Regional NPP and Carbon Stocks in Southwestern USA Rangelands:

Land-use Impacts on the Grassland-Woodland Balance

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Introduction

Questions

- What are the rates, dynamics, and ecological consequences of woody plant encroachment into grasslands?
- How do management practices influence these dynamics and affect future trajectories of change?

Goals

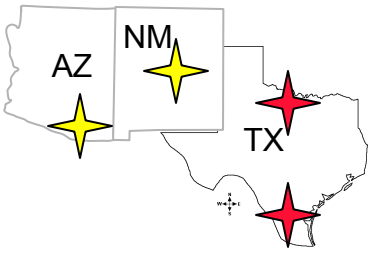
- Determine rates and dynamics of change through intensive study sites located throughout the Southwestern USA
- Understand consequences of management practices through study of ecosystem processes with different land-use legacies and scenario-building based on management strategies

Approach

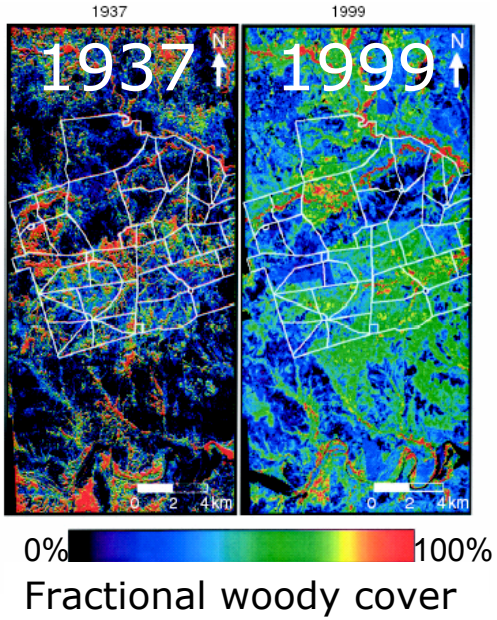
- Field measurements and isotope biogeochemistry for understanding ecological processes as influenced by management practices
- Remote sensing and ecosystem simulation modeling for regional assessment into the future

Significant Results & Future Work

- Discrepancies between studies of changes in Soil Organic Carbon:
  - Jackson et al. (2002) ⇒ declines
  - Our work ⇒ no change or increase depending on soil type
- Investigate land use legacies in region with well documented management history (AR)
- Determine ecological consequences of encroachment in more arid rangelands (NM)
- Combine ecosystem modeling and remote sensing to project carbon stocks for Southwestern rangelands

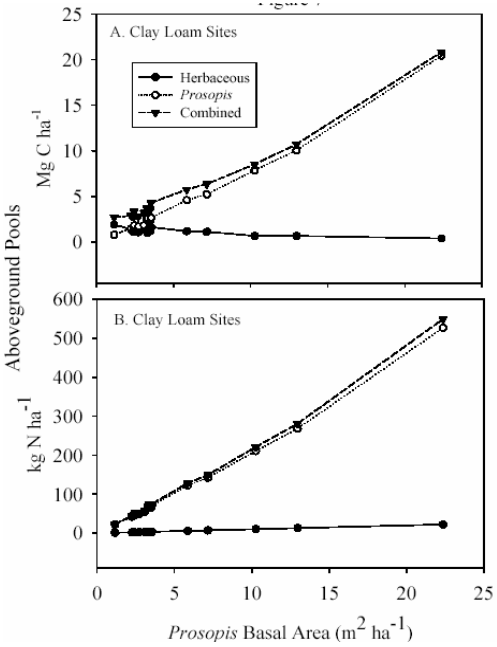


Woody plant fractional cover near Vernon, TX, over 63 years



* Changes in cover ranging from -75% to +500% depending on management history
* 32% net increase in carbon stocks across 400 km2 region

* Temperate system (N TX) - Increases in aboveground C & N pools due to increase in *Prosopis* (mesquite).
  - Ecosystem pools (*Prosopis* + herbaceous + litter+ upper 10cm soil) nearly doubled.
* Subtropical system (S TX) - 1.3x and 10x increase in soil and plant C pools, resp. with woody increases over past 100 years.



