Analyzing Agency Datasets Using the ESD Framework

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Need

The southwestern region of the US has experienced some of the highest rates of temperature increase and population growth in the country. These changes have led to loss of perennial vegetation and altered the abundance and distribution of plant species. Understanding how climate and land use change will affect plant communities and ecosystem function is critical for future management of southwestern lands.

While there are many model forecasts of how plant community composition will shift with climate and land use change, there is a critical need to validate these models and reduce their uncertainty using long-term empirical data. High quality vegetation datasets that have the spatial and temporal resolution to examine plant community dynamics and distinguish changes due to climate versus land use are extremely rare.

Agency datasets present an opportunity

BLM rangeland trend sites may provide an opportunity to fill these long-term data needs. The Hanksville (Henry Mountains) BLM district has conducted rangeland assessments on over 30 allotments in southeastern Utah, between Capitol Reef NP and Glen Canyon NRA, every 1-3 years since 1967. The allotments span 100 miles of sagebrush, grassland, and pinyon-juniper plant communities and include critical habitat for fish and wildlife. The dataset consists of:

- Plant cover and plant frequency measurements, by species, read every 1m on 100 m permanently marked transects.
- ~100 trend transects distributed across the district.
- Photos of the transects taken every visit to compliment vegetation measurements.

Our approach

The BLM data only existed in paper forms and no transect locations, metadata, or soil data existed. Thus, our approach was to:

- Digitize historical data (including photos)
- Relocate and georeference transects
- Characterize soils, including Ecological Site
- Obtain oral history from BLM range staff on grazing history
- Analyze historical data using the ESD framework to understand long-term trends and how soils mediate responses of communities to climate and grazing

