



Plant Community Composition and Structure Monitoring in Scotts Bluff National Monument

2013 Annual Report

Natural Resource Data Series NPS/NGPN/NRDS—2013/570



ON THE COVER

The Northern Great Plains Inventory & Monitoring field crew working at Scotts Bluff National Monument
Photograph by: J. Ladd, NPS

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The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. Data in this report were collected and analyzed using methods based on established peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Introduction

During the last century, much of the prairie within the Northern Great Plains has been plowed for cropland, planted with non-natives to maximize livestock production, or otherwise developed, making it one of the most threatened ecosystems in the United States. Within Nebraska, greater than 77% of the area of native mixed grass prairie has been lost since European settlement (Samson and Knopf 1994). The National Park Service (NPS) plays an important role in preserving and restoring some of the last pieces of intact prairies within its boundaries. The stewardship goal of the NPS is to “preserve ecological integrity and cultural and historical authenticity” (NPS 2012); however, resource managers struggle with the grim reality that there have been fundamental changes in the disturbance regimes, such as climate, fire, and grazing by large, native herbivores, that have historically maintained prairies and there is the continual pressure of exotic invasive species. Long-term monitoring in national parks is essential to sound management of prairie landscapes because it can provide information on environmental quality and condition, benchmarks of ecological integrity, and early warning of declines in ecosystem health.

Scotts Bluff National Monument (SCBL), established in 1919 to protect and preserve 2 iconic bluffs and the associated heritage of western expansion, covers 3,003 acres and is dominated by mixed-grass prairie with smaller areas of juniper woodlands, badlands, and riparian forests. Vegetation monitoring began in SCBL in 1997 by the Heartland Inventory & Monitoring Program (James 2010) and the Northern Great Plains Fire Ecology Program (FireEP; Wienk et al. 2011). In 2010, SCBL was incorporated into the Northern Great Plains Inventory & Monitoring Network (NGPN). At this time, vegetation monitoring protocols and plot locations were shifted to better represent the entire park and to coordinate efforts with the FireEP (Symstad et al. 2012b), and sampling efforts began in 2011 (Ashton et al. 2011). The long-term objectives of the NGPN plant community monitoring effort in SCBL are to:

1. Determine park-wide status and long-term trends in vegetation species composition (e.g., exotic vs. native) and structure (e.g., cover, height) of herbaceous and shrub species.
2. Determine status (at 5-yr intervals) and long-term trends of tree density by species, height class, and diameter class in lowland areas near targeted perennial streams.
3. Improve our understanding of the effects of external drivers and management actions on plant community species composition and structure by correlating changes in vegetation composition and structure with changes in climate, landscape patterns, atmospheric chemical composition, fire, and invasive plant control.

This report is intended to provide a timely release of basic data sets and data summaries from our sampling efforts in 2013 at SCBL. We visited 8 plots in a rotating panel design, and it will take 2 more years to visit every plot in the park twice (Figure 1). In addition, we surveyed vegetation in 4 plots that were first installed in 1997 by the Heartland Inventory & Monitoring Network. These plots are concentrated in the northeast corner of the park to evaluate the effectiveness of a golf course restoration project (Figure 1). We expect to produce reports with more in-depth data analysis and interpretation when we complete 5 years of sampling. In the interim, reports, spatial data, and data summaries can be provided for park management and interpretation upon request.

