



124-year Primer on Vegetation Change

*Dispatch from
Santa Rita Experimental Range*

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University of Arizona

26 September 2026
22nd Annual RISE Symposium
University of Arizona

Big Place + Long Time

21000 ha since 1902

Δ Vegetation = f (where, when, how, and what we look at)

Where: landscape position, soil, elevation

When: wet-dry, grazing, fire, new species

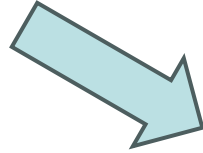
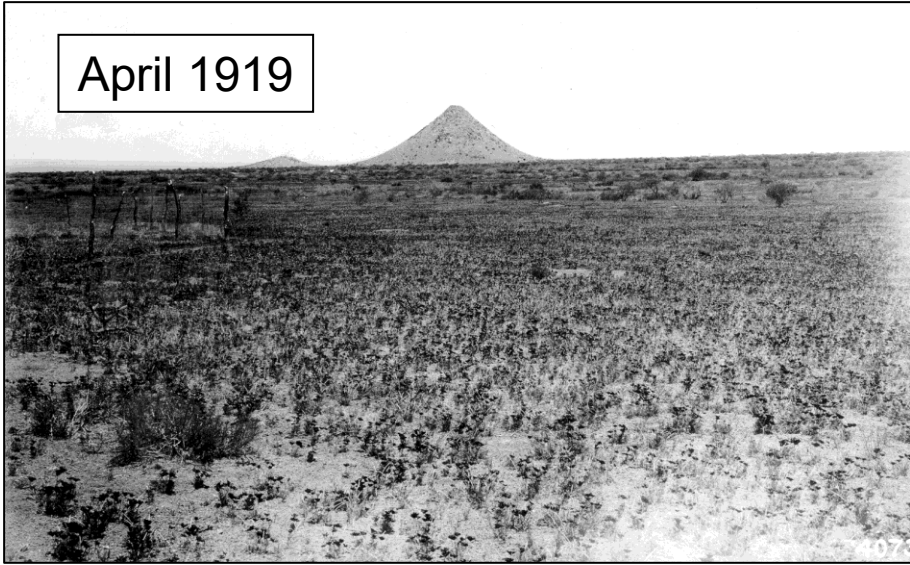
How: repeat photos, 1-m², 30-m line, 9.3-m²

What: cover, density, size-mass

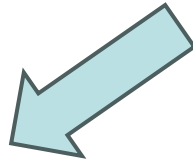
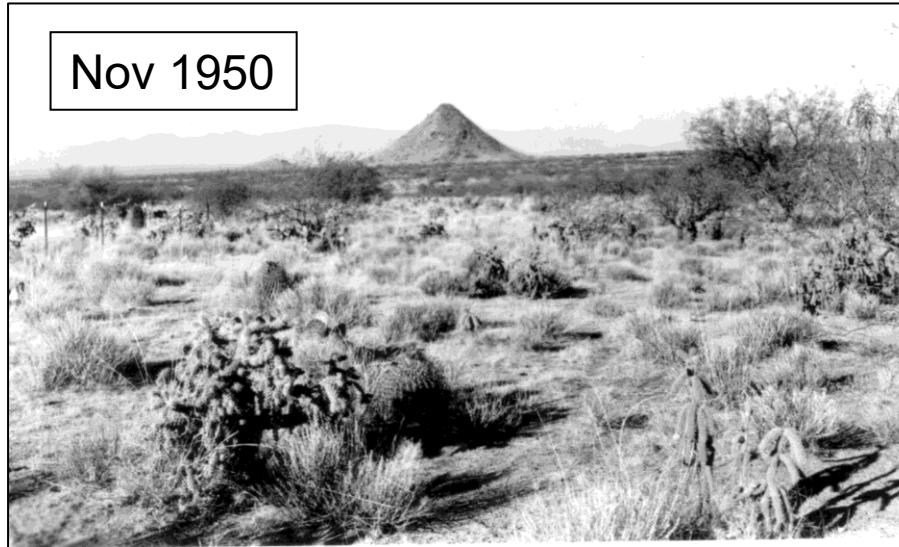
Combination enriches the story, and interpretation

Big Vegetation Change: *Mesquite* increase

April 1919



Nov 1950



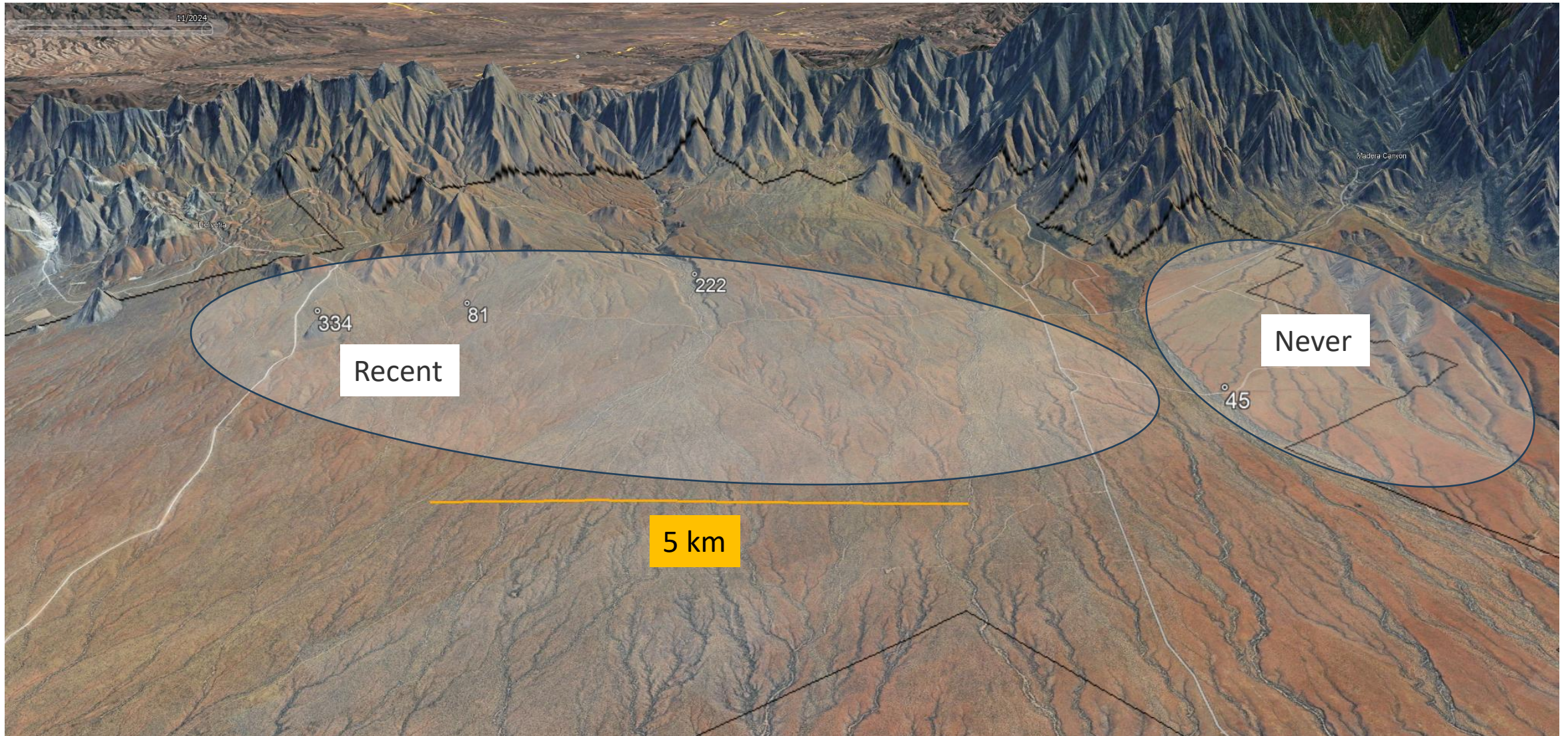
March 2023



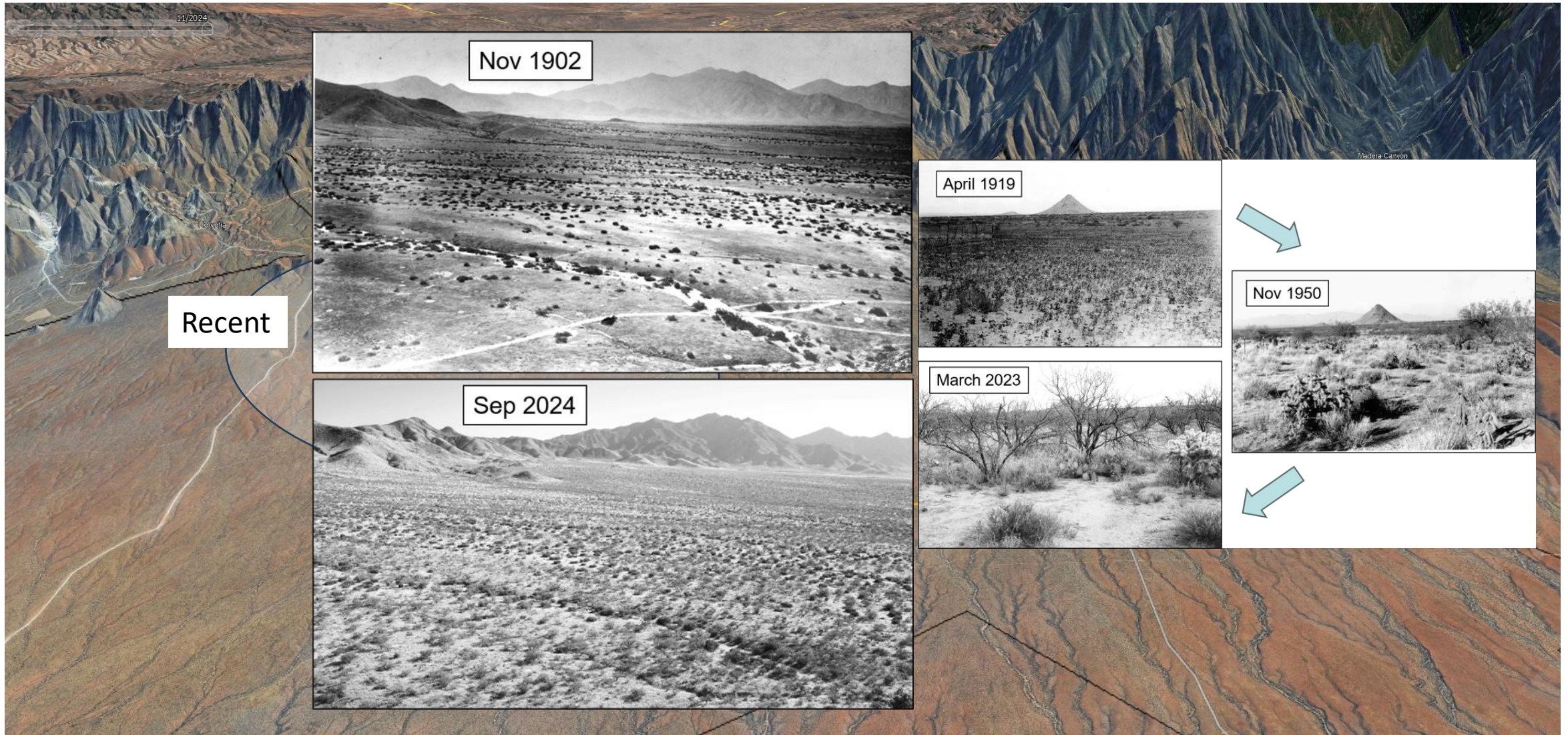
- Fires stopped
- Cattle spread seeds

Δ Vegetation = f (where, when, how, and what)

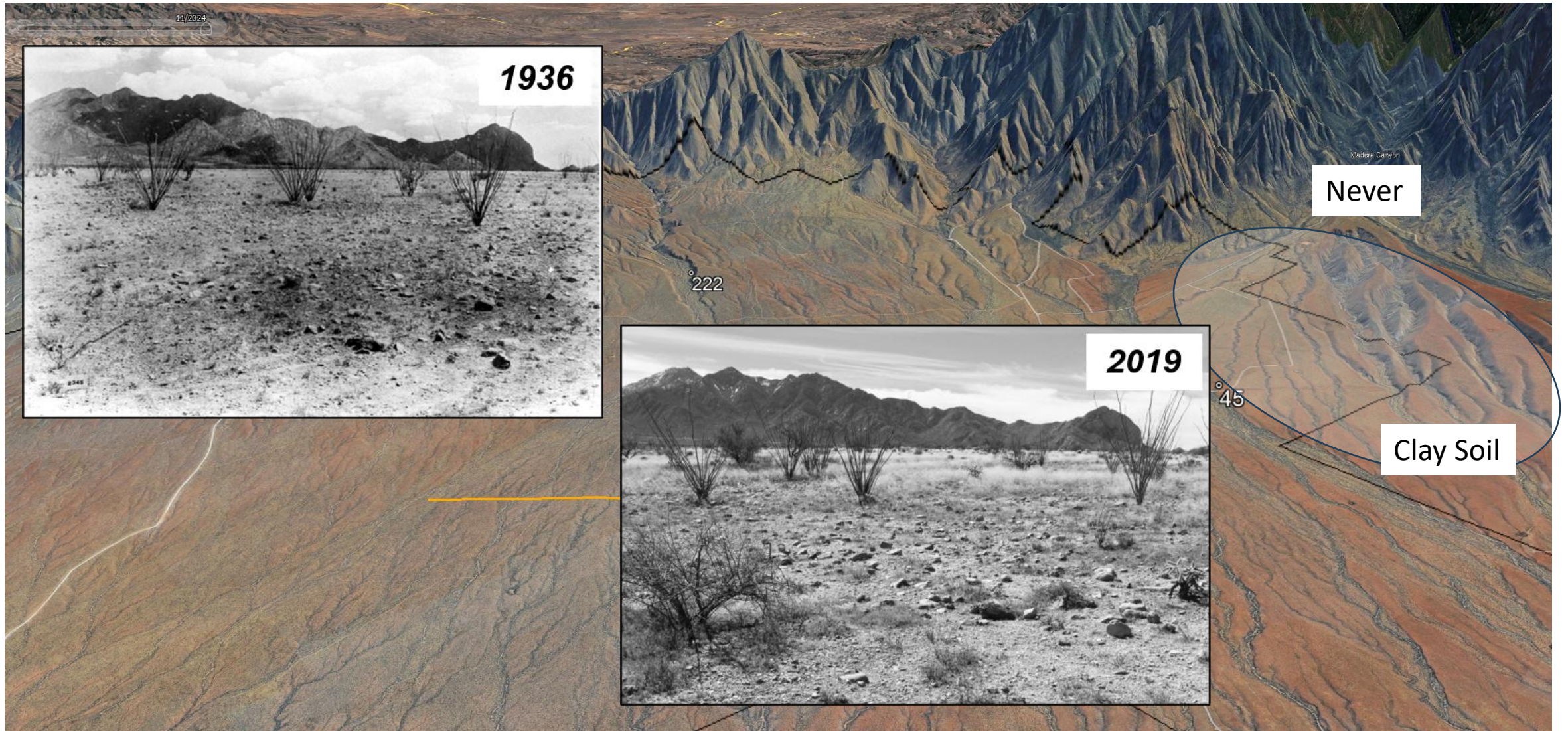
Where You Look: *Mesquite increase* ?



