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Natural Resource Stewardship and Science

Plant Community Composition and Structure Monitoring for Devils Tower National Monument

2013 Annual Report

Natural Resource Data Series NPS/NGPN/NRDS—2014/612

ON THE COVER
Long-term monitoring plot PCM_008 at Devils Tower National Monument, 2013
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Acknowledgments

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Introduction

The Black Hills is a 1.5 million hectare refuge of ponderosa pine (*Pinus ponderosa*) forest surrounded by the prairies of western South Dakota and eastern Wyoming. The ponderosa pine forest of the Black Hills is a unique ecosystem composed of species from the western Rocky Mountains, eastern deciduous forests, northern boreal forests, and the surrounding Great Plains (Larson and Johnson 2007). The National Park Service (NPS) plays an important role in preserving and restoring ponderosa woodlands 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 and fire, that have historically maintained ponderosa woodlands, and there is the continual pressure of exotic invasive species. In recent years, mountain pine beetle (*Dendroctonus ponderosae*) outbreaks have been of particular concern because they are increasing throughout the Black Hills and have caused 100% mortality of ponderosa pines in some areas (Hocking et al. 2010). Long-term monitoring in national parks is essential to sound management of ponderosa woodlands because it can provide information on environmental quality and condition, benchmarks of ecological integrity, and early warning of declines in ecosystem health.

Devils Tower National Monument (DETO) was established in 1906 as the first National Monument with a mission to protect and preserve the impressive rock tower and the lands around it. It is located in northeastern Wyoming on the edge of the Black Hills. The vegetation is a mosaic of ponderosa pine woodlands and mixed-grass prairie with a narrow riparian corridor of cottonwoods. The prevalence of exotic species in the park, changes in ponderosa pine density due to historic fire suppression, and the lack of cottonwood regeneration are of concern to park management and result in a fairly poor overall condition of native plant communities in the park (Komp et al. 2011). The Northern Great Plains Inventory & Monitoring Program (NGPN) began vegetation monitoring at DETO 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 DETO 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 park-wide status and long-term trends of tree density by species, height class, and diameter class, and of fuel loads by fuel classes.

3. Determine status (at 5-year intervals) and long-term trends of tree density by species, height class, and diameter class in lowland areas near targeted perennial streams.

4. 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 DETO in 2013, our third year of sampling. NGPN visited 8 plots (Figure 1). Not all plots are visited every year and it will take 2 more years to visit every plot in the park. 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. In 2013, we also completed a comprehensive survey of forest health at 75 sites within the park. The results from the forest survey will be described in a separate report expected to be published spring 2014.