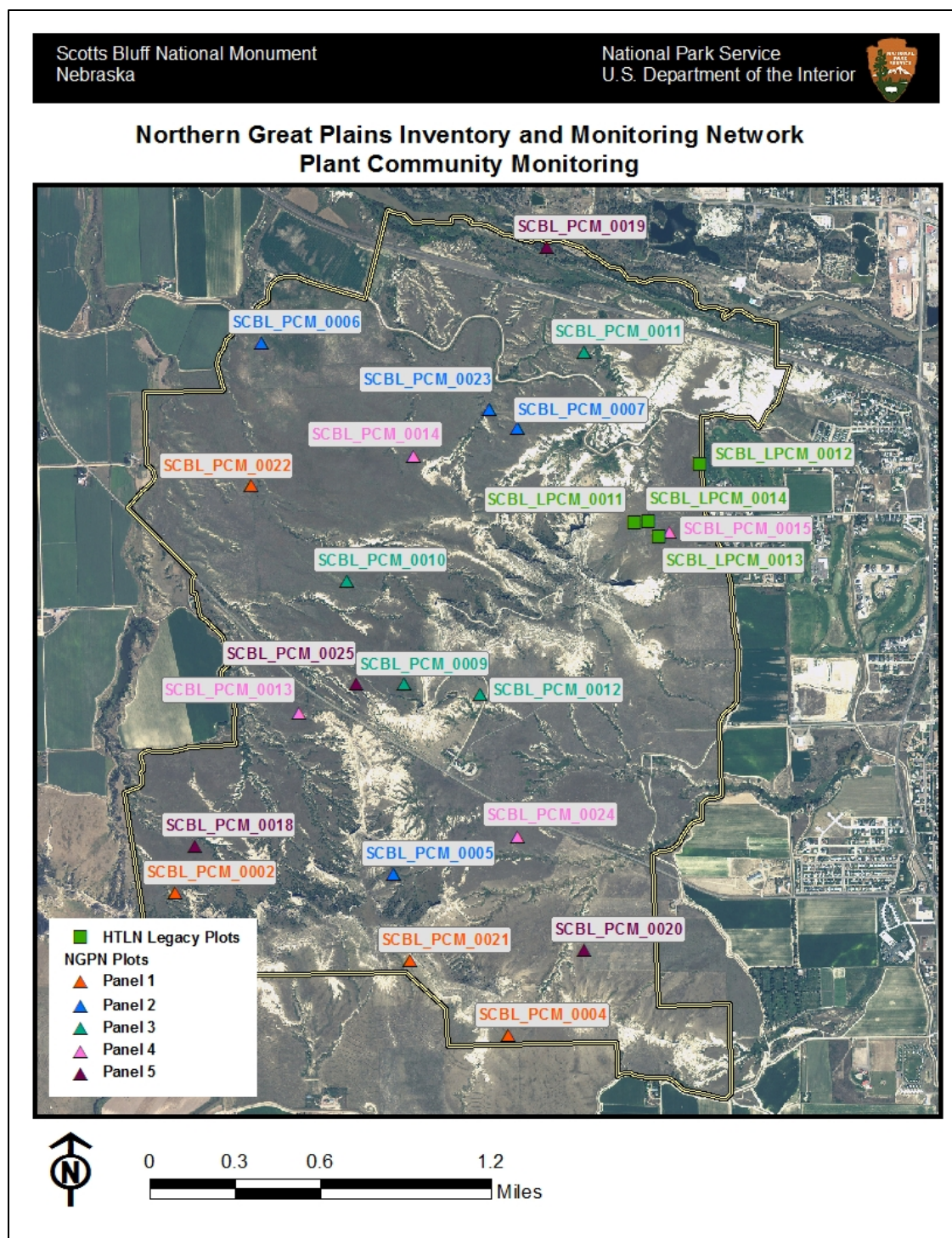


Figure 1. Map of Scotts Bluff National Monument (SCBL) and plant community monitoring (PCM) plots. Plots in Panel 2 (blue) and Panel 3 (green) were visited in 2013. In addition, 4 plots established by the Heartland Monitoring Network representing restored and native mixed-grass prairie were visited in 2013 (green).

Methods

The NGPN Plant Community Composition and Structure Monitoring Protocol (Symstad et al. 2012b, a) describes in detail the methods used for sampling long-term plots. Below, we briefly describe the general approach. For those interested in more detail please see Symstad et al. 2012, available at <http://science.nature.nps.gov/im/units/ngpn/monitor/plants.cfm>.

Sample design

We implemented a survey to monitor plant community structure and composition in SCBL using a spatially balanced probability design (Generalized Random Tessellation Stratified [GRTS]; Stevens and Olsen 2003, 2004). Using a GRTS design, we selected 20 randomly located sites within SCBL (Figure 1). We split these 20 sites into 5 panels with 4 sites each. We visit 2 panels (8 sites) every year, and after 5 years (2015) we will have visited all 20 sites twice. In 2011, we visited sites in panel 1 and panel 5, and in 2012 we visited sites in panel 1 and panel 2. In 2013, we visited sites in panel 2 and panel 3 during the last week of May (Figure 1). Data from these randomly selected sites can be used to estimate condition of vegetation communities for the whole park; over time, data can be used to discern trends in condition.

Plot layout and sampling

At each of the sites we visited, we recorded plant species cover and frequency in a rectangular, 50 m x 20 m (0.1 ha), permanent plot (Figure 2). Data on ground cover, herb-layer height ≤ 2 m, and plant cover were collected on two 50 m transects (the long sides of the plot) using a point-intercept method. Species richness data from the point-intercept method were supplemented with species presence data collected in 5 sets of nested square quadrats (0.01 m², 0.1 m², 1 m², and 10 m²) located systematically along each transect (Figure 2). In 2013, sampling at SCBL took an 8-person crew approximately 330 crew hours with travel time (see Appendix A for a detail of activities each day).

When woody species were present, tree regeneration and tall shrub density data were collected within a 10 m radius subplot centered in the larger 50 m x 20 m plot (Figure 2). Trees with diameter at breast height (DBH) > 15 cm, located within the entire 0.1 ha plot, were mapped and tagged. For each tree, the species, DBH, status, and condition (e.g., leaf-discoloration, insect-damaged, etc.) were recorded. In 2013, the only plot with trees or tall shrubs present was PCM_023. We found two live and sound juniper trees (*Juniperus scopulorum*) and an abundance of chokecherry (*Prunus virginiana*) seedlings. An assessment of forest structure and health will be conducted after 5 years, when more data are available. In addition to upland sampling, NGPN is scheduled to complete a survey of riparian forests in SCBL in 2014 and every 5 years thereafter.

