Long-term Effects of Shrub Treatments on Sagebrush Steppe Resilience and Diversity

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Progress Report CRM

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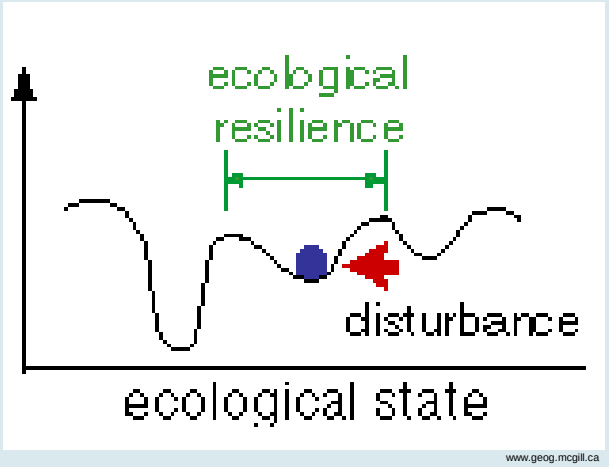
Diversity and resilience



Ecological resilience

- Resilience

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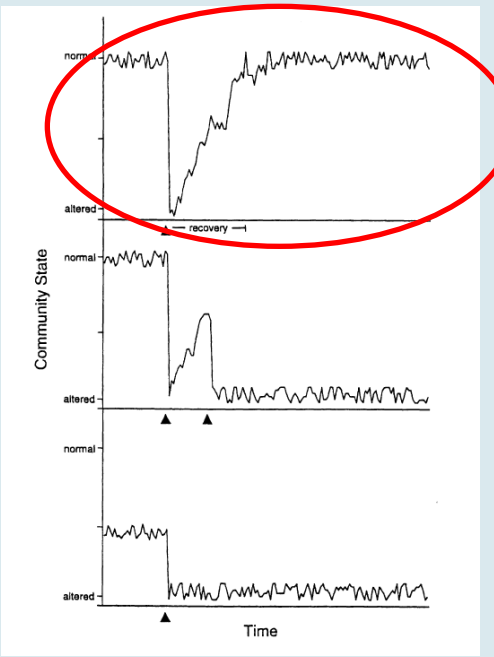
  - System's ability to recover from disturbance
    (van der Maarel 1993)
  - Characterized by amount of disturbance system can withstand before transitioning to another stable state
    (Gunderson 2000)



Paine *et al.* 1998

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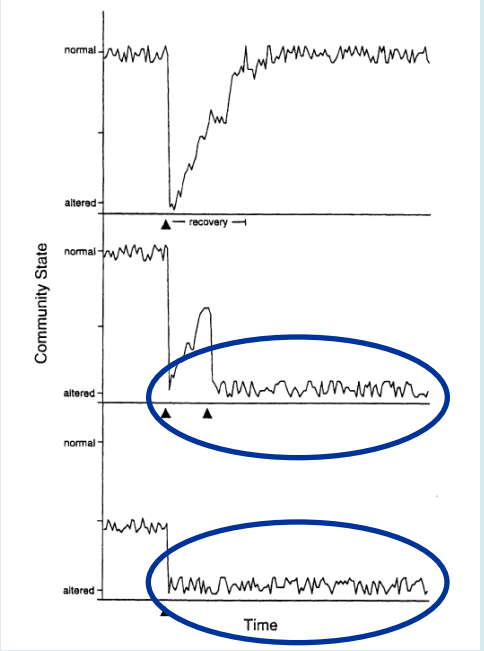


Paine *et al.* 1998

Legacy effects

- Sagebrush steppe
  - Shrub cover/biomass decline with treatment
  - Gradual recovery

