



Plant Community and Forest Composition and Structure Monitoring at Devils Tower National Monument

2018 Data Report

Natural Resource Data Series NPS/NGPN/NRDS—2019/1215



ON THE COVER

A view of the valley from monitoring plot PCM_008 at Devils Tower National Monument, 2018.
Photograph courtesy of the National Park Service

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Abstract

This report presents the results of vegetation monitoring efforts in 2018 at Devils Tower National Monument (DETO) by the Northern Great Plains Inventory and Monitoring Network (NGPN) and Fire Ecology Program (NGPFire). This was the eighth year of combined monitoring efforts.

Crew members from NGPN visited eight long-term monitoring plots to collect data on the plant communities at DETO. The NGPFire crew visited an additional 13 plots in the North Terrace and Graham Burn Units to collect plant community data following prescribed fire. This work is part of a long-term monitoring effort designed to provide a better understanding of the condition of the vegetation community and how it changes over time and in response to prescribed fire. NGPN and NGPFire staff measured species richness, herb-layer height, native and non-native species abundance, ground cover, and site disturbance at each of the six plots. This year monitoring crews also collected forest structure data from 75 plots in the park. In plots where woody species were present, tree regeneration, tall shrub density, tree density, and woody fuel loads were measured.

In 2018, monitoring crews identified 152 unique plant species in 77 monitoring plots. Of those species, 34 were exotic species. On average, the absolute cover of exotic species was greater than the absolute cover of native species. One rare grass species, fall rosette grass (*Dichanthelium wilcoxianum*; Wyoming state rank S2) was observed at DETO, and there were no state-listed noxious species observed in 2018. Trees were present in only thirty-one of the plots and these were dominated by ponderosa pine. Seedling density was highly variable with many sites having none and others had more than one thousand stems per hectare.

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 DETO, including M. Sherry, K. Frankenfeld, and C. Racay, for assisting with field work and providing ice pops on hot days. The 2018 NGPN vegetation field crew – C. Davis, I. Ashton, R. Manuel, T. Schaffner, M. Davis, R. Oltjenbruns, and S. Rockwood – and NGPFire crew – D. Swanson, K. Ronsani, I. Muirhead, and J. Roy- collected the data included in this report.

Introduction

Devils Tower National Monument (DETO) was established in 1906 as America's 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. Vegetation monitoring began at DETO in 1997 by the Northern Great Plains Fire Ecology Program (NGPFire; Wienk et al. 2011). In 2011, the Northern Great Plains Inventory & Monitoring Network (NGPN) combined efforts with NGPFire to establish a coordinated vegetation monitoring protocol and plot locations were shifted to better represent the entire park (Symstad et al. 2012b; Figures 1 and 2). Combined sampling efforts began in 2011 (Ashton et al. 2012). In this report, we provide summaries of the vegetation data collected at eight plant community plot visits, 13 fire effects plot visits, and 75 forest structure plot visits in 2018.

