



Plant Community Composition and Structure Monitoring for Badlands National Park

2013 Annual Report

Natural Resource Data Series NPS/NGPN/NRDS—2014/601



ON THE COVER

Navigating to a long-term monitoring plot at Badlands National Park, 2013

Photograph by: E. Moore, NPS

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January 2014

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

Ashton, I.W and M. Prowatzke. 2014. Plant community composition and structure monitoring for Badlands National Park: 2013 annual report. Natural Resource Data Series NPS/NGPN/NRDS—2014/601. National Park Service, Fort Collins, Colorado.

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Acknowledgments

We thank all the authors of the NGPN Plant Community Monitoring Protocol, particularly A. Symstad, for outstanding guidance on data collection and reporting. Thank you to the staff at BADL, particularly M. Haar for providing logistical support, safety checks and help in the field. The 2013 NGPN vegetation field crew of I. Ashton, M. Prowatzke, E. Moore, M. Owen, J. Ladd, J. Moran, C. Traft, and S. Rockwood collected all the data included in this report. We thank S. Wilson for invaluable support and instruction on managing data in the FFI database and for assistance with the GIS data.

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. 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 reality that there have been fundamental changes in the disturbance regimes, such as climate, fire, and large ungulate grazing, 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.

Badlands National Park (BADL) was established in 1939 as a National Monument and in 1978 became a National Park with a mission to protect and preserve 242,756 acres of rugged badlands, mixed-grass prairie, and rich fossil deposits. The vegetation is a mosaic of sparsely vegetated badlands, native mixed-grass prairie, woody draws, and exotic grasslands. The Northern Great Plains Inventory & Monitoring Program (NGPN) began vegetation monitoring at BADL in 2011 (Ashton et al. 2012). Vegetation monitoring protocols and plot locations were chosen to represent the entire park and to coordinate efforts with the Northern Great Plains Fire Ecology Program (FireEP). The long-term objectives of the NGPN and FireEP plant community monitoring effort (Symstad et al. 2012b) in BADL 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. 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 at BADL in 2013, our third year of sampling. We visited 20 plots, and it will take 7 more years to visit every plot in the park twice (Figure 1). We expect to produce reports with more in-depth data analysis and interpretation when we complete 5 and 10 years of sampling. In the interim, reports, spatial data, and data summaries can be provided for park management and interpretation upon request.

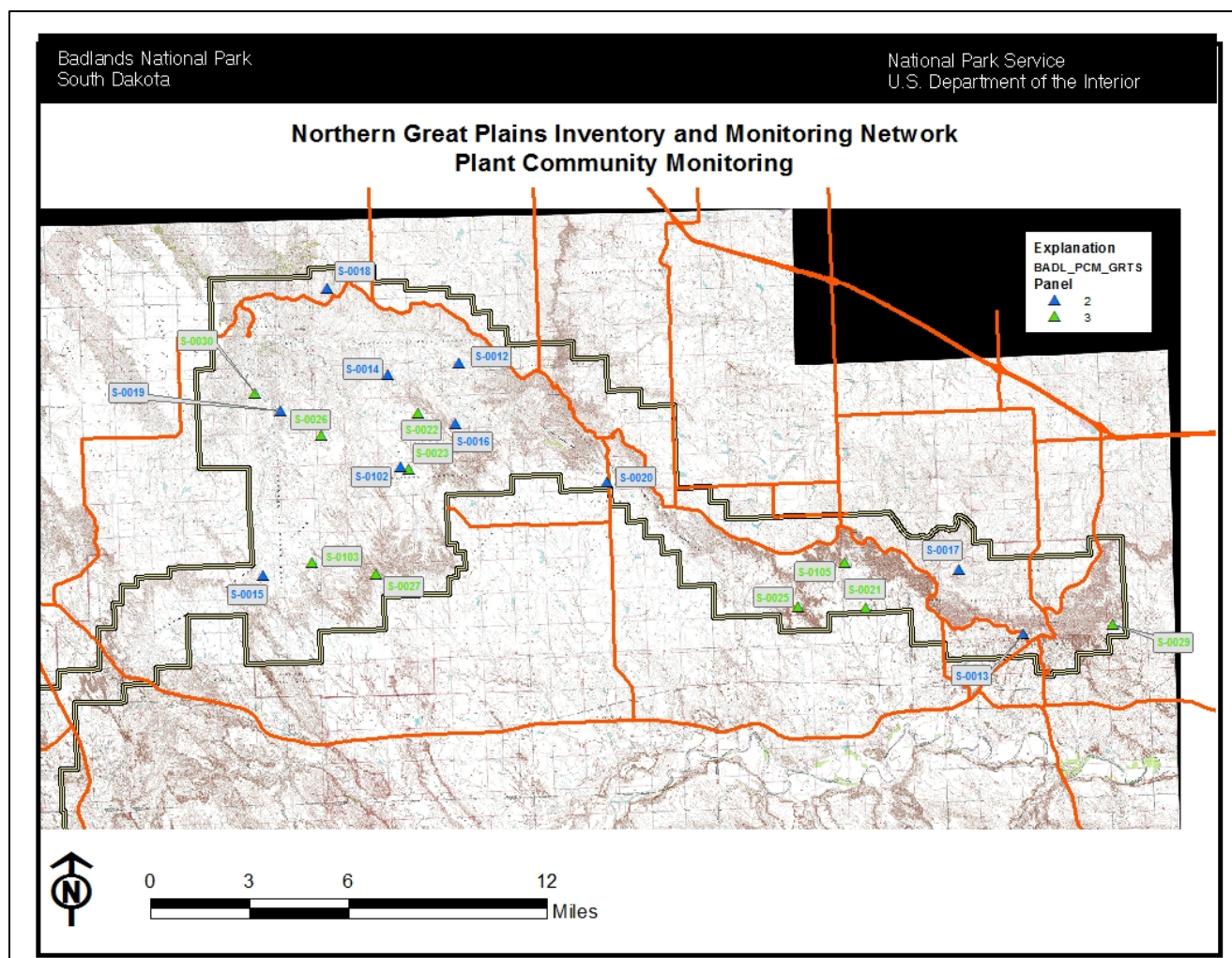


Figure 1. Map of Badlands National Park (BADL) and plant community monitoring plots surveyed in 2013.