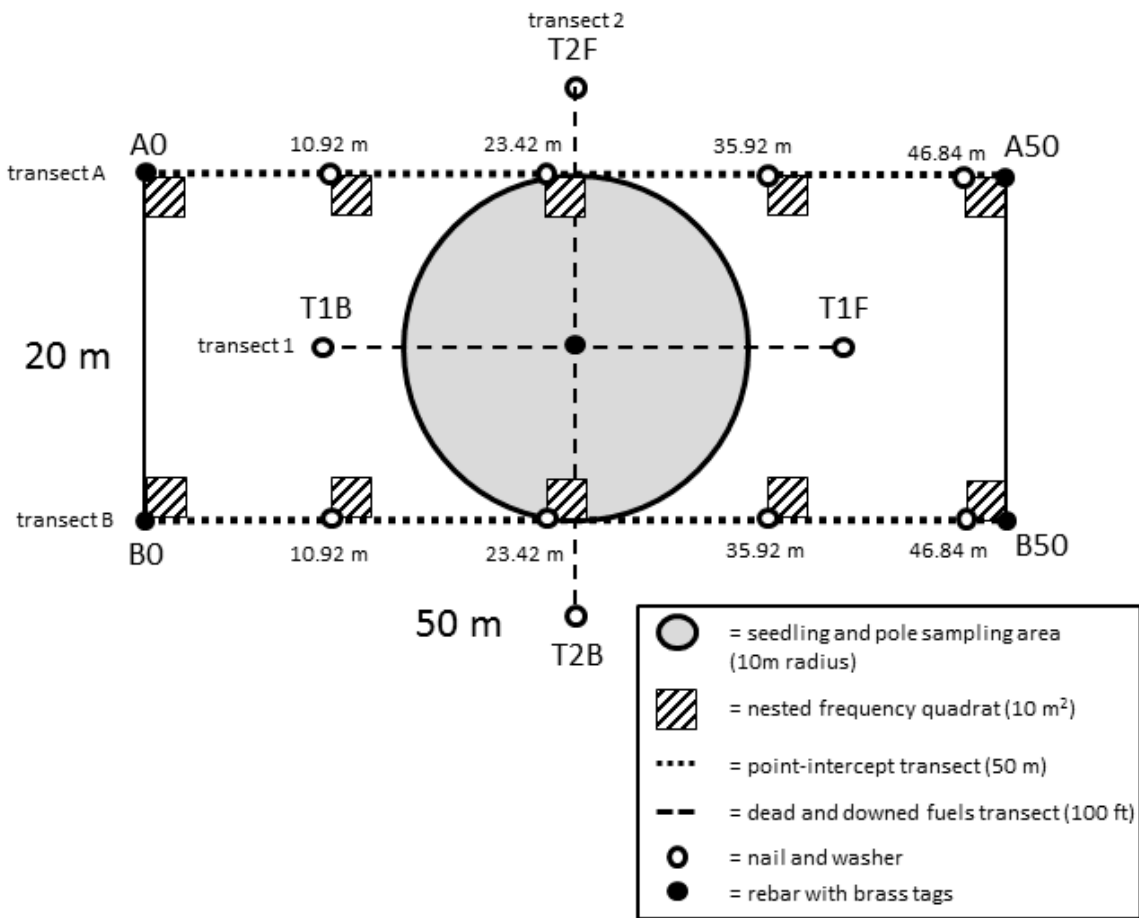


Figure 2. Long-term monitoring plot used for sampling vegetation in Scotts Bluff National Monument.

At all plots, we also surveyed the area for common disturbances and target species of interest to the park. Common disturbances included such things as roads, rodent mounds, animal trails, and fire. For all plots, the type and severity of the disturbances were recorded. We also surveyed the area for exotic species that have the potential to spread into the park and cause significant ecological impacts (Table 1). For each target species that was present at a site, an abundance class was given on a scale from 1-5 where 1 = one individual, 2 = few individuals, 3 = cover of 1-5%, 4 = cover of 5-25%, and 5 = cover > 25% of the plot. The information gathered from this procedure is critical for early detection and rapid response to such threats. In addition, we noted the presence of plant species that are considered rare or vulnerable to loss in Nebraska, and may occur in SCBL (Table 2).

Legacy Monitoring

In addition to the monitoring described above, 4 plots were visited in 2013 that were established in 1997 by the Heartland Inventory & Monitoring Program. At each of these plots, point-intercept, disturbance, and target species data were collected as described above. To be consistent with prior years of data collection, plant frequency was measured using circular subplots as described in the Heartland Networks' vegetation monitoring protocol. (James et al. 2009). The 4 plots chosen

represent native mixed-grass prairie in SCBL (LPCM_11 and 12) and a vegetation restoration effort in a former golf course (LCPM_13 and 14).

Table 1. Exotic species surveyed for at Scotts Bluff National Monument in 2013 as part of the early detection and rapid response program within the Northern Great Plains Network.

Scientific Name	Common Name	Habitat
<i>Alliaria petiolata</i>	garlic mustard	Riparian
<i>Polygonum cuspidatum</i> ; <i>P. sachalinense</i> ; <i>P.x bohemicum</i>	knotweeds	Riparian
<i>Pueraria montana</i> var. <i>lobata</i>	kudzu	Riparian
<i>Iris pseudacorus</i>	yellow iris	Riparian
<i>Ailanthus altissima</i>	tree of heaven	Riparian
<i>Lepidium latifolium</i>	perennial pepperweed	Riparian
<i>Arundo donax</i>	giant reed	Riparian
<i>Rhamnus cathartica</i>	common buckthorn	Riparian
<i>Heracleum mantegazzianum</i>	giant hogweed	Riparian
<i>Centaurea solstitialis</i>	yellow star thistle	Upland
<i>Hieracium aurantiacum</i> ; <i>H. caespitosum</i>	orange and meadow hawkweed	Upland
<i>Isatis tinctoria</i>	Dyer's woad	Upland
<i>Taeniatherum caput-medusae</i>	medusahead	Upland
<i>Chondrilla juncea</i>	rush skeletonweed	Upland
<i>Gypsophila paniculata</i>	baby's breath	Upland
<i>Centaurea virgata</i> ; <i>C. diffusa</i>	knapweeds	Upland
<i>Linaria dalmatica</i> ; <i>L. vulgaris</i>	toadflax	Upland
<i>Euphorbia myrsinites</i> & <i>E. cyperissias</i>	myrtle spurge	Upland
<i>Dipsacus fullonum</i> & <i>D. laciniatus</i>	common teasel	Upland
<i>Salvia aethiopis</i>	Mediterranean sage	Upland
<i>Ventenata dubia</i>	African wiregrass	Upland

Table 2. Rare species that were surveyed for during the 2013 field season at Scotts Bluff National Monument.