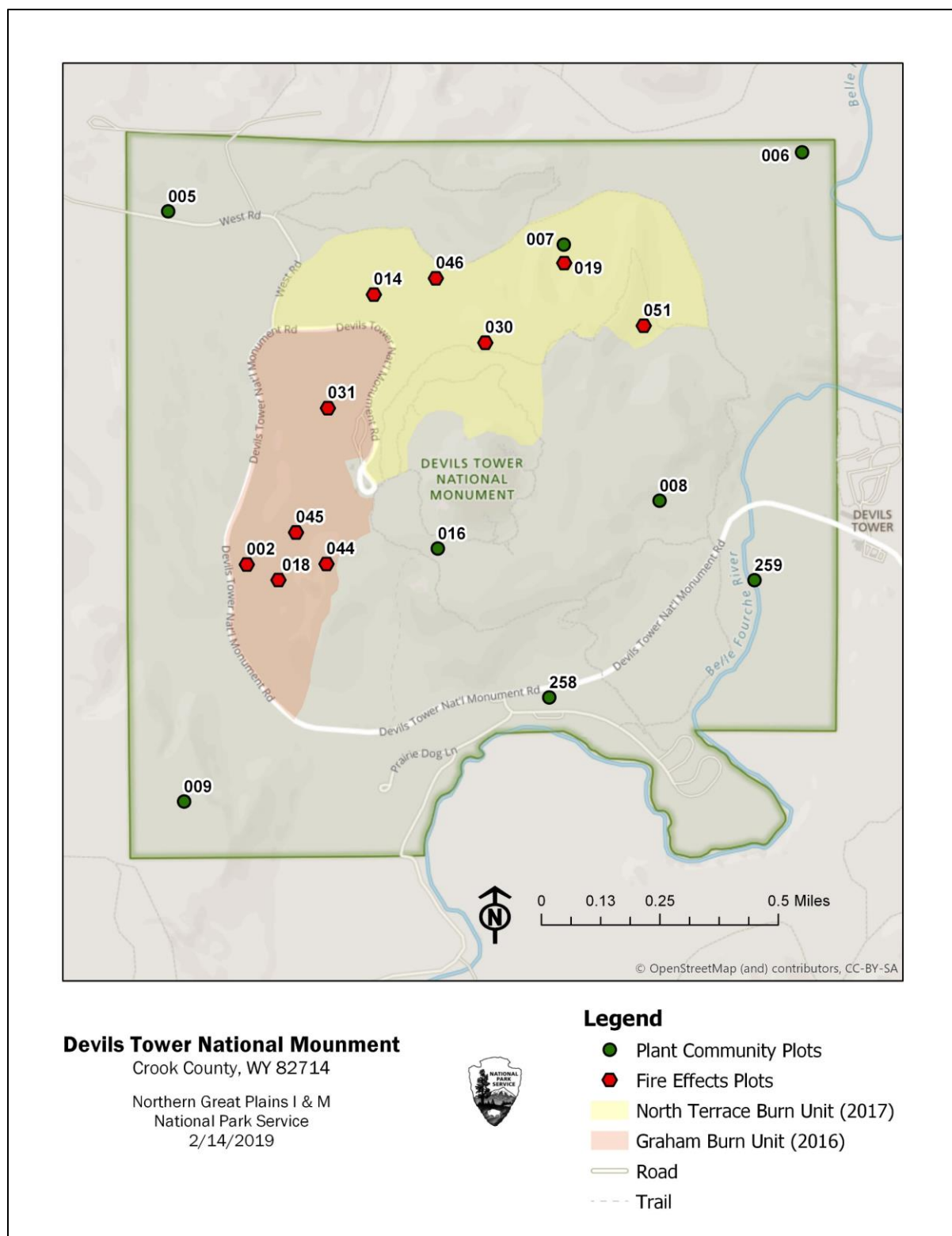
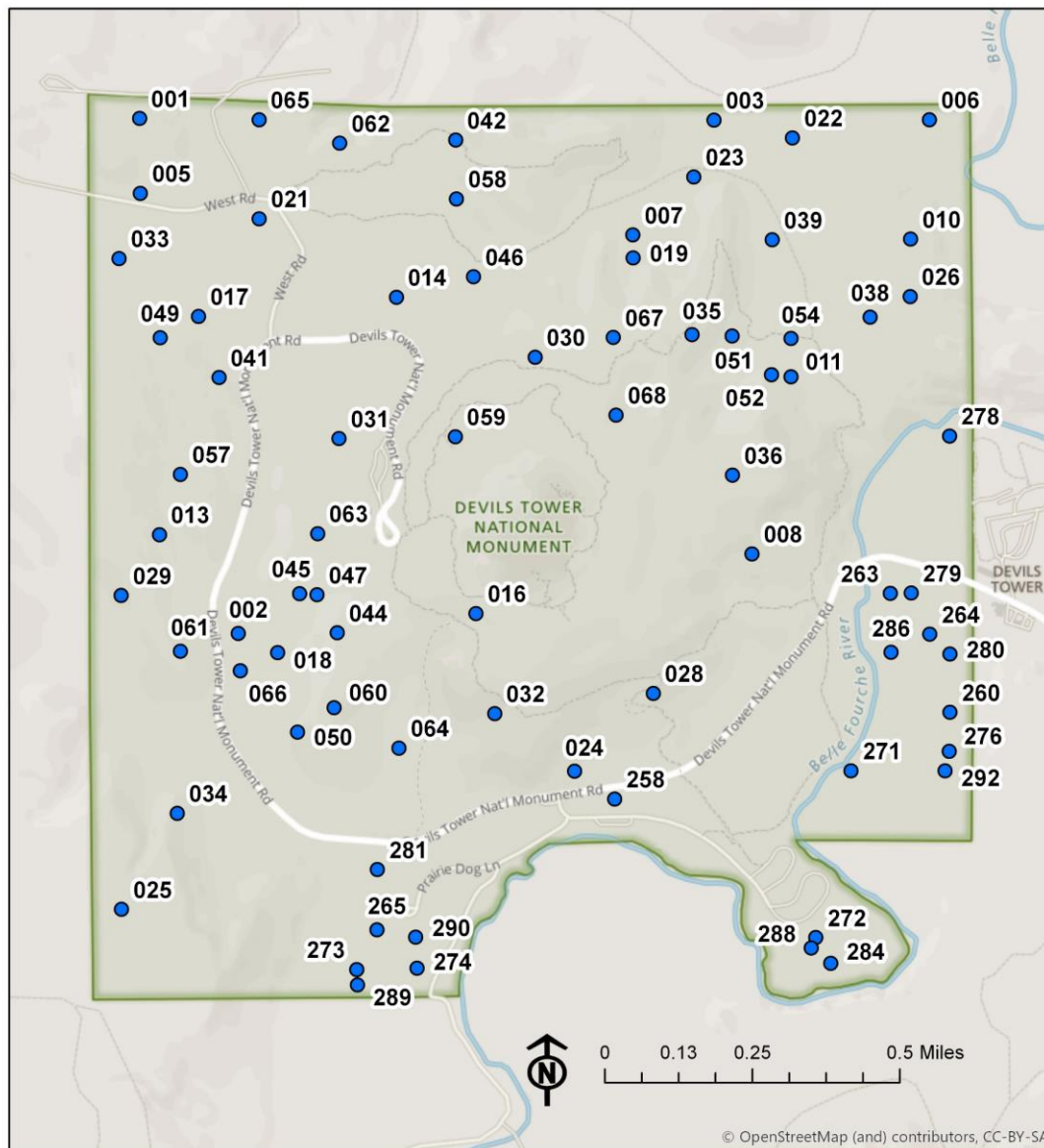


Figure 1. Map of Devils Tower National Monument plant community monitoring plots visited in 2018 by the Northern Great Plains Network Inventory & Monitoring Program (green) and the Fire Ecology Program (red). Prescribed fire burn unit areas are indicated by colored polygons on the map.



Devils Tower National Monument

Crook County, WY 82714

Northern Great Plains I & M

National Park Service

2/14/2019



Legend

● Forest Structure Plots

— Road

- - - Trail

Figure 2. Map of Devils Tower National Monument forest structure monitoring plots visited in 2018 by the Northern Great Plains Network Inventory & Monitoring Program and the Fire Ecology Program.

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. The general approach is briefly described below. For more detail, please see the monitoring protocol and standard operating procedures, available at <https://www.nps.gov/im/ngpn/plant-communities.htm>.

Sample Design

Plant Community Plots

The NGPN team 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 the GRTS design, NGPN selected 20 randomly located sites within DETO to install Plant Community Monitoring (PCM) plots. These 20 plots are split into five panels containing four plots each. The NGPN visits eight PCM plots (two panels) annually using a rotating sampling scheme that includes four plots visited the previous year and four plots that have not been visited for five years (Figure 1). In a full five-year rotation, each plot will be visited twice. In 2018, the NGPN crew visited PCM plots in panels 2 and 3 during the week of July 9-12 (Table 1). Of the eight plots, six were in upland habitat and two were in the riparian corridor (PCM_258 and PCM_259).

The Northern Great Plains Fire Ecology Program (NGPFire) crew has established sites at DETO using the same GRTS design, but those plot locations are not randomly selected. Rather, they are focused in active burn units. In 2018, five sites were visited in the North Terrace Burn Unit in the northern portion of the park and five sites were visited in the Graham Burn Unit in the western portion of the park (Figure 1).