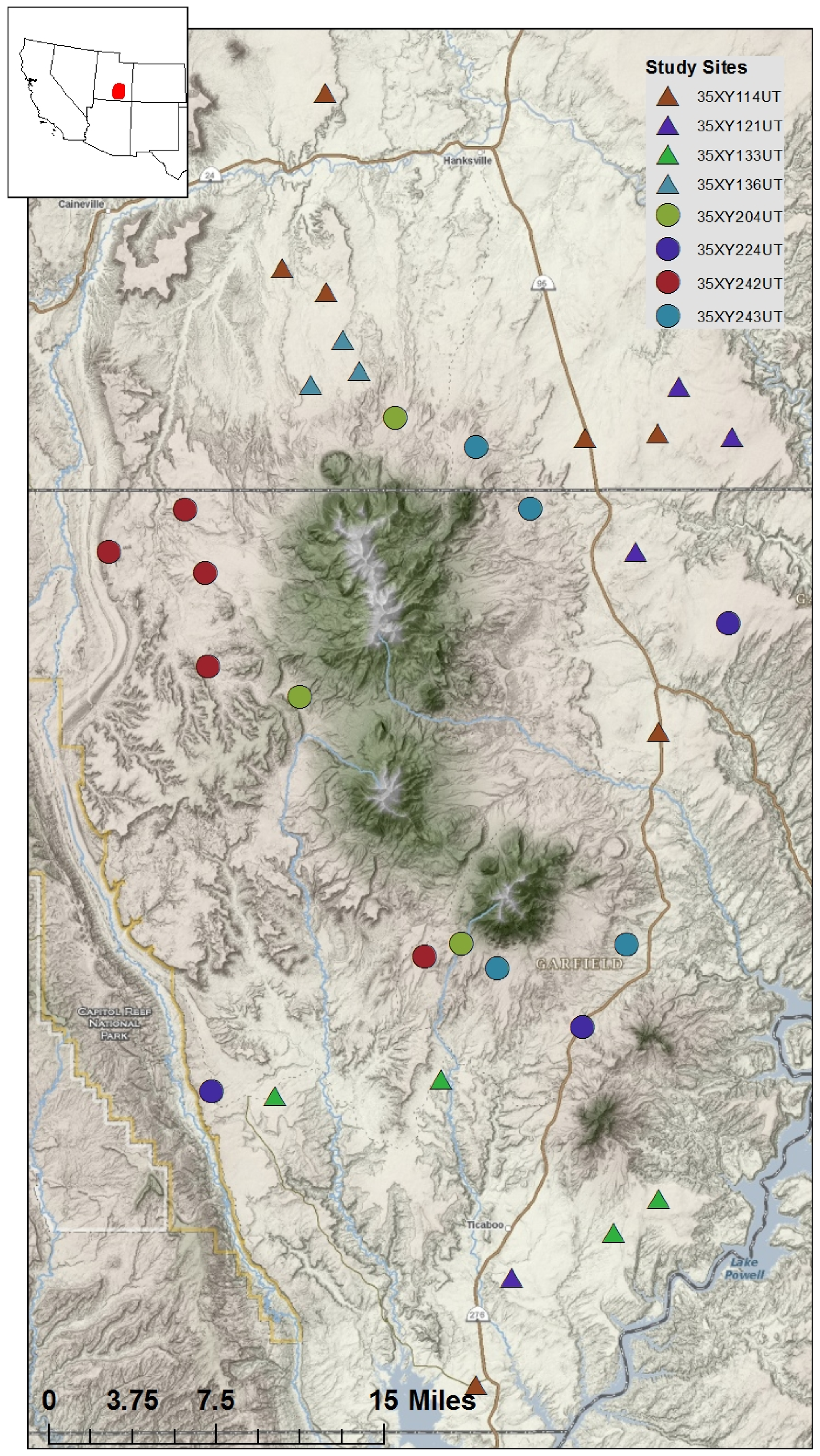


Fig. 1. Study area and plot locations. Plots where Ecological Sites were identified and, of those, only Ecological Sites with at least three plots are presented here.

Table 1. Ecological site number, name, soil features, and number of trend plots included in analyses.

Number	Name	Soil Features	#
35XY114UT	Desert Sand (Ephedra)	Coarse, deep eolian sands	6
35XY121UT	Desert Sandy Loam (Blackbrush)	Loamy sands to sandy loams; moderately deep (20-60")	4
35XY133UT	Desert Shallow Sandy Loam (Blackbrush)	Sandy loams to loamy sands from carbonate sandstones; shallow (<20") to petrocalcic	4
35XY136UT	Desert Stony Loam (Shadscale-Bud sagebrush)	Mixed alluvium from sandstone and shale, loamy-skeletal texture, deep (60")	3
35XY204UT	Semidesert Gravelly Loam (Wyoming Big Sagebrush)	Mixed alluvium from igneous and sandstone; gravelly loam surface texture.	3
35XY224UT	Semidesert Shallow Sand (Blackbrush)	Loamy sand to fine sand; eolian from calcareous sandstone; shallow (10-20") to bedrock	3
35XY242UT	Semidesert Gravelly Loam (Shadscale)	Alluvium or colluvium from mixed parent material; deep and loamy with 30% rock	5
35XY243UT	Semidesert Stony Loam (Blackbrush)	Deep, gravelly fine sandy loams to gravelly loams	4

Preliminary results:

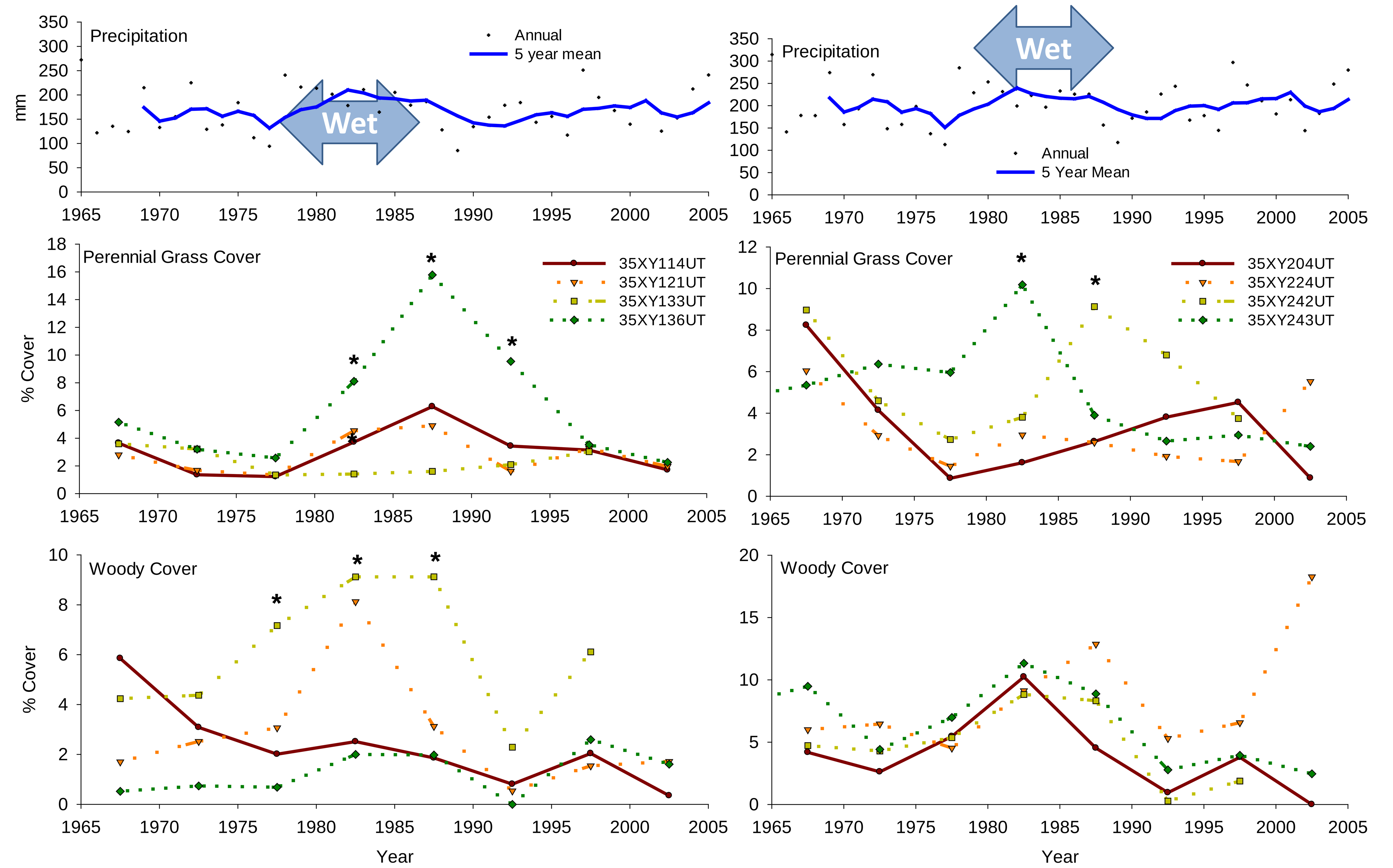
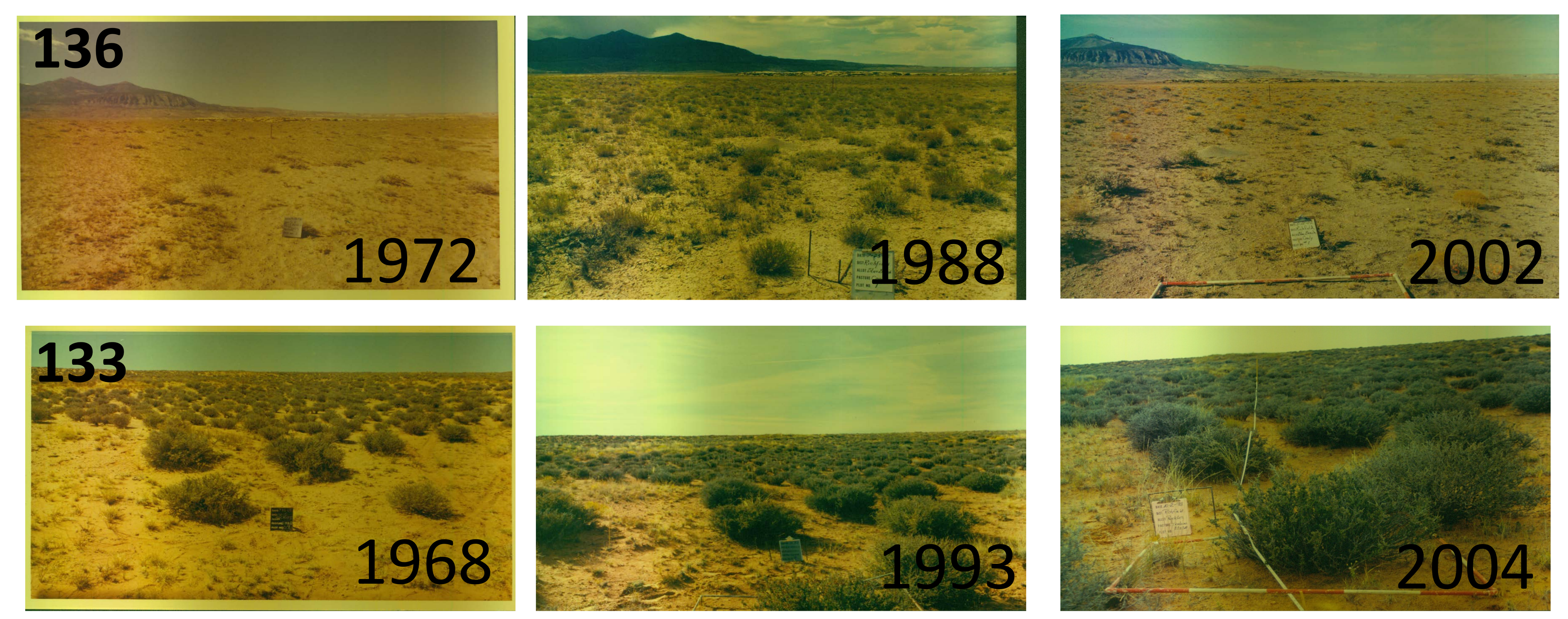