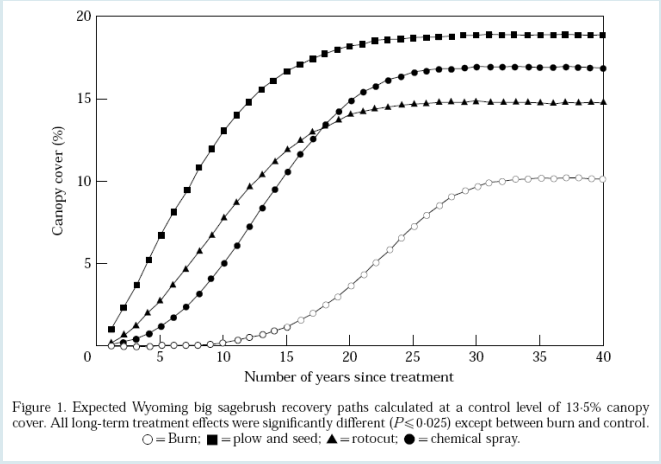


Figure 1. Expected Wyoming big sagebrush recovery paths calculated at a control level of 13·5% canopy cover. All long-term treatment effects were significantly different ($P \leq 0{\cdot}025$) except between burn and control. ○ = Burn; ■ = plow and seed; ▲ = rotocut; ● = chemical spray.

Watts and Wambolt 1996

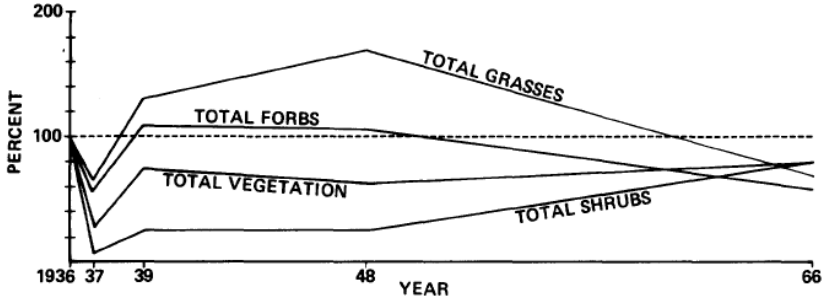


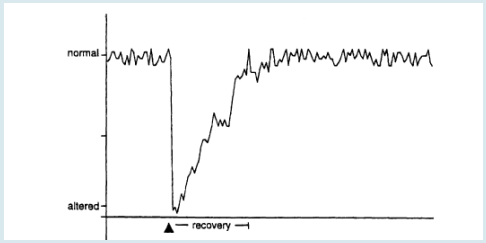
Fig. 1. *Trends of species classes on a planned burn near Dubois, Ida., 1936–1966. Values on burned plots are adjusted for the natural variation between years.*

Harniss and Murray 1973

Research Objective

- Assess resilience 

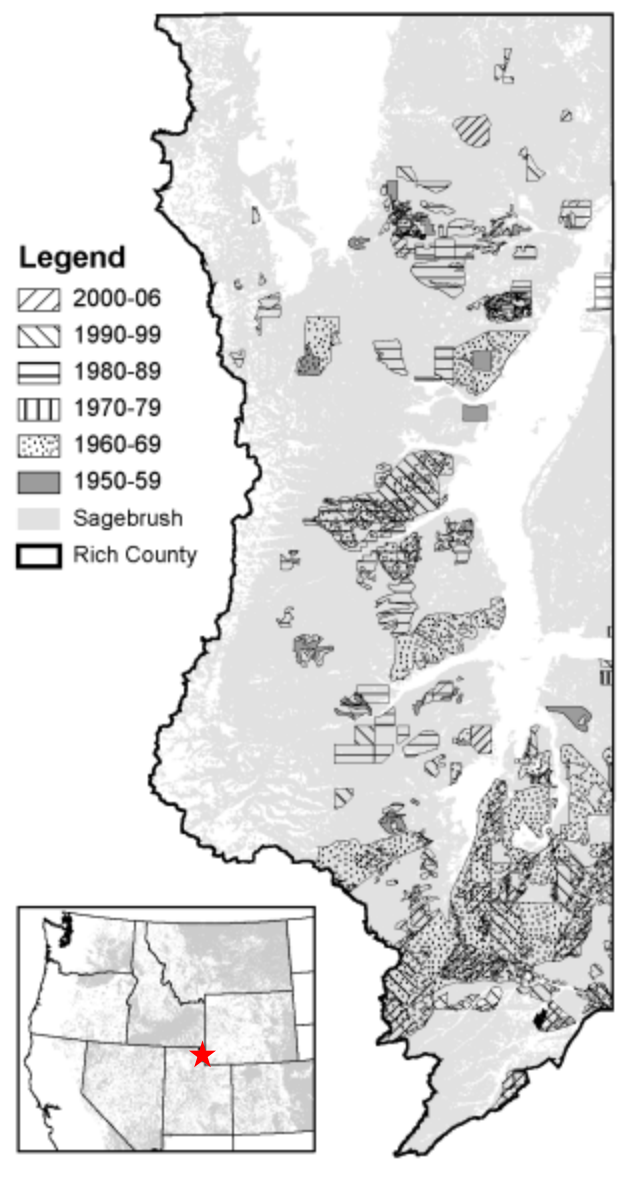
to shrub treatments
- Expected plant communities to be resilient and differences between treatment types



