



Southern Colorado Plateau

INVENTORY & MONITORING NETWORK

Chaco Culture National Historical Park/ H. Grabowska

Publication Brief - Upland Vegetation and Soils

2024

Title: Site Characterization and Change Over Time in Semi-Arid Grassland and Shrublands at Three Parks: Chaco Culture National Historical Park, Petrified Forest National Park, and Wupatki National Monument - Upland Vegetation and Soils Monitoring 2007–2021

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Location: <https://doi.org/10.36967/2301582>

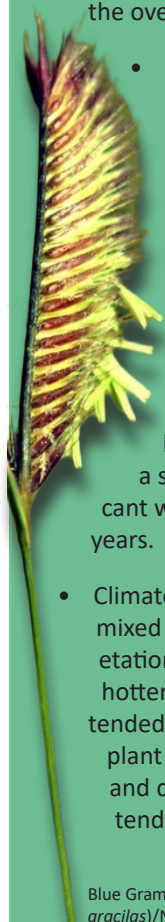


Four-wing Saltbush
(*Atriplex canescens*)/NPS

Vital Sign Monitoring Overview: [Long-term vegetation and soil monitoring](#) reveals how plant communities change over time in response to climate, disturbance, and management. Changes in vegetation, in turn, affect habitat quality for resident and migrant animal species. Monitoring how stable and functional the soils are provides a direct measure of the threat posed by erosion to these ecosystems.

KEY FINDINGS

- Warm season grasses are the dominant vegetation in these systems and comprise most of the overall cover.
- Nonnative species were not common. The most common nonnatives species were Russian thistle and cheat-grass.
- Perennial grass cover has decreased in a small but significant way in the last 15 years.
- Climate variables had mixed effects on vegetation, but drier and hotter spring seasons tended to decrease plant cover, while hot and dry July weather tended to increase it.



Blue Grama (*Butelou gracilis*)/NPS

Summary: This report presents results of upland vegetation and soil monitoring of semi-arid grasslands at three parks by the Southern Colorado Plateau Inventory and Monitoring Network (SCPN) from 2007–2021. The purpose is to compare and contrast five grassland ecological sites and examine how they have changed during the first 15 years of monitoring. Crews collected data on vegetation, both at the species level and by life-form (e.g., perennial grass, shrub, forb) soil stability, and soil texture at 150 plots within five target grassland/shrubland communities based on Natural Resource Conservation Service ecological site classification (30 plots per site).

Soils in plots at Petrified Forest National Park (PEFO) and Chaco Culture National Historical Park (CHCU) were deeper than those at Wupatki National Monument (WUPA). Physical and rudimentary soil crust comprised the largest component of the soil surface, except at Wupatki where surface gravel dominated. Cover of biological soil crust (cyanobacteria, lichen, and moss) was low. Soil had moderate stability.

From 2007–2021, SCPN crews identified 283 unique plant species. Cover of live vegetation ranged from 12–24%.

	CHCU Sandy Loam	PEFO Clayey Fan	PEFO Sandy Loam	WUPA Loamy	WUPA Volcanic
Perennial grasses					
Black grama					
Blue grama					
New Mexico needlegrass					
Galleta grass					
Dropseeds					
Indian ricegrass					
Shrubs					
Four-wing saltbush					
mound saltbush					
Snakeweed					
Winterfat					
Perennial forbs					
Annual forbs					
Exotic forbs					

Figure 1. Summary of direction of year effects (trend) for plant cover. Green indicates a positive trend (increasing cover), red a negative trend, and a gray box indicates that the trend was non-significant. Non-colored boxes indicate plant trends were not modeled for the ecological site.

Warm season grasses (C4 species) are adapted to grow under relatively warmer conditions compared to cool season grasses (C3 species) and made up more than 2/3 of vegetation in four of the five sites (>70% of total live foliar cover). Shrubs co-dominated at one site (WUPA L). Flowering plants (forbs) were an overall small component of total vegetation cover but contributed most of the diversity in these sites.