Fig. 2. Analysis of trends of two functional groups (perennial grasses and woody species) for two climate zones, testing for effect of Ecological Site (* indicates significant effect, $p < 0.05$). Due to uneven sampling dates, data was grouped into 5-year periods for analysis. A mixed model, repeated measures analysis was run for each 5-year period. **Preliminary results suggest responses of perennial grass and woody species to climate do differ among Ecological Sites, but differences only detectable during wet periods, suggesting resilience differs among study Ecological Sites.**

Fig. 3. Plot photos from desert ecological site (35XY136UT) that show large grass increase (Hilaria & Achnatherum) during 1980's wet period (top) and site photos that show large shrub increase through time (Coleogyne ramosissima ; 35XY133UT; bottom).



Conclusions. Agency datasets can provide a valuable long-term perspective for understanding plant community response to climate, especially in regions lacking long-term research sites. As was demonstrated here, ecological sites can explain a significant proportion of the among plot variation and should be accounted for in analysis. However, such contextual information is not often included in plot metadata and can require re-locating plots and field visits to characterize soils.

Future work. We plan to conduct soil characterizations at remaining trend sites and use soil property data and grazing history to conduct more in-depth analysis of grazing-soil-climate interactions. These results will further test regional Ecological Site concepts and provide evidence for data-driven state-and-transition models.

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