Forest Structure Plots

In 2013 and 2018, forest structure and composition monitoring was completed by NGPN and NGPFire using a set of 75 forested sites in DETO (Figure 2). The goal of this survey was to assess status and trends in forest condition. The forest survey will be repeated every five years (e.g., 2023, 2028, and so on). The forest structure monitoring site locations were selected using the same GRTS sampling scheme described above for plant community monitoring plots. In most cases, the plots used by NGPN and NGPFire to collect plant community and fire effects data in 2018 were also used to collect forest structure data, with the exceptions being PCM_009 and PCM_259, where only plant community data were collected.

Table 1. Field journal for monitoring plot visits at Devils Tower National Monument in 2018. A total of 77 plots were visited by Northern Great Plains Inventory & Monitoring and Fire Ecology Programs. The general type of vegetation data collected at each plot is indicated in the plot type column where FX refers to fire effects, PC2 is plant community panel 2, PC3 is plant community panel 3, and Forest Structure refers to tree and fuels data.

Plot	Plot Type	Date Visited	Program	Crew
DETO_PCM_001	Forest Structure	9/12/2018	NGPN	DJS, IWA, CJD
DETO_PCM_002	FX & Forest Structure	7/12/2018	NGPFire	DJS, IDM, KGR, JMR
DETO_PCM_003	Forest Structure	9/19/2018	NGPN	SLR, MBD, RDO, TLS
DETO_PCM_005	PC2 & Forest Structure	7/11/2018	NGPN	RMM, MBD, RDO
DETO_PCM_006	PC2 & Forest Structure	7/10/2018	NGPN	RMM, MBD, RDO
DETO_PCM_007	PC3 & Forest Structure	7/10/2018	NGPN	RMM, MBD, RDO
DETO_PCM_008	PC3 & Forest Structure	7/12/2018	NGPN	CJD, RMM, MBD, RDO, K. Frankenfeld
DETO_PCM_009	PC3	7/9/2018	NGPN	CJD, RMM, MBD, RDO
DETO_PCM_010	Forest Structure	9/13/2018	NGPN	SLR, TLS, IDM
DETO_PCM_011	Forest Structure	9/13/2018	NGPN	IWA, MBD, KGR, RDO
DETO_PCM_013	Forest Structure	9/11/2018	NGPN	IWA, CJD, TLS
DETO_PCM_014	FX & Forest Structure	8/1/2018 9/12/2018	NGPFire NGPN	KGR, JMR SLR, IDM, RDO, TLS
DETO_PCM_016	PC2 & Forest Structure	7/11/2018	NGPN	RMM, MBD, RDO
DETO_PCM_017	Forest Structure	9/12/2018	NGPN	SLR, IDM, RDO, TLS
DETO_PCM_018	FX & Forest Structure	7/12/2018	NGPFire	DJS, IDM, KGR, JMR
DETO_PCM_019	FX & Forest Structure	7/10/2018	NGPFire	DJS, IDM, KGR, JMR
DETO_PCM_021	Forest Structure	9/12/2018	NGPN	DJS, IWA, CJD
DETO_PCM_022	Forest Structure	9/19/2018	NGPN	SLR, MBD, RDO, TLS
DETO_PCM_023	Forest Structure	9/19/2018	NGPN	SLR, MBD, RDO, TLS
DETO_PCM_024	Forest Structure	9/10/2018	NGPN	SLR, MBD, JMR
DETO_PCM_025	Forest Structure	9/10/2018	NGPN	RMM, RDO, KGR
DETO_PCM_026	Forest Structure	9/13/2018	NGPN	SLR, TLS, IDM
DETO_PCM_028	Forest Structure	9/10/2018	NGPN	IWA, CJD, TLS
DETO_PCM_029	Forest Structure	9/11/2018	NGPN	IWA, CJD, TLS

Table 1 (continued). Field journal for monitoring plot visits at Devils Tower National Monument in 2018. A total of 77 plots were visited by Northern Great Plains Inventory & Monitoring and Fire Ecology Programs. The general type of vegetation data collected at each plot is indicated in the plot type column where FX refers to fire effects, PC2 is plant community panel 2, PC3 is plant community panel 3, and Forest Structure refers to tree and fuels data.

Plot	Plot Type	Date Visited	Program	Crew
DETO_PCM_030	FX & Forest Structure	7/10/2018	NGPFire	DJS, IDM, KGR, JMR
DETO_PCM_031	FX & Forest Structure	7/11/2018	NGPFire	DJS, IDM, KGR, JMR
DETO_PCM_032	Forest Structure	9/10/2018	NGPN	IWA, CJD, TLS
DETO_PCM_033	Forest Structure	9/12/2018	NGPN	SLR, IDM, RDO, TLS
DETO_PCM_034	Forest Structure	9/10/2018	NGPN	RMM, RDO, KGR
DETO_PCM_035	Forest Structure	9/18/2018	NGPN	SLR, MBD, RDO, TLS
DETO_PCM_036	Forest Structure	9/18/2018	NGPN	SLR, MBD, RDO, TLS
DETO_PCM_038	Forest Structure	9/19/2018	NGPN	SLR, MBD, RDO, TLS
DETO_PCM_039	Forest Structure	9/19/2018	NGPN	SLR, MBD, RDO, TLS
DETO_PCM_041	Forest Structure	9/12/2018	NGPN	SLR, IDM, RDO, TLS
DETO_PCM_042	Forest Structure	9/13/2018	NGPN	RMM, CJD, DJS,JMR
DETO_PCM_044	FX & Forest Structure	7/11/2018	NGPFire	DJS, IDM, KGR, JMR
DETO_PCM_045	FX & Forest Structure	7/11/2018	NGPFire	DJS, IDM, KGR, JMR
DETO_PCM_046	FX & Forest Structure	7/9/2018	NGPFire	DJS, IDM, KGR, JMR
DETO_PCM_047	Forest Structure	9/12/2018	NGPN	RMM, MBD, JRR, KGR
DETO_PCM_049	Forest Structure	9/12/2018	NGPN	SLR, IDM, RDO, TLS
DETO_PCM_050	Forest Structure	9/12/2018	NGPN	RMM, MBD, JRR, KGR
DETO_PCM_051	FX & Forest Structure	7/10/2018	NGPFire	DJS, IDM, KGR, JMR
DETO_PCM_052	Forest Structure	9/13/2018	NGPN	IWA, MBD, KGR, RDO
DETO_PCM_054	Forest Structure	9/13/2018	NGPN	IWA, MBD, KGR, RDO
DETO_PCM_057	Forest Structure	9/11/2018	NGPN	IWA, CJD, TLS
DETO_PCM_058	Forest Structure	9/13/2018	NGPN	RMM, CJD, DJS,JMR
DETO_PCM_059	Forest Structure	9/12/2018	NGPN	DJS, IWA, CJD
DETO_PCM_060	Forest Structure	9/12/2018	NGPN	RMM, MBD, JRR, KGR
DETO_PCM_061	Forest Structure	9/11/2018	NGPN	IWA, CJD, TLS
DETO_PCM_062	Forest Structure	9/12/2018	NGPN	DJS, IWA, CJD