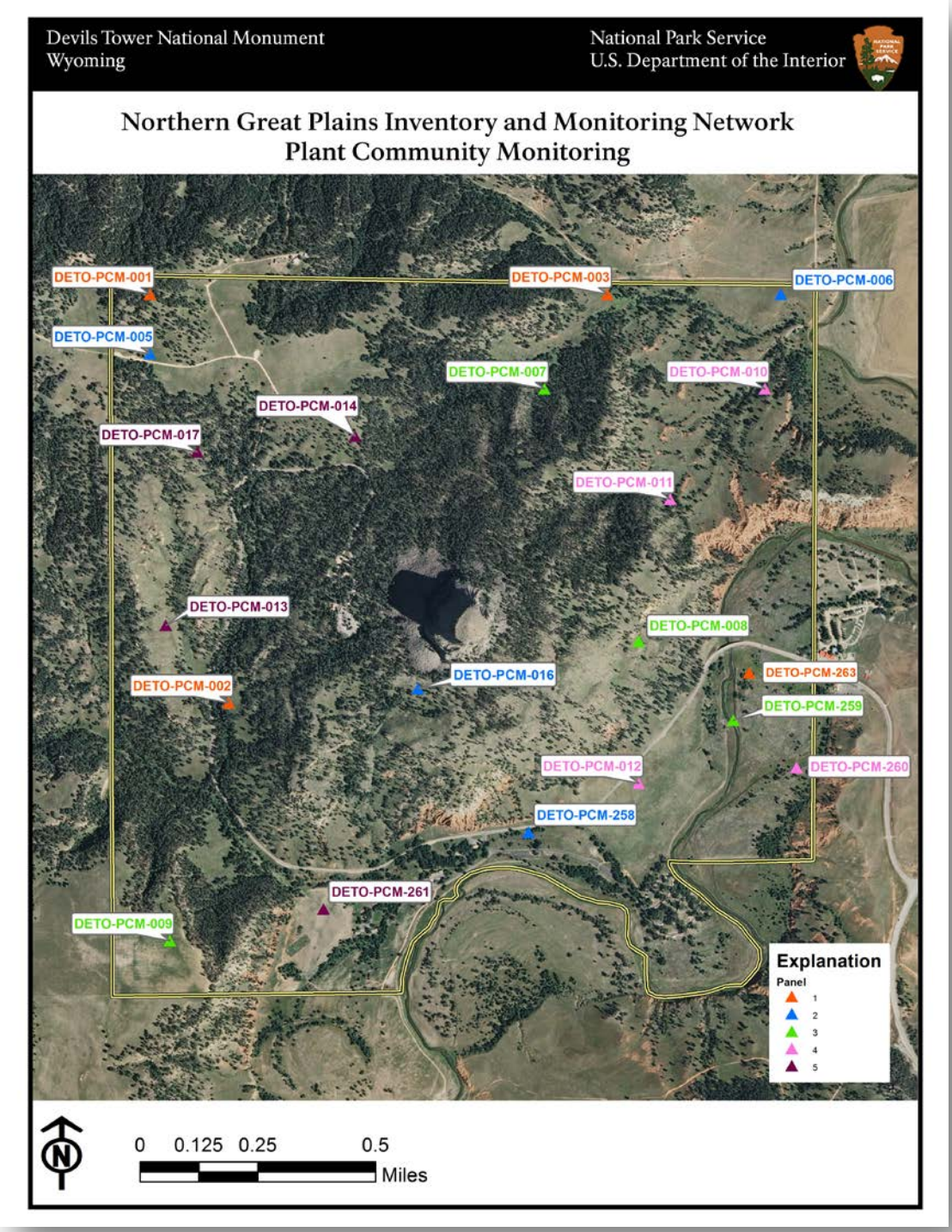


Figure 1. Map of Devils Tower National Monument (DETO) and plant community monitoring (PCM) plots. Plots in panel 2 (blue) and panel 3 (green) were visited in 2013.

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 DETO 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 DETO (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 (Figure 1). In 2013, we visited sites in panel 2 and panel 3 during the last week of 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 $\leq$ 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 m^2, 0.1 m^2, 1 m^2, and 10 m^2) located systematically along each transect (Figure 2). In 2013, sampling at DETO took a 4-person crew approximately 168 hours with travel time and some additional assistance from DETO staff (see Appendix A for a detail of activities each day).