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 BADL using a spatially balanced probability design (Generalized Random Tessellation Stratified [GRTS]; Stevens and Olsen 2003, 2004). Using a GRTS design, we selected 100 randomly located sites within BADL (Figure 1). We split these 100 sites into 10 panels with 10 sites each. We visit 2 panels (20 sites) every year, and after 10 years (2021) we will have visited all 100 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 (Figure 1). In 2013, we visited sites in panel 2 and panel 3 during mid- June. Data from these randomly selected sites can be used to estimate condition of vegetation communities for the whole park, and over time 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 BADL took an 8-person crew 9 field days (see Appendix A for a detail of activities each day).

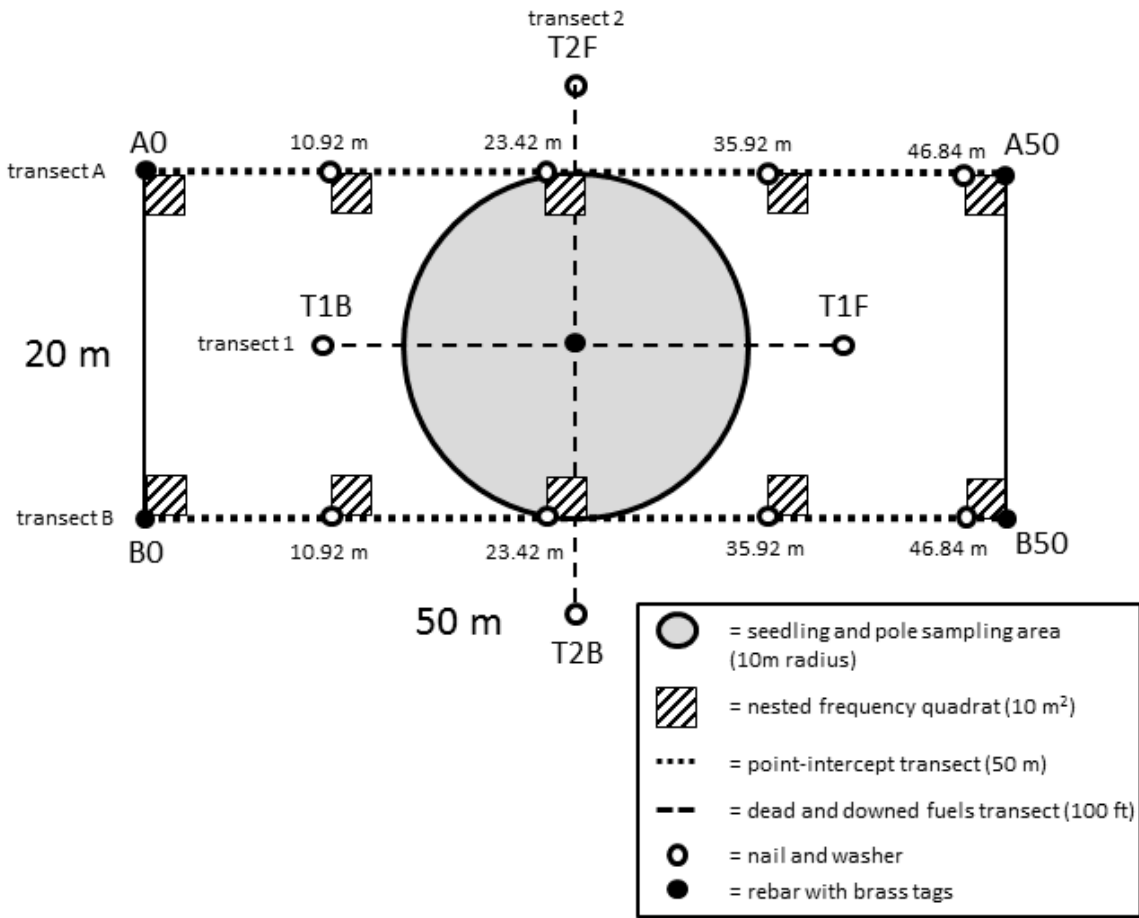


Figure 2. Long-term monitoring plot used for sampling vegetation in Badlands National Park.

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, we did not find any trees or seedlings within our plots.

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 South Dakota, and may occur in BADL (Table 2).

Table 1. Exotic species surveyed for at Badlands National Park 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. cyparissias</i>	myrtle spurge	Upland
<i>Dipsacus fullonum</i> & <i>D. laciniatus</i>	common teasel	Upland
<i>Salvia aethiops</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 Badlands National Park.

