net
carbon benefit.

Study Locations



Reduced Fire Severity = Fewer Emissions

- Thinning requires a C stock reduction (3.9 MMTCO₂)
- Avoided emissions (5.7 MMTCO₂)
- Avg US 20 tCO₂/yr



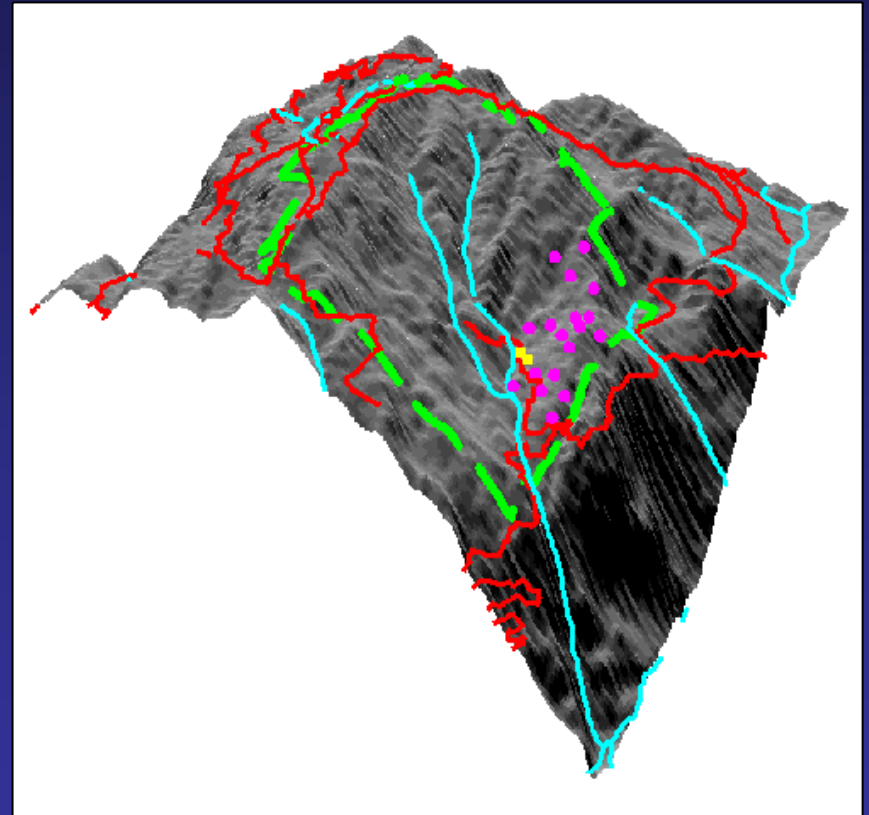
Hurteau, Koch, and Hungate (2008)

Hypothesis:

A forest structure that approximates the pre-suppression structure will be most resistant to wildfire and have the greatest carbon benefit

Forests, Wildfire, & Carbon

- Fire suppressed forest structure
- Modeled structural treatments
- Modeled 97th percentile fire weather