Where You Look: *Mesquite increase RECENT*



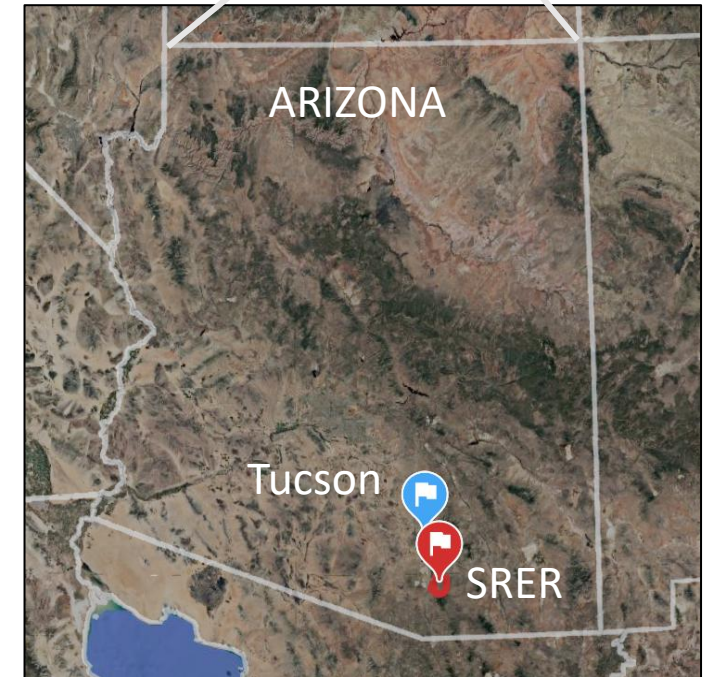
Where You Look: *Mesquite increase NEVER*



Santa Rita Experimental Range (SRER)

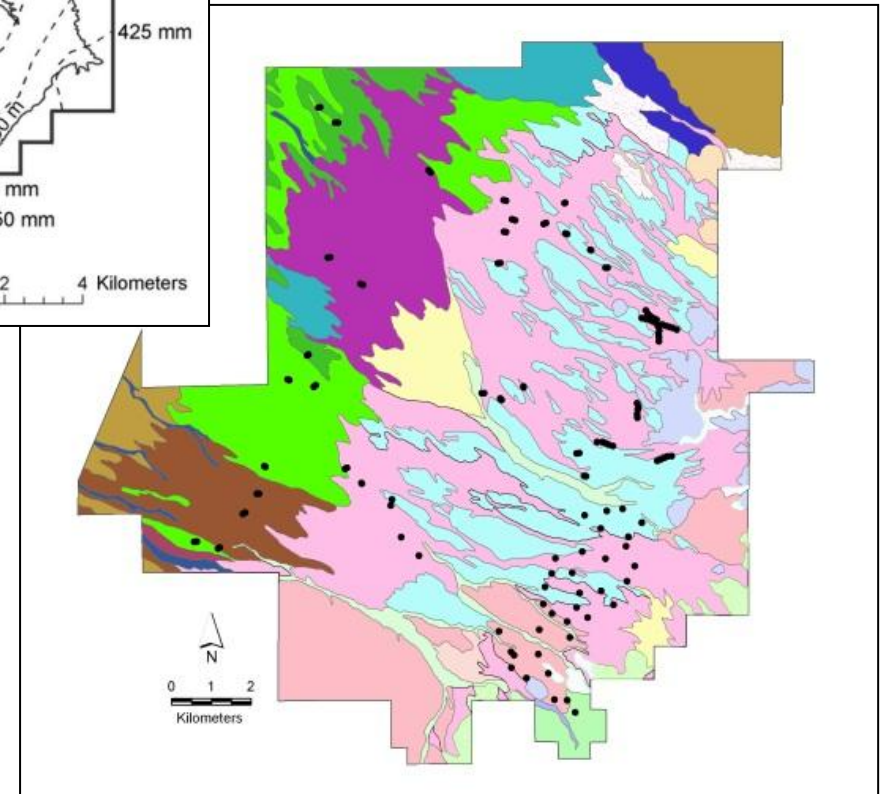
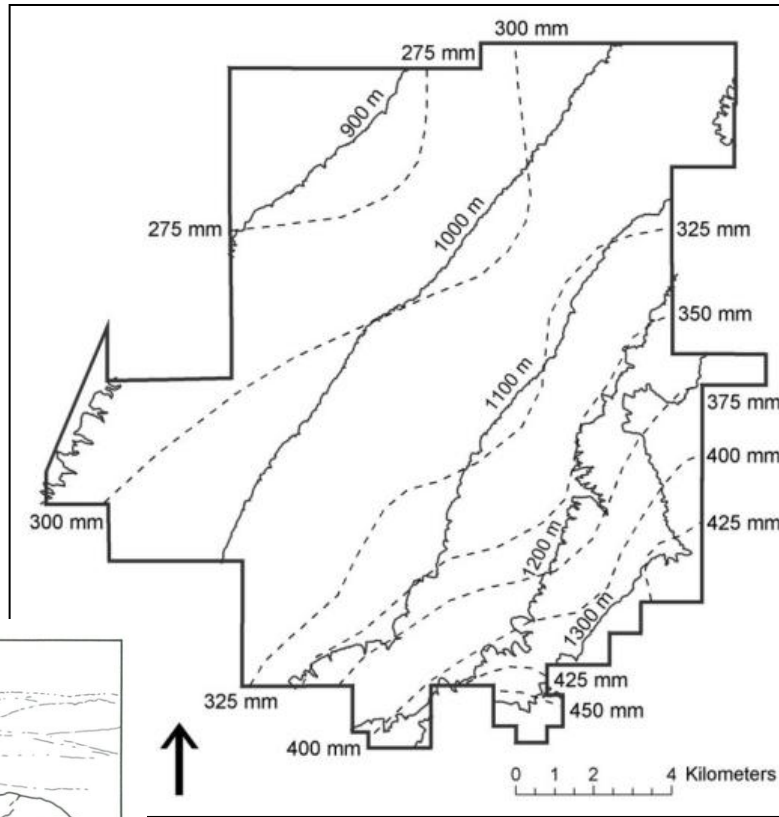
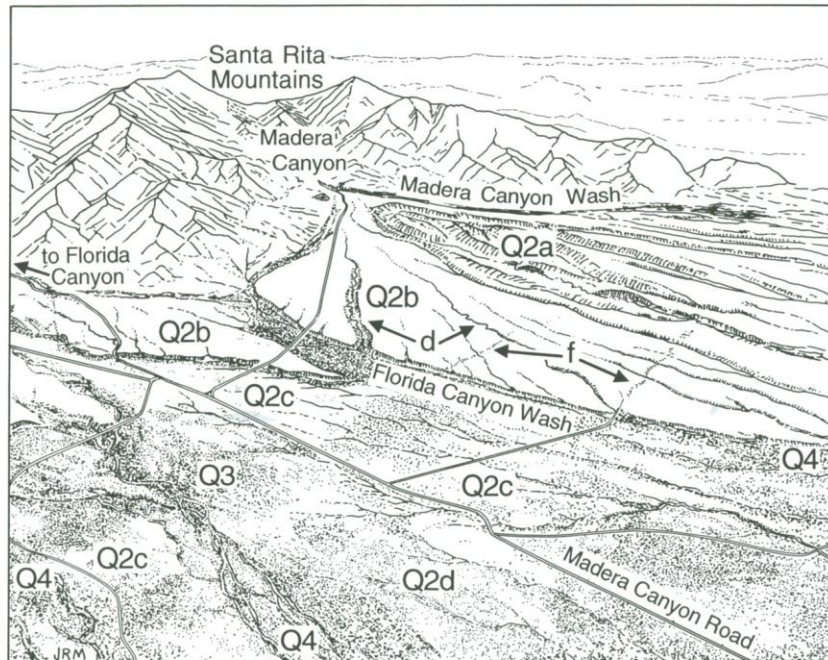
Location and History

- ✓ Southern AZ, USA, 50 km south of Tucson
- ✓ **Founded in 1902: oldest in United States**
- ✓ **Digital Open Access since 2002**
 - <https://santarita.arizona.edu/>
- ✓ **University of Arizona since 1988**



Diverse Environment

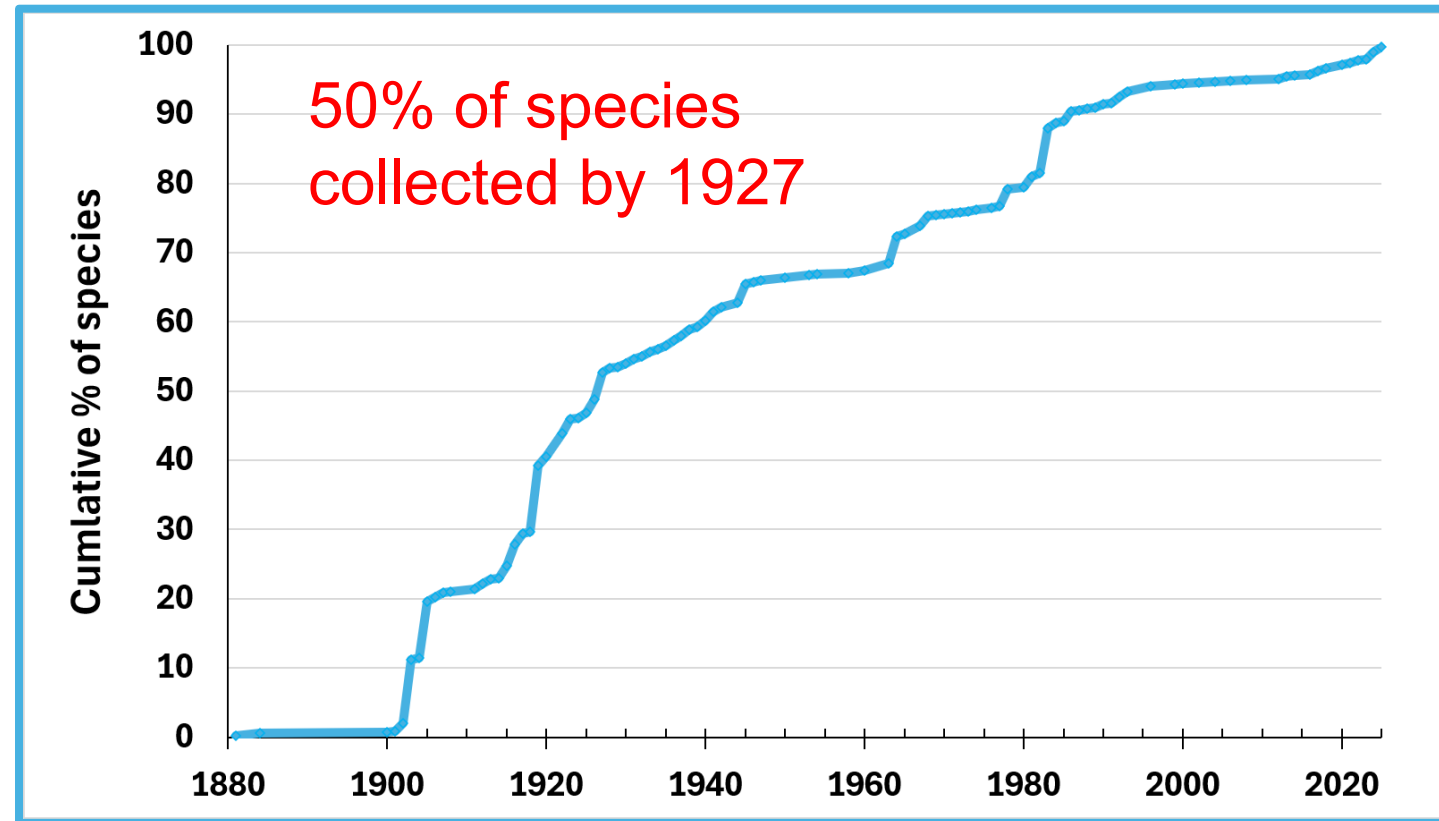
- 850 - 1550 m elevation
- 270 - 450 mm annual ppt
- 19.7 - 17.7 °C annual
- 32 soil types
- 7 geomorphic types



