



Southern Colorado Plateau

INVENTORY & MONITORING NETWORK

Publication Brief - Upland Vegetation and Soils

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Report Title: Vegetation trends in pinyon-juniper woodlands in Southern Colorado Plateau Network parks

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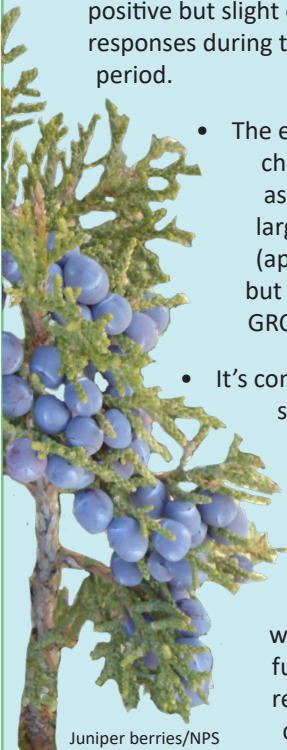


Pinyon pinecones/Neal Herbert NPS

Vital Sign Monitoring Overview: Monitoring [upland vegetation and soils](#) reveals how plant communities and soil stability change over time in response to climate, disturbance, and management.

KEY FINDINGS

- Vegetation was similar at MEVE and GRCA (sparsely vegetated understories of grass and shrubs and overstories with relatively dense canopy cover dominated by both juniper and pinyon pine).
- The understory at BAND was relatively more vegetated and diverse with greater numbers of forb and shrub species. BAND also contained relatively less dense canopies compared to GRCA & MEVE.
- Overall, vegetation was stable or exhibited positive but slight changes in analyzed responses during the 15-year monitoring period.
- The exotic annual grass, cheatgrass, was an exception as it showed a relatively large increase at BAND (approximately 2% per year), but it decreased slightly at GRCA.
- It's concerning that spring water stress appears to have negative impacts on many species in these systems, as predicted earlier snowmelt and higher spring temperatures in these woodlands during the future will almost certainly result in drier springs in the coming decades.



Juniper berries/NPS

Summary: The [Southern Colorado Plateau Network](#) (SCPN) has monitored vegetation and soils in pinyon-juniper woodlands at three national park units (Figure 1), [Bandelier National Monument](#) (BAND), [Grand Canyon National Park](#) (GRCA) and [Mesa Verde National Park](#) (MEVE) since 2007. This report analyzes 15 years of data and examines both the overall character of the sites as well as change over time in selected indicators.

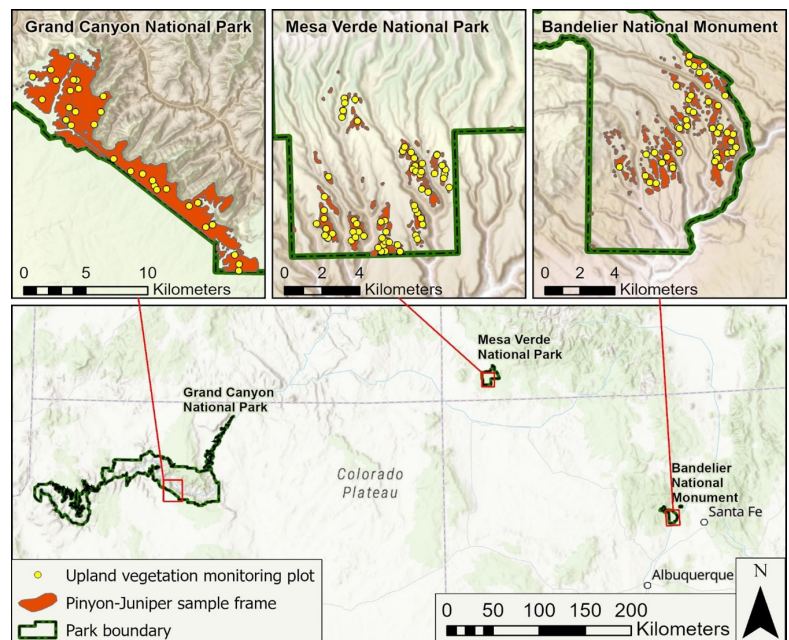
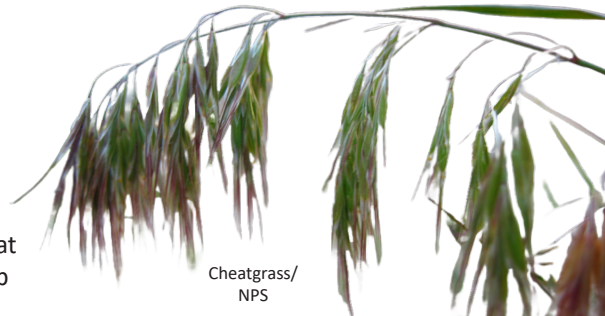


Figure 1. Maps of the sampling frames and plot locations for the three NPS units included in this report. (NPS/KRISTIN STRAKA)

Soils varied by texture, development, and depth across sites and between plots within sites, particularly at BAND. Soil aggregate stability (ability of clumps of soil particles to withstand forces that can break them apart, such as water, wind, or physical disturbance) was moderate across all sites, and duff and litter comprised the majority of the soil surface cover.