Paine *et al.* 1998

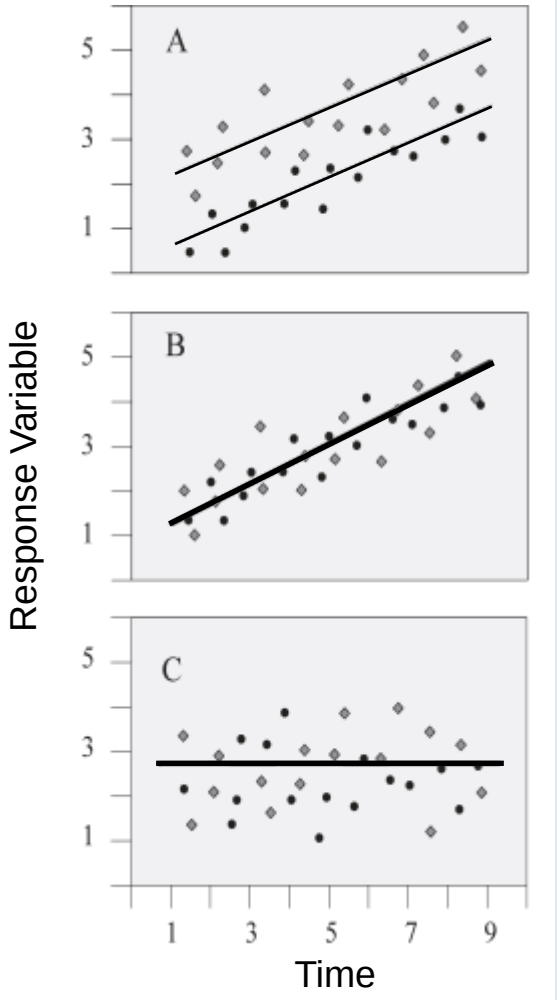
Study area

- Rich County, UT
  - Centered in sagebrush steppe distribution
  - Sagebrush steppe comprises >75% area
  - 50-year history of shrub treatments
- Field Sampling
  - Plant surveys across time-since-treatment and reference sites