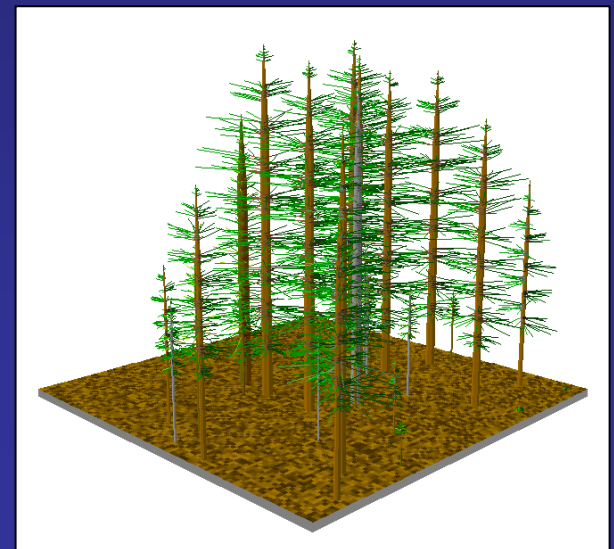
Treatments

- 1865 Forest Structure
- Restoration thin
- Thin from below
- No thin

All treatments crossed with
prescribed fire

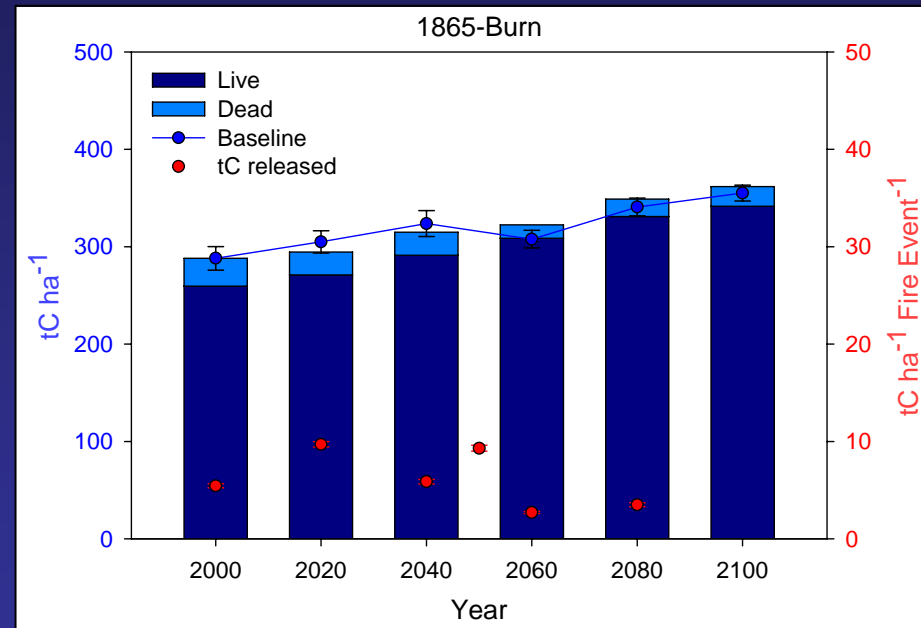
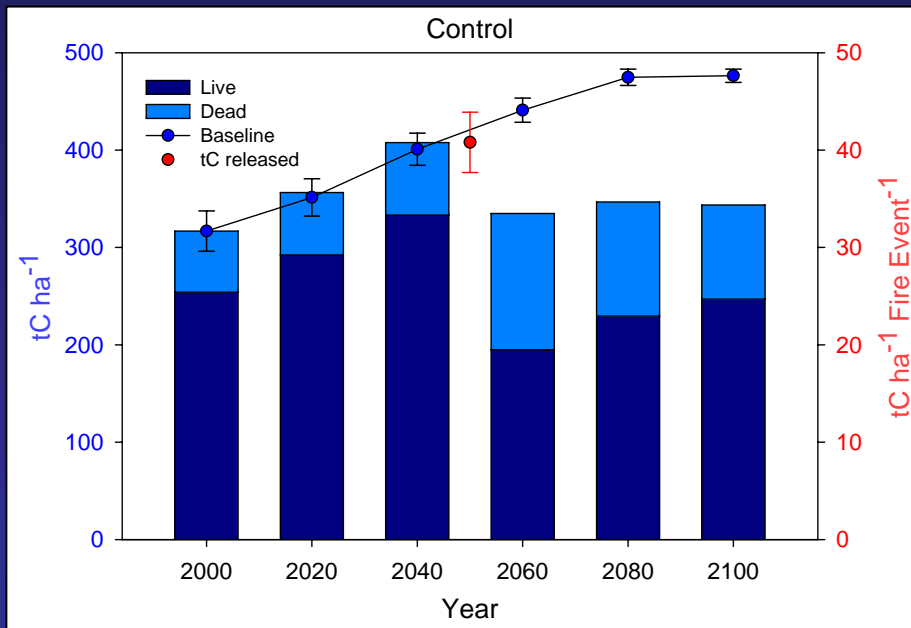