Overall, pinyon-juniper vegetation was similar at MEVE and GRCA. These parks contained sparsely vegetated understories of grass and shrubs and overstories with relatively dense canopy cover dominated by Utah juniper (*Juniperus osteosperma*) and two-needle pinyon pine (*Pinus edulis*).

In contrast, the understory at BAND was more vegetated and diverse with greater numbers of forb and shrub species. Pinyon-juniper sites at BAND also contained relatively less dense canopies compared to GRCA & MEVE. Few pinyon pine occurred at BAND with overstory dominance by one-seed juniper (*Juniperus monosperma*). Seedlings and saplings of both tree genera were present at all sites but were least common at BAND. Species composition of the understory differed among sites. Species richness was low overall but was highest at BAND. Nonnative plants were not common at most sites, except for cheatgrass (*Bromus tectorum*) at BAND which had up to 40% cover at some plots.



Cheatgrass/
NPS

Measured values (or responses) analyzed for trend included: cover and frequency of lifeform groups (graminoid, forb, shrub, cactus or succulents); cover and frequency of dominant plant species; seedling and sapling density; overstory basal area; canopy cover; soil stability; and species richness. Overall, there was a pattern of stability or positive but slight changes in analyzed responses during the 15-year monitoring period. Most notably, species richness increased at every site and cover of shrubs (BAND P, GRCA P, MEVE S) and cactus/succulents (GRCA P, MEVE L, MEVE S) increased at 3 of 4 sites. One exception to the rule of small changes

was the exotic annual grass, cheatgrass, which showed a relatively large increase at BAND, increasing about 2% per year on average. Cheatgrass cover decreased slightly at GRCA.

Climate variables had significant effects on several vegetation responses. Increasing spring water stress (spring deficit) tended to reduce vegetation cover across all sites, and water stress during the previous year (prev. year deficit) had negative effects on perennial grasses (Figure 2). Other covariates had mixed or mostly weak effects. The importance of spring water stress is concerning since predicted earlier snowmelt and higher spring temperatures in these semi-arid woodlands will almost certainly result in drier springs in the coming decades.

Overall, there was little overstory tree mortality during the monitoring period, but mortality was highest in pinyons at GRCA. Seedling and sapling densities showed slight increases at many sites during the monitoring period.

	Spring deficit	Winter deficit	Prev. year deficit	2 year deficit	AGDD	Aridity index
Perennial grasses	-	+	-		o	
Muttongrass	-	+	-		-	+
Blue grama	-	o	-		o	+
Squirreltail	-	-	-		+	o
Shrubs		o	o	-	o	o
Big sagebrush	o	o	o		o	o
Mountain mahogany	o	o	o		o	o
Snakeweed	-	+	o		o	-
Antelope bitterbrush	o	o	o		o	+
Cliffrose	o	o	o		o	o
Cactus	o	o	o	o	o	-
Opuntia spp.	o	-	o			-
Forbs	o		-		-	+
Ragleaf bahia	-	+	o		o	o
Field wormwood	-	o	+		+	-
Toadflax penstemon	o	+	-		-	o
Spiny phlox	o	o	o		o	o
Cheatgrass	-	+	+		o	o
Juniper seedlings	o	o	o			
Pinyon seedlings	o	o	o			
Juniper saplings	o	o	o	o		
Pinyon saplings	-	o	o	o		

Figure 2. Summary of direction of covariate effects on modeled responses for climatic water deficit, accumulated growing degree-days (AGDD), and aridity. Green (+) indicates the covariate had a significant positive effect on the response, red (-) a significant negative effect and a gray box (o) indicates that the effect was non-significant. Non-colored, no symbol boxes indicate that a given model did not include that covariate.



Upland vegetation crew member collects nested quadrats data. They are looking for all the unique plant species inside nested quadrat frames while their co-workers records their findings. (Megan Swan/NPS)

Special thanks to each and every upland vegetation and soils field crew, who without their hard work and dedication, this long-term dataset would not exist.

Management Implications:

- Limit disturbance to pinyon-juniper woodlands wherever possible, particularly to avoid introducing invasive grasses that can increase the risk of stand-replacing fire.
- In old growth, persistent woodlands like those found at GRCA and MEVE, stand thinning may not increase drought resiliency and risks introducing invasive annual grasses.
- Changing climate may create unsuitable conditions over much of the current range of PJ woodlands. Management may consider directed or accepted transition to shrubland systems.