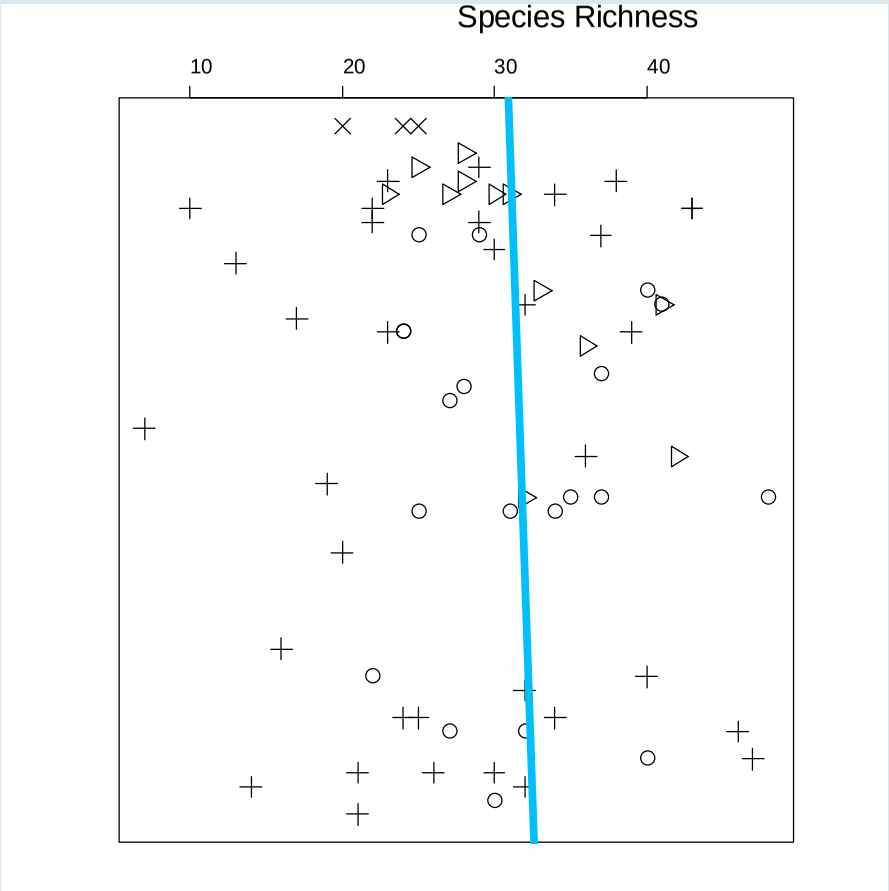


Resilience to shrub treatment

- ANCOVA
  - Time since disturbance as factor of interest (covariate)
  - Controls for variation associated with time
  - Test whether disturbance effects exist over time and between treatment types

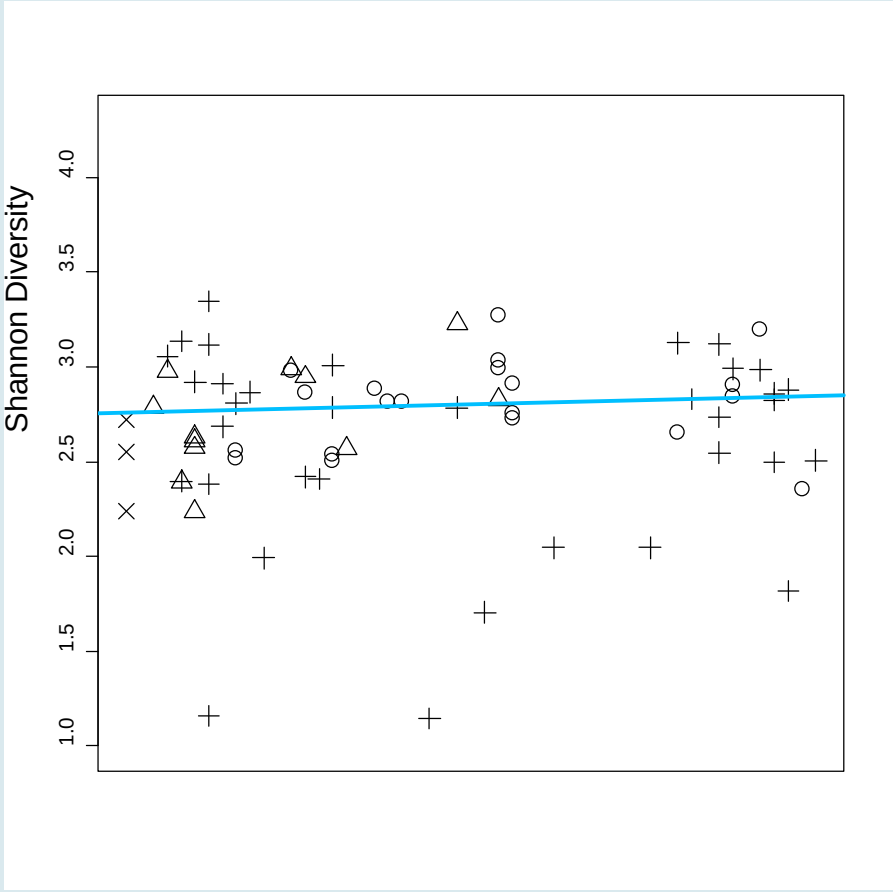


A	Time Effect Treatment Effect
B	Time Effect **No** Treatment Effect
C	**No** Time Effect **No** Treatment Effect