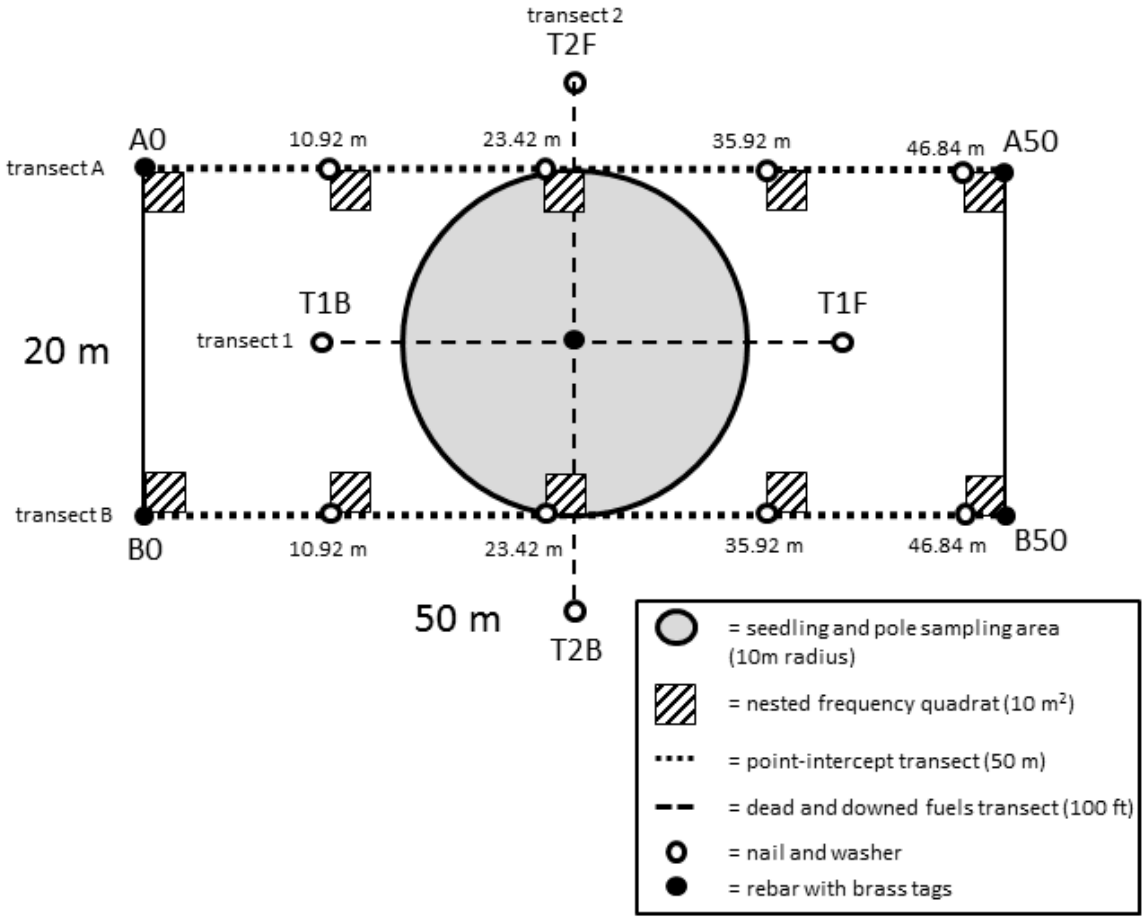


Figure 2. Long-term monitoring plot used for sampling vegetation in Devils Tower National Monument.

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, are mapped and tagged. For each tree, the species, DBH, status, and condition (e.g., leaf-discoloration, insect-damaged, etc.) are recorded. In ponderosa pine woodlands, dead and downed woody fuel load data were collected on two perpendicular 100 ft (30.48 m) transects centered at the center of the plot (Figure 2). These plots were a subset of 75 plots that were visited as part of the more comprehensive survey of DETO forests completed in 20132. Rather than repeat the analysis and interpretation of tree and fuel data for this subset, it will be included in a more comprehensive report on the status of DETO's forests.

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 recorded the approximate area of the disturbance in square meters. 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 Wyoming, and may occur in DETO (Table 2).

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

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

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

Scientific Name	Common Name
Asclepias verticillata	whorled milkweed
Carex alopecoidea	foxtail sedge
Carex emoryi	Emory's sedge
Diaperia prolifera	bighead pygmy cudweed
Dichanthelium wilcoxianum	fall rosette grass
Elymus villosus	hairy wildrye
Glandularia bipinnatifida	Dakota (mock) vervain
Helianthemum bicknellii	hoary frostweed
Oenothera laciniata	cutleaf evening primrose
Polystichum lonchitis	holly fern
Verbesina encelioides	cowpen crownbeard

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.

Disturbances were recorded in square meters and ranged from 0 (not present) to 2290 (the whole plot area) for each type of disturbance. We report the sum of all individual disturbances, so the value can be greater than 2290 m^2.

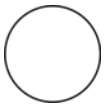
Reporting on Natural Resource Condition

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

Devils Tower NM experienced abnormally dry 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 abnormally dry conditions. Average canopy cover was 135% (Table 4) in 2013, which was similar to 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 81% plant litter.

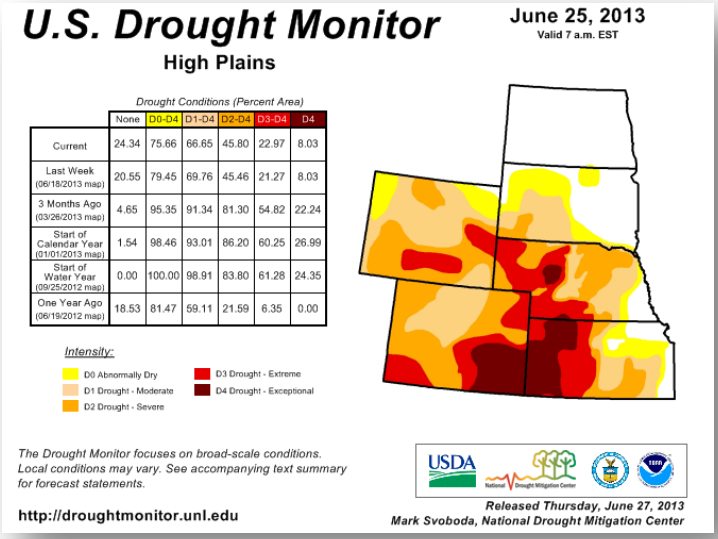


Figure 3. Drought conditions in early June 2013 in the Northern Great Plains. Devils Tower National Monument experienced abnormally dry conditions at that time.

We found 126 plant species in 2013 at DETO (Appendix B). Graminoids, which includes grasses, sedges, and rushes, accounted for most of the vegetative cover at DETO, but trees, forbs, shrubs and subshrubs (defined as a low-growing shrub usually under 0.5m) were also abundant (Figure 4). We found 24 exotic species at the park, all of which were either forbs or graminoids. The shrubs, subshrubs, and trees were all native species. Oregon grape (*Berberis repens*) was the only subshrub we recorded in the park. It was found at only one site where it accounted for a large proportion of the plant cover.