2000

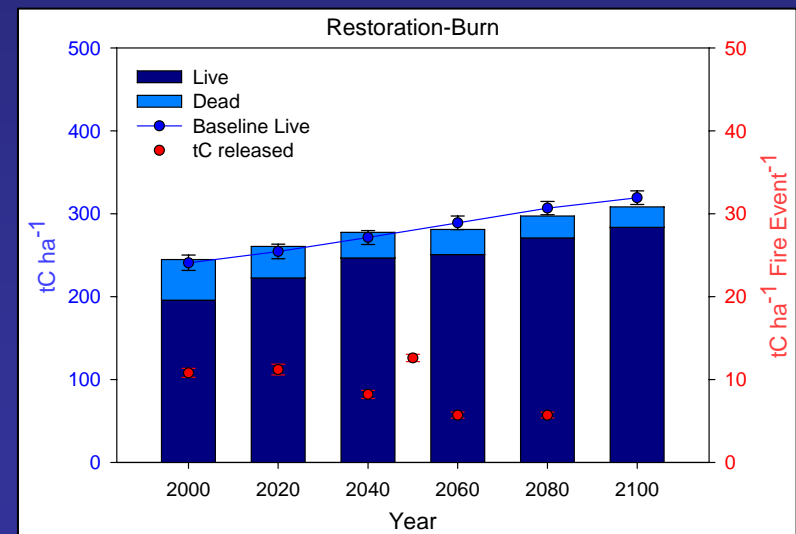
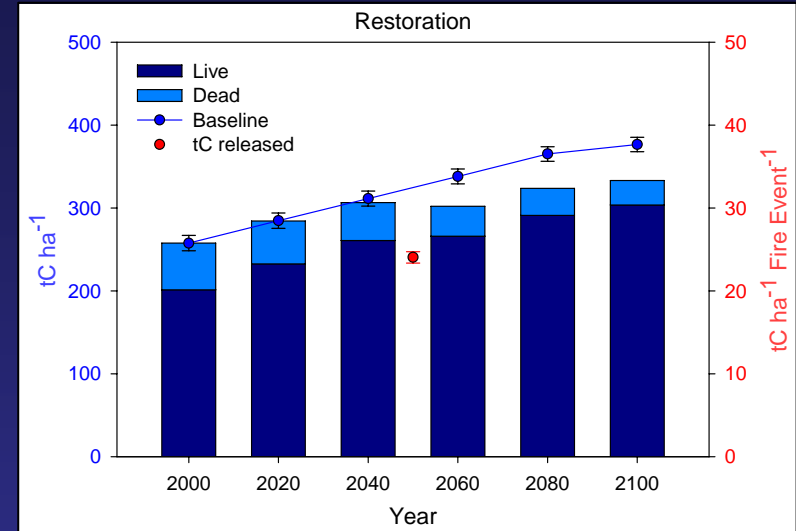
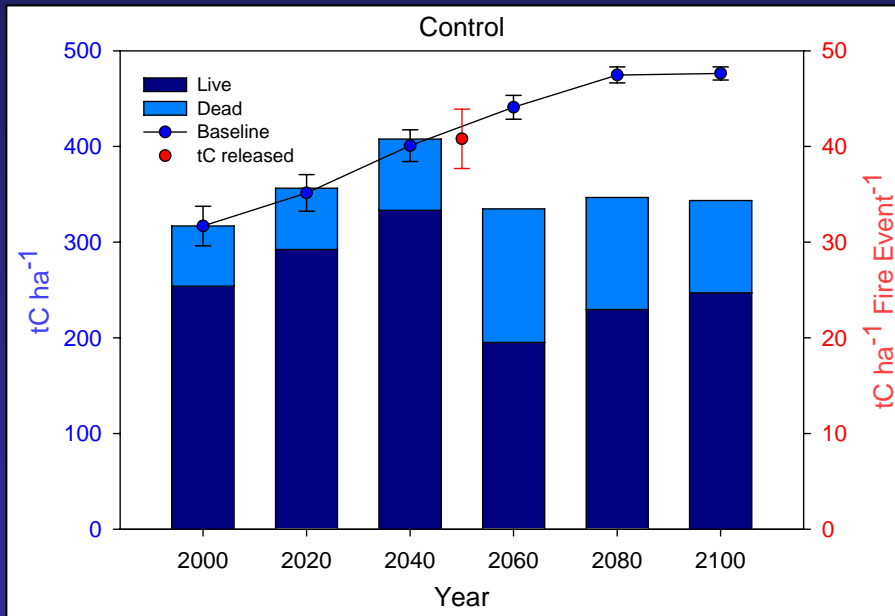


