



# Grassland Health on Grazed and Ungrazed Lands at Capitol Reef National Park, 2009–2018



*At Capitol Reef National Park, long-term monitoring reveals some signs of recovery on previously grazed grasslands.*

## What We Wanted to Know

When Capitol Reef National Park was established in 1971, there were 19 active livestock-grazing allotments in the park. By the 1990s, all but two of these grazing permits were retired. Another was retired in 2018. Knowing the condition of park grasslands, how they’ve changed since grazing ended, and which factors are affecting their condition can help park managers figure out where restoration projects are most needed—and most likely to succeed. This helps ensure tax dollars are wisely spent.

But park managers don’t have the capacity to collect the information themselves. To help them obtain it, the Northern Colorado Plateau Network (NCPN) has monitored the ecological health of vegetation and soils in grasslands in the northern part of the park for more than 10 years. We do that by returning to the same places to measure different qualities of vegetation and soils year after year. Comparing the results tells us if conditions are getting better or worse. This analysis can also help us compare grazed to ungrazed grasslands, and tell us how climate may be affecting conditions on the ground.

## What We Did

From 2009 to 2018, the NCPN monitored two groups of ecological sites, deep grasslands and rocky grasslands, at three livestock-grazing allotments with differ-

### At a Glance

- Knowing the condition of grasslands helps park managers optimize the use of scarce resource dollars.
- In the retired Cathedral/Rock Springs allotments, vegetation and soils were in relatively good condition. Trends were stable or improving.
- In the grazed Hartnet allotment, condition was declining for 9 of 22 vegetation and soil parameters across two site types.
- Seasonal precipitation was an important influence on vegetation cover.
- There was some evidence of continued recovery of vegetation and soils in the Cathedral/Rock Springs allotments.
- Continued monitoring will be crucial to providing managers with the information they need for effective decisionmaking and resource allocation.

ent grazing histories in the northern part of the park (see table). Deep grasslands were monitored in all three allotments. Rocky grasslands were monitored only in the Hartnet allotment, due to their paucity in the others.

At each monitoring site, we measured 11 parameters of vegetation and soil condition: total plant cover, perennial-grass cover, cool-season grass cover,

warm-season grass cover, shrub cover, shrub density, frequency of exotic species, biological soil crust cover, bare-soil cover, soil stability, and canopy-gap size. Generally speaking, these parameters measure how much of the monitoring site is covered by plants, and the ability of soil to resist erosion.

## What We Learned

Overall, vegetation and soils in the ungrazed Cathedral/Rock Springs (CRS) allotments were in relatively good condition. Trends were stable or improving (see table, next page). Vegetation in the CRS deep grasslands was generally stable, with increases in warm-season grass cover. The allotments had low invasion by exotic annual plant species. They showed good recovery from past grazing, based on limited historical data. Condition was both good and improving for all soil parameters.

Things looked somewhat different in the grazed Hartnet deep and rocky grasslands, where condition was declining for 9 of 22 parameters. Condition was considered good only for parameters related to shrubs and soils. In Hartnet deep grasslands, cool-season grass cover was very low, which may be due to both livestock-grazing pressure and warming conditions that did not favor cool-season grasses. Frequency of exotics was somewhat high. Hartnet rocky grasslands had fairly low invasion by exotic-plant species, but grass and shrub cover were decreasing and particularly susceptible to declines during drought.

Condition was improving for all soil parameters across all grassland types and sites. However, current conditions in the Hartnet deep grasslands suggest there is still a moderate-to-high potential for erosion.

Upland monitoring sites at Capitol Reef National Park, 2009–2018.

Allotment	Grazing history	Grassland type
Cathedral	~80% of animal unit months (AUMs) retired in 1989, the rest retired in 1999	deep grasslands
Rock Springs	Retired in 1989	deep grasslands
Hartnet	Grazed until May 2018, then retired	deep grasslands, rocky grasslands

Banner photo: Upland vegetation and soils monitoring crew with globemallow, Capitol Reef National Park, June 2015. NPS/Amy Washuta.