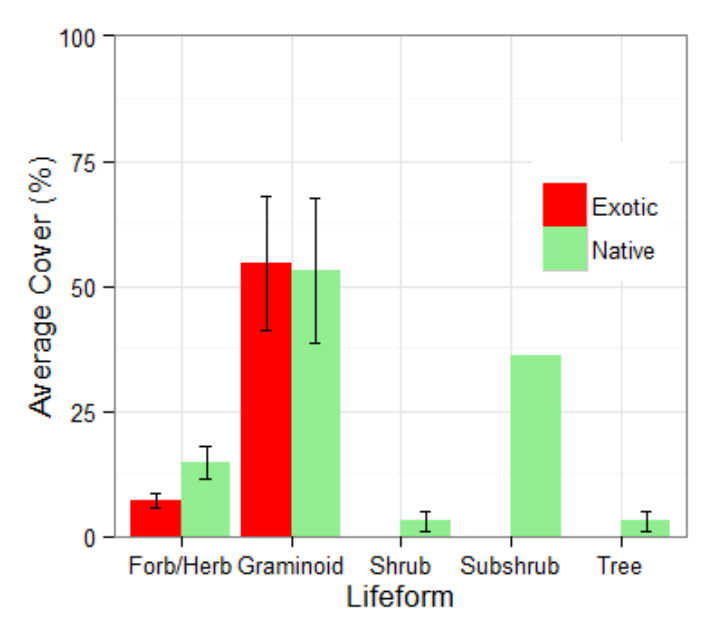


Figure 4. Average cover by lifeform and nativity in 6 plant community monitoring plots in Devils Tower National Monument in 2013. Native (green) and exotic (red) graminoids were the most abundant lifeform across the plots. Bars represent means ± standard errors.

There was some variation in species composition across the 8 sites. The most common species in the sites we visited were graminoids (Figure 5). Kentucky bluegrass (*Poa pratensis*), an exotic grass, was very abundant throughout the park. We found two rare species in the park: Emory's sedge (*Carex emoryi*) and whorled milkweed (*Asclepias verticillata).* The sedge was found in one riparian site and the milkweed was found at two upland sites.

Table 4. Natural resource condition summary table for upland plant communities in Devils Tower National Monument (DETO).

Indicator of Condition	Specific Measures	2013 Value (mean ± SE)	Reference Condition and Data Source	Condition Status/ Trend	Rationale for Resource Condition
Upland Plant Community Structure and Composition	Absolute herb-layer canopy cover	135 ± 11.6 %	TBD [1]		The park is characterized by low native species richness. Only one site has a native diversity within the natural range of variability. The upland areas of the park are much more diverse than the riparian areas. 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. Future work is needed to determine if the reference condition for native species richness is relevant for Black Hills Parks.
	Native species richness (based on average of 10 1m^2 quadrats per plot)	5 ± 0.7 species	8-18 species [2]		
	Evenness (based on point-intercept of 2-50m transects per plot)	0.68 ± 0.04	TBD [1]		
Exotic Plant Early Detection and Management	Relative cover of exotic species	43 ± 9 %	≤ 10 % cover		In general, the sites in DETO had a high cover of exotic species. Only one site had ≤10% cover. Kentucky bluegrass was the most widespread and abundant exotic species. Leafy spurge was also common, but it was found in low abundance.
	Annual Brome cover	1.3 ± 1.1 %	≤ 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. Gutenspergen, editor. Application of threshold concepts in natural resource decision making. Springer Verlag.