1865

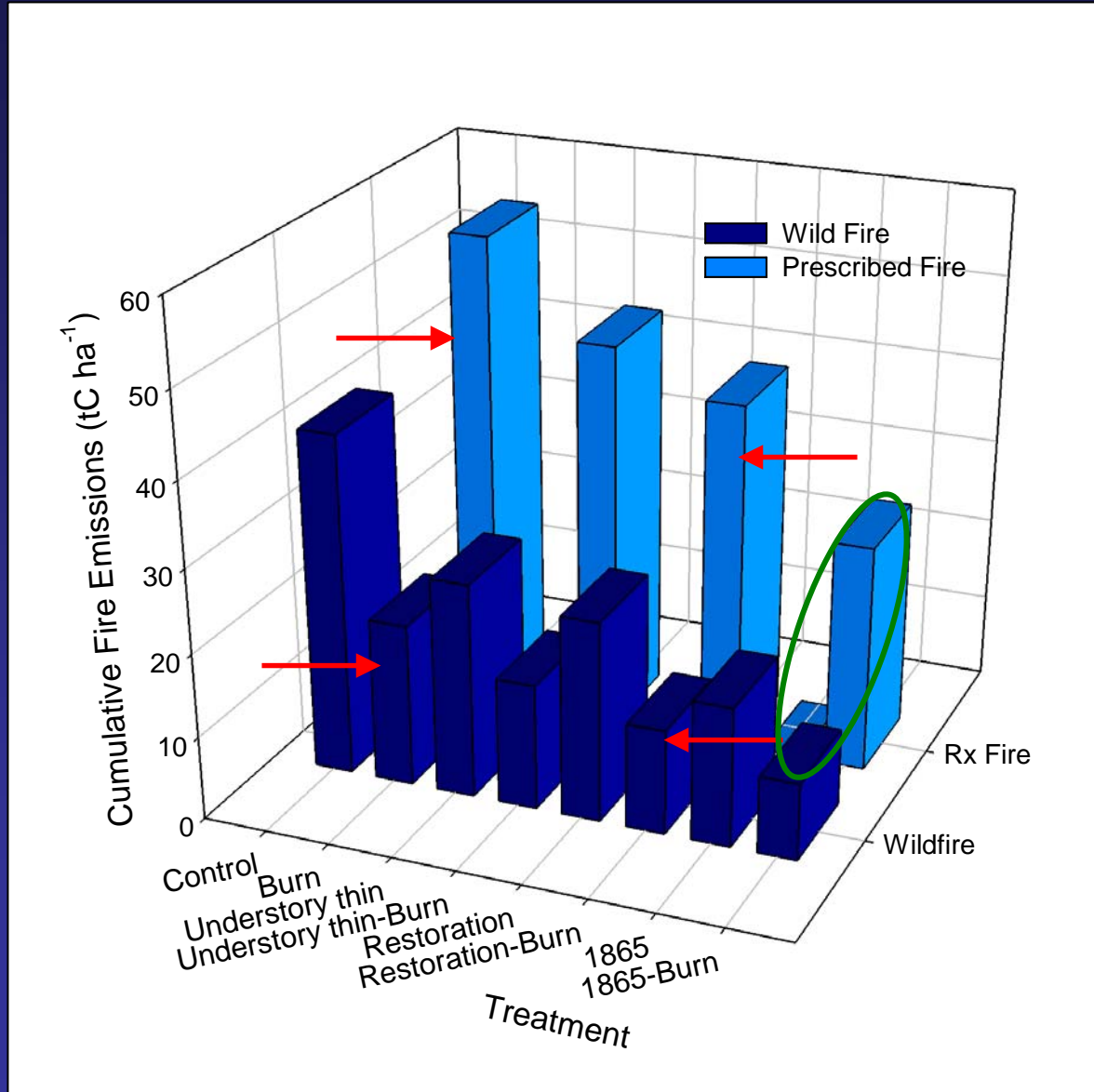
Current vs. Historic



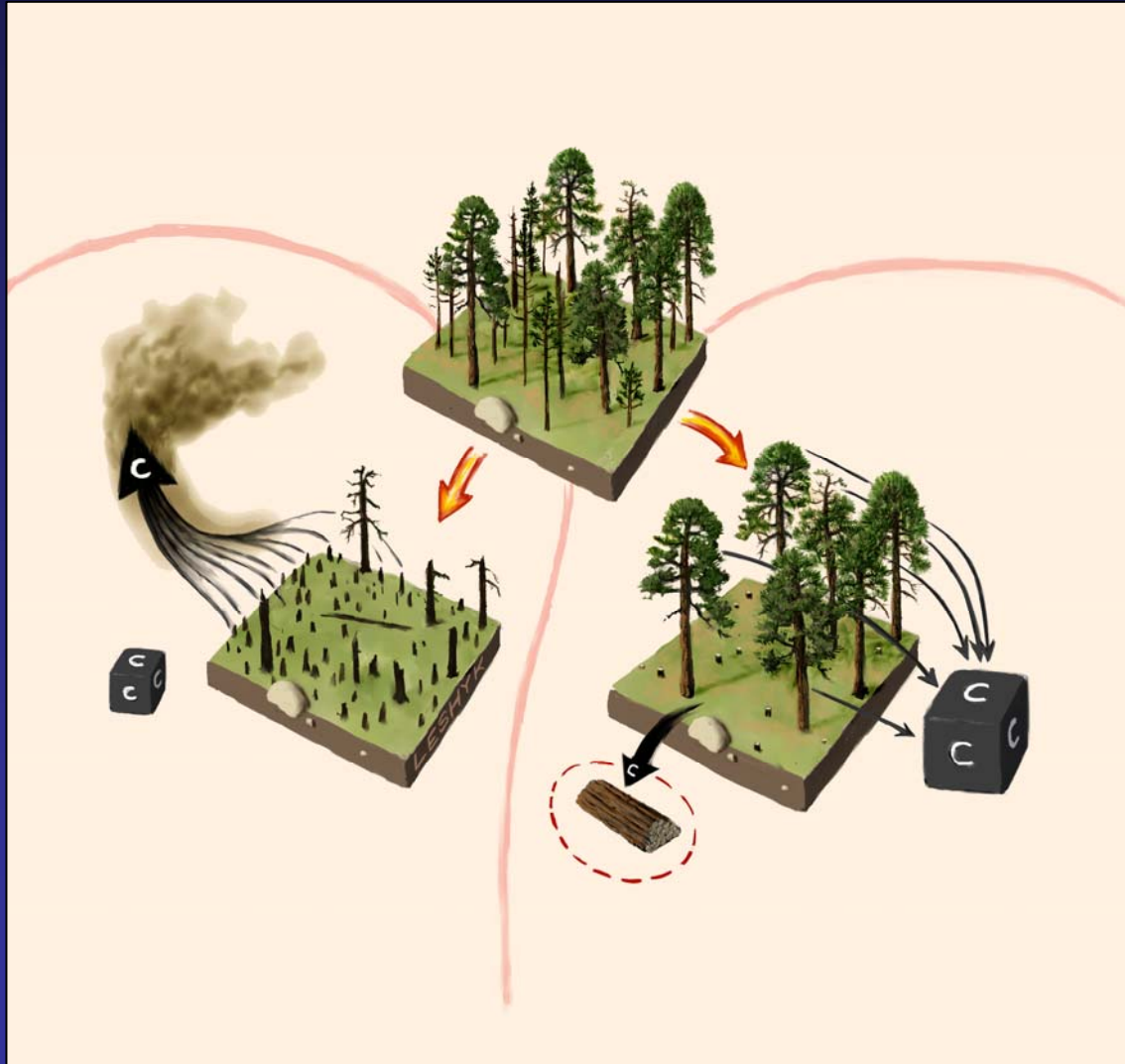
Control vs. Restoration



Restoration = Lower Emissions



Risk in Forest Carbon Offsets

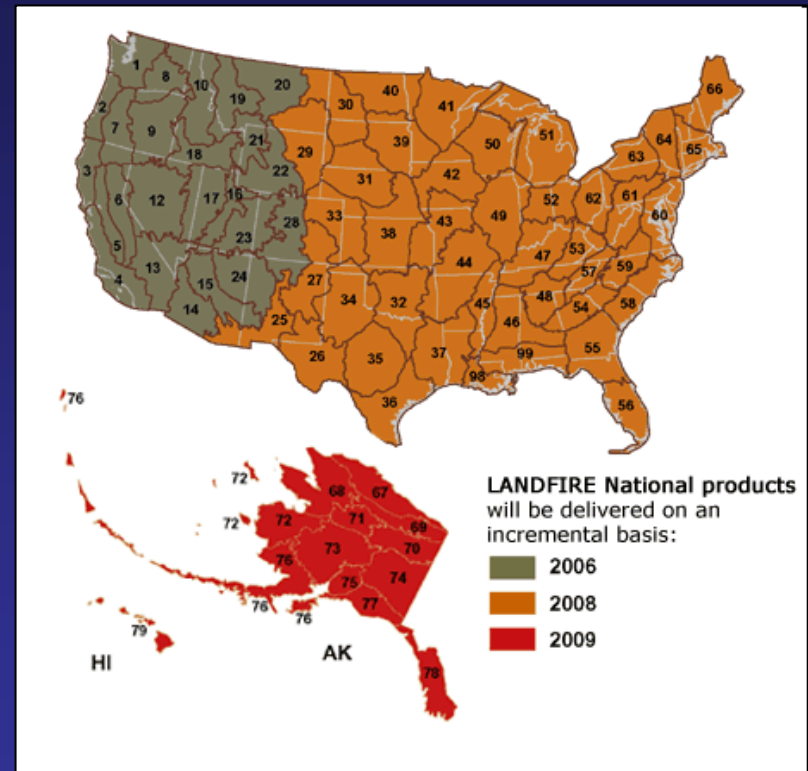


Incorporating Risk

- Currently $tC = tC$, regardless of forest type
- Buffer pools as a hedge against loss
 - Voluntary Carbon Standard

Data Layers

- Fire Regime Condition Class Departure
- Mean Fire Return Interval
- Existing Vegetation Type