Table 1 (continued). Field journal for monitoring plot visits at Devils Tower National Monument in 2018. A total of 77 plots were visited by Northern Great Plains Inventory & Monitoring and Fire Ecology Programs. The general type of vegetation data collected at each plot is indicated in the plot type column where FX refers to fire effects, PC2 is plant community panel 2, PC3 is plant community panel 3, and Forest Structure refers to tree and fuels data.

Plot	Plot Type	Date Visited	Program	Crew
DETO_PCM_063	Forest Structure	9/18/2018	NGPN	SLR, MBD, RDO, TLS
DETO_PCM_064	Forest Structure	9/10/2018	NGPN	SLR, MBD, JMR
DETO_PCM_065	Forest Structure	9/12/2018	NGPN	DJS, IWA, CJD
DETO_PCM_066	Forest Structure	9/12/2018	NGPN	RMM, MBD, JRR, KGR
DETO_PCM_067	Forest Structure	9/18/2018	NGPN	SLR, MBD, RDO, TLS
DETO_PCM_068	Forest Structure	9/18/2018	NGPN	SLR, MBD, RDO, TLS
DETO_PCM_258	PC2 & Forest Structure	7/11/2018	NGPN	RMM, MBD, RDO
DETO_PCM_259	PC3	7/9/2018	NGPN	CJD, RMM, MBD, RDO
DETO_PCM_260	Forest Structure	9/11/2018	NGPN	SLR, MBD, JMR
DETO_PCM_263	Forest Structure	9/11/2018	NGPN	RMM, RDO, KGR
DETO_PCM_264	Forest Structure	9/11/2018	NGPN	SLR, MBD, JMR
DETO_PCM_265	Forest Structure	9/5/2018	NGPN	RMM, RDO, MBD
DETO_PCM_271	Forest Structure	9/11/2018	NGPN	RMM, RDO, KGR
DETO_PCM_272	Forest Structure	9/10/2018	NGPN	IWA, CJD, TLS, RMM
DETO_PCM_273	Forest Structure	9/5/2018	NGPN	RMM, RDO, MBD
DETO_PCM_274	Forest Structure	9/5/2018	NGPN	SLR, TLS, CJD
DETO_PCM_276	Forest Structure	9/11/2018	NGPN	SLR, MBD, JMR
DETO_PCM_278	Forest Structure	9/11/2018	NGPN	RMM, RDO, KGR
DETO_PCM_279	Forest Structure	9/11/2018	NGPN	RMM, RDO, KGR
DETO_PCM_280	Forest Structure	9/11/2018	NGPN	SLR, MBD, JMR
DETO_PCM_281	Forest Structure	9/5/2018	NGPN	SLR, TLS, CJD
DETO_PCM_284	Forest Structure	9/10/2018	NGPN	SLR, RDO, MBD
DETO_PCM_286	Forest Structure	9/11/2018	NGPN	RMM, RDO, KGR
DETO_PCM_288	Forest Structure	9/10/2018	NGPN	IWA, CJD, TLS, RMM
DETO_PCM_289	Forest Structure	9/5/2018	NGPN	RMM, RDO, MBD
DETO_PCM_290	Forest Structure	9/5/2018	NGPN	SLR, TLS, CJD
DETO_PCM_292	Forest Structure	9/11/2018	NGPN	SLR, MBD, JMR

Plot Layout and Sampling

Plant Community Plots

At each site visited, the NGPN crew recorded plant species cover and frequency in a rectangular, 50 m x 20 m (0.1 ha), permanent plot (Figure 3). 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 (Figures 3 and 4). Species richness data from the point-intercept method were supplemented with species presence data collected in five 1 m² quadrats located systematically along each transect (Figures 3 and 4). If a plant species was identified in the plot but was not included on the verified park species list, a voucher plant specimen was collected when possible and submitted to a botanist for independent verification. NGPFire collected point-intercept data from ten plots visited in the Graham and North Terrace units but did not collect species presence data from quadrats.

When woody species were present within 38 m of plot center, tree regeneration and tall shrub density data were collected within a 10 m radius subplot centered in the larger 50 m x 20 m (0.1 ha) plot. Trees within the entire 0.1 ha plot with a diameter at breast height (DBH) of > 15 cm were mapped and tagged. For each tree, the species, DBH, status (live or dead), and condition (e.g., leaf-discoloration, insect-damaged) were recorded. For all poles ($2.54 \leq \text{DBH} \leq 15$ cm) located within the 10 m radius subplot, only DBH and status were recorded. Tree and tall shrub species with DBH < 2.54 cm (seedlings) were tallied by species within the 10 m radius subplot. In 2018, NGPN changed the way these species counts were made. In previous years, once the count for a species had reached 100, seedlings of that species were not counted in the following quarters and a calculated estimate was made when the data was analyzed. Now, all seedling species present are always counted or estimated in all four quarters of the 10 m radius subplot while in the field. Dead and downed woody fuel load data were collected along two perpendicular, 100 ft (30.49 m) transects (fuel lines) with midpoints at the center of the plot (Figure 3), following Brown's Line methods (Brown 1974, Brown et al. 1982). Fuel load data were only collected if at least one piece of woody litter or fuel intersected a fuel line.