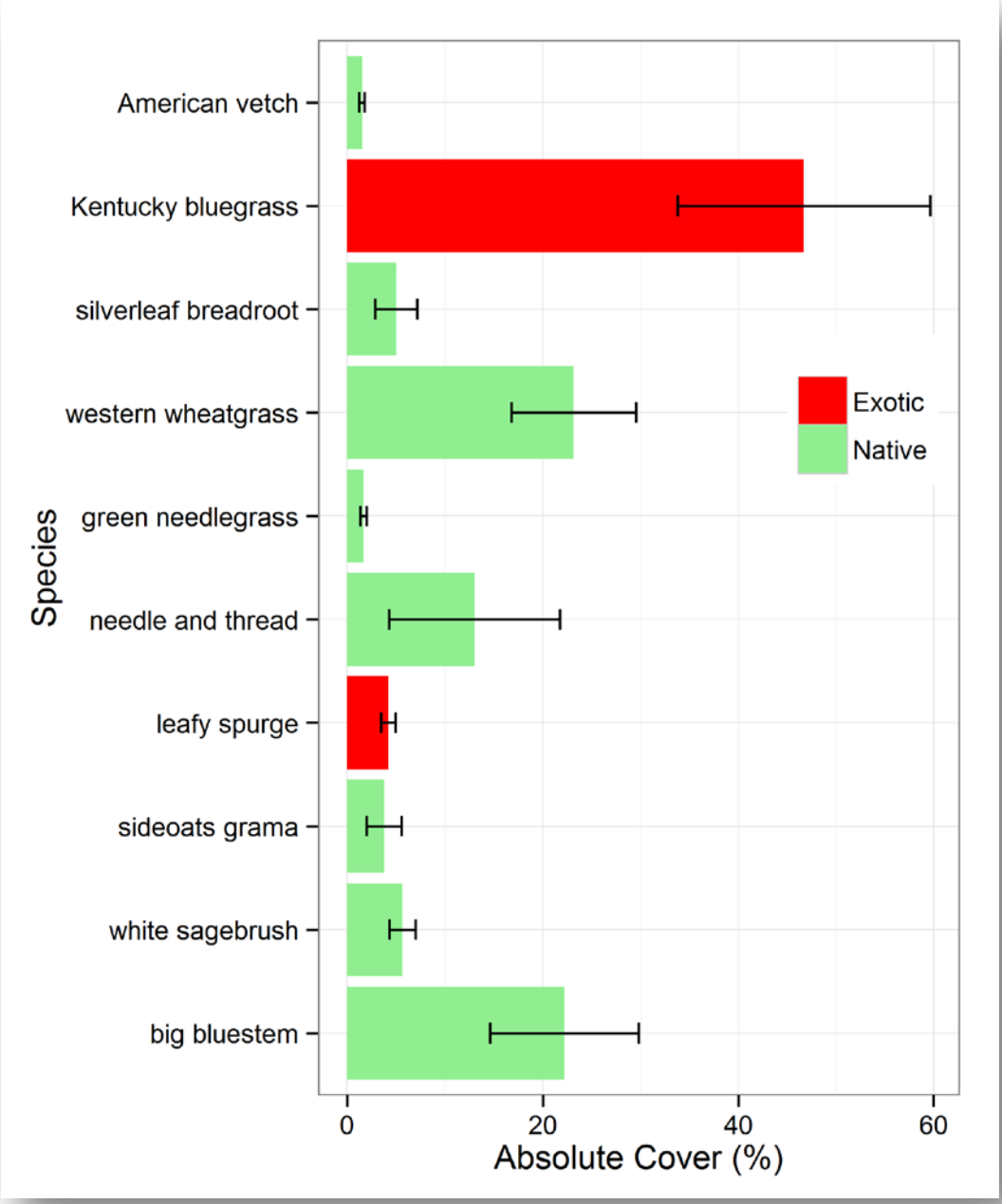


Figure 5. The average absolute cover of the 10 most common native (green) and exotic (red) plants recorded at Devils Tower National Monument in 2013. Bars represent means ± standard errors.

Average species richness at each of the 8 plots was measured by point-intercept and in 1 m^2 and 10 m^2 quadrats (Table 5). On average, there are about 3 exotic species within the 1 m^2 quadrat (Table 5). From the point-intersect data, we found average plot diversity, H', to be 1.9 ± 0.13. Evenness, J', averaged 0.68 ± 0.04 across the plots (Table 4). When including only native species, average diversity and evenness were 1.8 ± 0.2 and 0.72 ± 0.06, respectively.

Table 5. Average plant species richness in 8 plots at Devils Tower National Monument in 2013. Values represent means ± standard errors, n=8.

	Point-intercept	1 m^2 quadrats	10 m^2 quadrats
Species richness	17 ± 1.0	8 ± 0.5	14 ± 1.0
Native species richness	12 ± 1.1	5 ± 0.7	9 ± 1.1
Exotic species richness	5 ± 0.8	3 ± 0.3	5 ± 0.6
Graminoid species richness	8 ± 0.9	4 ± 0.3	5 ± 0.4
Forb species richness	8 ± 0.8	4 ± 0.3	9 ± 0.7

While there was some variation across sites, the upland plots we visited in DETO tended to have a moderate diversity of native plants and the riparian plots a low diversity of native plants compared to other mixed-grass prairies.