Scientific Name	Common Name
<i>Allium drummondii</i>	Drummond's onion
<i>Astragalus barrii</i>	Barr's milkvetch
<i>Astragalus hyalinus</i>	summer orophaca
<i>Clematis hirsutissima</i>	hairy clematis
<i>Cryptantha cana</i>	silver-mounded candleflower
<i>Ericameria parryi</i>	Parry's rabbitbrush
<i>Erigeron ochroleucus</i>	buff fleabane
<i>Eriogonum visherii</i>	Visher's buckwheat
<i>Ipomopsis spicata</i>	spiked ipomopsis
<i>Oenothera flava</i>	yellow evening primrose
<i>Orobanche uniflora</i>	one-flowered broomrape
<i>Physaria arenosa</i>	sidesaddle bladderpod
<i>Physaria montana</i>	mountain bladderpod
<i>Solidago velutina</i>	3-nerve goldenrod
<i>Thelesperma megapotamicum</i>	Hopi tea
<i>Townsendia exscapa</i>	Easter daisy

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 developed 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 the FFI database as needed.

Plant life forms (e.g., shrub, forb) were based on definitions from the USDA Plants Database (USDA-NRCS 2012). Warm-season grasses were identified primarily using a guide by Skinner (2010). Summaries were produced using the FFI reporting and query tools, and statistical summaries and graphics were generated using R software (version 2.15.1).

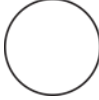
We measured diversity at the plots in 3 ways: species richness, the Shannon Index, and Pielou's Index of Evenness. Species richness is simply a count of the species recorded in an area. The Shannon Index, H' , is a measure of the number of species in an area and how even abundances are across the community. 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; values near 0 indicate dominance by a single species, and values near 1 indicate nearly equal abundance of all species present.

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://www.nps.gov/stateoftheparks/>). 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, warrants moderate caution, or warrants 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. In some case, reference conditions can be determined only after we have accumulated more years of data. When this is the case, we refer to these as "To be determined" and estimate condition based on our professional judgment.

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://www.nps.gov/stateoftheparks/>).

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

Badlands NP experienced moderate to severe drought conditions throughout the winter and into the spring of 2013 (Figure 3). When the NGPN visited the park in June, recent wet weather allowed for some green-up, but overall the park was still experiencing drought conditions. Average canopy cover was 120% (Table 4) in 2013, which was much higher than the 82% seen the previous year (Ashton et al. 2013). There was a large amount of standing litter on the ground with ground cover at the sites averaging 69% plant litter.

We found 181 plant species in 2013 at BADL (Appendix B). Graminoids, which includes grasses, sedges, and rushes, accounted for most of the vegetative cover at BADL, but forbs, shrubs, and subshrubs (defined as a low-growing shrub usually under 0.5m) were also found along the transects (Figure 4). We found 27 exotic species at the park, all of which were either forbs or graminoids.

There was some variation in species composition across the 20 sites. The most common species in the sites we visited were western wheatgrass, cheatgrass, and Japanese brome (Figure 5). Annual bromes (cheatgrass and Japanese brome) were much more abundant in 2013 than they had been in 2012; increasing from 1% to 16% cover (Ashton et al. 2013).

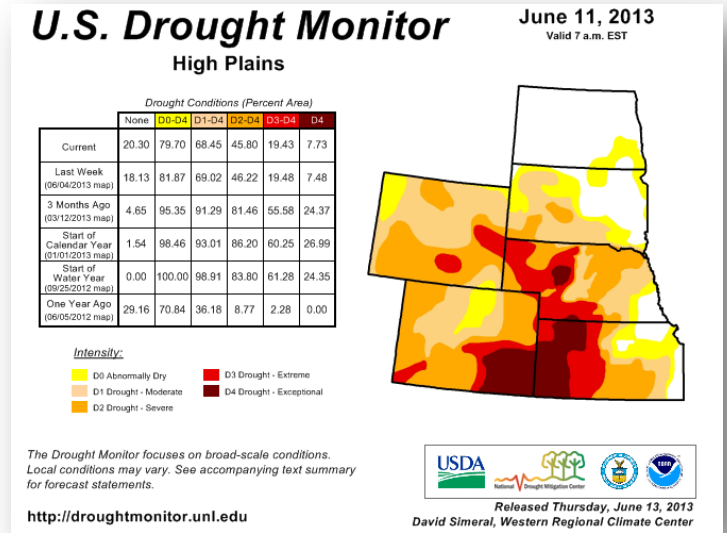


Figure 3. Drought conditions in early June 2013 in the Northern Great Plains. Badlands National Park experienced severe to extreme drought at that time.

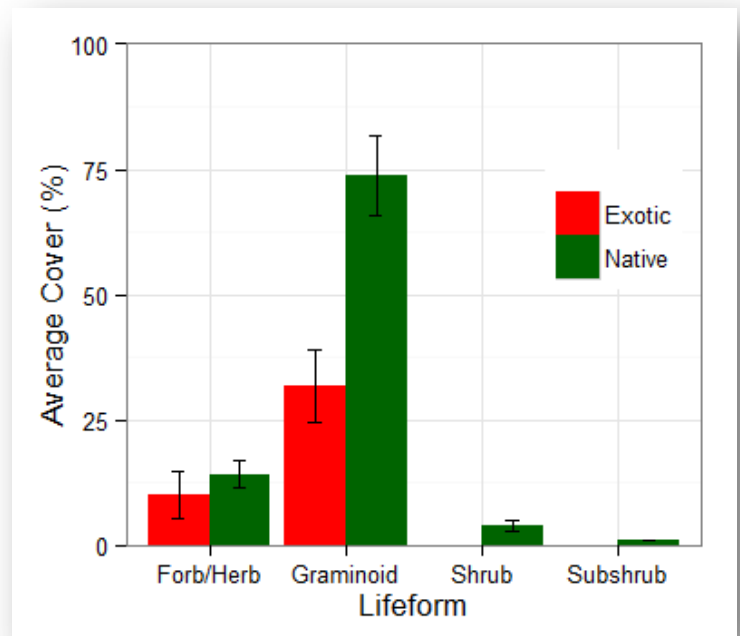


Figure 4. Average cover by lifeform and nativity in 20 plant community monitoring plots in Badlands National Park in 2013. Native (green) and exotic (red) graminoids were the most abundant lifeform across the plots. Bars represent means $\pm$ standard errors.