Scientific Name	Common Name
<i>Astragalus barrii</i>	Barr's milkvetch
<i>Astragalus pectinatus</i>	narrowleaf milkvetch
<i>Astragalus shortianus</i>	Short's milkvetch
<i>Boechara holboellii</i>	limestone rockcress
<i>Dalea cylindriceps</i>	Andean prairie clover
<i>Ericameria parryi</i>	Parry's rabbitbrush
<i>Fritillaria atropurpurea</i>	spotted mission bells
<i>Lappula cenchrusoides</i>	stickseed
<i>Linanthus caespitosus</i>	matted prickly phlox
<i>Lomatium nuttalli</i>	Nuttall's biscuitroot
<i>Mentzelia albicaulis</i>	whitestem stickleaf
<i>Paronychia sessiliflora</i>	stemless nailwort
<i>Phacelia hastata</i>	spearhead phacelia
<i>Physaria arenosa</i>	sidesaddle bladderpod
<i>Physaria brassicoides</i>	double twinpod
<i>Stephanomeria runcinata</i>	desert skeletonplant

Data Management and Analysis

We used FFI (FEAT/FIREMON Integrated; <http://frames.gov/ffi/>) as the primary software environment for managing our sampling data. FFI is used by a variety of agencies (e.g., NPS, USDA Forest Service, U.S. Fish and Wildlife Service), has a national-level support system, and generally conforms to the Natural Resource Database Template standards established by the Inventory and Monitoring Program.

Species scientific names, codes, and common names are from the USDA Plants Database (USDA-NRCS 2012). However, nomenclature follows the Integrated Taxonomic Information System (ITIS) (<http://www.itis.gov>). In the few cases where ITIS recognizes a new name that was not in the USDA PLANTS database, the new name was used and a unique plant code was assigned.

After data for the sites were entered, 100% of records were verified to the original data sheet to minimize transcription errors. A further 10% of records were reviewed a second time. After all data were entered and verified, automated queries were used to check for errors in the data. When errors were caught by the crew or the automated queries, changes were made to the original datasheets and/or the FFI database as needed.

Plant life forms (e.g., shrub, forb) were based on definitions from the USDA Plants Database (USDA-NRCS 2012). Summaries were produced using the FFI reporting and query tools and statistical summaries, and graphics were generated using R software (version 2.15.1).

We measured diversity at the plots in 3 ways: species richness, the Shannon Index, and Pielou's Index of Evenness. Species richness is simply a count of the species recorded in an area. The Shannon Index, H' , is a measure of the number of species in an area and how even abundances are across the community. It typically ranges between 0 (low richness and evenness) to 3.5 (high species richness and evenness). Pielou's Index of Evenness, J' , measures how even abundances are across taxa. It ranges between 0 and 1, where higher numbers indicate that a community is not even or that just a few species make up the majority of the total cover.

Reporting on Natural Resource Condition

Results were summarized in a Natural Resource Condition Table based on the templates from the State of the Park report series (<http://www1.nrintra.nps.gov/im/stateoftheparks/index.cfm>). The goal is to improve park priority setting and to synthesize and communicate complex park condition information to the public in a clear and simple way. By focusing on specific indicators, such as exotic species cover, it will also be possible and straightforward to revisit the metric in subsequent years. The status and trend of each indicator is scored and assigned a corresponding symbol based on the key found in Table 3.

We chose a set of indicators and specific measures that can describe the condition of vegetation in the Northern Great Plains and the status of exotic plant invasions. The measures include: absolute herb-layer canopy cover, native species richness, evenness, relative cover of exotic species, and annual brome cover. Reference values were based on descriptions of historic condition and variation, past studies, and/or management targets. Current park condition was compared to a reference value,

and status was scored as good condition, caution, or significant concern based on this comparison (Table 3). Good condition was applied to values that fell within the range of the reference value, and significant concern was applied to conditions that fell outside the bounds of the reference value

Table 3. Key to the symbols used in the Natural Resource Condition Table. The background color represents the current status, the arrow summarizes the trend, and the thickness of the outside line represents the degree of confidence in the assessment. A symbol that does not contain an arrow indicates that there is insufficient information to assess a trend. Based on the State of the Park reports (<http://www1.nrintra.nps.gov/im/stateoftheparks/index.cfm>).

Condition Status		Trend in Condition		Confidence in Assessment	
	Warrants Significant Concern		Condition is Improving		High
	Warrants Moderate Concern		Condition is Unchanging		Medium
	Resource is in Good Condition		Condition is Deteriorating		Low

Results and Discussion

Scotts Bluff NM experienced severe to extreme drought conditions throughout the winter and into the spring of 2013 (Figure 3). When the NGPN visited the park in May, recent wet weather allowed for some green-up, but overall the park was still experiencing drought conditions. Average canopy cover was 99% (Table 4) in 2013, which was similar to the previous year (Ashton et al. 2012). There was a large amount of standing litter on the ground with ground cover at the sites averaging 83% plant litter. Overall, there seemed to be little change in ground or vegetation cover between 2012 and 2013.

We found 87 plant species in 2013 at SCBL (Appendix B). Graminoids, which includes grasses, sedges, and rushes, accounted for most of the vegetative cover at SCBL, but shrubs and subshrubs (defined as a low-growing shrub usually under 0.5m) were also abundant (Figure 4). We found 14 exotic species at the park, all of which were either forbs or graminoids. The shrubs and subshrubs were all native species.

There was a great deal of variation in species composition across the 8 sites. Cheatgrass (*Bromus tectorum*) and western wheatgrass (*Pascopyrum smithii*) were the only species found at all 8 sites. The most common species in the sites we visited were graminoids, and most were native species (Figure 5). We did not find any targeted exotic species, but we did find the rare plant spotted fritillary (*Fritillaria atropurpurea*) at one site (Figure 6).