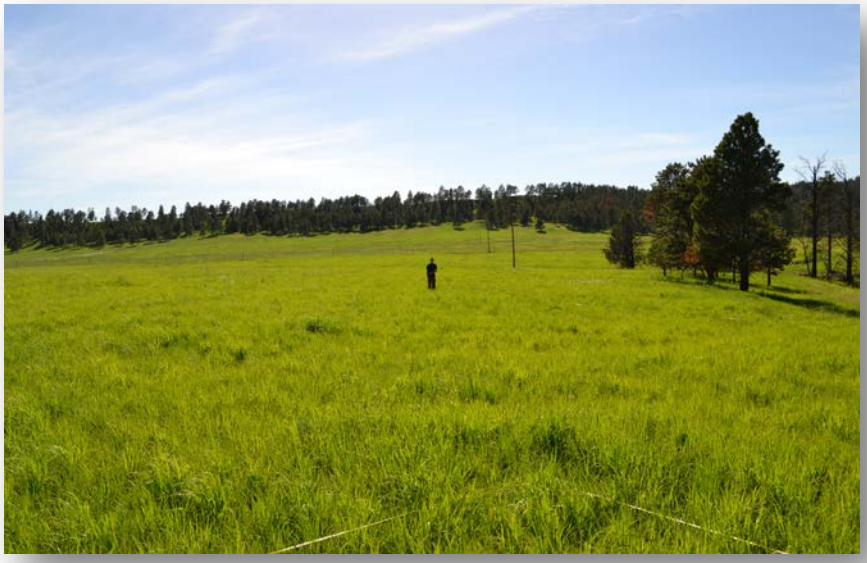


Figure 6. Long-term monitoring site PCM_009 at Devils Tower National Monument. In 2013, we found it to have a high native plant diversity and low exotic cover relative to the other sites in the park.

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 in a moderately grazed site in Montana ranged between 8 and 18 species per square meter (10-90th percentile range) between 1933-1945 (Symstad and Jonas, *in press*). Since there are no long-term records of mixed-grass prairie diversity within the Black Hills, we are relying on these data as a reference condition. Future work is needed to develop a robust reference condition for plant communities in the Black Hills. Compared to the nearby mixed-grass prairie, DETO is below the natural range (Table 4, native richness in the 1 m^2 quadrat and Table 5). The highest diversity was seen in site PCM_009 (Table 6), which lies within a revegetation site on an upper terrace in the southwest portion of the park (Figure1). The lowest native diversity was seen in the riparian plots which had fewer than 3 native species per square meter.

The average relative cover of exotic species at sites in DETO was high (43 ± 9%; Table 4). However, like species richness, cover of exotic species varied considerably among sites (Table 6). Site PCM_016 was the only site with an exotic cover of less than 10%. The highest cover of exotic

species was 79%, found within the riparian area at PCM_258. Kentucky bluegrass accounted for a majority of the exotic cover in all plots, but other exotics such as leafy spurge (2.4% cover), cheatgrass, and Canada thistle were also abundant (Table 6). We did not find any of exotic early detection species (Table 1) in the park.

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

Plot	Native species richness in 1 m^2	Exotic cover (%)	Annual brome cover (%)	Kentucky bluegrass cover (%)	Disturbance within site (m^2)
Upland					
DETO_PCM_005	6	58	1	54	2300
DETO_PCM_006	7	43	0	41	1521
DETO_PCM_007	5	70	0	61	1005
DETO_PCM_008	6	32	0	23	1000
DETO_PCM_009	8	14	0	11	2290
DETO_PCM_016	7	7	1	0	1020
Riparian					
DETO_PCM_258	3	79	0	12	2417
DETO_PCM_259	2	42	9	20	400
Park Average	*5 ± 0.7*	*43 ± 9*	*1 ± 1.1*	*28± 7.8*	-

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 fire, but there was also evidence of mountain pine beetles, small mammal excavations, flooding, and revegetation projects. With this small sample size, we found no correlation with disturbance and native richness or exotic cover. However, the site with the highest exotic cover (PCM_258) has the highest area of disturbance and is adjacent to the main road.

Summary

In conclusion, the ponderosa woodlands, mixed-grass prairie, and riparian plant communities within the boundaries of DETO are characterized by low native species richness. The riparian areas maintain a lower species richness and higher exotic cover than the upland areas. To retain ecological integrity it is important to continue efforts to reduce the cover of invasive plants. Kentucky bluegrass presents a potential challenge to DETO because it is so abundant, and more research on the consequences of the invasion is needed. Annual bromes are an emerging threat in DETO, and keeping them in low abundance will help maintain native plant diversity. Continued monitoring efforts will be critical to track changes in the condition of the vegetation communities in DETO.

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

Plant community composition monitoring in Devil's Tower National Monument was completed using a crew of 4 people working 4, 10-hour days. We spent 168 total crew hours. We also had the assistance of 5 park staff, each helping for ½ to 2 days.