Table 4. Natural resource condition summary table for upland plant communities in Badlands National Park (BADL).

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	120 $\pm$ 15.4 %	TBD ⁽¹⁾		BADL plays a vital role in protecting and managing some of the largest remnants of native mixed-grass prairie in the region. The park is characterized by moderate native species richness that falls within a natural range of variability. The condition assessment for canopy cover and evenness is based on professional judgment, but as we collect more data and understand the natural range of variability our confidence in these assessments will increase.
	Native species richness (based on average of 10 1m ² quadrats per plot)	7 $\pm$ 0.6 species	3-15 species ⁽²⁾		
	Evenness (based on point-intercept of 2-50m transects per plot)	0.75 $\pm$ 0.02	TBD ⁽¹⁾		
Exotic Plant Early Detection and Management	Relative cover of exotic species	26 $\pm$ 4 %	$\leq$ 10 % cover		In general, the sites in BADL had a high cover of exotic species. Only 4 of the sites visited in 2013 had exotic cover less than 10% cover. The lowest exotic cover was seen in badland areas. Sweetclover and annual bromes present a large challenge to BADL, and more research on effective management strategies in the mixed-grass prairie is greatly needed.
	Annual brome cover	16 $\pm$ 3.1 %	$\leq$ 10 % cover		

References and Data Sources:

1. To be determined when more data are available. 2. 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. Gutsenspergen, editor. Application of threshold concepts in natural resource decision making. Springer Verlag.

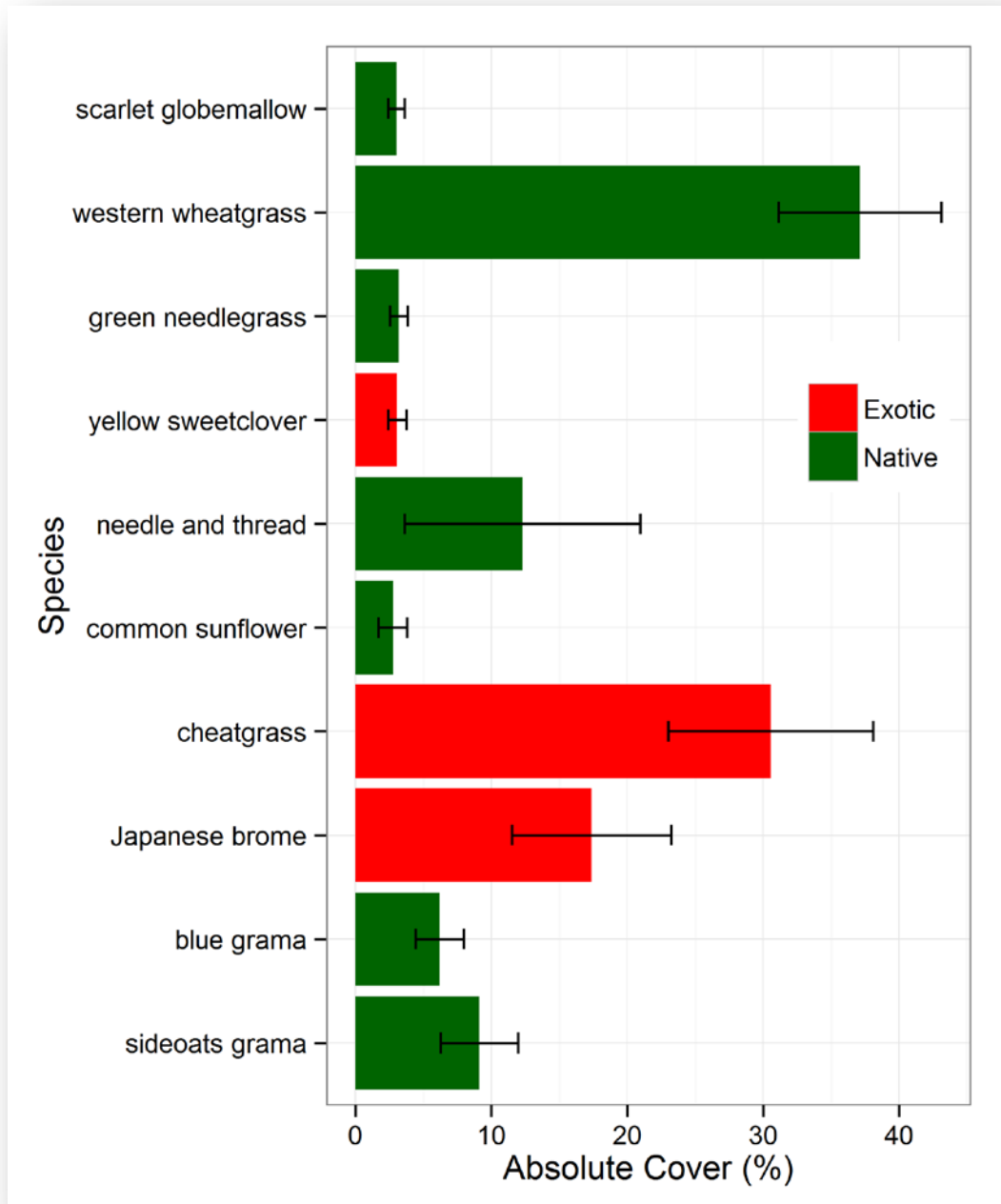


Figure 5. The average absolute cover of the 10 most common native (green) and exotic (red) plants recorded at Badlands National Park in 2013. Bars represent means $\pm$ standard errors.