Forest Structure Plots

The methods used for forest structure monitoring were similar to those previously described for plant community monitoring plots. Data were collected for tree density and condition, seedling density, disturbance type and extent, and target species cover at each forest monitoring plot. There were some important differences between plant community and forest structure protocols. In forest structure plots (1) the plot size was smaller and data on trees were only collected within a 10 m radius around plot center (Figure 3 below; only the seedling and pole sampling area); (2) trees were not tagged; (3) neither point-intercept nor 1 m² quadrat data were collected; (4) disturbances and target species were measured when they were located within a 50 ft radius of the center (Figure 3; Transect 1 and 2 are the diameters of the circle); and (5) target species included both early detection species (Table 2) and more widespread exotic species that were identified as management concerns (Table 3).

Common disturbances were assessed and documented at each plot. The type of disturbance, such as animal trails, erosion or prairie dogs was recorded. In 2018 a new category called soil disturbance was added, which is defined as loose, exposed soil from all sources. Plots were also assessed for the

presence and abundance of target exotic species (Table 2), which is critical for early detection and rapid response to exotic species threats. These species were chosen in collaboration with the Midwest Invasive Plant Network, Northern Great Plains Exotic Plant Management Team, park managers, and local weed experts. Each target species was assigned an abundance class from 1–5, based on an ocular estimate of cover, where 1 = one individual, 2 = few individuals, 3 = cover of 1–5%, 4 = cover of 5–25%, and 5 = cover > 25% of the plot.

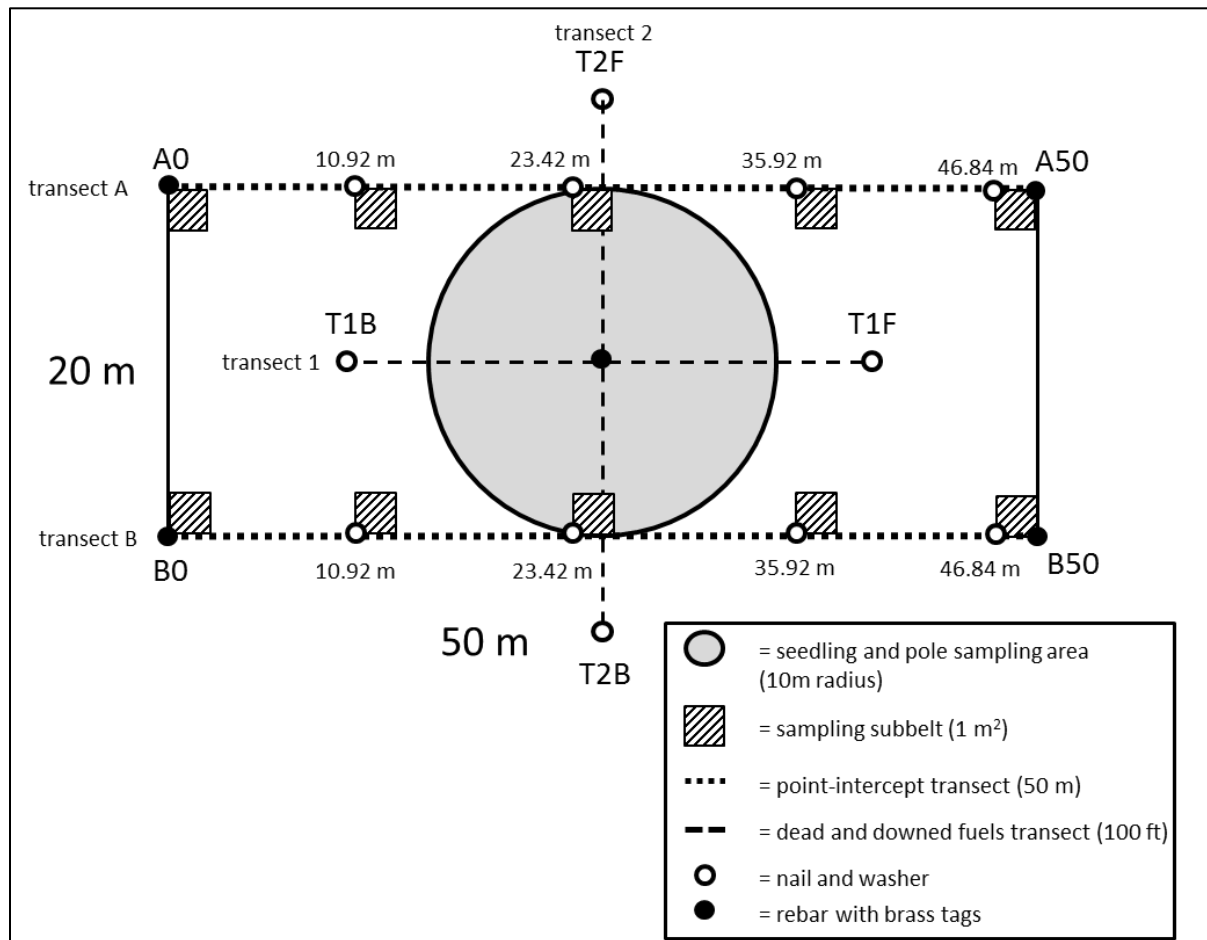


Figure 3. Long-term monitoring plot layout used for sampling vegetation used by the Northern Great Plains Inventory and Monitoring vegetation crew.

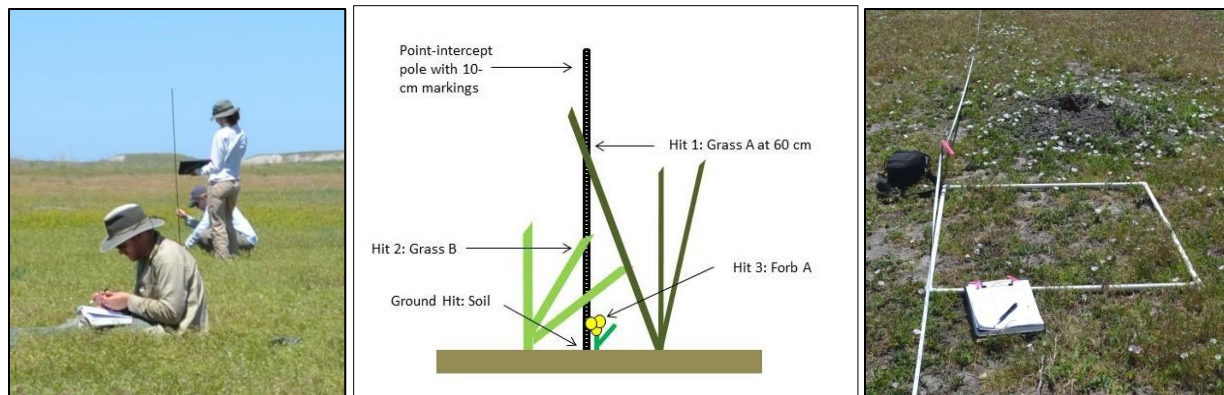


Figure 4. The Northern Great Plains Inventory & Monitoring vegetation crew used point-intercept (left and center panel) and quadrats (right panel) to document plant diversity and abundance.