Flora: current and cumulative

- 814 species, 394 genera; 94 families,
- 35 *non-native species* (4.3%)

Family (Top 6)	Species #
Asteraceae	133
Poaceae	120
Fabaceae	66
Euphorbiaceae	39
Brassicaceae	29
Cactaceae	26



Δ Vegetation = f (where, **when**, how, and what)

When You Look

Vegetation Response to Long-term Precipitation-Temperature Patterns

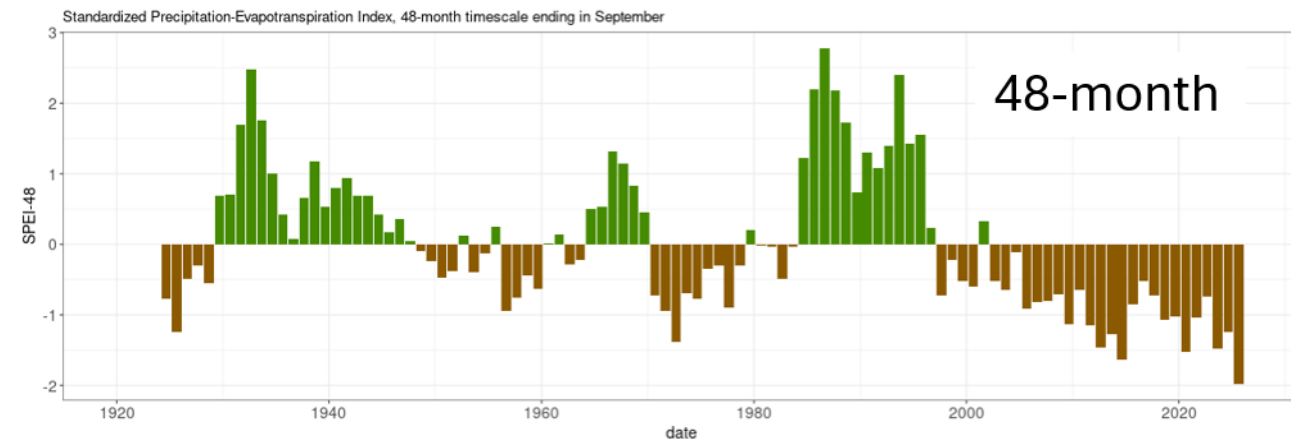
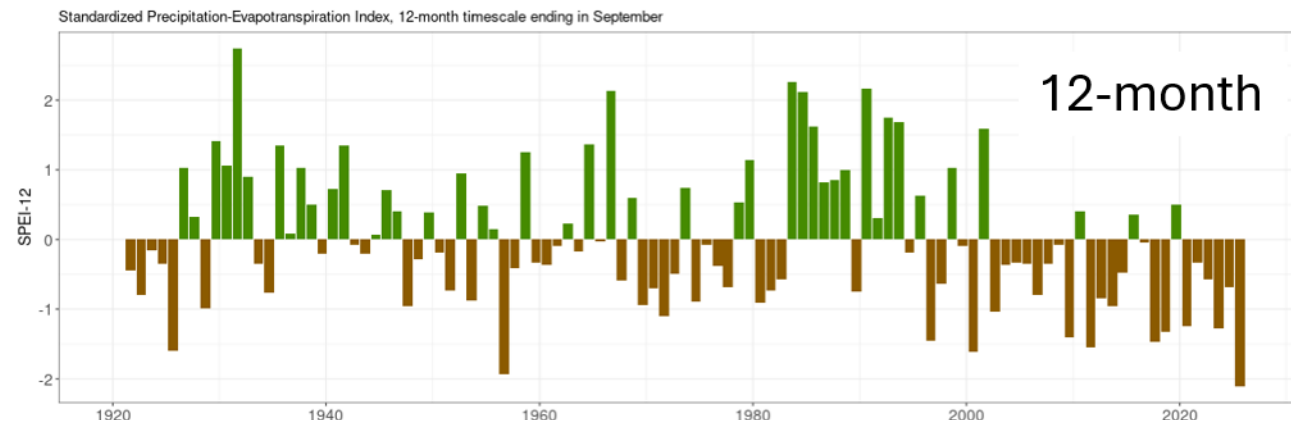
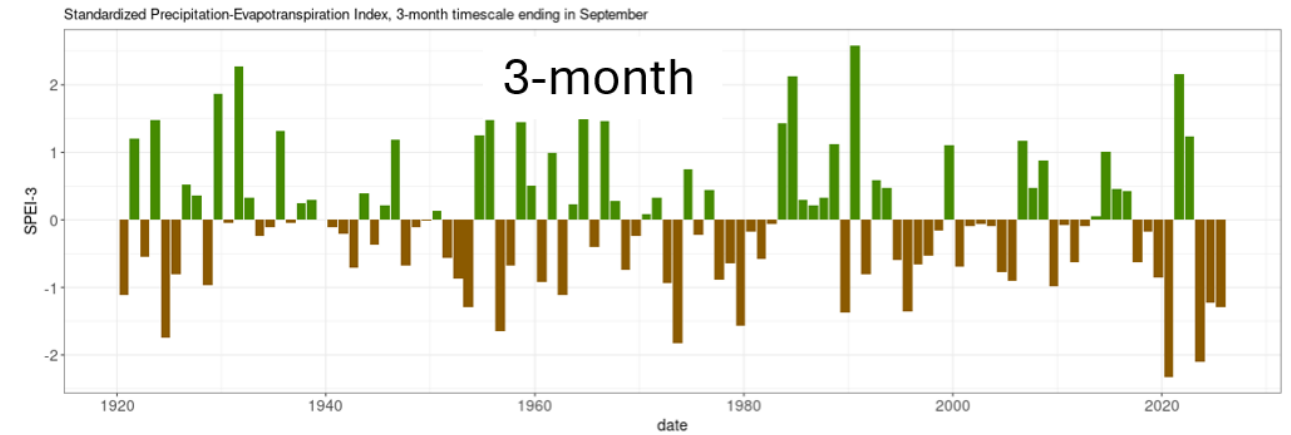
1922-2025

SPEI

Standardized Precipitation-Evapotranspiration Index

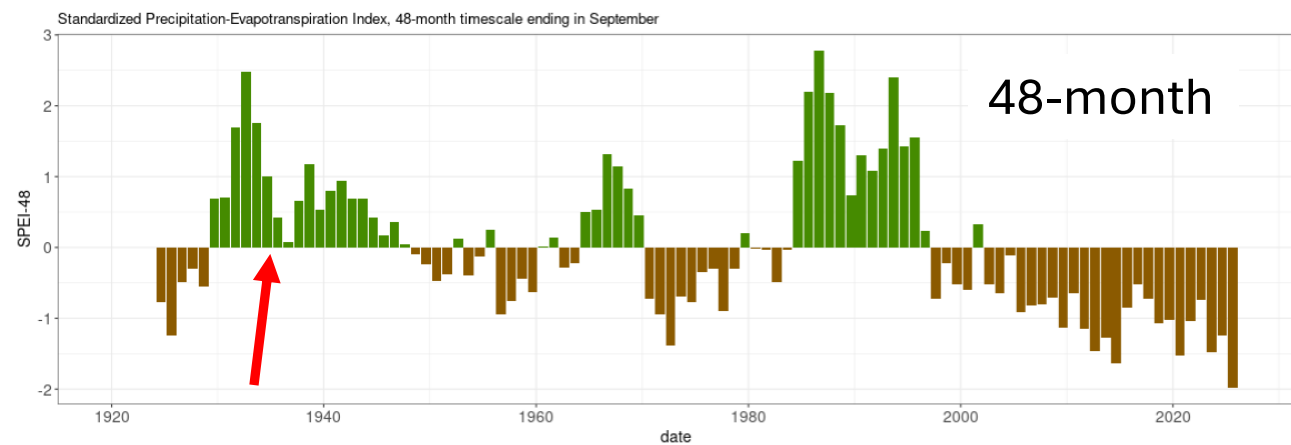
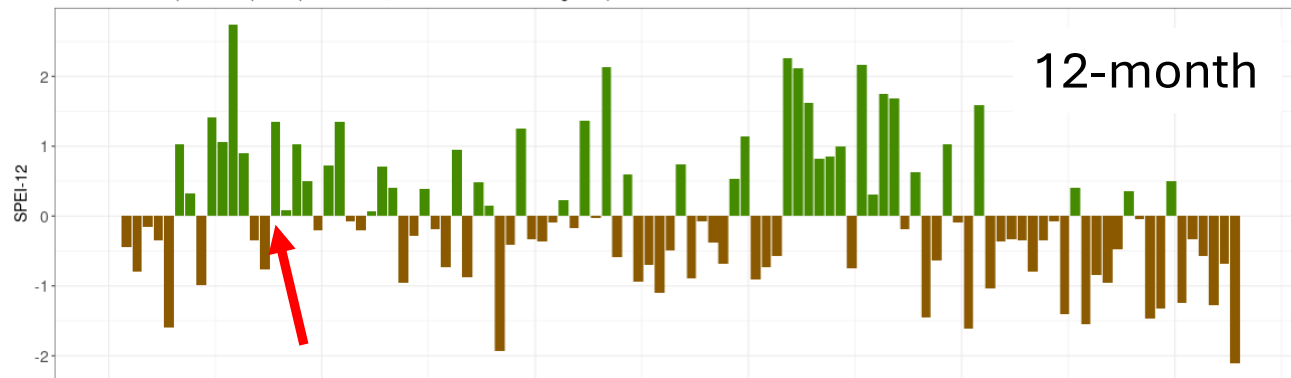
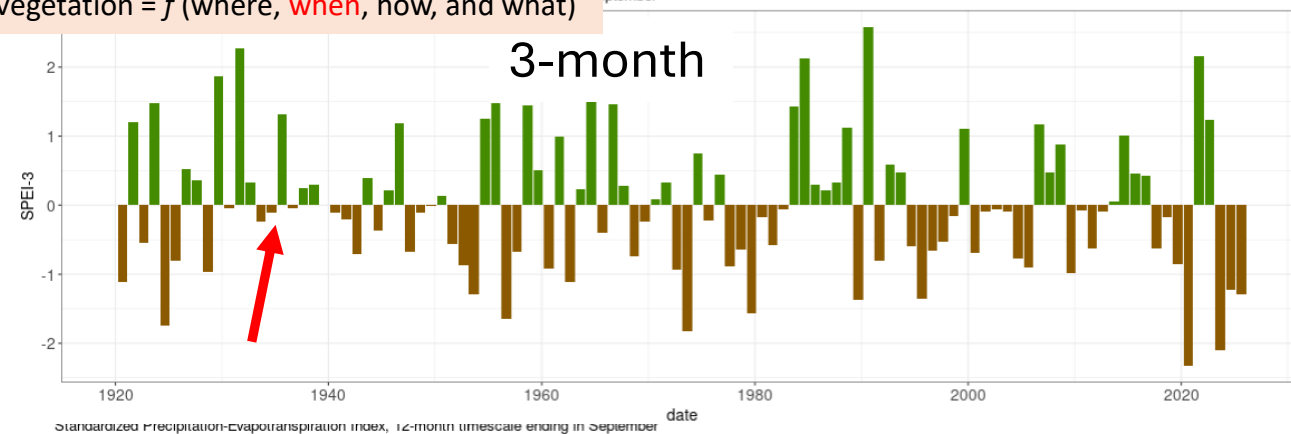
<https://uaclimateextension.shinyapps.io/SPItool/>

McClaran and Wei. 2014. <https://doi.org/10.1890/11-0704.1>

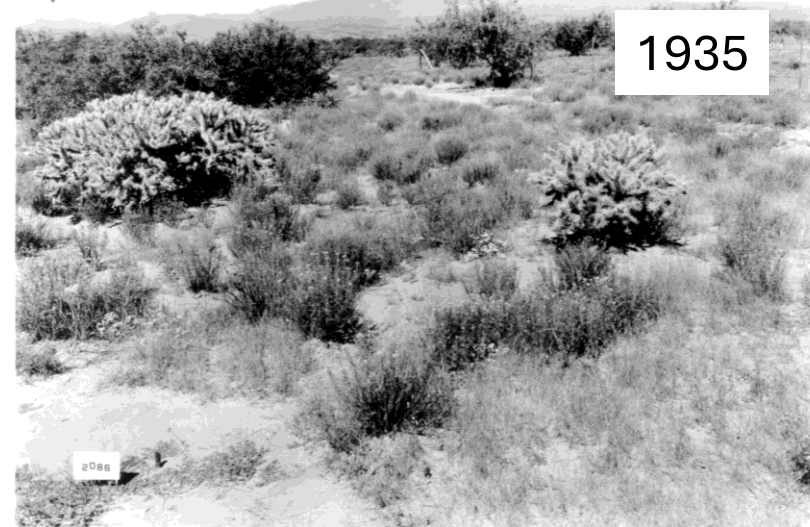
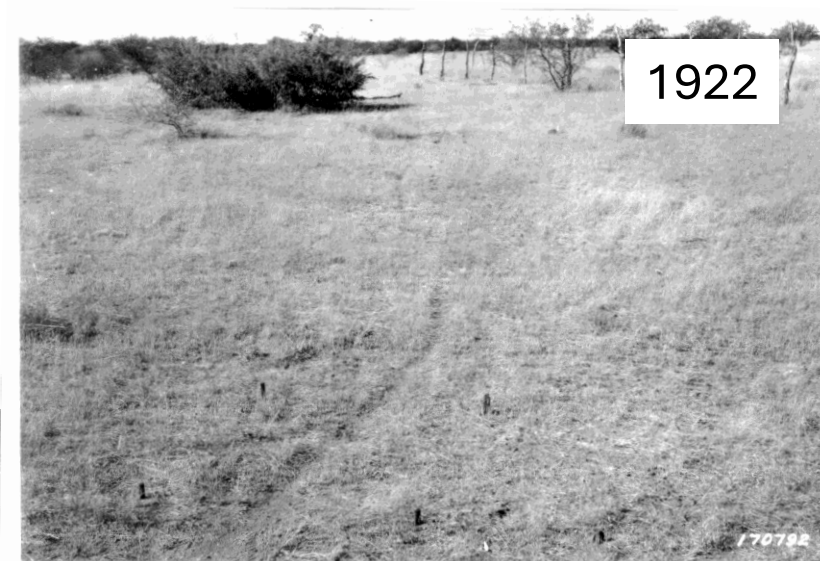