Average species richness at each of the 20 plots was measured by point-intercept and in 1 m² and 10 m² quadrats (Table 5). On average, there are about 3 exotic species within the 1 m² quadrat (Table 5). From the point-intersect data, we found average plot diversity, H' , to be 1.97 ± 0.10 . Evenness, J' ,

averaged 0.75 ± 0.02 across the plots (Table 4). When including only native species, average diversity and evenness were 1.66 ± 0.10 and 0.71 ± 0.02 , respectively.

Table 5. Average plant species richness in 20 plots at Badlands National Park in 2013. Values represent means $\pm$ standard errors, $n=20$ for point-intercept and $n=19$ for quadrats.

	Point-intercept	1 m ² quadrats	10 m ² quadrats
Species richness	16 ± 1.3	10 ± 0.6	16 ± 1.0
Native species richness	12 ± 1.0	7 ± 0.6	12 ± 1.0
Exotic species richness	4 ± 0.6	3 ± 0.3	4 ± 0.6
Graminoid species richness	7 ± 0.8	4 ± 0.4	5 ± 0.4
Forb species richness	8 ± 0.8	6 ± 0.4	10 ± 1.2

While there was some variation across sites, the plots we visited in BADL tended to have a moderate 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). 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



Figure 6. Long-term monitoring site PCM_027 at Badlands National Park. In 2013, we found this badland site to have a low native plant diversity relative to the other sites in the park that are more typical mixed-grass prairie.

30 years (Symstad and Jonas, in press). Compared to this, BADL is within the natural range (Table 4, native richness in the 1 m² quadrat and Table 5). The lowest diversity was seen in site PCM_027 (2 species within 1-m²; Figure 6). This site is covered by badlands, presenting inhospitable growing conditions. As such, it has a very low canopy cover compared to the more typical mixed-grass prairie sites.

The average relative cover of exotic species at sites in BADL was high ($26 \pm 4\%$; Table 4). However, like species richness, cover of exotic species varied considerably among sites (Table 6). Site PCM_014 had no exotic species; however, like PCM_027 it was a badlands site with very little plant cover. The highest cover of exotic species was 77%, found at PCM_030, which fell within an old

prairie dog town. Annual bromes accounted for a majority of the exotic cover in all plots, but other exotics such as yellow sweetclover were also abundant (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.

Table 6. Characteristics of the plant community at 20 plots in Badlands National Park 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)
BADL_PCM_0012	9	23	19	0
BADL_PCM_0013	7	41	39	20
BADL_PCM_0014	5	0	0	100
BADL_PCM_0015	7	32	32	0
BADL_PCM_0016	6	10	8	0
BADL_PCM_0017	7	6	0	410
BADL_PCM_0018	14	3	3	0
BADL_PCM_0019	6	33	16	10
BADL_PCM_0020	7	29	19	10
BADL_PCM_0021	10	10	6	2290
BADL_PCM_0022	7	28	22	445
BADL_PCM_0023	9	26	0	1175
BADL_PCM_0025	5	42	16	40
BADL_PCM_0026	10	6	4	0
BADL_PCM_0027	2	21	14	50
BADL_PCM_0029	NA	42	37	0
BADL_PCM_0030	4	77	17	2015
BADL_PCM_0102	7	13	7	850
BADL_PCM_0103	6	53	47	2310
BADL_PCM_0105	5	29	11	3340
<i>Park Average</i>	<i>7 ± 0.6</i>	<i>26 ± 4</i>	<i>16 ± 3.1</i>	-

In addition to the species targeted for early detection in the Northern Great Plains region, Badlands National Park is concerned about specific exotic plant species listed in Table 7. We did not find any of these species in the plots visited in 2013.

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 animal trails, but there was also evidence of past fire, bison wallows, erosion

and flooding. When sampling across the park is complete in 2015 and we have a larger data set, we hope to explore how disturbance relates to plant diversity and exotic cover.

Table 7. Exotic species of management concern to Badlands National Park.

Scientific Name	Common Name
<i>Elaeagnus angustifolia</i>	Russian olive
<i>Euphorbia esula</i>	leafy spurge
<i>Falcaria vulgaris</i>	sickleweed
<i>Poa bulbosa</i>	bulbous bluegrass
<i>Potentilla recta</i>	sulphur cinquefoil
<i>Rhaponticum repens</i>	Russian knapweed
<i>Sideritis montana</i>	mountain ironwort
<i>Tamarix</i> spp.	tamarisk
<i>Tanacetum vulgare</i>	common tansy
<i>Thymelaea passerina</i>	spurge flax

Summary

In conclusion, BADL plays a vital role in protecting and managing some of the largest remnants of native mixed-grass prairie in the region. Many areas of the park have a high cover of exotic species, and to retain ecological integrity it is important to continue efforts to reduce the cover of invasive plants. Yellow sweetclover and annual bromes present a large challenge to managing grasslands in BADL, and more research on effective management strategies in the mixed-grass prairie is greatly needed. Allowing natural disturbances such as fire, grazing, and prairie dog use may be critical to maintaining plant diversity in BADL, but it should be balanced with the need to protect intact native communities and prevent further invasions of exotic species. Continued monitoring efforts will be critical to track changes in the condition of the vegetation communities in BADL.