Table 2. Exotic species included in the Northern Great Plains Network's early detection and rapid response program. These are species that are either highly uncommon or not currently present in the park.

Habitat	Scientific Name	Common Name
Riparian	<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
Upland	<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 aethiopis</i>	Mediterranean sage
Upland	<i>Ventenata dubia</i>	African wiregrass

Table 3. Exotic species included in the Northern Great Plains Network's forest structure exotic species surveys. These are species that are more likely to be observed in monitoring plots, but are still a management concern for park managers.

Family	Scientific Name	Common Name
Apiaceae	<i>Conium maculatum</i>	poison hemlock
	<i>Heracleum mantegazzianum</i>	giant hogweed
Asteraceae	<i>Arctium minus</i>	common burdock
	<i>Carduus nutans</i>	musk thistle
	<i>Centaurea diffusa</i>	diffuse knapweed
	<i>Centaurea solstitialis</i>	yellow star thistle
	<i>Centaurea stoebe</i>	spotted knapweed
	<i>Centaurea virgata</i>	squarrose knapweed
	<i>Chondrilla juncea</i>	rush skeletonweed
	<i>Cirsium arvense</i>	Canada thistle
	<i>Cirsium vulgare</i>	bull thistle
	<i>Hieracium aurantiacum</i>	orange hawkweed
	<i>Hieracium caespitosum</i>	meadow hawkweed
	<i>Onopordum acanthium</i>	Scotch thistle
	<i>Rhaponticum repens</i>	Russian knapweed/hardheads
Boraginaceae	<i>Cynoglossum officinale</i>	houndstongue
Brassicaceae	<i>Alliaria petiolata</i>	garlic mustard
	<i>Hesperis matronalis</i>	dame's rocket
	<i>Lepidium latifolium</i>	perennial pepperweed
	<i>Isatis tinctoria</i>	Dyer's woad
	<i>Thlaspi arvense</i>	field pennycress
Caryophyllaceae	<i>Gypsophila paniculata</i>	baby's breath
Chenopodiaceae	<i>Salsola tragus</i>	Russian thistle
Convolvulaceae	<i>Convolvulus arvensis</i>	field bindweed
Dipsacaceae	<i>Dipsacus fullonum</i>	common teasel
	<i>Dipsacus laciniatus</i>	cutleaf teasel
Euphorbiaceae	<i>Euphorbia cyparissias</i>	cypress spurge
	<i>Euphorbia esula</i>	leafy spurge
	<i>Euphorbia myrsinites</i>	myrtle spurge
Fabaceae	<i>Melilotus officinalis</i>	yellow sweetclover
	<i>Pueraria montana var. lobata</i>	kudzu

Table 3 (continued). Exotic species included in the Northern Great Plains Network’s forest structure exotic species surveys. These are species that are more likely to be observed in monitoring plots, but are still a management concern for park managers.

Family	Scientific Name	Common Name
Iridaceae	<i>Iris pseudacorus</i>	yellow iris
Lamiaceae	<i>Salvia aethiopis</i>	Mediterranean sage
Poaceae	<i>Arundo donax</i>	giant reed
	<i>Bromus inermis</i>	smooth brome
	<i>Bromus japonicus</i>	Japanese brome
	<i>Bromus tectorum</i>	cheatgrass
	<i>Taeniatherum caput-medusae</i>	medusahead
	<i>Ventenata dubia</i>	African wiregrass
Polygonaceae	<i>Fallopia japonica</i> var. <i>japonica</i>	Japanese knotweed
	<i>Fallopia sachalinense</i>	giant knotweed
	<i>Fallopia X bohemica</i>	Bohemian knotweed
Rhamnaceae	<i>Rhamnus cathartica</i>	common buckthorn
Scrophulariaceae	<i>Linaria vulgaris</i>	yellow toadflax
	<i>Verbascum thapsus</i>	common mullein
Simaroubaceae	<i>Ailanthus altissima</i>	tree of heaven

Data Management and Analysis

FFI (FEAT/FIREMON Integrated; <http://frames.gov/ffi/>) was the primary software environment used 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, common names, and native status are from the USDA Plants Database (USDA-NRCS 2018). However, nomenclature follows the Integrated Taxonomic Information System (ITIS). In the few cases where ITIS recognized 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 were entered in the database, 100% of records were verified with the original data sheets to minimize transcription errors, followed by a 10% review of records to confirm accuracy. Automated queries were used to check for any remaining errors in the data. When errors were identified by the crew or the automated queries, corrections were made to the original datasheets and the FFI database.

Data summaries were produced using the FFI reporting and query tools. The number of species encountered in each plot was calculated using data from point-intercept, quadrat, woody species, and target species protocols. Absolute cover was calculated using point-intercept data and is the total

number of vegetation intercepts. This is often greater than 100% because more than one species can be intercepted per point due to overlapping vegetation.

The conservation status rank of plant species observed at DETO in 2018 was determined by cross-referencing with the NatureServe conservation status list, as well as the Nebraska rare plant species lists. For the purpose of this report, a species is considered rare or of conservation concern if its global (G) or state (S) conservation status rank is classified as critically imperiled (G1/S1), imperiled (G2/S2), or vulnerable (G3/S3). The 2018 species list was also cross-referenced with the list of county and state noxious weeds maintained by the [Wyoming Weed and Pest Council](#).