Δ Vegetation = f (where, **when**, how, and what)

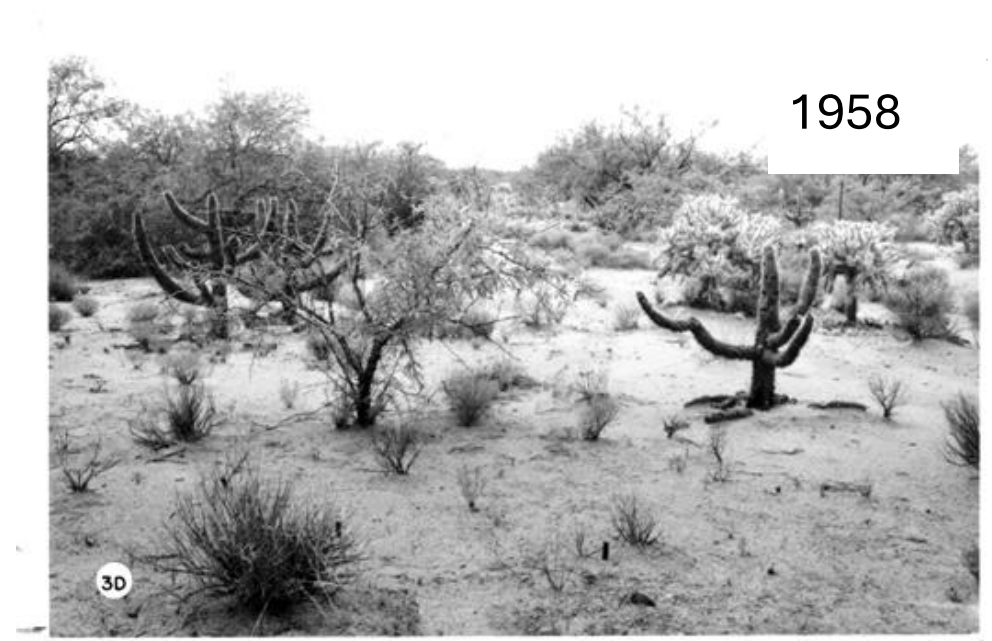
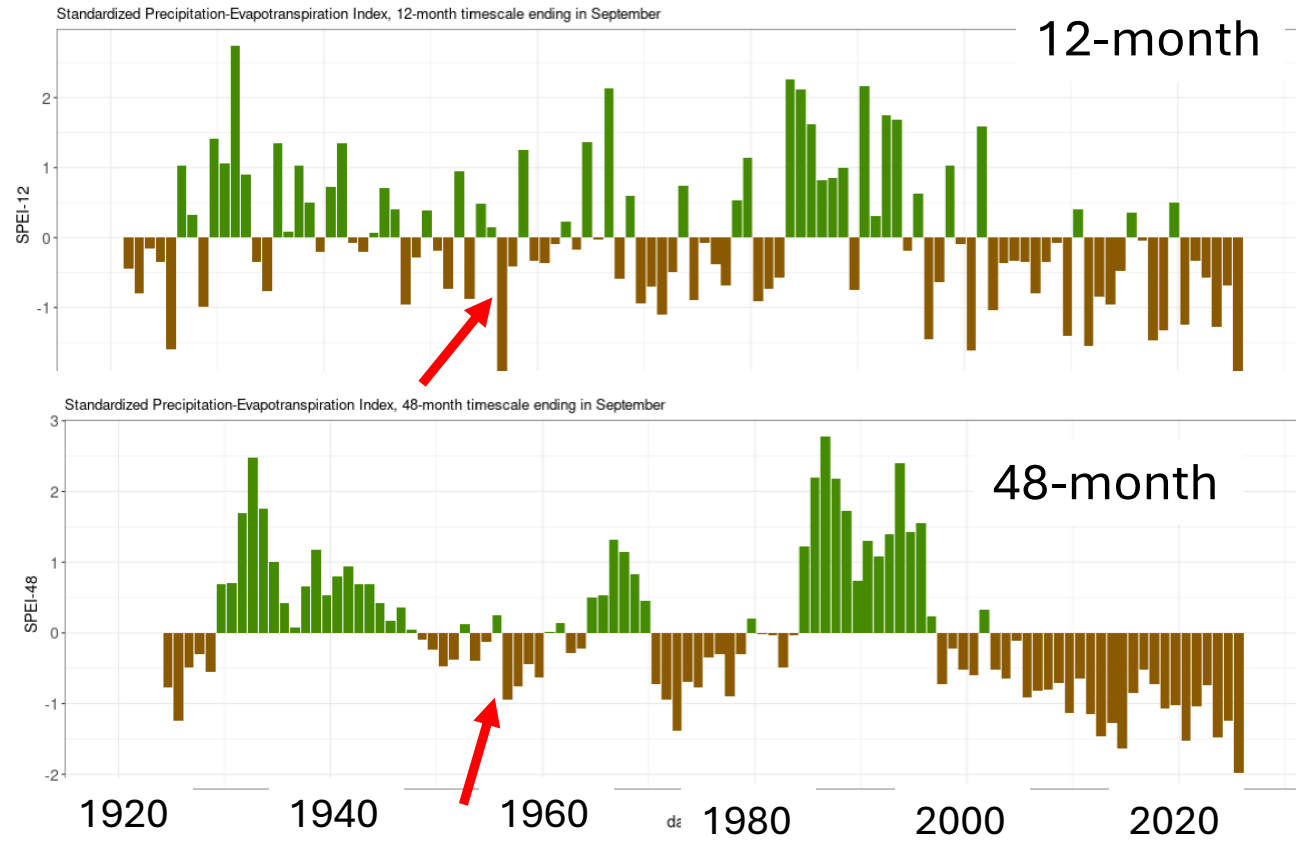
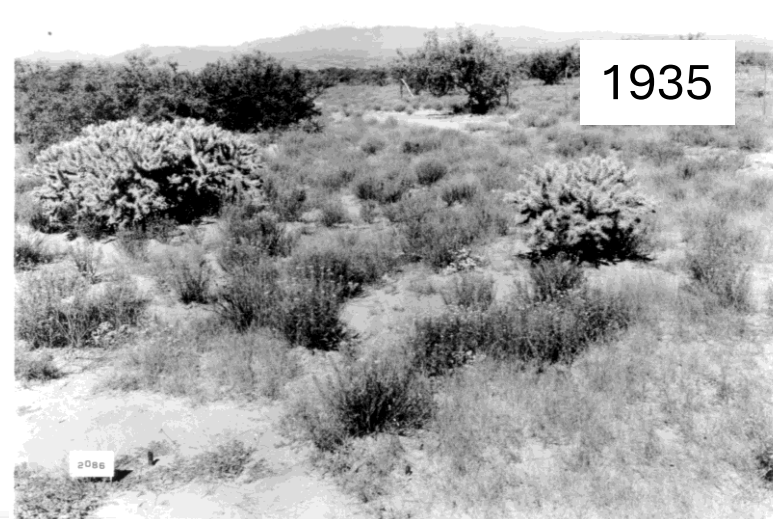
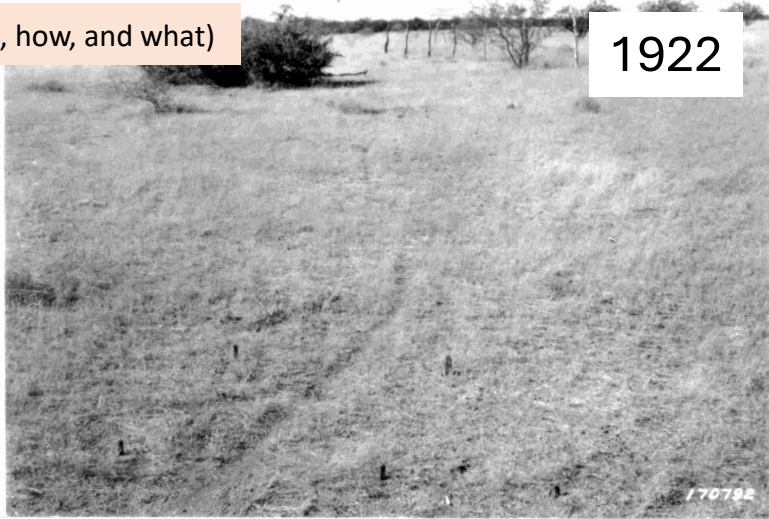
September



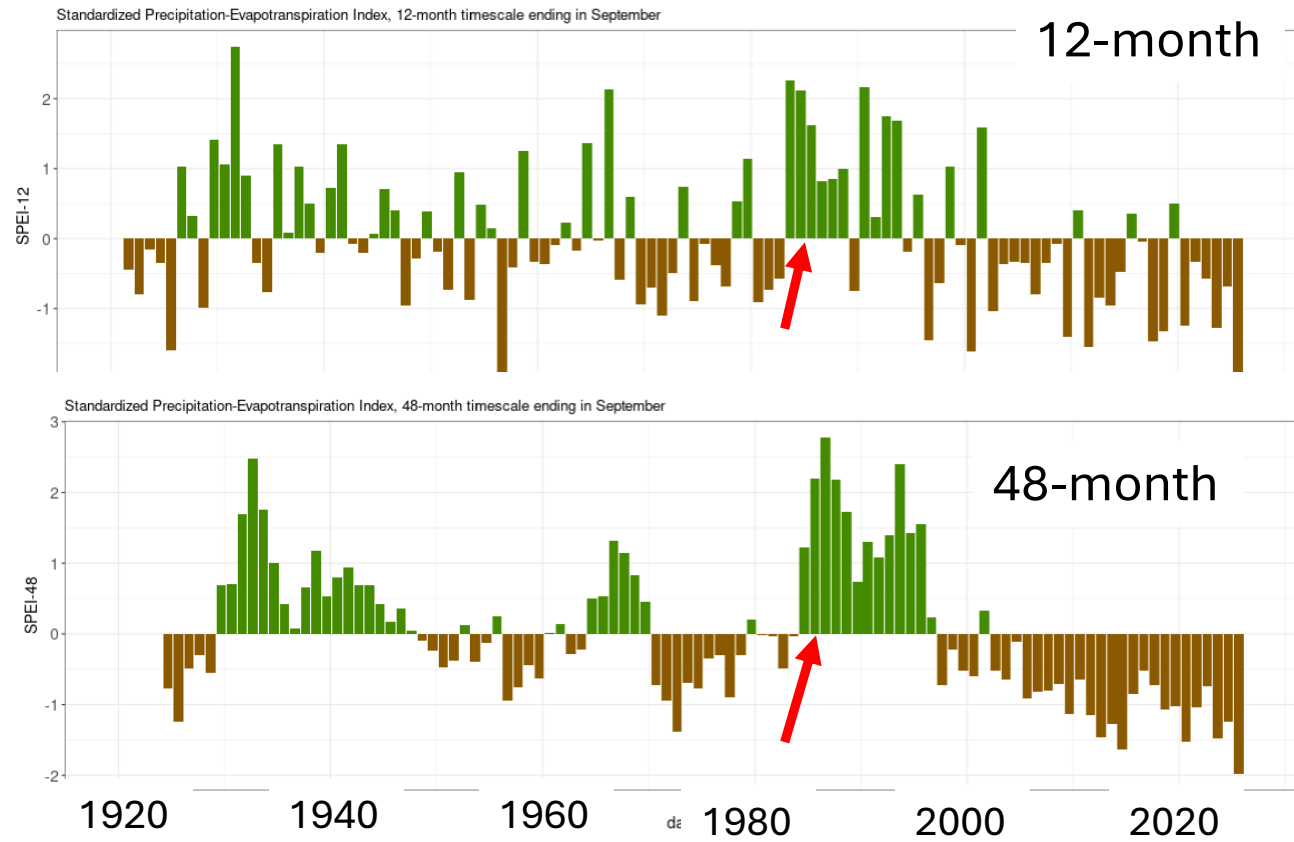
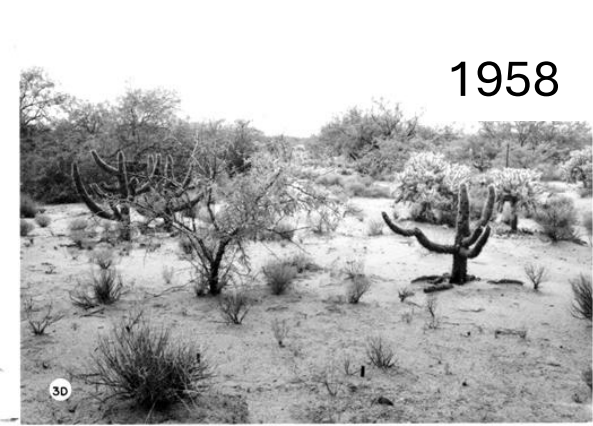
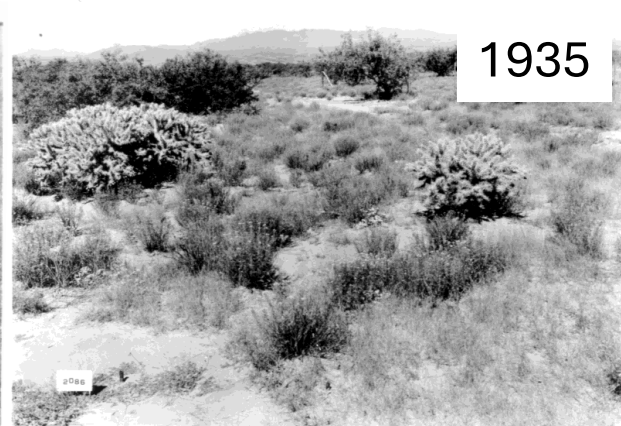
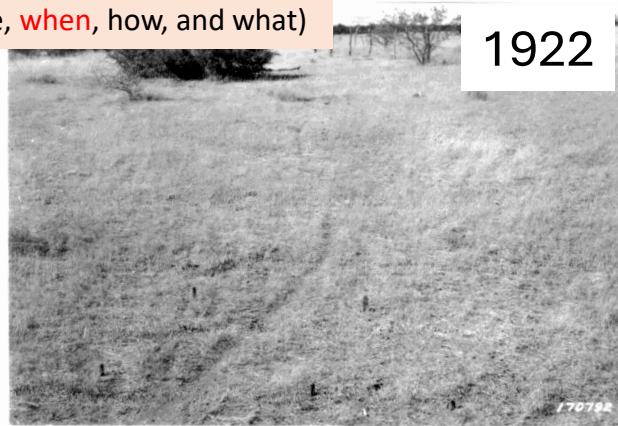
1920 1940 1960 1980 2000 2020