Species Richness
10
20
30
40

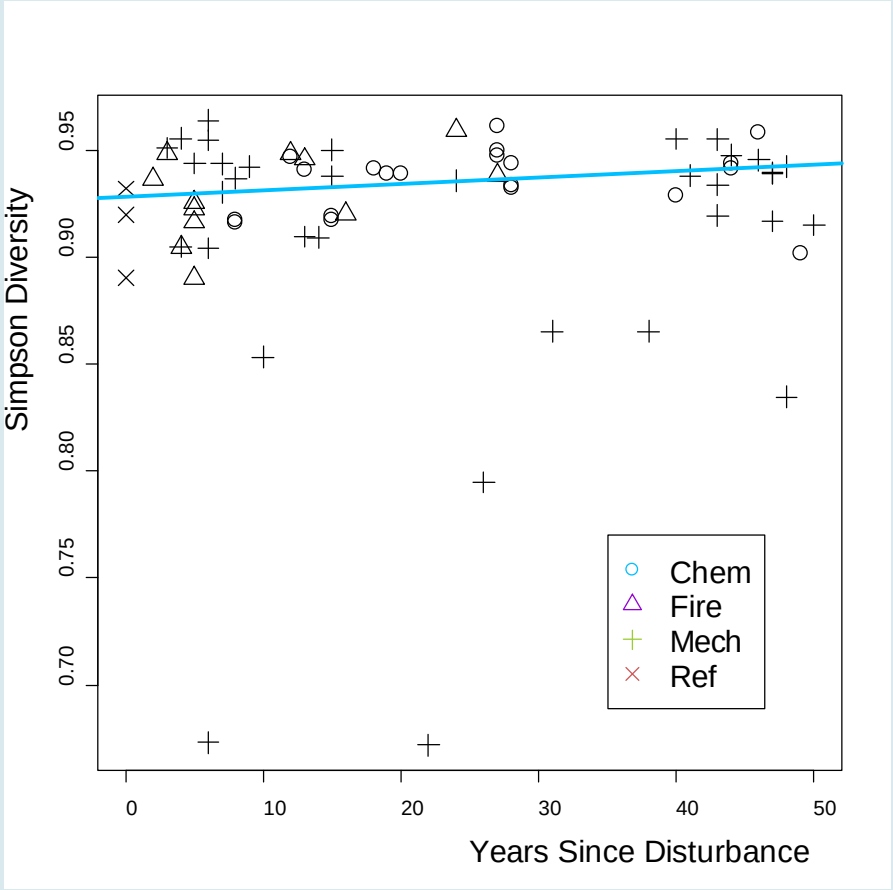
Resilience to shrub treatment

- Shannon diversity
  - Number of species present
  - Evenness (relative abundance)
  - Greater evenness increases diversity score



Resilience to shrub treatment

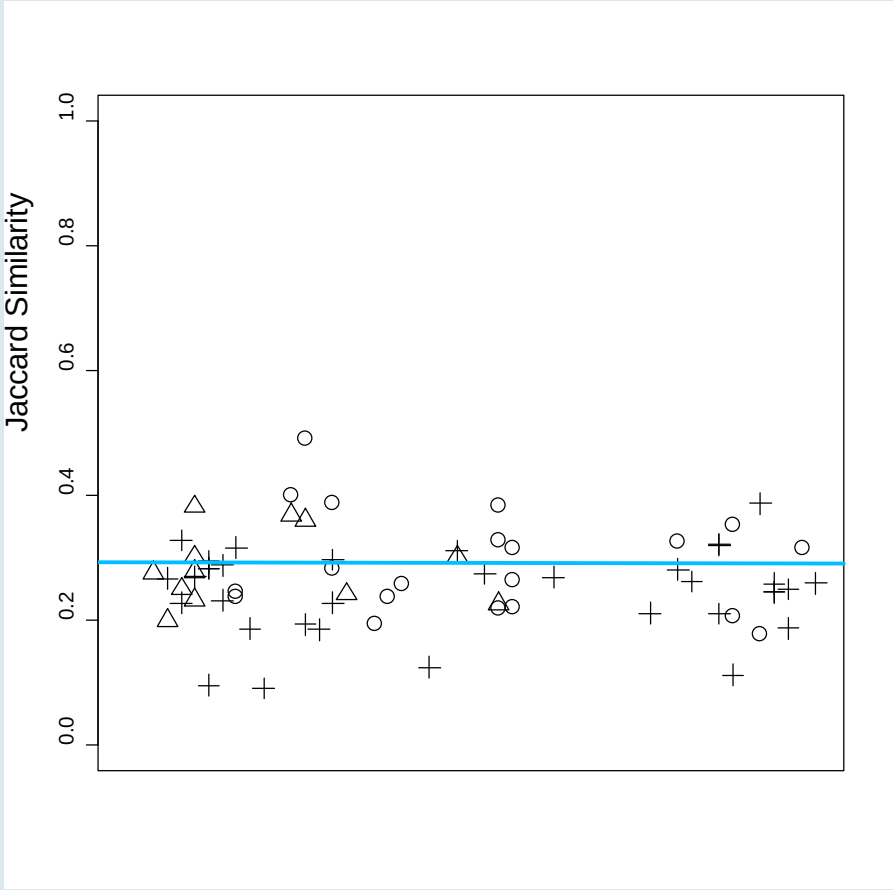
- Simpson diversity
  - Number of species present
  - Evenness (relative abundance)
  - Probability that two randomly selected species will be the same