Results

There are 472 vascular plant species on the DETO species list, and NGPN and NGPFire monitoring crews identified a total of 152 species from 77 monitoring plots in 2018 (Table 4). Of these species, 34 are exotic or unknown origin species for the park. Most of these species were identified from the 18 plant community plot visits. The 2018 species list was cross-referenced with state-wide rare and noxious exotic species lists for Wyoming. One rare grass species, fall rosette grass (*Dichanthelium wilcoxianum*; state rank S2) was observed at DETO, where the species' scattered distribution in the northern Great Plains reaches its western extent. There were no state-listed noxious species observed in 2018.

Table 4. List of all plant species identified in Devils Tower National Monument plant community, fire effects, and forest structure monitoring plots in 2018. In the Notes column, "Exotic" indicates that a species is not native to the park or, in the case where only the genus was identified, there are some species within that genus that are exotic. State or county noxious weed species are designated in the Notes column. Species that are not on the NPS species list are indicated in as new. Species considered rare, or of conservation concern, in Wyoming are indicated with their state conservation rank (WYS1, WYS2, or WYS3).

Family	Species Code	Scientific Name	Common Name	Notes
Aceraceae	ACNE2	<i>Acer negundo</i>	boxelder	–
Agavaceae	YUGL	<i>Yucca glauca</i>	soapweed yucca	–
Apocynaceae	APCA	<i>Apocynum cannabinum</i>	Indianhemp	–
Asclepiadaceae	ASPU	<i>Asclepias pumila</i>	plains milkweed	–
Asclepiadaceae	ASSP	<i>Asclepias speciosa</i>	showy milkweed	–
Asteraceae	ACMI2	<i>Achillea millefolium</i>	common yarrow	–
Asteraceae	AMPS	<i>Ambrosia psilostachya</i>	Cuman ragweed	–
Asteraceae	ANPA4	<i>Antennaria parvifolia</i>	small-leaf pussytoes	–
Asteraceae	ANTEN	<i>Antennaria</i>	pussytoes	–
Asteraceae	ARFR4	<i>Artemisia frigida</i>	prairie sagewort	–
Asteraceae	ARLU	<i>Artemisia ludoviciana</i>	white sagebrush	–
Asteraceae	BREU	<i>Brickellia eupatorioides</i>	false boneset	–
Asteraceae	CANU4	<i>Carduus nutans</i>	nodding plumeless thistle	exotic
Asteraceae	CIAR4	<i>Cirsium arvense</i>	Canada thistle	exotic
Asteraceae	CIFL	<i>Cirsium flodmanii</i>	Flodman's thistle	–
Asteraceae	CIUN	<i>Cirsium undulatum</i>	wavyleaf thistle	–
Asteraceae	CIVU	<i>Cirsium vulgare</i>	bull thistle	exotic
Asteraceae	COCA5	<i>Conyza canadensis</i>	Canadian horseweed	–
Asteraceae	ERST3	<i>Erigeron strigosus</i>	prairie fleabane	–

Table 4 (continued). List of all plant species identified in Devils Tower National Monument plant community, fire effects, and forest structure monitoring plots in 2018. In the Notes column, “Exotic” indicates that a species is not native to the park or, in the case where only the genus was identified, there are some species within that genus that are exotic. State or county noxious weed species are designated in the Notes column. Species that are not on the NPS species list are indicated in as new. Species considered rare, or of conservation concern, in Wyoming are indicated with their state conservation rank (WYS1, WYS2, or WYS3).

Family	Species Code	Scientific Name	Common Name	Notes
Asteraceae	HIERA	<i>Hieracium</i>	hawkweed	exotic
Asteraceae	LASE	<i>Lactuca serriola</i>	prickly lettuce	exotic
Asteraceae	LOAR5	<i>Logfia arvensis</i>	field cottonrose	–
Asteraceae	LYJU	<i>Lygodesmia juncea</i>	rush skeletonplant	–
Asteraceae	MUOB99	<i>Mulgedium oblongifolium</i>	blue lettuce	–
Asteraceae	ONAC	<i>Onopordum acanthium</i>	Scotch cottonthistle	exotic
Asteraceae	RACO3	<i>Ratibida columnifera</i>	upright prairie coneflower	–
Asteraceae	SOMI2	<i>Solidago missouriensis</i>	Missouri goldenrod	–
Asteraceae	SONE	<i>Solidago nemoralis</i>	gray goldenrod	–
Asteraceae	SORI2	<i>Solidago rigida</i>	stiff goldenrod	–
Asteraceae	SYER	<i>Symphyotrichum ericoides</i>	white heath aster	–
Asteraceae	SYFA	<i>Symphyotrichum falcatum</i>	white prairie aster	–
Asteraceae	SYOB	<i>Symphyotrichum oblongifolium</i>	aromatic aster	–
Asteraceae	TAOF	<i>Taraxacum officinale</i>	common dandelion	exotic
Asteraceae	TRDU	<i>Tragopogon dubius</i>	yellow salsify	exotic
Asteraceae	XASP99	<i>Xanthisma spinulosum</i>	lacy tansyaster	–
Berberidaceae	BERE	<i>Berberis repens</i>	Oregon grape	–
Boraginaceae	CYOF	<i>Cynoglossum officinale</i>	gypsyflower	exotic
Boraginaceae	LIIN2	<i>Lithospermum incisum</i>	narrowleaf stoneseed	–
Boraginaceae	ONBE	<i>Onosmodium bejariense</i>	soft-hair marbleseed	–
Brassicaceae	ALDE	<i>Alyssum desertorum</i>	desert madwort	exotic
Brassicaceae	ARPY4	<i>Arabis pycnocarpa</i>	creamflower rockcress	–
Brassicaceae	CAMI2	<i>Camelina microcarpa</i>	littlepod false flax	exotic
Brassicaceae	DEPI	<i>Descurainia pinnata</i>	western tansymustard	–
Brassicaceae	HEMA3	<i>Hesperis matronalis</i>	dames rocket	exotic
Brassicaceae	THAR5	<i>Thlaspi arvense</i>	field pennycress	exotic
Cactaceae	OPFR	<i>Opuntia fragilis</i>	brittle pricklypear	–
Campanulaceae	CARO2	<i>Campanula rotundifolia</i>	bluebell bellflower	–

Table 4 (continued). List of all plant species identified in Devils Tower National Monument plant community, fire effects, and forest structure monitoring plots in 2018. In the Notes column, “Exotic” indicates that a species is not native to the park or, in the case where only the genus was identified, there are some species within that genus that are exotic. State or county noxious weed species are designated in the Notes column. Species that are not on the NPS species list are indicated in as new. Species considered rare, or of conservation concern, in Wyoming are indicated with their state conservation rank (WYS1, WYS2, or WYS3).