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

Plant community composition monitoring in Badlands National Park was completed using a crew of 8 people working 8, 10-hour days plus 1, 10 hour day of 4 people. We spent approximately 700 total crew hours. In addition, park staff contributed 10 hours of field support.

Date	Day of week	Approximate Travel Time (hrs)	Housing	Sites Completed
June 10, 2013	Monday	3	Ann's Motel	PCM-0018 PCM-0025 PCM-0017
June 11, 2013	Tuesday	3	Ann's Motel	PCM-0025 PCM-0013 PCM-0020 PCM-0030
June 12, 2013	Wednesday	3	Ann's Motel	PCM-0022 PCM-0102 PCM-0023
June 13, 2013	Thursday	3	N/A	PCM-0019 PCM-0016
June 17, 2013	Monday	3	N/A	PCM-0012 PCM-0018
June 18, 2013	Tuesday	3	N/A	PCM-0025 PCM-0021 PCM-0105
June 19, 2013	Wednesday	3	N/A	PCM-0103 PCM-0026
June 20, 2013	Thursday	3	N/A	PCM-0027 (attempt)
July 16, 2013	Wednesday	3	N/A	PCM-0027

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

Family	Code	Scientific Name	Common Name	Exotic
Agavaceae	YUGL	<i>Yucca glauca</i>	soapweed yucca	
Amaranthaceae	AMBL	<i>Amaranthus blitoides</i>	mat amaranth	*
Anacardiaceae	RHTR	<i>Rhus trilobata</i>	skunkbush sumac	
	TORY	<i>Toxicodendron rydbergii</i>	western poison ivy	
Apiaceae	LOFO	<i>Lomatium foeniculaceum</i>	desert biscuitroot	
	LOMA3	<i>Lomatium macrocarpum</i>	bigseed biscuitroot	
	MUDI	<i>Musineon divaricatum</i>	leafy wildparsley	
Asclepiadaceae	ASPU	<i>Asclepias pumila</i>	plains milkweed	
	ASSP	<i>Asclepias speciosa</i>	showy milkweed	
	ASVE	<i>Asclepias verticillata</i>	whorled milkweed	
Asteraceae	ACMI2	<i>Achillea millefolium</i>	common yarrow	
	AMAR2	<i>Ambrosia artemisiifolia</i>	annual ragweed	
	ARCA13	<i>Artemisia cana</i>	silver sagebrush	
	ARDR4	<i>Artemisia dracunculus</i>	tarragon	
	ARFR4	<i>Artemisia frigida</i>	prairie sagewort	
	ARLO7	<i>Artemisia longifolia</i>	longleaf wormwood	
	ARLU	<i>Artemisia ludoviciana</i>	white sagebrush	
	BREU	<i>Brickellia eupatorioides</i>	false boneset	
	CIAR4	<i>Cirsium arvense</i>	Canada thistle	*
	CIUN	<i>Cirsium undulatum</i>	wavyleaf thistle	
	COCA5	<i>Conyza canadensis</i>	Canadian horseweed	
	DYPA	<i>Dyssodia papposa</i>	fetid marigold	
	DIPR2	<i>Diaperia prolifera</i>	bighead pygmyweed	
	ECAN2	<i>Echinacea angustifolia</i>	blacksamson echinacea	
	ERNA10	<i>Ericameria nauseosa</i>	rubber rabbitbrush	
	ERPU2	<i>Erigeron pumilus</i>	shaggy fleabane	
	ERST3	<i>Erigeron strigosus</i>	prairie fleabane	
	GRSQ	<i>Grindelia squarrosa</i>	curlycup gumweed	
	GUSA2	<i>Gutierrezia sarothrae</i>	broom snakeweed	
	HEAN3	<i>Helianthus annuus</i>	common sunflower	
	HEMA2	<i>Helianthus maximiliani</i>	Maximilian sunflower	