Resilience to shrub treatment

- Scored on similarity to pre-treatment conditions (reference communities)
- Jaccard similarity

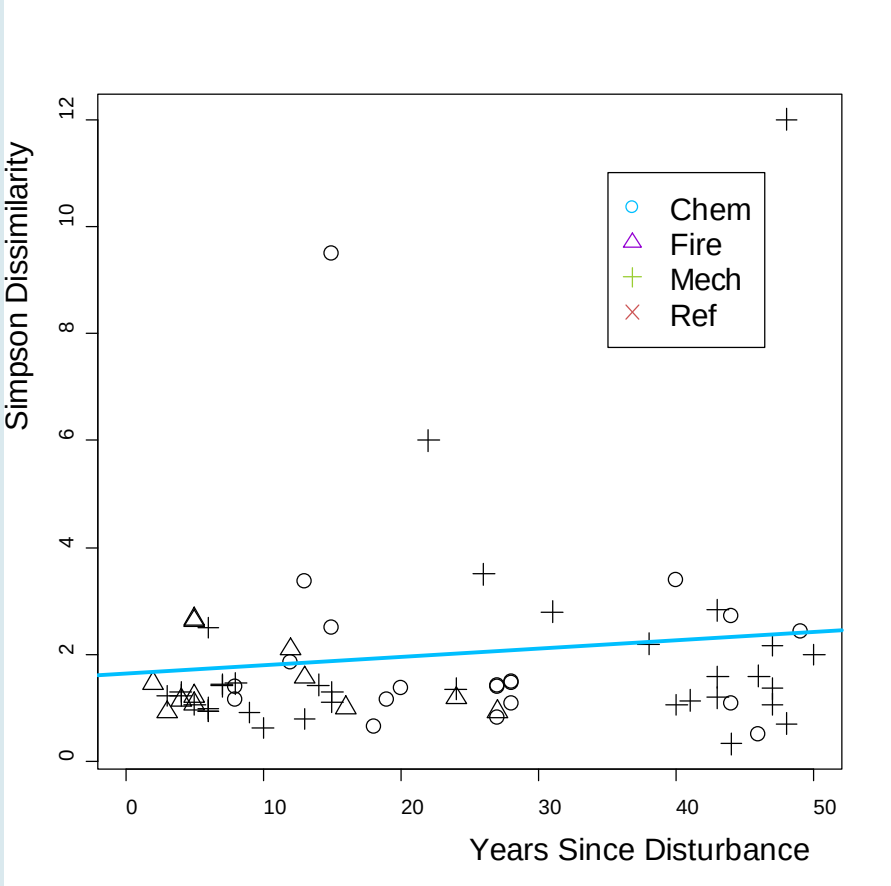
  $0 < \text{Jaccard} < 1$