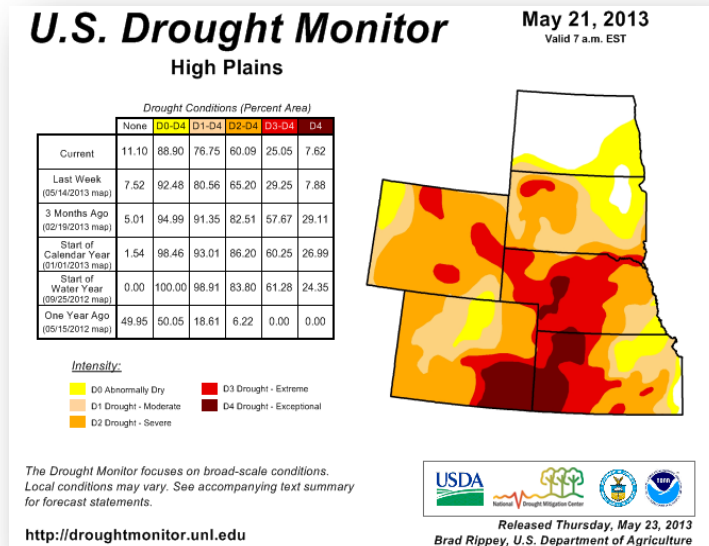


Figure 3. Drought conditions in late May 2013 in the Northern Great Plains. Scotts Bluff National Monument experienced severe to extreme drought at that time.

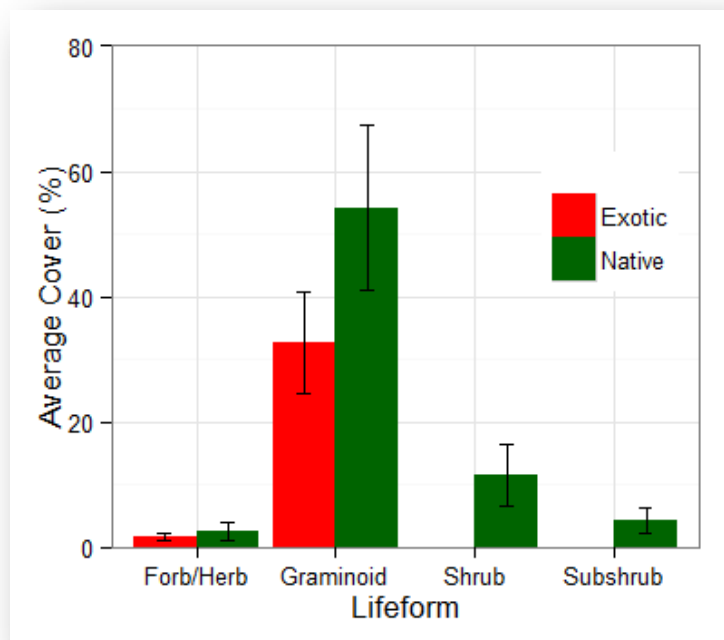


Figure 4. Average cover by lifeform and nativity in 8 plant community monitoring plots in Scotts Bluff National Monument in 2013. Native (green) and exotic (red) graminoids were the most abundant lifeform across the plots. Bars represent means $\pm$ standard errors.

Table 4. Natural resource condition summary table for upland plant communities in SCBL in 2013.

Indicator of Condition	Specific Measures	2013 Value (mean $\pm$ SE)	Reference Condition and Data Source	Condition Status/Trend	Rationale for Resource Condition
Upland Plant Community Structure and Composition	Absolute herb-layer canopy cover	99 $\pm$ 10.8 %	TBD		SCBL plays a vital role in protecting and managing some of the last remnants of native mixed-grass prairie in the region. The park is characterized by low native species richness, but average richness is within a natural range of variability. The one plot that fell below the range was in an active prairie dog town. While native diversity was low, the rare plant, spotted fritillary, was found in one site near the South Bluff.
	Native species richness (based on average of 10-1m ² quadrats per plot)	4 $\pm$ 0.5 species	3-15 species ⁽¹⁾		
	Evenness (based on point-intercept of 2-50m transects per plot)	0.65 $\pm$ 0.05	TBD		
Exotic Plant Early Detection and Management	Relative cover of exotic species	37 $\pm$ 10 %	< 10 % cover		While many areas of SCBL have a high cover of exotic species, there are other areas that have low exotic cover and a high diversity of native plants. Overall however, exotic plants are a significant concern in the park. Annual bromes present the largest challenge to SCBL, and more research on effective management strategies in the mixed-grass prairie is greatly needed.
	Annual Brome cover	35 $\pm$ 10 %	< 10 % cover		

References and Data Sources:

1. Symstad, A. J. and J. L. Jonas. *in press*. Using natural range of variation to set decision thresholds: a case study for Great Plains grasslands.in G. R. Gutenspergen, editor. Application of threshold concepts in natural resource decision making. Springer Verlag.