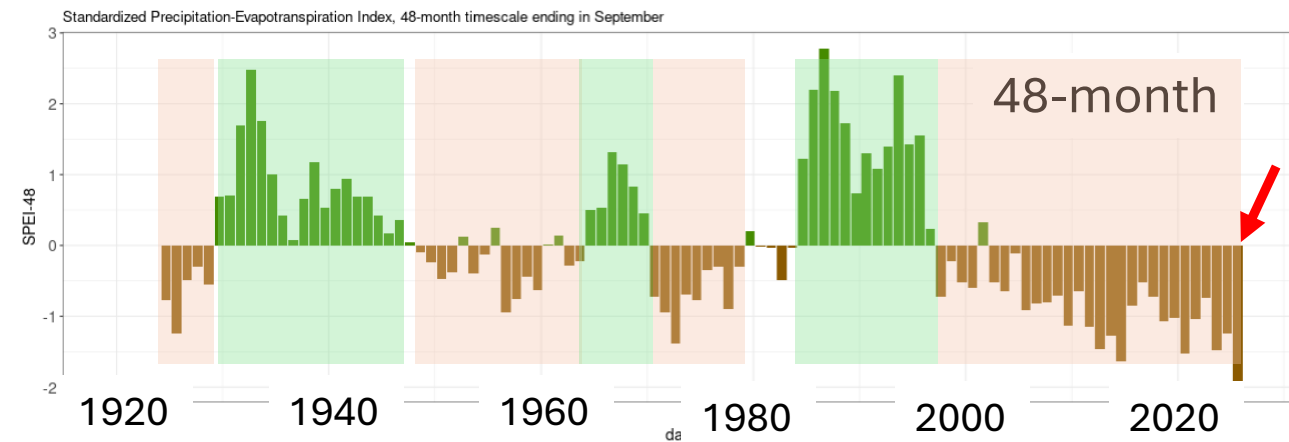
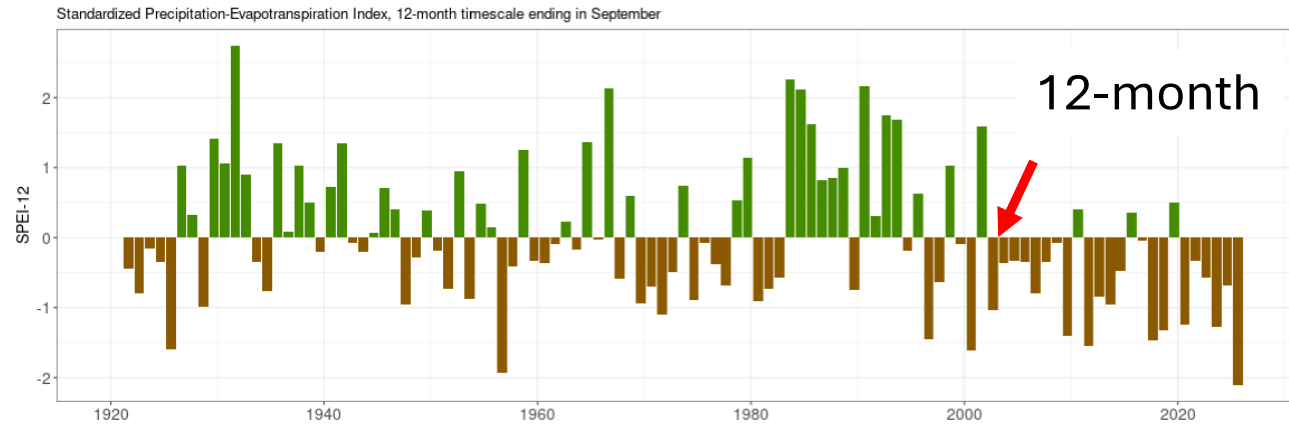
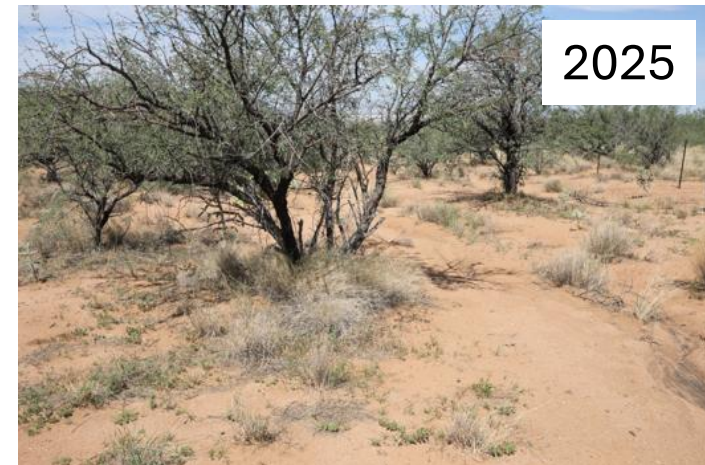
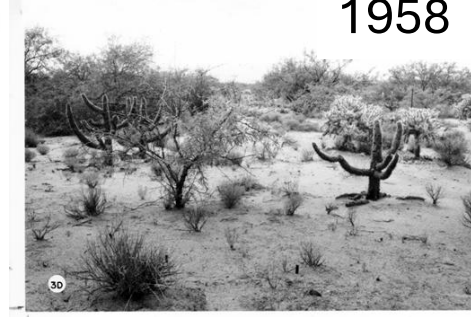
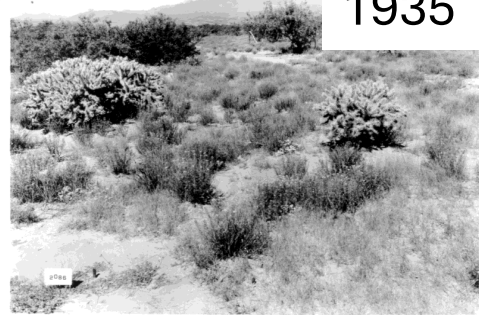
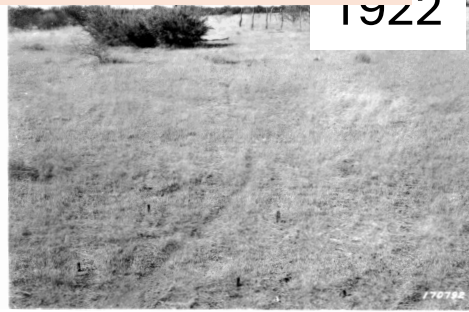
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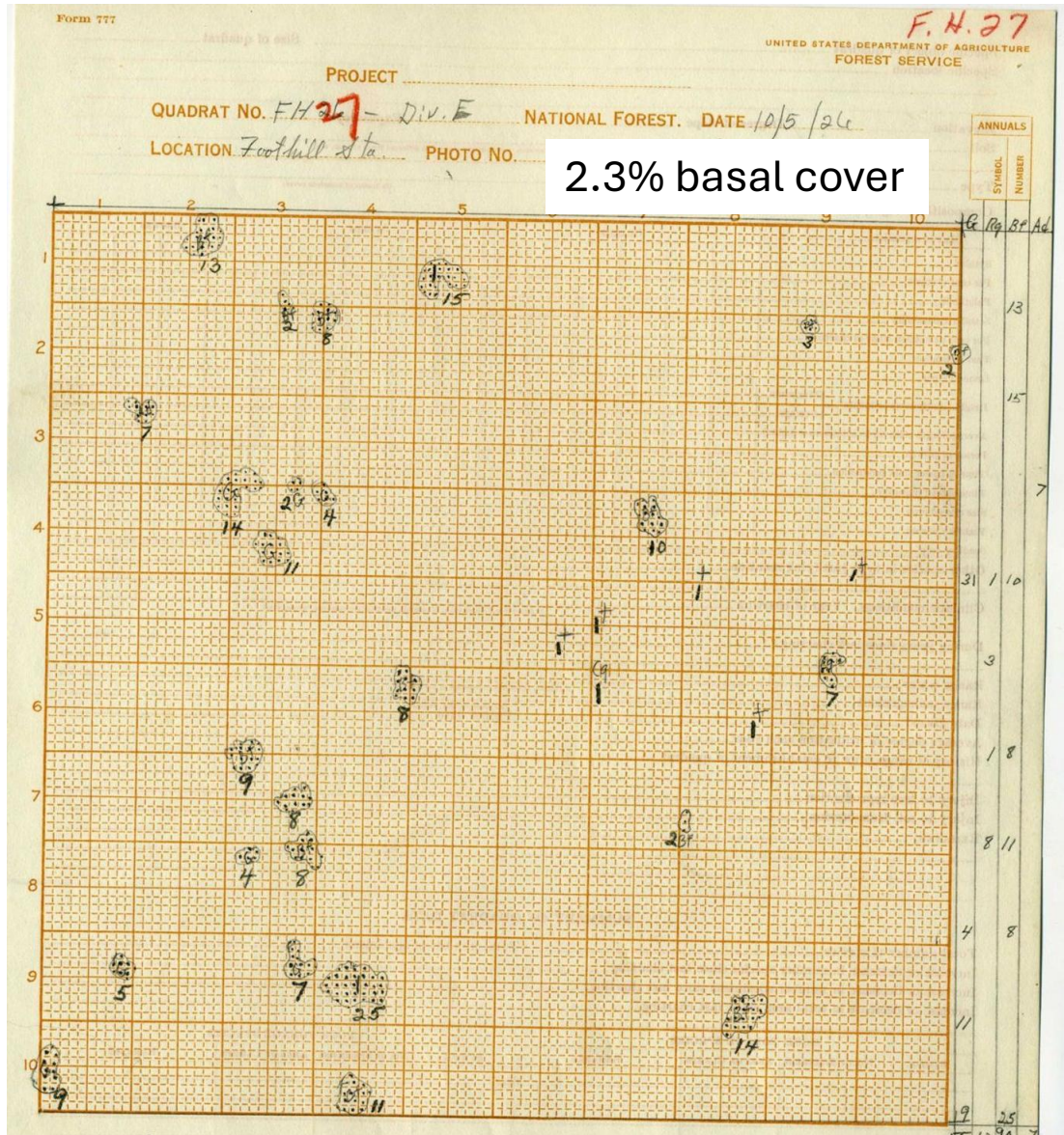
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How You Look: 1-m² plots 1915-1947

178 Plots and 1953 Total observations



No. 164203 4/1922 "Pantograph in action."