Family	Code	Scientific Name	Common Name	Exotic
Asteraceae	HEVI4	<i>Heterotheca villosa</i>	hairy false goldenaster	
	IVAX	<i>Iva axillaris</i>	povertyweed	
	LASE	<i>Lactuca serriola</i>	prickly lettuce	*
	LIPU	<i>Liatris punctata</i>	dotted blazing star	
	LYJU	<i>Lygodesmia juncea</i>	rush skeletonplant	
	PAPL12	<i>Packera plattensis</i>	prairie groundsel	
	RACO3	<i>Ratibida columnifera</i>	upright prairie coneflower	
	SOMI2	<i>Solidago missouriensis</i>	Missouri goldenrod	
	SOMO	<i>Solidago mollis</i>	velvety goldenrod	
	SYER	<i>Symphyotrichum ericoides</i>	white heath aster	
	SYOB	<i>Symphyotrichum oblongifolium</i>	aromatic aster	
	TAOF	<i>Taraxacum officinale</i>	common dandelion	*
	TEAC	<i>Tetaneuris acaulis</i>	stemless four-nerve daisy	
	TRDU	<i>Tragopogon dubius</i>	yellow salsify	*
	XAST	<i>Xanthium strumarium</i>	rough cocklebur	
Boraginaceae	CRCE	<i>Cryptantha celosioides</i>	buttecandle	
	LACE	<i>Lappula cenchrusoides</i>	Great Plains stickseed	
	LAOC3	<i>Lappula occidentalis</i>	flatspine stickseed	
	LASQ	<i>Lappula squarrosa</i>	European stickseed	*
	LIIN2	<i>Lithospermum incisum</i>	narrowleaf stoneseed	
	MELA3	<i>Mertensia lanceolata</i>	prairie bluebells	
Brassicaceae	ALDE	<i>Alyssum desertorum</i>	desert madwort	*
	CAMI2	<i>Camelina microcarpa</i>	littlepod false flax	*
	CHTE2	<i>Chorispura tenella</i>	crossflower	*
	COOR	<i>Conringia orientalis</i>	hare's ear mustard	*
	DEPI	<i>Descurainia pinnata</i>	western tansymustard	
	DESO2	<i>Descurainia sophia</i>	herb sophia	*
	DRRE2	<i>Draba reptans</i>	Carolina draba	
	ERCH9	<i>Erysimum cheiranthoides</i>	wormseed wallflower	
	ERIN7	<i>Erysimum inconspicuum</i>	shy wallflower	
	LEDE	<i>Lepidium densiflorum</i>	common pepperweed	
Brassicaceae	SIAL2	<i>Sisymbrium altissimum</i>	tall tumbledustard	*

Family	Code	Scientific Name	Common Name	Exotic
	THAR5	<i>Thlaspi arvense</i>	field pennycress	*
Cactaceae	OPFR	<i>Opuntia fragilis</i>	brittle pricklypear	
	OPMA2	<i>Opuntia macrorhiza</i>	twistspine pricklypear	
	OPPO	<i>Opuntia polyacantha</i>	plains pricklypear	
Caprifoliaceae	SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry	
Caryophyllaceae	CEAR4	<i>Cerastium arvense</i>	field chickweed	
Chenopodiaceae	ATAR2	<i>Atriplex argentea</i>	silverscale saltbush	
	ATCA2	<i>Atriplex canescens</i>	fourwing saltbush	
	CHENO	<i>Chenopodium</i>	goosefoot	*
	CHPR5	<i>Chenopodium pratericola</i>	desert goosefoot	
	HAGL	<i>Halogeton glomeratus</i>	saltlover	*
	KRLA2	<i>Krascheninnikovia lanata</i>	winterfat	
	MONU	<i>Monolepis nuttalliana</i>	Nuttall's povertyweed	
	SATR12	<i>Salsola tragus</i>	prickly Russian thistle	*
Commelinaceae	TROC	<i>Tradescantia occidentalis</i>	prairie spiderwort	
Convolvulaceae	COAR4	<i>Convolvulus arvensis</i>	field bindweed	*
Cyperaceae	CAREX	<i>Carex</i>	sedge	
	CABR10	<i>Carex brevior</i>	shortbeak sedge	
	CADU6	<i>Carex duriuscula</i>	needleleaf sedge	
	CAFI	<i>Carex filifolia</i>	threadleaf sedge	
	CAIN9	<i>Carex inops</i>	long-stolon sedge	
	ELAC	<i>Eleocharis acicularis</i>	needle spikerush	
	ELCO2	<i>Eleocharis compressa</i>	flatstem spikerush	
	ELPA3	<i>Eleocharis palustris</i>	common spikerush	
Euphorbiaceae	EUPHO	<i>Euphorbia</i>	spurge	*
	EUMA8	<i>Euphorbia marginata</i>	snow on the mountain	
	EUSE5	<i>Euphorbia serpyllifolia</i>	thymeleaf sandmat	
	EUSP	<i>Euphorbia spathulata</i>	warty spurge	
Fabaceae	AMCA6	<i>Amorpha canescens</i>	leadplant	
	ASTRA	<i>Astragalus</i>	milkvetch	
	ASAG2	<i>Astragalus agrestis</i>	purple milkvetch	
	ASCR2	<i>Astragalus crassicaarpus</i>	groundplum milkvetch	

Family	Code	Scientific Name	Common Name	Exotic
Fabaceae	ASGI5	<i>Astragalus gilviflorus</i>	plains milkvetch	
	ASGR3	<i>Astragalus gracilis</i>	slender milkvetch	
	ASMI10	<i>Astragalus missouriensis</i>	Missouri milkvetch	
	ASPL2	<i>Astragalus plattensis</i>	Platte River milkvetch	
	ASRA2	<i>Astragalus racemosus</i>	cream milkvetch	
	DACA7	<i>Dalea candida</i>	white prairie clover	
	DAPU5	<i>Dalea purpurea</i>	purple prairie clover	
	GLLE3	<i>Glycyrrhiza lepidota</i>	American licorice	
	LAPO2	<i>Lathyrus polymorphus</i>	manystem pea	
	MELU	<i>Medicago lupulina</i>	black medick	*
	MESA	<i>Medicago sativa</i>	alfalfa	*
	MEOF	<i>Melilotus officinalis</i>	yellow sweetclover	*
	OXLA3	<i>Oxytropis lambertii</i>	purple locoweed	
	PEAR6	<i>Pedimelum argophyllum</i>	silverleaf Indian breadroot	
	PECU3	<i>Pedimelum cuspidatum</i>	largebract Indian breadroot	
	PEES	<i>Pedimelum esculentum</i>	large Indian breadroot	
	PSTE5	<i>Psoralegium tenuiflorum</i>	slimflower scurfpea	
	VIAM	<i>Vicia americana</i>	American vetch	
Geraniaceae	GECA5	<i>Geranium carolinianum</i>	Carolina geranium	
Hydrophyllaceae	ELNY	<i>Ellisia nyctelea</i>	Aunt Lucy	
Iridaceae	SIAN3	<i>Sisyrinchium angustifolium</i>	narrowleaf blue-eyed grass	
Lamiaceae	HEHI	<i>Hedeoma hispida</i>	rough false pennyroyal	
	SARE3	<i>Salvia reflexa</i>	lanceleaf sage	
Liliaceae	ALTE	<i>Allium textile</i>	textile onion	
	CANU3	<i>Calochortus nuttallii</i>	sego lily	
	LEMO4	<i>Leucocrinum montanum</i>	common starlily	
	LIRI	<i>Linum rigidum</i>	stiffstem flax	
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	scarlet globemallow	
Nyctaginaceae	MILI3	<i>Mirabilis linearis</i>	narrowleaf four o'clock	
Oxalidaceae	OXST	<i>Oxalis stricta</i>	common yellow oxalis	
Plantaginaceae	PLEL	<i>Plantago elongata</i>	prairie plantain	
	PLPA2	<i>Plantago patagonica</i>	woolly plantain	

