Validating Expert-Based State and Transition Models using Long-Term Data

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1. Introduction and Objectives

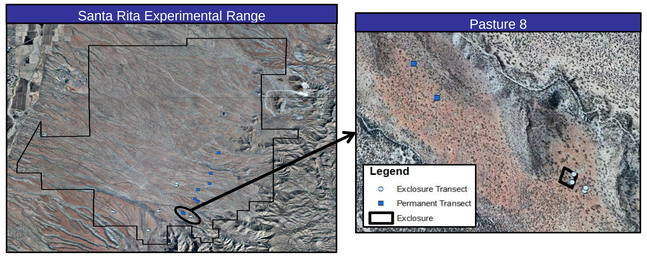
Introduction

- State and transition models (STMs) define States as vegetation with distinct species composition and Transitions as the actions or events that cause composition to change States.
- Ecological sites have unique STMs and they are used to plan and evaluate land management activities.
- Expert-based STMs are prepared by professionals with local management and ecological knowledge, but they are rarely validated with independent information from other locations or subsequent "transition" events.

Objectives and Approach

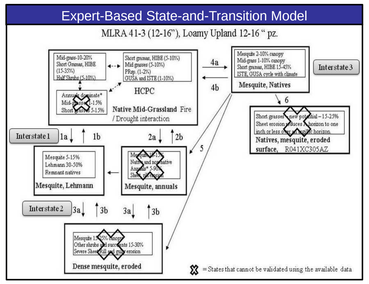
- Use long-term vegetation, climate, and land use information from the Santa Rita Experimental Range to validate expert-based STMs for seven ecological sites.
- Our validation describes 1) the range of species composition within and among States and 2) correspondence of predicted Transition actions and events with actual actions and events when Transitions did and did not occur.

2. Ecological Site – Loamy Upland 12-16" PZ



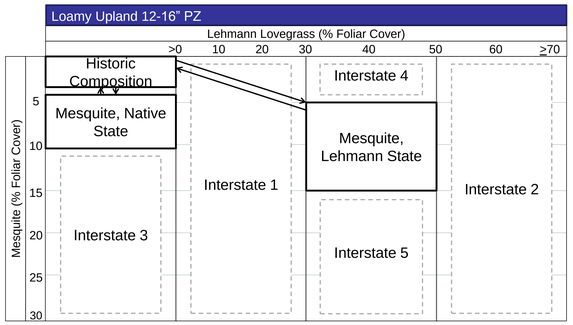
3. Expert-Based State and Transition Model

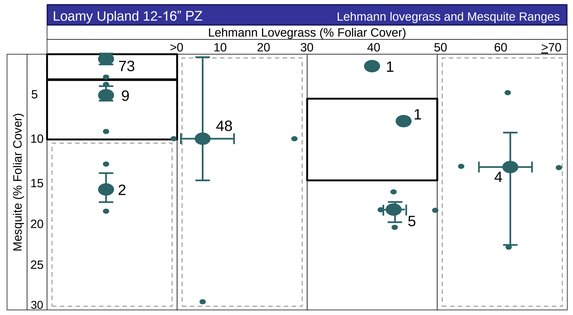
- States distinguished along two axes: mesquite and Lehmann lovegrass foliar cover.
- Transition catalog defines events and actions that lead to shifts in composition between States.



Transition Catalog	
Number	Action or Event
1a	**Proximity to seed source, introduction of seeds, management related to perennial grass cover**
1b	**Not known. Possibly herbicide to remove perennial exotics**
2a	Continuous heavy grazing, persistent low perennial grass cover
2b	Proper or no grazing, seeding or planting of native grasses, herbicide treatment of annuals, ripping, contouring
3a	Continuous heavy grazing with drought, low grass cover
3b	Mechanical/herbicide treatment of shrubs, proper/no grazing, seeding/planting of native grasses, maintenance treatment for shrubs
4a	**Lack of fire with proper or no grazing**
4b	**Mechanical or herbicide treatment of shrubs**
5	Continuous heavy grazing with drought and soil degradation
6	Loss of soil surface

4. Composition Among States





Schematic Design of State and Transition Model

- Axes: Lehman lovegrass and Mesquite (% Foliar Cover)
- Rules for converting basal cover to foliar cover :