Anderson et al. 2012. <https://doi.org/10.1890/11-2200.1>

Δ Vegetation = f (where, when, **how**, and **what**)



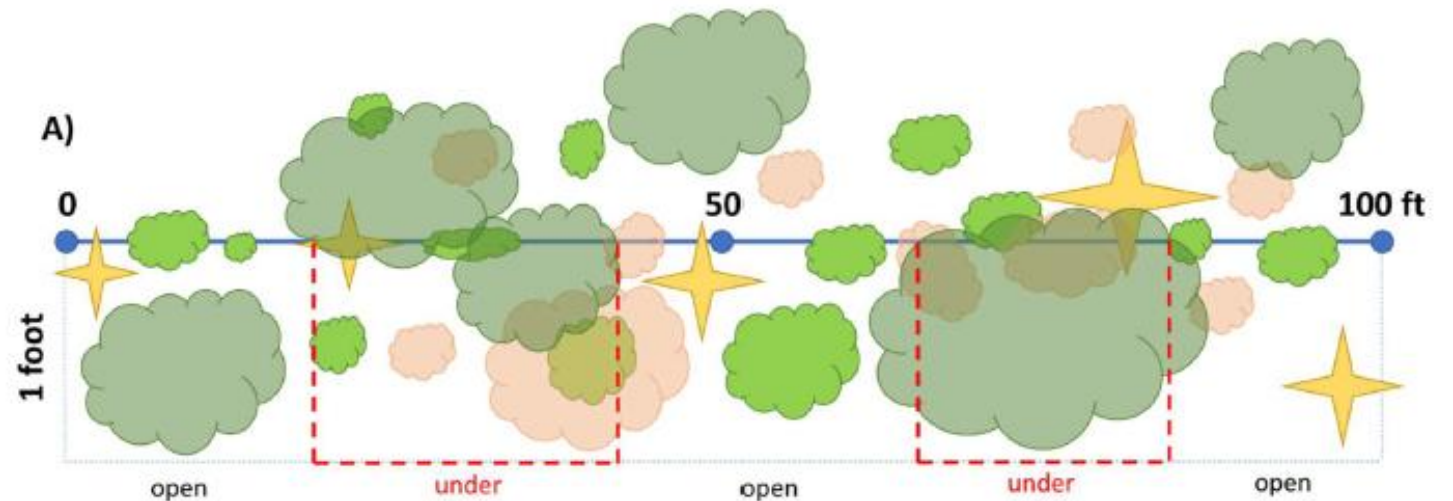
How and What You Look At

30-m line transect since 1959 *COVER*

9.3 m² since 1972 *DENSITY*

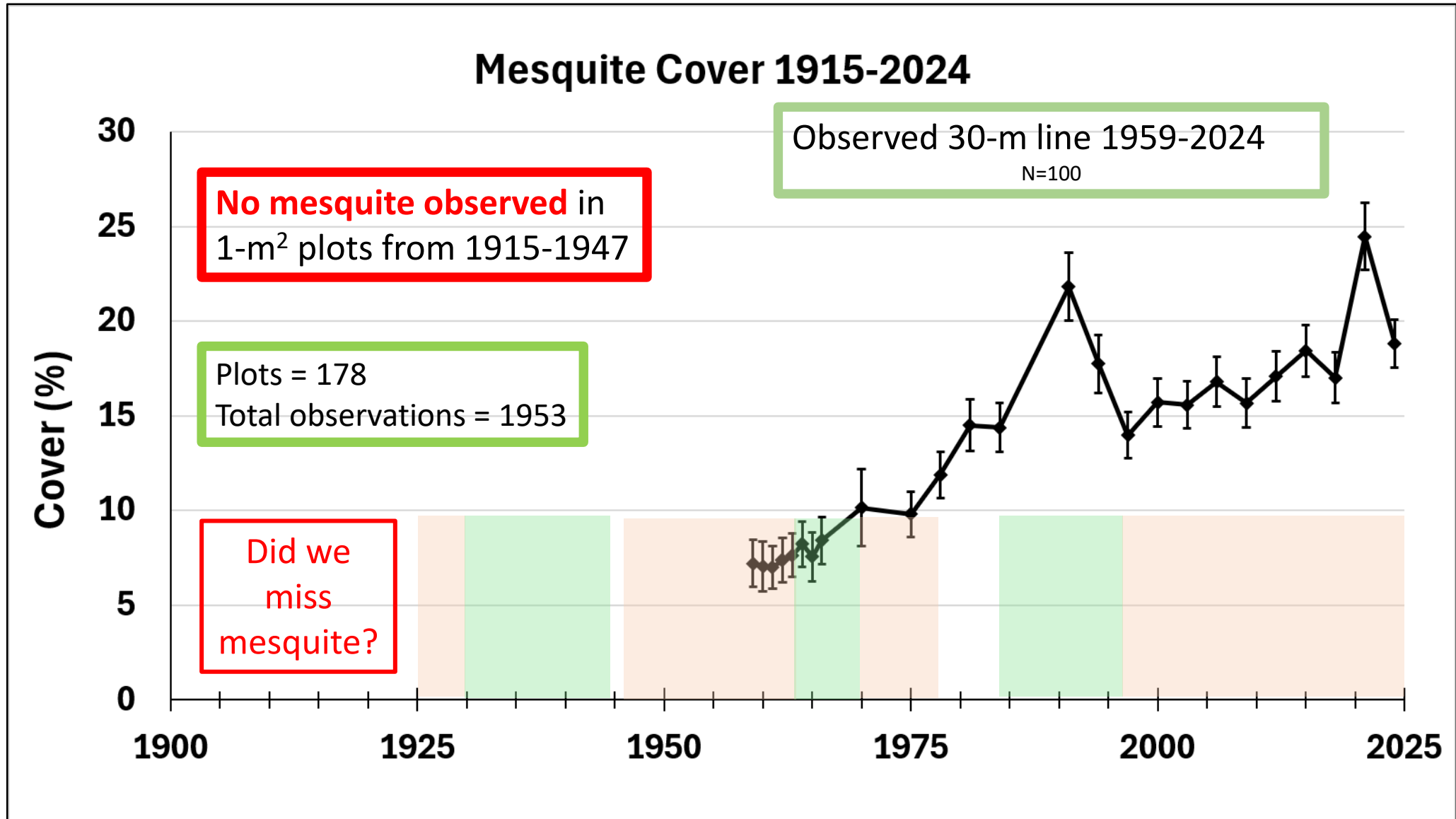
9.3 m² since 2009 *GRASS SIZE-MASS*

Combination enriches the story, and interpretation

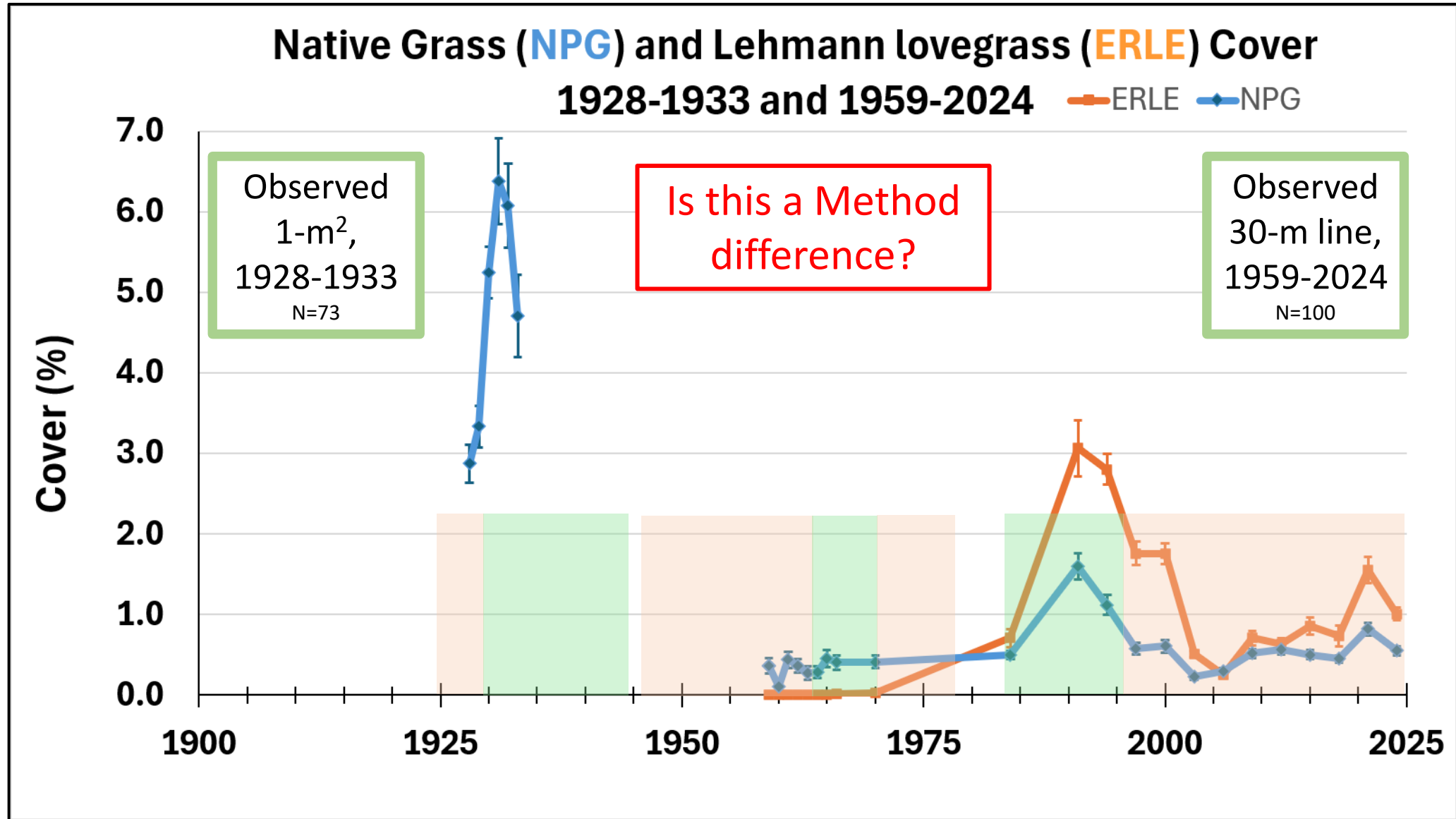


<https://santarita.arizona.edu/data-resources/data-download/long-term-vegetation-transects/ongoing-vegetation-transects>

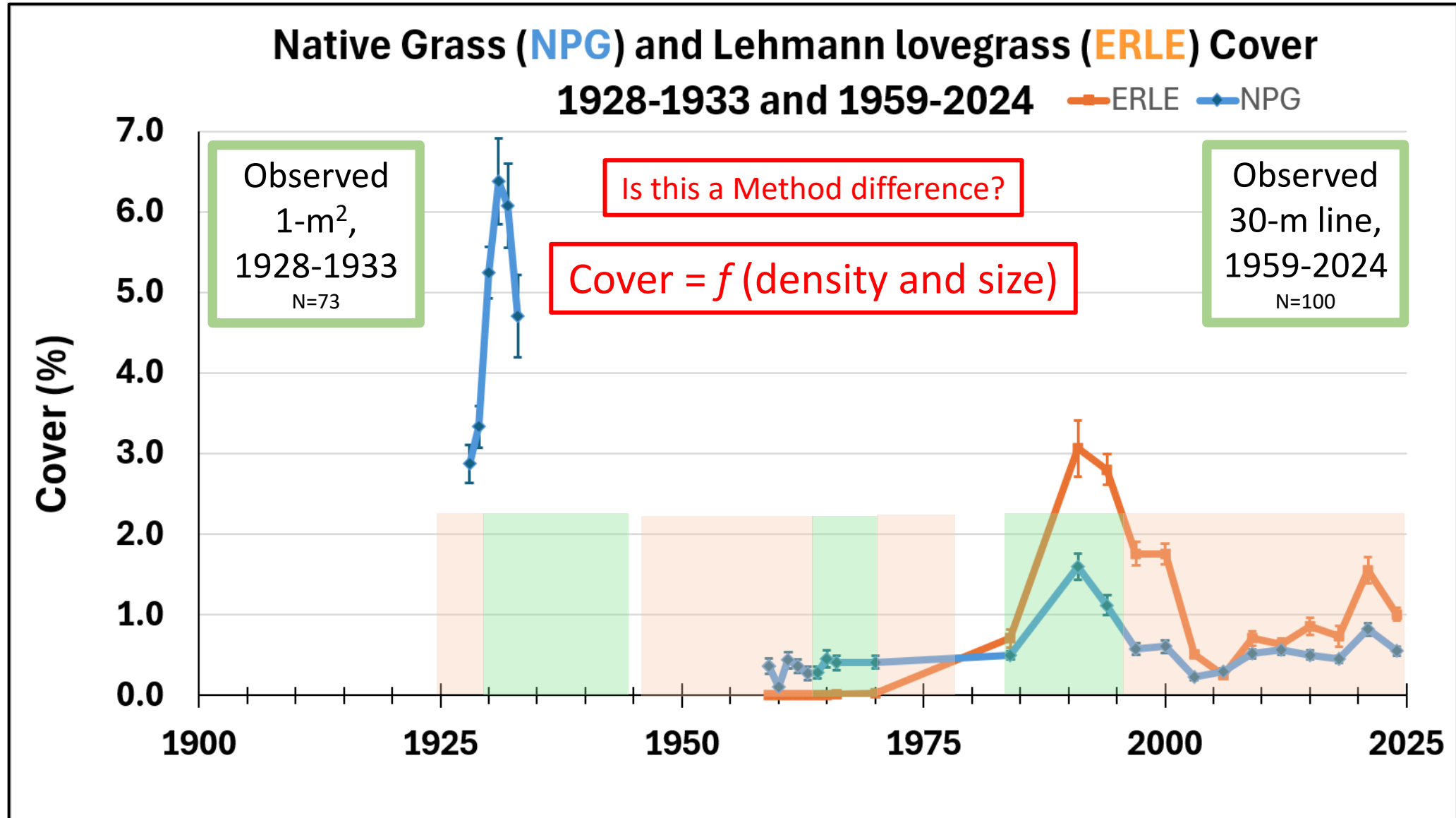
Bagchi et al. 2012. <https://doi.org/10.1890/11-0704.1>; Bagchi et al. 2017. <https://doi.org/10.1002/eap.1544>