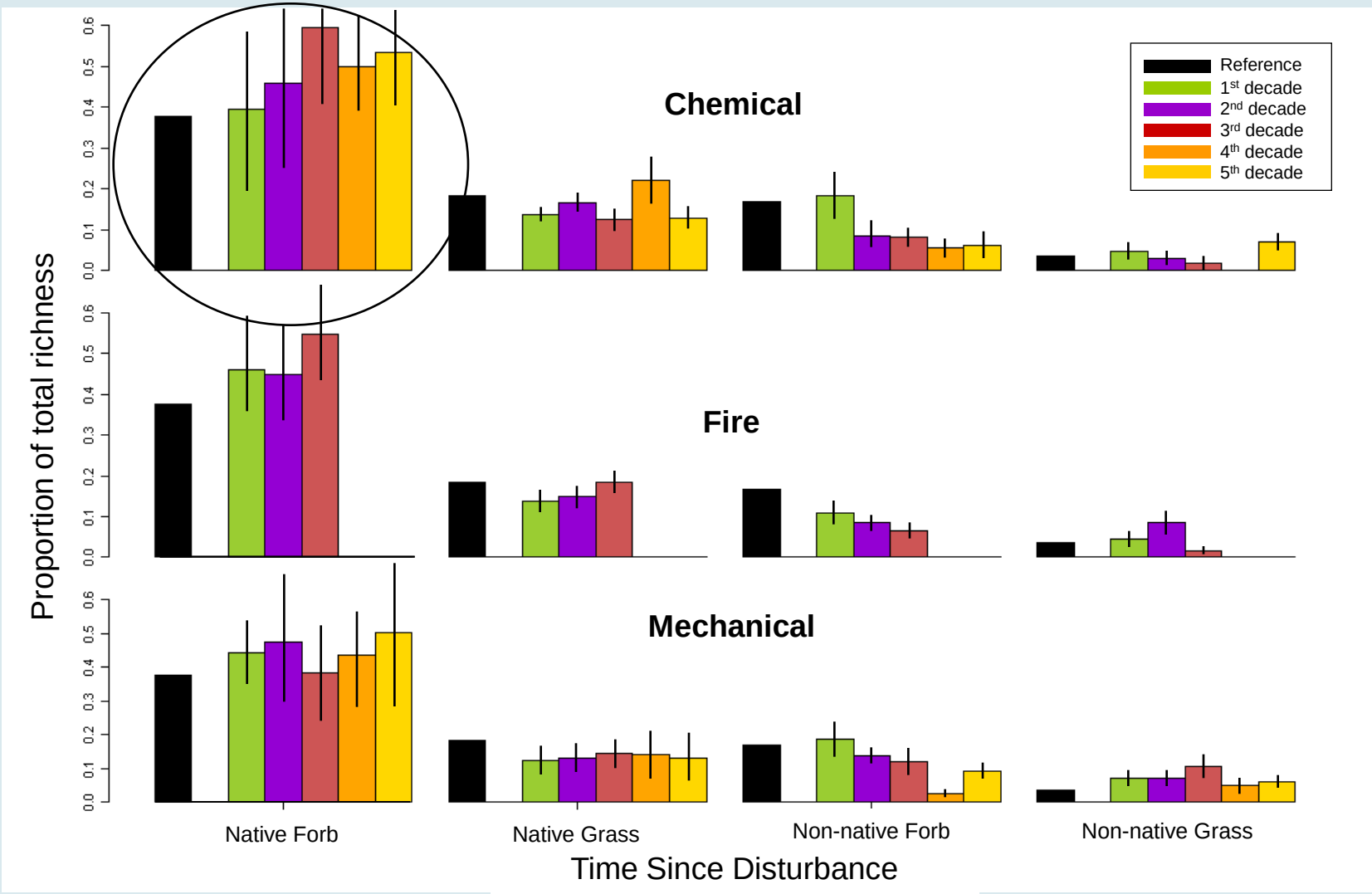
Resilience to shrub treatment

- Scored on similarity to pre-treatment conditions (reference communities)
- Simpson dissimilarity