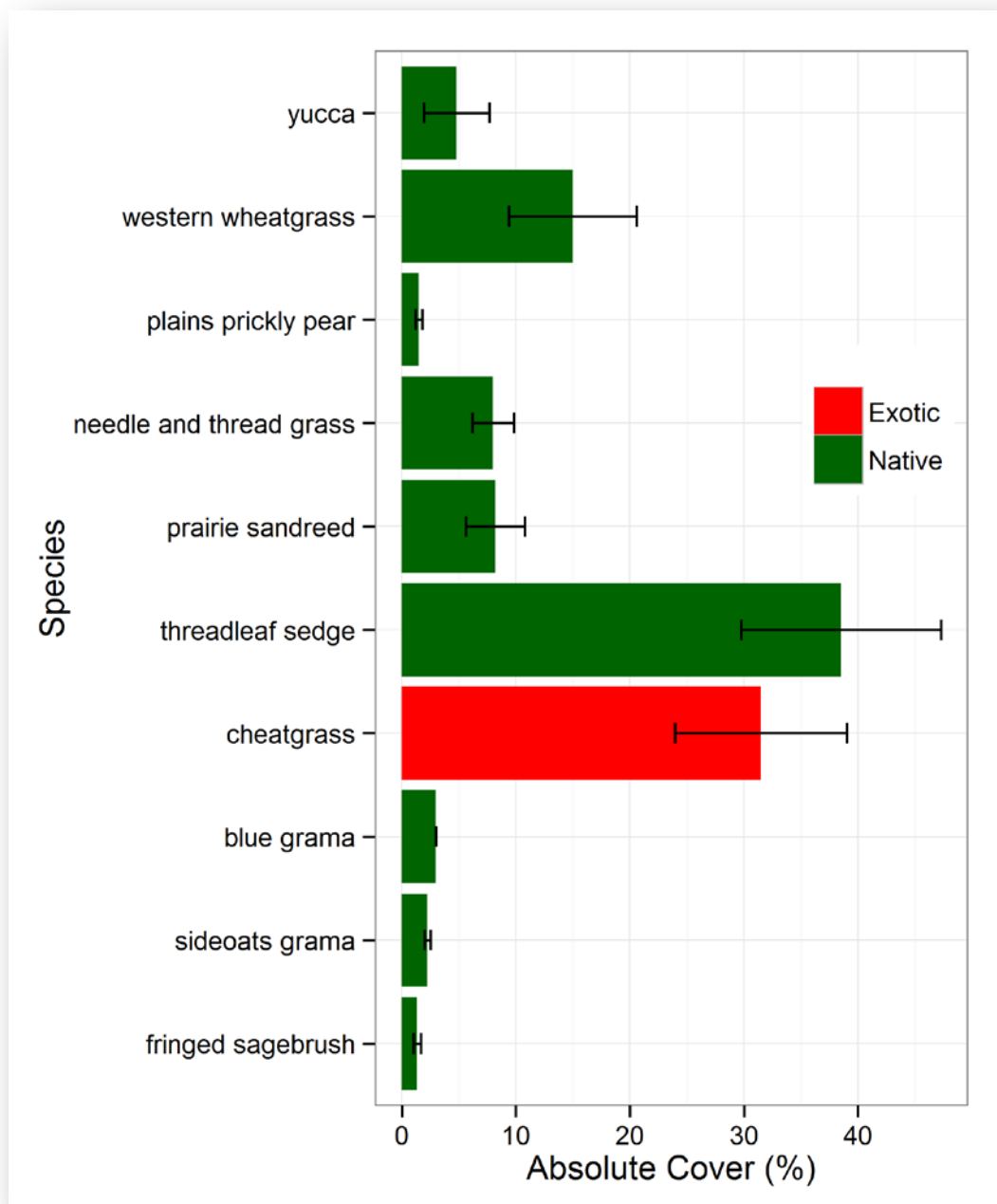


Figure 5. The average absolute cover of the 10 most common native (green) and exotic (red) plants recorded at Scotts Bluff National Monument in 2013. Bars represent means $\pm$ standard errors.



Figure 6. *Fritillaria atropurpurea*, a rare plant, seen at long-term monitoring plots in Scotts Bluff National Monument in 2013. Photograph by Patrick Alexander courtesy of Southwest Environmental Information Network (<http://swbiodiversity.org/seinet/taxa/index.php?taxon=3043>).

Average species richness at each of the 8 plots was measured by point-intercept and in 1 m² and 10 m² quadrats (Table 5). On average, there are about 2 exotic species within the 1 m² quadrat (Table 5). From the point-intersect data, we found average plot diversity, H' , to be 1.4 ± 0.18 . Evenness, J' , averaged 0.65 ± 0.05 across the plots (Table 3). When including only native species, average diversity and evenness were 1.4 ± 0.2 and 0.72 ± 0.05 , respectively.

Table 5. Average plant species richness in 8 plots at Scotts Bluff National Monument in 2013. Values represent means $\pm$ standard errors, $n=8$.

	Point-intercept	1 m ² quadrats	10 m ² quadrats
Species richness	10 ± 1.6	6 ± 0.6	11 ± 1.0
Native species richness	8 ± 1.6	4 ± 0.5	8 ± 1.0
Exotic species richness	2 ± 0.2	2 ± 0.1	3 ± 0.1
Graminoid species richness	6 ± 0.8	3 ± 0.4	5 ± 0.5
Forb species richness	2 ± 0.6	3 ± 0.2	5 ± 0.5

While there was some variation across sites, the plots we visited in SCBL tended to have a low diversity of native plants compared to other mixed-grass prairies. Species richness in the mixed-grass prairie is determined by numerous factors including fire regime, grazing, prairie dog disturbance, and weather fluctuations (Symstad and Jonas 2011). In SCBL, there is also a mixed history of past land-use practices that have affected current species richness. For instance, the site PCM_0006 lies in the northwestern part of the park and was once a feedlot, heavily grazed, and seeded. While it is difficult to define a reference condition for species richness that can vary so much spatially and temporally, the natural range of variation over long-time periods may be a good starting point (Symstad and Jonas *in press*). Long-term records of species diversity in mixed-grass prairie from a relatively undisturbed site in Kansas vary between 3 and 15 species per square meter over the course of 30 years (Symstad and Jonas, *in press*). Compared to this, SCBL is within the natural range (Table 5,

native richness in the 1 m² quadrat and Table 4) but is very low, and site PCM_0006 falls below this reference condition.

The average relative cover of exotic species at sites in SCBL was high ($37 \pm 10\%$; Table 3). However, like species richness, cover of exotic species varied considerably among sites (Table 6). Sites PCM_0009 and PCM_0012 had a low cover of exotic species. The highest cover of exotic species was 91%, found at PCM_0006 (Figure 7).