Grass Cover 1928-2024

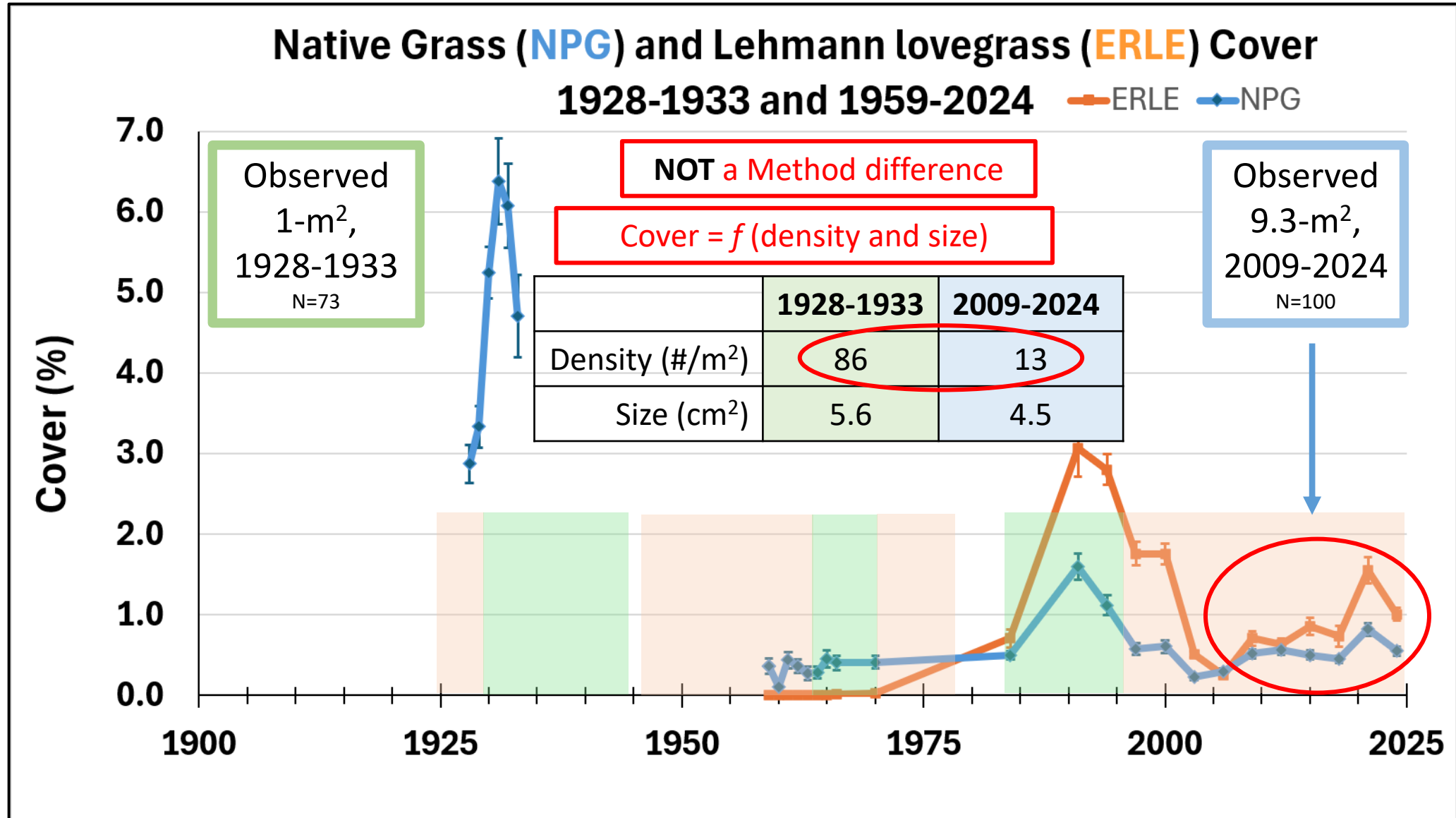


Grass Cover 1928-2024



$\Delta \text{Vegetation} = f(\text{where, when, how, and what})$

Grass Cover and Density 1928-2024



Combination enriches the story, and interpretation

Big Place + Long Time

21000 ha since 1902

Δ Vegetation = f (where, when, how, and what we look at)

Where: landscape position, soil, elevation

When: wet-dry, grazing, fire, new species

How: repeat photos, 1-m², 30-m line, 9.3-m²

What: cover, density, size-mass

Virtual Access

Website: <https://santarita.arizona.edu/>

“Search”: Santa Rita Experimental Range



SRER Website



THE UNIVERSITY OF ARIZONA

Arizona
Experiment Station

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Explore and enjoy over 100 years of
accomplishments and contributions of the longest
continuously operating research area in the United
States!

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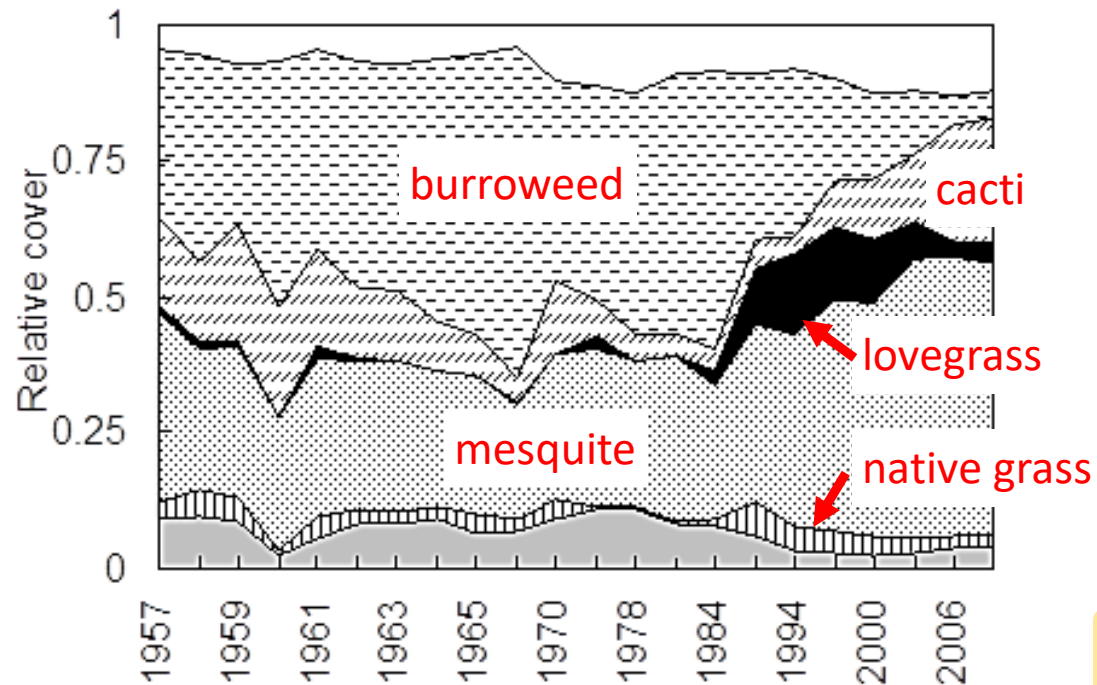
The SRER is part of the [Arizona Experiment Station](#) system



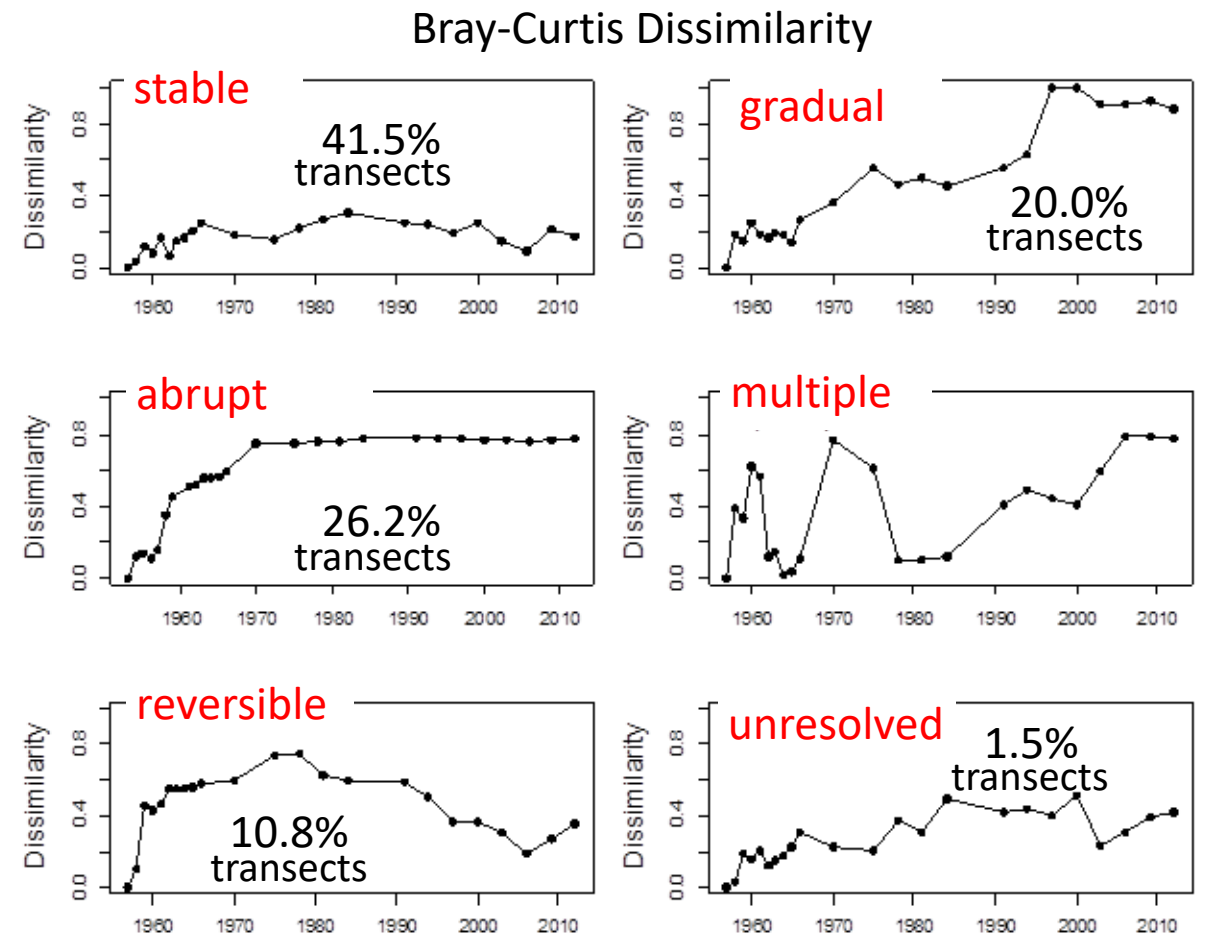
Thank you.
Questions?



What You Like At: Vegetation Cover Change Transition Types 1957-2014



Bagchi et al. 2012. <https://doi.org/10.1890/11-0704.1>
Bagchi et al. 2017. <https://doi.org/10.1002/eap.1544>