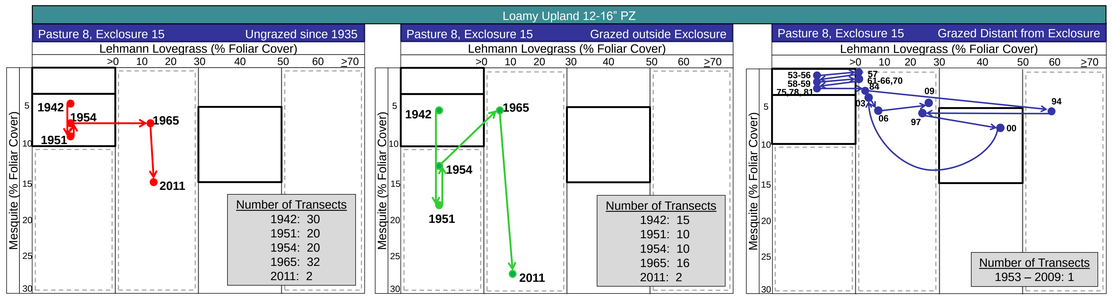
Basal-Foliar Conversion	Historic Comp.	Interstate 1	Mesquite, Lehmann State	Interstate 2
Basal Cover (%)	0	>0 to <3	3 to 4	>4
Foliar Cover (%)	0	>0 to <30	30 to 50	>50

- Solid line boxes define States described in the STM
  1. Historic Composition (HCPC), 2. Mesquite, Native State, and 3. Mesquite, Lehmann State
- Solid lines with arrows define Transitions in the STM
- Interstates are vegetation values and ranges that are possible, but not defined in the STM (dashed line boxes)
  - Interstate 1: >0 to <30% Lehmann lovegrass
  - Interstate 2: >50% Lehmann lovegrass
  - Interstate 3: >15% mesquite, 0% Lehmann lovegrass
  - Interstate 4: 0-5% mesquite, 30-50% Lehmann lovegrass
  - Interstate 5: >15% mesquite, 30-50% Lehmann lovegrass

Species Composition Within-Among States

- All measures in a particular State or Interstate were summarized together to calculate properties of measurements
- Larger circles represent the average
- Cross bars represent the interquartile range (25-75th percentile) of each species
- Smaller circles represent maximum and minimum values
- Numbers represent the total number of locationXyear measures used to characterize States and Interstates

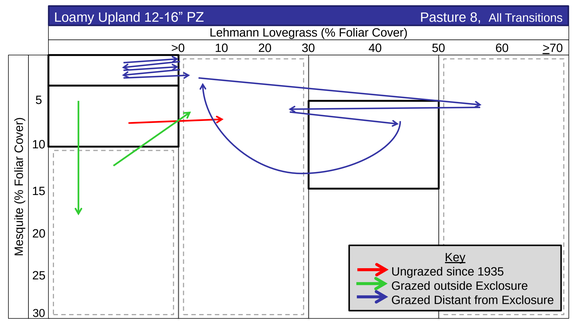
5. Transitions Between States



Ungrazed since 1935
Vegetation change between 1942-2011

Grazed directly outside of exclosure
Vegetation change between 1942-2011

Grazed distant from exclosure
Vegetation change between 1953-2009



Summary of Transitions in Pasture 8

- Currently (2009/2011), all locations in Interstate #1, regardless of grazing history
- Only one transition between States
  - Transition 1a: Mesquite, Native to Mesquite, Lehmann
  - Consistent with proximity of seed source
  - Transition develops over many time intervals
  - Does not persist in that State, occurred only once
- State and Interstates: Exits, Entrances, and Re-Entries
  - Exit from Mesquite, Native State to Interstates 1 and 3 is common
  - Exit from Historic State to Interstate 1 is common
  - Re-entry to Historic State from Interstate 1 is if Lehmann <0.43%
  - Entrance to Mesquite, Lehmann State from Interstate 1 once

6. Discussion

Framework

- Schematic Design allows for States and Interstates to be clearly defined. Two axes are manageable and supports visualization of States and Transitions.

Assessing State Boundaries

- Transitions Rare Between Existing States
  - Only occurred once, and not suddenly
- Behavior in Interstate May Inform State Boundary Revision
  - Exit from States to Interstates is common
  - Return to State from Interstates is common
  - New Interstate Boundaries should include reversible composition
  - New State Boundaries should rarely have reversals
  - May need new Interstates for mesquite abundance
- Conversion from Basal to Foliar Cover
  - May hide or inflate State changes

Assessing Transition Actions and Events

- Confirms Seed Proximity for Transition 1a
  - Eventually, Lehmann lovegrass persists with or without grazing
- Does Not Reject Mesquite Transitions 4a and 4b
  - No sites with fire and none with mesquite removal practices
  - Mesquite increase in all sites, but may be faster without grazing

7. Future Work

- Six other ecological sites at the Santa Rita Experimental Range will be validated following the same procedures outlined in this poster.
- Finish compilation of transition actions and events. Determine differences in probability.
- Assess differences in native perennial grass (and other species) among states and transitions.
- Revise current STMs by adjusting State boundaries and include Interstates as vegetation compositions where transition reversals are more likely to occur.
- Develop STM based on basal cover values.

8. Acknowledgements

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