Date	Day of week	Approximate Travel Time (hrs)	Housing	Sites Completed
June 24, 2013	Monday	2	DETO Belle Fourche Campground	PCM-258 PCM-005
June 25, 2013	Tuesday	N/A	DETO Belle Fourche Campground	PCM-005 PCM-006 PCM-008
June 26, 2013	Wednesday	N/A	DETO Belle Fourche Campground	PCM-016 PCM-007 PCM-009
June 27, 2013	Thursday	2	N/A	PCM-259

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

Family	Code	*Scientific Name*	Common Name	Exotic
Aceraceae	ACNE2	*Acer negundo*	boxelder	
Agavaceae	YUGL	*Yucca glauca*	soapweed yucca	
Asclepiadaceae	ASPU	*Asclepias pumila*	plains milkweed	
	ASSP	*Asclepias speciosa*	showy milkweed	
	ASVE	*Asclepias verticillata*	whorled milkweed	
	ASVI	*Asclepias viridiflora*	green comet milkweed	
Asteraceae	ACMI2	*Achillea millefolium*	common yarrow	
	AMPS	*Ambrosia psilostachya*	Cuman ragweed	
	ANPA4	*Antennaria parvifolia*	small-leaf pussytoes	
	ARFR4	*Artemisia frigida*	prairie sagewort	
	ARLU	*Artemisia ludoviciana*	white sagebrush	
	BREU	*Brickellia eupatorioides*	false boneset	
	CIAR4	*Cirsium arvense*	Canada thistle	*
	CIUN	*Cirsium undulatum*	wavyleaf thistle	
	CIVU	*Cirsium vulgare*	bull thistle	*
	COCA5	*Conyza canadensis*	Canadian horseweed	
	ECAN2	*Echinacea angustifolia*	blacksamson echinacea	
	ERST3	*Erigeron strigosus*	prairie fleabane	
	GRSQ	*Grindelia squarrosa*	curlycup gumweed	
	HEAN3	*Helianthus annuus*	common sunflower	
	LASE	*Lactuca serriola*	prickly lettuce	*
	LOAR5	*Logfia arvensis*	field cottonrose	
	LYJU	*Lygodesmia juncea*	rush skeletonplant	
	MINU	*Microseris nutans*	nodding microseris	
	ONAC	*Onopordum acanthium*	Scotch cottonthistle	*
	RACO3	*Ratibida columnifera*	upright prairie coneflower	
	SOMO	*Solidago mollis*	velvety goldenrod	
	SYFA	*Symphyotrichum falcatum*	white prairie aster	
	TAOF	*Taraxacum officinale*	common dandelion	*
	TRDU	*Tragopogon dubius*	yellow salsify	*
Berberidaceae	BERE	*Berberis repens*	Oregon grape	
Boraginaceae	CYOF	*Cynoglossum officinale*	houndstongue	*
	LAOC3	*Lappula occidentalis*	flatspine stickseed	

Family	Code	*Scientific Name*	Common Name	Exotic
	LIIN2	*Lithospermum incisum*	narrowleaf stoneseed	
Brassicaceae	ALDE	*Alyssum desertorum*	desert madwort	*
	CAMI2	*Camelina microcarpa*	littlepod false flax	*
	DEPI	*Descurainia pinnata*	western tansymustard	
	DRRE2	*Draba reptans*	Carolina draba	
	LEDE	*Lepidium densiflorum*	common pepperweed	
	SIAL2	*Sisymbrium altissimum*	tall tumblemustard	*
	THAR5	*Thlaspi arvense*	field pennycress	*
Cactaceae	OPFR	*Opuntia fragilis*	brittle pricklypear	
	OPPO	*Opuntia polyacantha*	plains pricklypear	
Campanulaceae	CARO2	*Campanula rotundifolia*	bluebell bellflower	
Caprifoliaceae	SYOC	*Symphoricarpos occidentalis*	western snowberry	
Caryophyllaceae	CEAR4	*Cerastium arvense*	field chickweed	
	SIAN2	*Silene antirrhina*	sleepy silene	
Chenopodiaceae	CHENO	*Chenopodium*	goosefoot	*
	CHSI2	*Chenopodium simplex*	mapleleaf goosefoot	
Commelinaceae	TROC	*Tradescantia occidentalis*	prairie spiderwort	
Convolvulaceae	COAR4	*Convolvulus arvensis*	field bindweed	*
Cupressaceae	JUSC2	*Juniperus scopulorum*	Rocky Mountain juniper	
Cyperaceae	CAREX	*Carex*	sedge	
	CABR10	*Carex brevior*	shortbeak sedge	
	CAEM2	*Carex emoryi*	Emory's sedge	
	CAFI	*Carex filifolia*	threadleaf sedge	
	CAHO5	*Carex hoodii*	Hood's sedge	
	CAIN9	*Carex inops*	sun sedge	
	CAXE	*Carex xerantica*	whitescale sedge	
Equisetaceae	EQLA	*Equisetum laevigatum*	smooth horsetail	
Euphorbiaceae	EUES	*Euphorbia esula*	leafy spurge	*
Fabaceae	ASTRA	*Astragalus*	milkvetch	
	ASAG2	*Astragalus agrestis*	purple milkvetch	
	ASFL2	*Astragalus flexuosus*	flexile milkvetch	
	ASLA27	*Astragalus laxmannii*	Laxmann's milkvetch	
	ASPL2	*Astragalus plattensis*	Platte River milkvetch	
	DACA7	*Dalea candida*	white prairie clover	
	DAPU5	*Dalea purpurea*	purple prairie clover	