Family	Code	Scientific Name	Common Name	Exotic
Poaceae	ACHY	<i>Achnatherum hymenoides</i>	Indian ricegrass	
	AGCR	<i>Agropyron cristatum</i>	crested wheatgrass	*
	ARPU9	<i>Aristida purpurea</i>	purple threeawn	
	BOCU	<i>Bouteloua curtipendula</i>	sideoats grama	
	BODA2	<i>Bouteloua dactyloides</i>	buffalograss	
	BOGR2	<i>Bouteloua gracilis</i>	blue grama	
	BRIN2	<i>Bromus inermis</i>	smooth brome	*
	BRTE	<i>Bromus tectorum</i>	cheatgrass	*
	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed	
	DIOL	<i>Dichanthelium oligosanthos</i>	Heller's rosette grass	
	DISP	<i>Distichlis spicata</i>	saltgrass	
	ELYMU	<i>Elymus</i>	wildrye	*
	ELCA4	<i>Elymus canadensis</i>	Canada wildrye	
	ELEL5	<i>Elymus elymoides</i>	squirreltail	
	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	
	HECO26	<i>Hesperostipa comata</i>	needle and thread	
	HOJU	<i>Hordeum jubatum</i>	foxtail barley	
	HOPU	<i>Hordeum pusillum</i>	little barley	
	KOMA	<i>Koeleria macrantha</i>	prairie Junegrass	
	MUCU3	<i>Muhlenbergia cuspidata</i>	plains muhly	
	NAVI4	<i>Nassella viridula</i>	green needlegrass	
	PACA6	<i>Panicum capillare</i>	witchgrass	
	PAVI2	<i>Panicum virgatum</i>	switchgrass	
	PASM	<i>Pascopyrum smithii</i>	western wheatgrass	
	PHPR3	<i>Phleum pratense</i>	timothy	*
	POCO	<i>Poa compressa</i>	Canada bluegrass	*
	POPR	<i>Poa pratensis</i>	Kentucky bluegrass	*
	POSE	<i>Poa secunda</i>	Sandberg bluegrass	
	SCSC	<i>Schizachyrium scoparium</i>	little bluestem	
	SEVI4	<i>Setaria viridis</i>	green bristlegrass	*
	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed	
	VUOC	<i>Vulpia octoflora</i>	sixweeks fescue	

Family	Code	Scientific Name	Common Name	Exotic
Polemoniaceae	COLI2	<i>Collomia linearis</i>	tiny trumpet	
	IPCO5	<i>Ipomopsis congesta</i>	ballhead ipomopsis	
	PHAN4	<i>Phlox andicola</i>	prairie phlox	
	PHHO	<i>Phlox hoodii</i>	spiny phlox	
Polygalaceae	POAL4	<i>Polygala alba</i>	white milkwort	
	POVE	<i>Polygala verticillata</i>	whorled milkwort	
Polygonaceae	ERFL4	<i>Eriogonum flavum</i>	alpine golden buckwheat	
	ERPA9	<i>Eriogonum pauciflorum</i>	fewflower buckwheat	
	PORA3	<i>Polygonum ramosissimum</i>	bushy knotweed	
	RUCR	<i>Rumex crispus</i>	curly dock	*
Ranunculaceae	DECA3	<i>Delphinium carolinianum</i>	Carolina larkspur	
Rosaceae	PRVI	<i>Prunus virginiana</i>	chokecherry	
	ROAR3	<i>Rosa arkansana</i>	prairie rose	
Rubiaceae	GALIU	<i>Galium</i>	bedstraw	
Santalaceae	COUM	<i>Comandra umbellata</i>	bastard toadflax	
Scrophulariaceae	PEAL2	<i>Penstemon albidus</i>	white penstemon	
	PEGR5	<i>Penstemon gracilis</i>	lilac penstemon	
Solanaceae	PHLO4	<i>Physalis longifolia</i>	longleaf groundcherry	
	SORO	<i>Solanum rostratum</i>	buffalobur nightshade	
	SOTR	<i>Solanum triflorum</i>	cutleaf nightshade	
Verbenaceae	VEBR	<i>Verbena bracteata</i>	bigbract verbena	
Verbenaceae	VEST	<i>Verbena stricta</i>	hoary verbena	
Violaceae	VINU2	<i>Viola nuttallii</i>	Nuttall's violet	