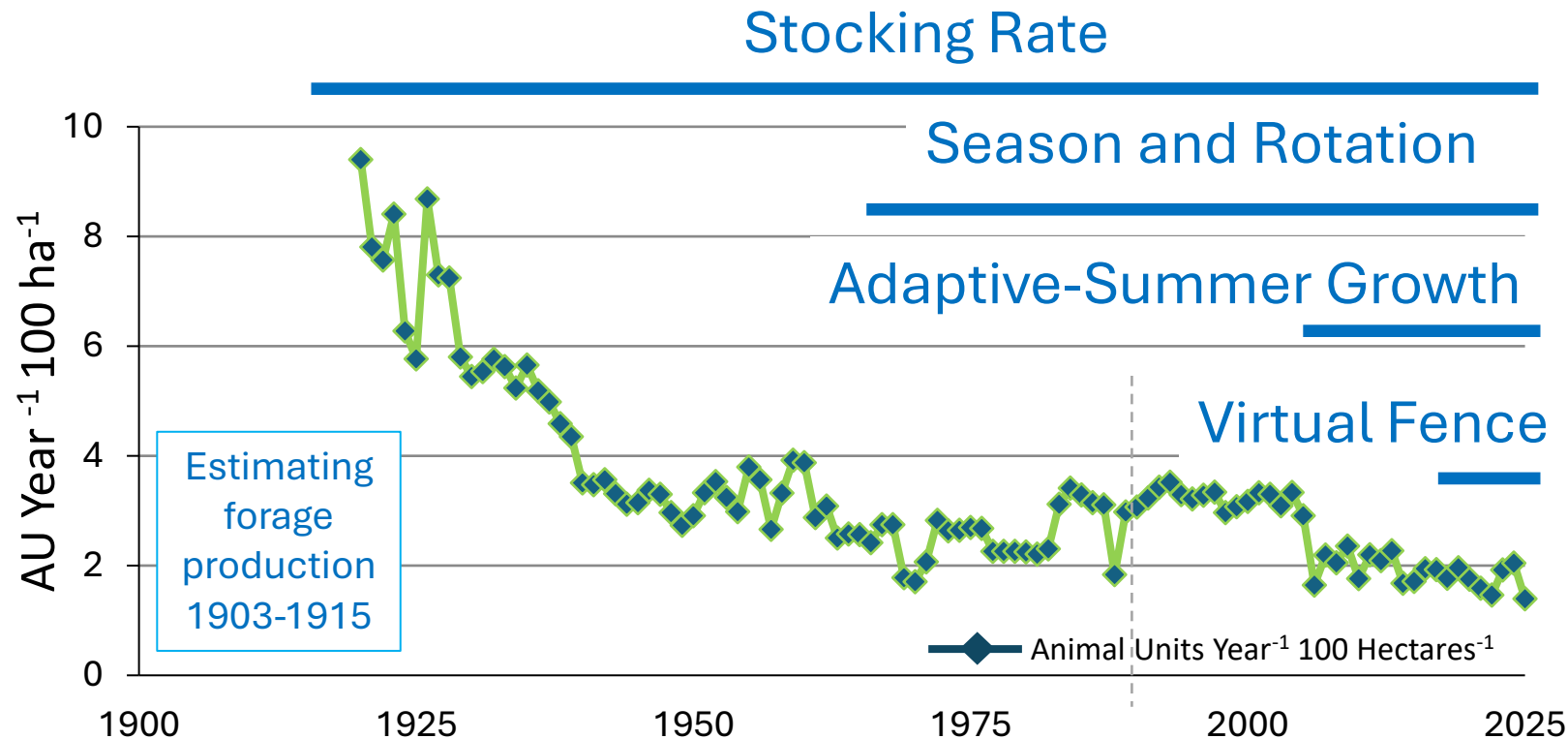


Future

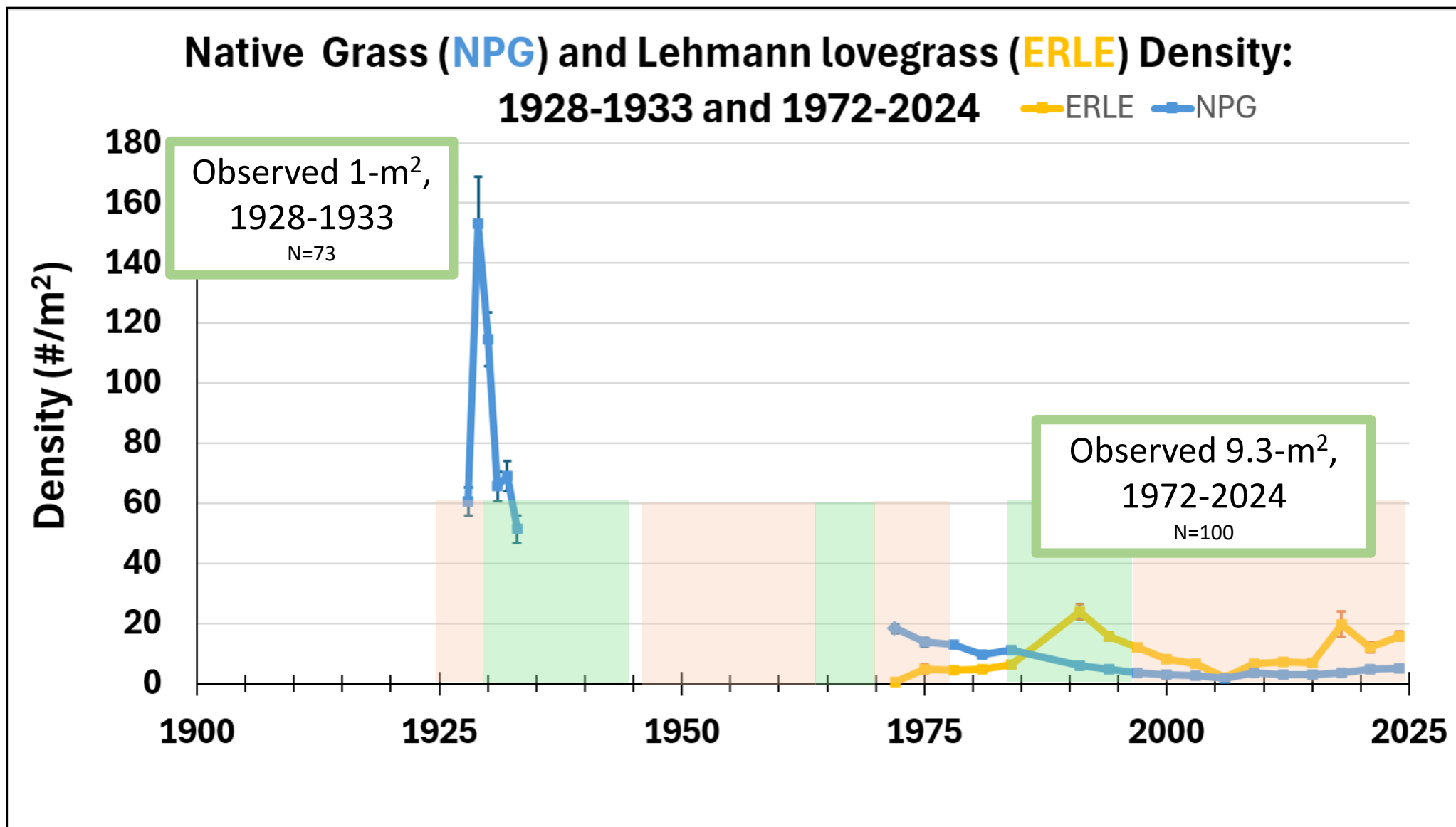
1. Update with additional measures 2018, 2021, 2024, 2027
2. Density v. Cover for grass composition
3. Identify species/locations associated with transition types

Livestock Management Research

- Stocking Rate,
- Season and Rotation,
- Ensuring Summer Growth



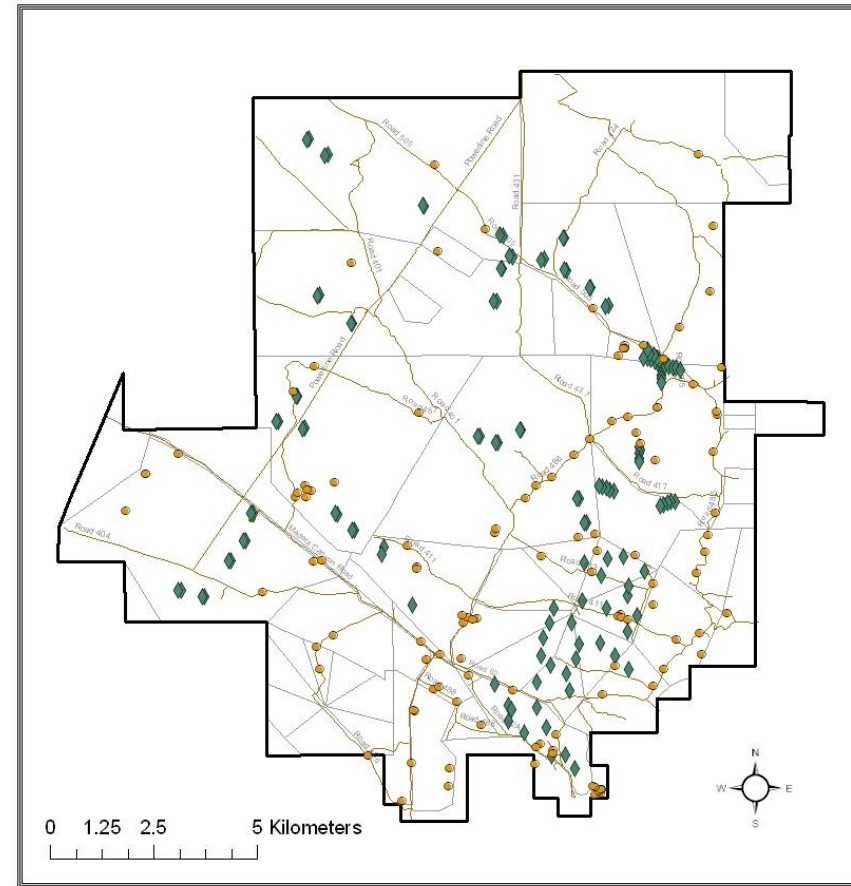
How You Look: Grass Density 1928-2024

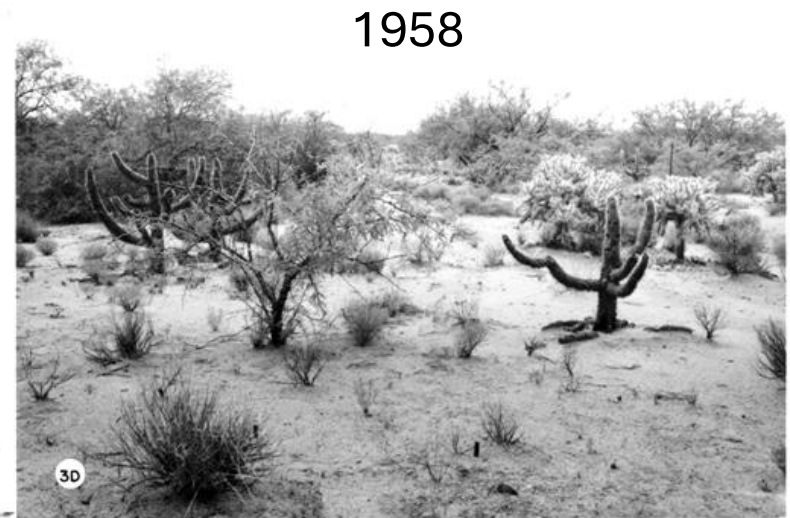
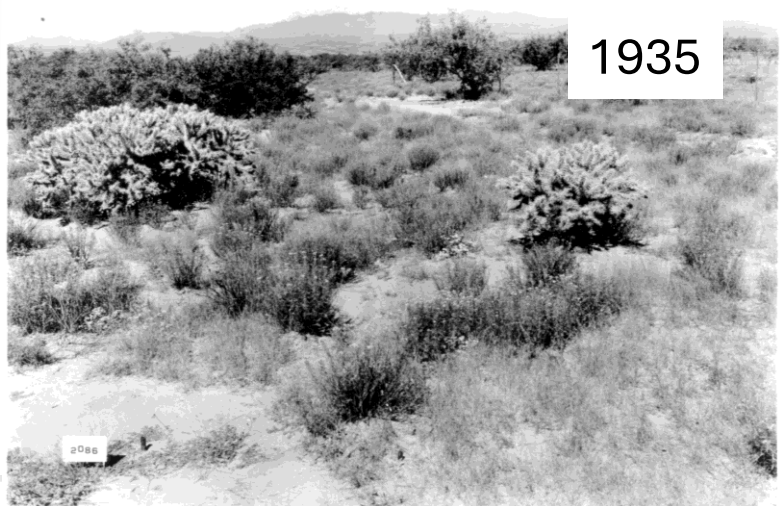
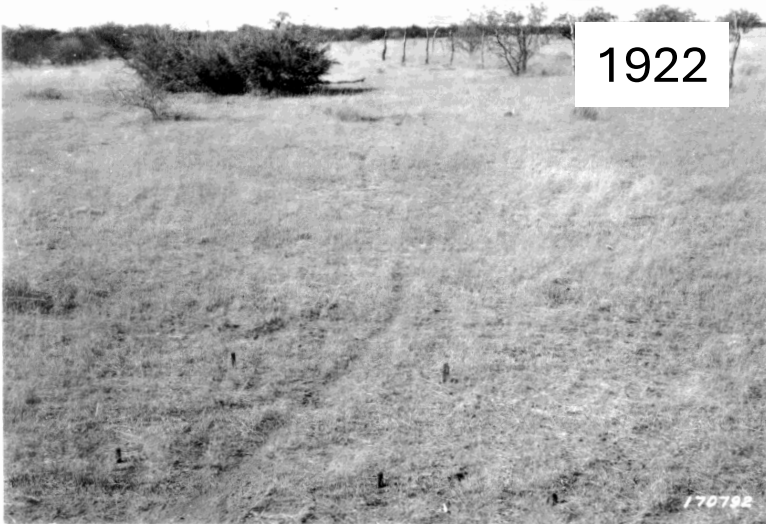


119 Repeat Photography Sites

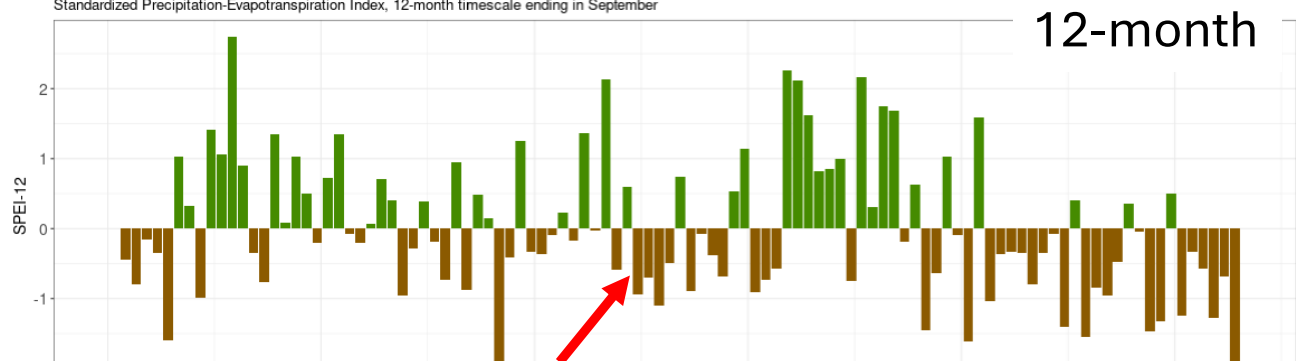


131 Long-term Transects





Standardized Precipitation-Evapotranspiration Index, 12-month timescale ending in September



Standardized Precipitation-Evapotranspiration Index, 48-month timescale ending in September