Family	Code	*Scientific Name*	Common Name	Exotic
	GLLE3	*Glycyrrhiza lepidota*	American licorice	
Fabaceae	MELU	*Medicago lupulina*	black medick	*
	MEOF	*Melilotus officinalis*	yellow sweetclover	*
	PEAR6	*Pediomelum argophyllum*	silverleaf Indian breadroot	
	PEES	*Pediomelum esculentum*	large Indian breadroot	
	THRH	*Thermopsis rhombifolia*	prairie thermopsis	
	VIAM	*Vicia americana*	American vetch	
Fagaceae	QUMA2	*Quercus macrocarpa*	bur oak	
Hydrophyllaceae	ELNY	*Ellisia nyctelea*	Aunt Lucy	
Lamiaceae	HEHI	*Hedeoma hispida*	rough false pennyroyal	
	MEAR4	*Mentha arvensis*	wild mint	
	NECA2	*Nepeta cataria*	catnip	*
Liliaceae	ALTE	*Allium textile*	textile onion	
	CANU3	*Calochortus nuttallii*	sego lily	
Linaceae	LIRI	*Linum rigidum*	stiffstem flax	
Malvaceae	SPCO	*Sphaeralcea coccinea*	scarlet globemallow	
Nyctaginaceae	MILI3	*Mirabilis linearis*	narrowleaf four o'clock	
Oleaceae	FRPE	*Fraxinus pennsylvanica*	green ash	
Pinaceae	PIPO	*Pinus ponderosa*	ponderosa pine	
Plantaginaceae	PLPA2	*Plantago patagonica*	woolly plantain	
Poaceae	AGCR	*Agropyron cristatum*	crested wheatgrass	*
	ANGE	*Andropogon gerardii*	big bluestem	
	ARPU9	*Aristida purpurea*	purple threeawn	
	BOCU	*Bouteloua curtipendula*	sideoats grama	
	BOGR2	*Bouteloua gracilis*	blue grama	
	BRIN2	*Bromus inermis*	smooth brome	*
	BRTE	*Bromus tectorum*	cheatgrass	*
	CALO	*Calamovilfa longifolia*	prairie sandreed	
	DASP2	*Danthonia spicata*	poverty oatgrass	
	ELRE4	*Elymus repens*	quackgrass	*
	ELTR7	*Elymus trachycaulus*	slender wheatgrass	
	HECO26	*Hesperostipa comata*	needle and thread	
	HESP11	*Hesperostipa spartea*	porcupinegrass	
	KOMA	*Koeleria macrantha*	prairie Junegrass	
	MUCU3	*Muhlenbergia cuspidata*	plains muhly	

Family	Code	*Scientific Name*	Common Name	Exotic
	NAVI4	*Nassella viridula*	green needlegrass	
Poaceae	PASM	*Pascopyrum smithii*	western wheatgrass	
	PHAR3	*Phalaris arundinacea*	reed canarygrass	
	POCO	*Poa compressa*	Canada bluegrass	*
	POPR	*Poa pratensis*	Kentucky bluegrass	*
	SCSC	*Schizachyrium scoparium*	little bluestem	
	SPCR	*Sporobolus cryptandrus*	sand dropseed	
Polemoniaceae	COLI2	*Collomia linearis*	tiny trumpet	
	PHAN4	*Phlox andicola*	prairie phlox	
	PHHO	*Phlox hoodii*	spiny phlox	
Polygonaceae	RUCR	*Rumex crispus*	curly dock	*
Primulaceae	ANOC2	*Androsace occidentalis*	western rockjasmine	
Rosaceae	PRAM	*Prunus americana*	American plum	
	PRVI	*Prunus virginiana*	chokecherry	
	ROAR3	*Rosa arkansana*	prairie rose	
Rubiaceae	GAAP2	*Galium aparine*	stickywilly	
	GABO2	*Galium boreale*	northern bedstraw	
Scrophulariaceae	VETH	*Verbascum thapsus*	common mullein	*
	VEPE2	*Veronica peregrina*	neckweed	
Solanaceae	PHHE5	*Physalis heterophylla*	clammy groundcherry	
Urticaceae	PAPE5	*Parietaria pensylvanica*	Pennsylvania pellitory	
Violaceae	VICA4	*Viola canadensis*	Canadian white violet	
	VINU2	*Viola nuttallii*	Nuttall's violet	