Snakeweed
(*Gutierrezia sarothrae*)/NPS

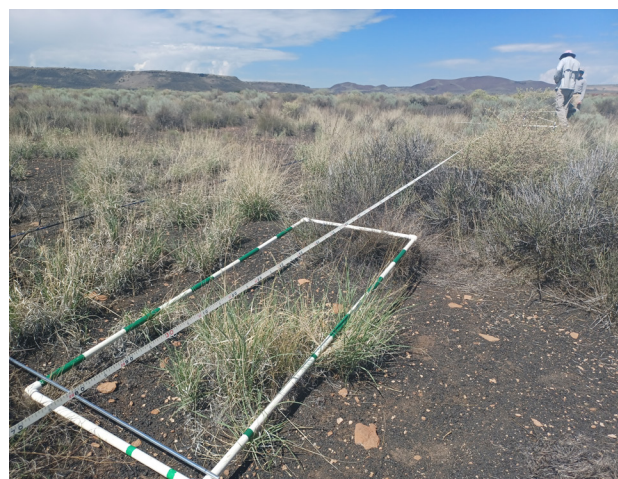


Less than 4% of species were non-native. Russian thistle (*Salsola tragus*) was the most frequently sampled nonnative, occurring in > 50% of plots at Wupatki in the volcanic upland ecological site. Cheatgrass (*Bromus tectorum*) was the second most common nonnative species but occurred in < 10% of the plots at all ecological sites.

Changes over time (trend) were assessed using Bayesian hierarchical models that included year effects and site-specific covariates of seasonal water stress and topography. Models revealed significant decreases in cover in some modeled responses, most notably in the cover of perennial grass at all five sites (Fig. 1). Shrub and forb responses were mixed. Changes in richness, or the number of unique species identified per plot, differed by site, decreasing at the sandy loam site at CHCU but increasing in sandy loam at PEFO and in the volcanic site at WUPA (Fig. 1).

	Lag year deficit	Winter deficit	Spring deficit	Summer deficit	July deficit	AGDD
Perennial grasses						
Black grama						
Blue grama						
New Mexico needlegrass						
Galleta grass						
Dropseeds						
Indian ricegrass						
Shrubs						
Four-wing saltbush						
mound saltbush						
Snakeweed						
Winterfat						
Perennial forbs						
Annual forbs						
Exotic forbs						

Figure 2. Summary of direction of climate variables effects on modeled responses. Green indicates a positive effect, red a negative effect and a gray box indicates that the effect was not significant. Non-colored boxes indicate that a given model did not include that covariate.



SCPN Upland Vegetation field biologists hard at work measuring plots in Wupatki National Monument (2023). Photo by Chris Calvo

Plant cover was influenced by climate variables evaluated, but direction of these effects varied. The most consistent effects were that greater water stress in July (July deficit) and higher number of spring days with temperatures favorable to plant growth (Accumulated growing degree days or AGDD) increased cover of perennial grasses and shrubs during the same year (Fig. 2). However, greater water stress in the spring season (Spring deficit) had a negative effect on many responses (Fig. 2).

Reduced cover of perennial grass and increasing cover of shrubs and weedy forbs has been predicted for Southwestern grasslands in response to hotter and drier conditions due to human-caused climate change. Perennial grass trends reported here support those predictions. Continued drought conditions will likely worsen negative changes in these systems.



The non-native Russian thistle (*Salsola tragus*)/Liz Makings

Management Implications:

The negative trend in grass cover and few non-native species, highlights the importance of limiting disturbance in these areas, including livestock trespassing and road or trail building.

Maintaining these sites to prevent further decline coupled with thoughtful restoration tactics will help to support a stable ecosystem in the face of human-caused climate change.

Petrified Forest National Park/Andrew V. Kearns