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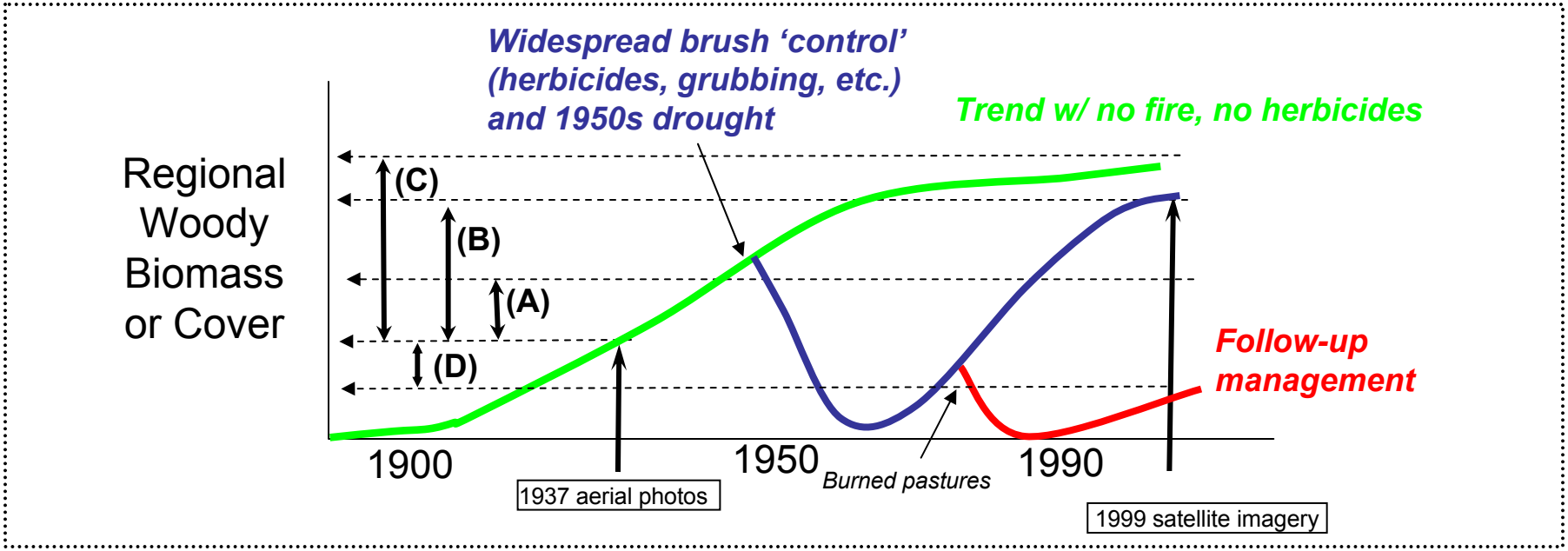
Significant Results

1. Aboveground carbon pools increase 2 to 10 times with woody plant encroachment in temperate and tropical grassland systems, respectively.
2. Belowground soil organic carbon (0-10cm) showed no change to doubled values depending on soil type and disturbance.
3. Nonlinearities in response to management require knowledge of sufficient temporal resolution and historical land use to capture and understand sources of variation.
4. Field observations, remote sensing and ecosystem modeling are necessary in combination to understand the biogeochemical properties and dynamics of land management impacts on grasslands undergoing woody plant encroachment.

Challenges to assessing regional woody plant cover and dynamics



- Potential mismatch of remote sensing and ecosystem & disturbance dynamics may mislead carbon pool estimates
- Setbacks and rates of recovery from disturbance depend on:
  - Type, intensity and spatial extent of disturbance
  - Soil type
  - Environmental conditions proceeding and following disturbance
  - Regenerative traits

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