  $0 < \text{Simpson} < \infty$



Community composition



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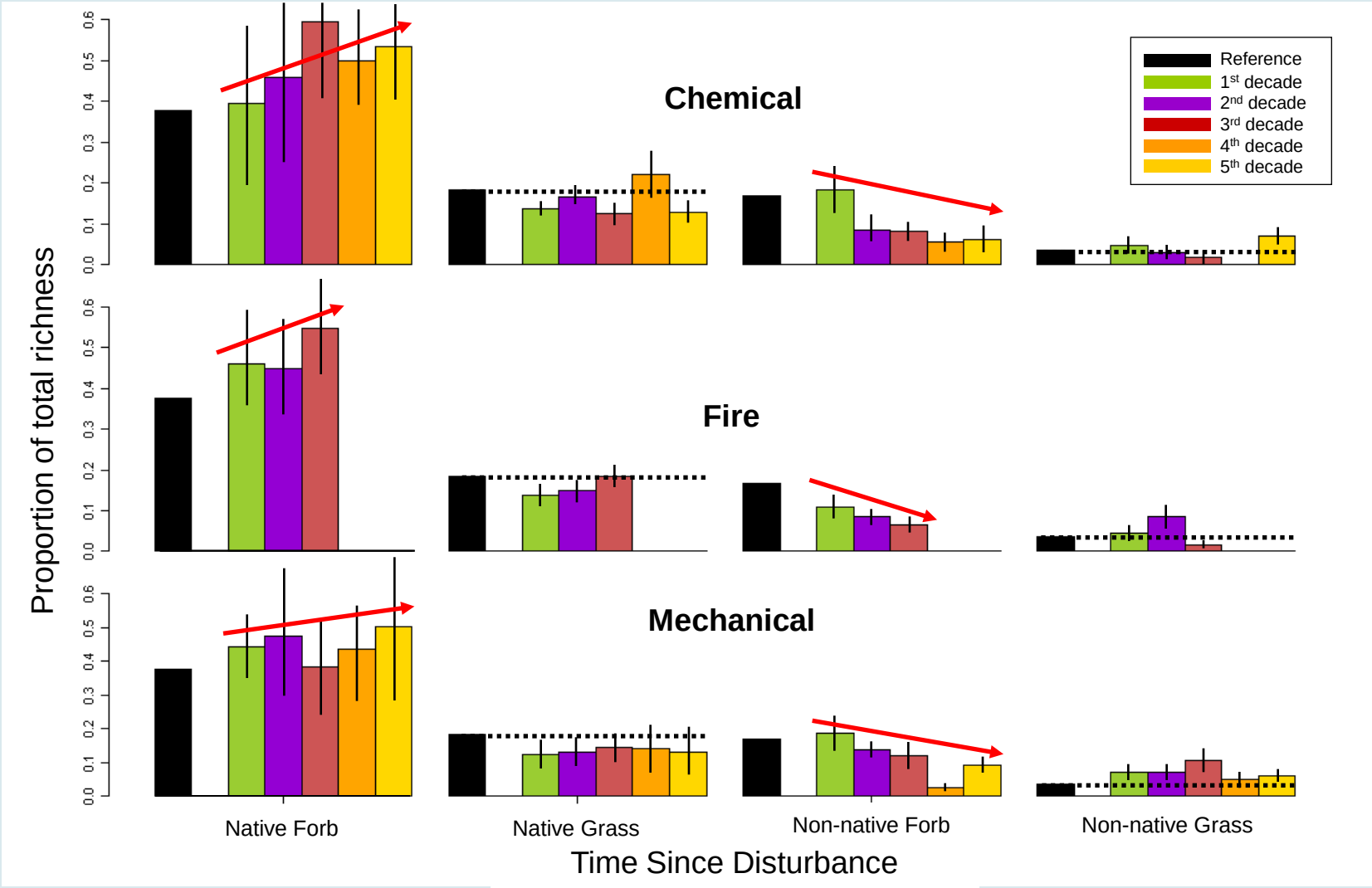
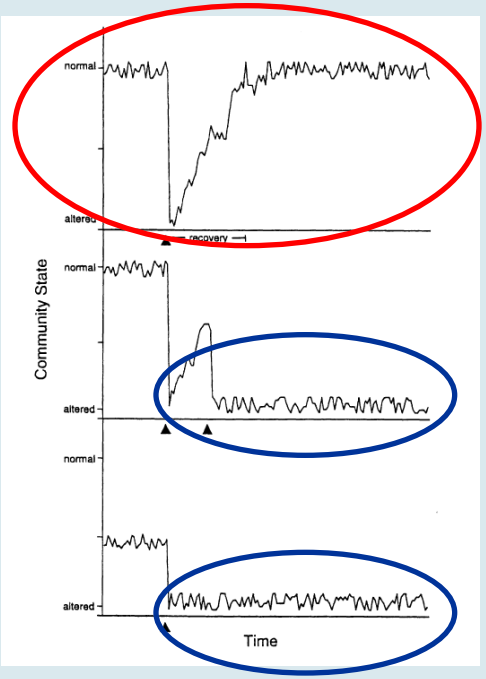


Conclusions

- Expected
  - Plant community to show resilient response to shrub treatments
  - Differences between treatment types
- Observed
  - Flat, linear response
  - No indication of return to pre-treatment conditions within 50-years
  - Differences between treatment types



Conclusions

- Fire and chemical treatments produce plant communities that are most similar to each other over the long-term
- Mechanical treatments lead to plant communities different from fire, chemical
- All three treatment types create plant communites significantly different from pre-treatment conditions (reference sites)

The end of my tale…

Questions?