Risk-based C Valuation

$$V_d = V_c \cdot [1 - F(1 - M/P)], \text{ when } M < P$$

Fire Suppressed Ponderosa Pine = 26% of market value

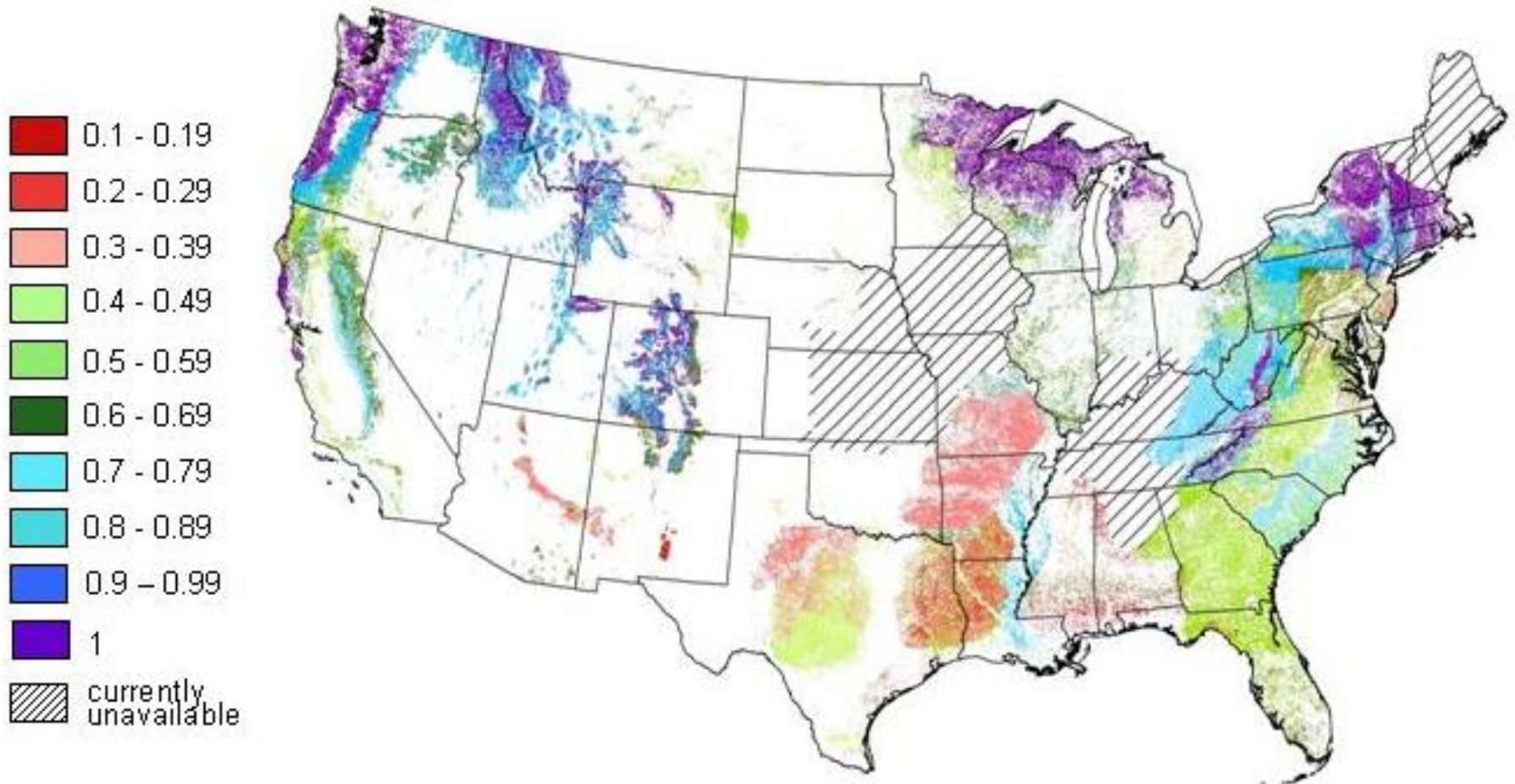
V_d = Discounted Value

V_c = Market Value tC

F = Fire Regime Condition Class Departure

M = Mean Fire Return Interval

C Value Coefficients by Forest Type



Hurteau et al. (2009)

Robust to Management Actions

Assume $V_c = \$20$

Fire suppressed Sierran Mixed-conifer

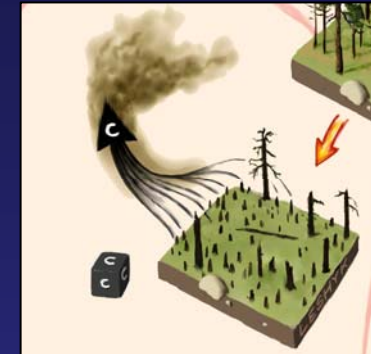
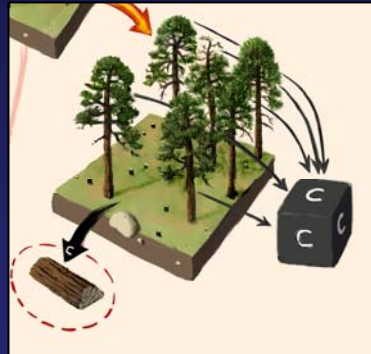
$$V_d = 20 \cdot [1 - 0.46 \cdot (1 - \frac{30}{100})] = \$13.56$$

Restored Sierran Mixed-conifer

$$V_d = 20 \cdot [1 - 0.01 \cdot (1 - \frac{30}{100})] = \$19.86$$

Restored Forest is worth \$6.30/tC more

Year 50 Wildfire Simulation



250 tC ha⁻¹, \$4965 ha⁻¹

195 tC ha⁻¹, \$2644 ha⁻¹



Total = 47.8 tC ha⁻¹

0 tC ha⁻¹

Lumber = 28.6 tC ha⁻¹, \$572 ha⁻¹

Waste = 19.2 tC ha⁻¹, \$384 ha⁻¹



WF = 12.6 tC ha⁻¹, \$252 ha⁻¹

40.8 tC ha⁻¹, \$816 ha⁻¹

RxF = 41.6 tC ha⁻¹, \$832 ha⁻¹

Total

278.6 tC ha⁻¹, \$4069 ha⁻¹

195 tC ha⁻¹, \$1828 ha⁻¹

Take Home Message

- Fuels reduction treatments have carbon costs
- Management can influence:
 - Emissions
 - Post-fire C stocks
- Key Points:
 - Consolidate carbon in large trees
 - Fire is an important system process



Collaborators and Support

- **Bruce Hungate**
- **George Koch**
- **Malcolm North**

- **Western Regional Center of the National Institute for Climatic Change Research**
- **USDA Forest Service**