Cheatgrass accounted for a majority of the exotic cover (Table 6). The presence of annual bromes in mixed grass prairie is associated with decreased productivity

and altered nutrient cycling (Ogle et al. 2003), and there is strong evidence from regions further west that cheatgrass alters fire regimes and the persistence of native species (D'Antonio and Vitousek 2003). Reducing the cover of annual bromes remains a major challenge for the park, as it has been for the past 15 years.



Figure 7. Long-term monitoring site PCM_0006 fell within a prairie dog town at Scotts Bluff National Monument. In 2013, we found it to have a low native diversity and high exotic cover.

Table 6. Characteristics of the plant community at 8 plots in Scotts Bluff National Monument in 2013 including average cover of annual bromes, exotic plant cover, and area of disturbance.

Plot	Native species richness in 1 m ²	Exotic cover (%)	Annual brome cover (%)	Disturbance within site (m ²)
SCBL_PCM_0005	5	45	39	20
SCBL_PCM_0006	2	91	89	2290
SCBL_PCM_0007	4	24	24	250
SCBL_PCM_0009	5	6	6	90
SCBL_PCM_0010	4	60	60	221
SCBL_PCM_0011	4	24	23	30
SCBL_PCM_0012	6	8	8	2360
SCBL_PCM_0023	6	36	33	0
<i>Park Average</i>	4 ± 0.5	37 ± 10	35 ± 9.8	-

Disturbance from grazing, prairie dogs, fire, and humans affects plant community structure and composition in mixed-grass prairie. For this reason, we measured the approximate area affected by natural and human disturbances at each site we visited. In 2013, the most common disturbance was from small rodents and prairie dogs, but there was also evidence of fire and deer trails. PCM_0006,

which was on the edge of the prairie dog town, and PCM_0012 had evidence of being burned (Table 5). With this small sample size, we found no correlation with disturbance and native richness or exotic cover.

Legacy Plots

Four plots that were established in 1997 by the Heartland Inventory & Monitoring Program were visited by NGPN in 2013. The two plots that were part of a restoration project after reclaiming a golf course had much higher exotic cover than nearby control plots in mixed-grass prairie (Table 7). Native diversity was relatively high in the restored site LPCM_14. These patterns are similar to that found from 1998-2009 (James 2010).

Table 7. Characteristics of the plant community at restored and mixed-grass prairie plots in Scotts Bluff National Monument in 2013.

Plot	Native species richness in 1 m ²	Exotic cover (%)	Annual brome cover (%)	Species richness in 10 m ²
<i>Native mixed-grass</i>				
SCBL_PCM_11	5	14	14	8
SCBL_PCM_12	5	2	0	8
<i>Restored community</i>				
SCBL_PCM_13	2	74	72	6
SCBL_PCM_14	4	41	40	11

Summary

In conclusion, SCBL plays a vital role in protecting and managing some of the last remnants of native mixed-grass prairie in the area. While some areas of the park are highly impacted and have a high cover of exotic species, there are other areas that have low exotic cover and a high diversity of native plants. To retain ecological integrity it is important to continue efforts to reduce the cover of invasive plants. Annual bromes present the largest challenge to SCBL, and more research on effective management strategies in the mixed-grass prairie is greatly needed. Continued monitoring efforts will be critical to track changes in the condition of the vegetation communities in SCBL.

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Appendix A: Field journal for plant community monitoring in SCBL for the 2013 season

Plant community composition monitoring in Scotts Bluff National Monument was completed using a crew of 8 people working 4, 10-hour days. We spent 330 total crew hours.

Date	Day of week	Approximate Travel Time (hrs)	Housing	Sites Completed
May 20, 2013	Monday	4.5	Monument Inn and Suites	PCM-005
May 21, 2013	Tuesday	N/A	Monument Inn and Suites	PCM-009 PCM-012 PCM-11 PCM-060
May 22, 2013	Wednesday	N/A	Monument Inn and Suites	PCM-007 PCM-023 PCM-011 LPCM -11
May 23, 2013	Thursday	4.5	N/A	LPCM -13 LPCM -14 LPCM -12