Grassland Recovery in Retired Allotments

Our analysis found some evidence that grasslands retired from grazing in the Cathedral and Rock Springs allotments show recovery over the past 10–30 years. Although trends in most vegetation indicators were stable from 2009 to 2018, warm-season grass cover increased in the CRS allotments. We expected to see increases in cool-season grass cover—a sign of recovery from past livestock grazing—but conditions appeared to be unchanged over our 10 years of monitoring. Historical data and photos suggest much recovery may have occurred before NCPN monitoring began. In the retired CRS allotments, soil stability and biological soil crust cover were higher, and increasing at a faster rate, than in the grazed Hartnet allotments. A soil-stability rating increase of 2.1 in the CRS allotments from 2009 to 2018 was an impressive rate of recovery. Soil stability is positively correlated with biological soil crust cover, and our repeat photos showed substantial crust development over the 10 years of monitoring (see figure).

Effects of Livestock Grazing on Hartnet Grasslands

Overall, our analysis indicated declining trends in condition for four of the seven vegetation indicators in the grazed Hartnet deep grasslands, compared to only one declining trend in the retired CRS deep grasslands. In the Hartnet deep grasslands, cover of cool-season grasses (typically favored by livestock) was notably low. In addition to pressure from livestock grazing, declining vegetation trends may be related to increasing aridity, as the Southwest continues to warm. Care should be taken when



Repeat photos of the soil surface at a monitoring plot in the Cathedral allotment in 2009 (left) and 2018 (right). Pinnacling of biological soil crust increased substantially by 2018.

interpreting our data because differences are small and credible intervals in our models are relatively wide. However, the direction and consistency of these trends across several indicators are clear. Soil conditions appear to be improving in the Hartnet deep grasslands—but more slowly than in the CRS deep grasslands. Cover of biological soil crust is still low in the Hartnet deep grasslands.

Climate Drivers and Grasslands

In desert grasslands, previous-year precipitation affects the availability of water and nutrients for grasses the following spring. For all grass-cover metrics in Capitol Reef National Park, the effect of the previous year’s monsoon precipitation was twice as strong as that of cool-season precipitation. Our models also provided evidence that cool-season precipitation increased biological soil crust cover and decreased bare-soil cover, and that both cool-season and monsoon precipitation increased soil stability.

But there is still much uncertainty about how seasonal precipitation may or may not change in the future. We do know that as temperatures increase, so does evapotranspiration, meaning more water

would be required to maintain current conditions. Changes in seasonality of precipitation could be some of the most important drivers of change in mixed cool- and warm-season semiarid grasslands.

Livestock grazing in the Hartnet allotment was retired on May 1, 2018. A year later, NCPN monitoring crews began documenting any changes in vegetation or soils associated with this change in management. They noted some early signs of recovery in spring 2019: many tiny bunches of Indian ricegrass in the Hartnet deep grasslands that appeared to be thriving after the wet winter of 2018–2019. It is unclear if any of these grass seedlings survived the dry conditions later that summer, but events like this provide hope that cool-season grass cover in the Hartnet deep grasslands will increase after conditions are favorable for establishment.

Continued monitoring will be crucial to providing park managers with the information they need for science-based decisionmaking and effective resource allocation.

Summary of conditions for grasslands in Capitol Reef National Park with different grazing histories and grassland types.

Vital sign	Indicator	Condition/Trend*		
		Cathedral/Rock Springs deep grasslands (retired)	Hartnet deep grasslands (grazed)	Hartnet rocky grasslands (grazed)
Upland plant communities	Total cover	↔	↓	↓
	Perennial-grass cover	↔	↓	↓
	Cool-season grass cover	↔	↓	↓
	Warm-season grass cover	↑	↔	↓
	Shrub cover	↓	↓	↓
	Shrub density	↔	↔	↑
	Frequency of exotic species	↑	↑	↔
Soil stability	Biological soil crust cover	↑	↑	↑
	Bare-soil cover	↑	↑	↑
	Soil-stability rating	↑	↑	↑
	Canopy-gap size	↑	↑	↑

\*Green indicates the indicator was in good condition. Yellow indicates condition that warrants moderate concern. Red indicates condition that warrants significant concern. An upward arrow means the condition is improving. A sideways arrow means the condition is unchanging. A downward arrow means the condition is deteriorating. Note that decreasing frequency of exotic species, bare-soil cover, and canopy-gap sizes are considered improving trends. A dashed line means confidence is low. A solid line means confidence is medium. No conditions were reported with high confidence due to the relatively short dataset (≤10 years), wide credible intervals, and limited historical data.