Appendix B: List of plant species found in 2013 at SCBL

Family	Code	Scientific Name	Common Name	Exotic
Agavaceae	YUGL	<i>Yucca glauca</i>	yucca	
Anacardiaceae	RHTR	<i>Rhus trilobata</i>	skunkbush, skunkbush sumac	
Apiaceae	CYGL99	<i>Cymopterus glomeratus</i>	plains parsley	
Asclepiadaceae	ASCLE	<i>Asclepias</i>	milkweed	
Asteraceae	AMPS	<i>Ambrosia psilostachya</i>	perennial ragweed, western ragweed	
	ARFI2	<i>Artemisia filifolia</i>	sand sagebrush	
	ARFR4	<i>Artemisia frigida</i>	fringed sagebrush	
	COCA5	<i>Conyza canadensis</i>	Canadian horseweed, horseweed	
	ERNA10	<i>Ericameria nauseosa</i>	rubber rabbitbrush	
	ERCA4	<i>Erigeron canus</i>	hoary fleabane	
	GRSQ	<i>Grindelia squarrosa</i>	curlycup gumweed	
	GUSA2	<i>Gutierrezia sarothrae</i>	broom snakeweed	
	HEAN3	<i>Helianthus annuus</i>	annual sunflower	
	HEVI4	<i>Heterotheca villosa</i>	hairy false goldaster,	
	LASE	<i>Lactuca serriola</i>	prickly lettuce, wild lettuce	*
	LIPU	<i>Liatris punctata</i>	dotted blazing star, dotted gayfeather	
	LYJU	<i>Lygodesmia juncea</i>	skeletonplant	
	MUOB99	<i>Mulgedium oblongifolium</i>	blue lettuce	
	SERI2	<i>Senecio riddellii</i>	Riddell's ragwort	
	SOMI2	<i>Solidago missouriensis</i>	prairie goldenrod	
	TAOF	<i>Taraxacum officinale</i>	dandelion	*
	TRDU	<i>Tragopogon dubius</i>	common salsify	*
Boraginaceae	XASP99	<i>Xanthium spinulosum</i>	lacy tansyaster	
	CYOF	<i>Cynoglossum officinale</i>	gypsyflower, houndstongue	*
	LAOC3	<i>Lappula occidentalis</i>	flatspine stickseed, western sticktight	
Brassicaceae	LIIN2	<i>Lithospermum incisum</i>	fringed gromwell	
	DEPI	<i>Descurainia pinnata</i>	western tansymustard	
	DRRE2	<i>Draba reptans</i>	Carolina draba	
	LEDE	<i>Lepidium densiflorum</i>	common pepperweed	
	SIAL2	<i>Sisymbrium altissimum</i>	tumble mustard	*
Cactaceae	OPPO	<i>Opuntia polyacantha</i>	plains pricklypear	
Caprifoliaceae	SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry, wolfberry	
Chenopodiaceae	CHENO	<i>Chenopodium</i>	goosefoot	*
	KOSC	<i>Kochia scoparia</i>	common kochia	*
	KRLA2	<i>Krascheninnikovia lanata</i>	winterfat	
	SATR12	<i>Salsola tragus</i>	prickly Russian thistle	*
Commelinaceae	TROC	<i>Tradescantia occidentalis</i>	prairie spiderwort	
Convolvulaceae	COAR4	<i>Convolvulus arvensis</i>	field bindweed	*
Cupressaceae	JUSC2	<i>Juniperus scopulorum</i>	Rocky Mountain juniper	
Cyperaceae	CAREX	<i>Carex</i>	carex, sedge	
	CADU6	<i>Carex duriuscula</i>	needleleaf sedge	
	CAFI	<i>Carex filifolia</i>	threadleaf sedge	
	CAIN9	<i>Carex inops</i>	long-stolon sedge, sun sedge	
Euphorbiaceae	CRTE4	<i>Croton texensis</i>	skunkweed	
	EUGL3	<i>Euphorbia glyptosperma</i>	ribseed sandmat	
Fabaceae	ASGR3	<i>Astragalus gracilis</i>	slender milkvetch	
	LAPO2	<i>Lathyrus polymorphus</i>	manystem peavine	
	MEOF	<i>Melilotus officinalis</i>	yellow sweet-clover	*
	PSTE5	<i>Psoraleidum tenuiflorum</i>	scurfpea	
	THRH	<i>Thermopsis rhombifolia</i>	goldenpea	
	VIAM	<i>Vicia americana</i>	American vetch	
Grossulariaceae	RIAU	<i>Ribes aureum</i>	golden currant	
Liliaceae	ALTE	<i>Allium textile</i>	prairie onion, textile onion, wild onion	
	FRAT	<i>Fritillaria atropurpurea</i>	spotted fritillary	

Family	Code	Scientific Name	Common Name	Exotic
	LEMO4	<i>Leucocrinum montanum</i>	star-lily	
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	scarlet globemallow	
Melanthiaceae	TOVE2	<i>Toxicoscordion venenosum</i>	meadow deathcamas	
Nyctaginaceae	MIAL4	<i>Mirabilis albida</i>	white four o'clock	
Onagraceae	OESU99	<i>Oenothera suffrutescens</i>	scarlet beeblossom	
Poaceae	AGCR	<i>Agropyron cristatum</i>	crested wheatgrass	*
	BOCU	<i>Bouteloua curtipendula</i>	sideoats grama	
	BOGR2	<i>Bouteloua gracilis</i>	blue grama	
	BRIN2	<i>Bromus inermis</i>	awnless brome, smooth brome	*
	BRTE	<i>Bromus tectorum</i>	cheatgrass	*
	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed	
	ELLA3	<i>Elymus lanceolatus</i>	thickspike wheatgrass	
	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	
	HECO26	<i>Hesperostipa comata</i>	needleandthread	
	KOMA	<i>Koeleria macrantha</i>	junegrass	
	NAVI4	<i>Nassella viridula</i>	green needlegrass	
	PASM	<i>Pascopyrum smithii</i>	western wheatgrass	
	POPR	<i>Poa pratensis</i>	Kentucky bluegrass	*
	POSE	<i>Poa secunda</i>	big bluegrass	
	SCSC	<i>Schizachyrium scoparium</i>	little bluestem	
	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed	
	VUOC	<i>Vulpia octoflora</i>	sixweeks grass, sixweeks fescue	
Polemoniaceae	PHAN4	<i>Phlox andicola</i>	prairie phlox	
	PHHO	<i>Phlox hoodii</i>	Hood's phlox, spiny phlox	
Polygonaceae	ERFL4	<i>Eriogonum flavum</i>	alpine golden buckwheat	
	RUSA	<i>Rumex salicifolius</i>	willow dock	
Rosaceae	PRVI	<i>Prunus virginiana</i>	chokecherry	
Rosaceae	ROWO	<i>Rosa woodsii</i>	Wood's rose	
Scrophulariaceae	PENST	<i>Penstemon</i>	beard tongue	
	PEAL2	<i>Penstemon albidus</i>	white penstemon	
Solanaceae	PHHI8	<i>Physalis hispida</i>	groundcherry, prairie ground-cherry	
	PHLO4	<i>Physalis longifolia</i>	common groundcherry	
Unknown Family	UNKFORB	<i>Unknown forb</i>	unknown forb	*
Verbenaceae	VEBR	<i>Verbena bracteata</i>	bigbract verbena	
Violaceae	VINU2	<i>Viola nuttallii</i>	Nuttall's violet	