Family	Species Code	Scientific Name	Common Name	Notes
Caprifoliaceae	SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry	–
Caryophyllaceae	CEAR4	<i>Cerastium arvense</i>	field chickweed	–
Caryophyllaceae	SIAN2	<i>Silene antirrhina</i>	sleepy silene	–
Chenopodiaceae	CHSI2	<i>Chenopodium simplex</i>	mapleleaf goosefoot	–
Chenopodiaceae	SATR12	<i>Salsola tragus</i>	prickly Russian thistle	exotic
Commelinaceae	TROC	<i>Tradescantia occidentalis</i>	prairie spiderwort	–
Cupressaceae	JUSC2	<i>Juniperus scopulorum</i>	Rocky Mountain juniper	–
Cyperaceae	CABR10	<i>Carex brevior</i>	shortbeak sedge	–
Cyperaceae	CADU6	<i>Carex duriuscula</i>	needleleaf sedge	–
Cyperaceae	CAFI	<i>Carex filifolia</i>	threadleaf sedge	–
Cyperaceae	CAIN9	<i>Carex inops</i>	long-stolon sedge	–
Cyperaceae	CAPE42	<i>Carex pellita</i>	woolly sedge	–
Cyperaceae	CAREX	<i>Carex</i>	sedge	–
Cyperaceae	CASP7	<i>Carex sprengelii</i>	Sprengel's sedge	–
Equisetaceae	EQLA	<i>Equisetum laevigatum</i>	smooth horsetail	–
Euphorbiaceae	EUES	<i>Euphorbia esula</i>	leafy spurge	exotic
Euphorbiaceae	EUPHO	<i>Euphorbia</i>	spurge	–
Euphorbiaceae	EUSP	<i>Euphorbia spathulata</i>	warty spurge	–
Fabaceae	ACAM99	<i>Acmispon americanus</i>	American bird's-foot trefoil	–
Fabaceae	ASAG2	<i>Astragalus agrestis</i>	purple milkvetch	–
Fabaceae	ASFL2	<i>Astragalus flexuosus</i>	flexile milkvetch	–
Fabaceae	ASMI10	<i>Astragalus missouriensis</i>	Missouri milkvetch	–
Fabaceae	ASTRA	<i>Astragalus</i>	milkvetch	–
Fabaceae	DACA7	<i>Dalea candida</i>	white prairie clover	–
Fabaceae	DAPU5	<i>Dalea purpurea</i>	purple prairie clover	–
Fabaceae	GLLE3	<i>Glycyrrhiza lepidota</i>	American licorice	–
Fabaceae	MELU	<i>Medicago lupulina</i>	black medick	exotic
Fabaceae	MEOF	<i>Melilotus officinalis</i>	yellow sweetclover	exotic

Table 4 (continued). List of all plant species identified in Devils Tower National Monument plant community, fire effects, and forest structure monitoring plots in 2018. In the Notes column, “Exotic” indicates that a species is not native to the park or, in the case where only the genus was identified, there are some species within that genus that are exotic. State or county noxious weed species are designated in the Notes column. Species that are not on the NPS species list are indicated in as new. Species considered rare, or of conservation concern, in Wyoming are indicated with their state conservation rank (WYS1, WYS2, or WYS3).

Family	Species Code	Scientific Name	Common Name	Notes
Fabaceae	PEAR6	<i>Pedimelum argophyllum</i>	silverleaf Indian breadroot	–
Fabaceae	PEES	<i>Pedimelum esculentum</i>	large Indian breadroot	–
Fabaceae	THRH	<i>Thermopsis rhombifolia</i>	prairie thermopsis	–
Fabaceae	VIAM	<i>Vicia americana</i>	American vetch	–
Fagaceae	QUMA2	<i>Quercus macrocarpa</i>	bur oak	–
Geraniaceae	GECA5	<i>Geranium carolinianum</i>	Carolina geranium	–
Iridaceae	SIMO2	<i>Sisyrinchium montanum</i>	strict blue-eyed grass	–
Lamiaceae	HEHI	<i>Hedeoma hispida</i>	rough false pennyroyal	–
Lamiaceae	MEAR4	<i>Mentha arvensis</i>	wild mint	–
Lamiaceae	NECA2	<i>Nepeta cataria</i>	catnip	exotic
Liliaceae	CANU3	<i>Calochortus nuttallii</i>	sego lily	–
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	scarlet globemallow	–
Oleaceae	FRPE	<i>Fraxinus pennsylvanica</i>	green ash	–
Onagraceae	OESU99	<i>Oenothera suffrutescens</i>	scarlet beeblossom	–
Oxalidaceae	OXALI	<i>Oxalis</i>	woodsorrel	exotic
Pinaceae	PIPO	<i>Pinus ponderosa</i>	ponderosa pine	–
Plantaginaceae	PLPA2	<i>Plantago patagonica</i>	woolly plantain	–
Poaceae	AGCR	<i>Agropyron cristatum</i>	crested wheatgrass	exotic
Poaceae	ANGE	<i>Andropogon gerardii</i>	big bluestem	–
Poaceae	ARPU9	<i>Aristida purpurea</i>	purple threeawn	–
Poaceae	BOCU	<i>Bouteloua curtipendula</i>	sideoats grama	–
Poaceae	BODA2	<i>Bouteloua dactyloides</i>	buffalograss	–
Poaceae	BOGR2	<i>Bouteloua gracilis</i>	blue grama	–
Poaceae	BRIN2	<i>Bromus inermis</i>	smooth brome	exotic
Poaceae	BRJA	<i>Bromus japonicus</i>	Japanese brome	exotic
Poaceae	BRTE	<i>Bromus tectorum</i>	cheatgrass	exotic
Poaceae	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed	–
Poaceae	DASP2	<i>Danthonia spicata</i>	poverty oatgrass	–

Table 4 (continued). List of all plant species identified in Devils Tower National Monument plant community, fire effects, and forest structure monitoring plots in 2018. In the Notes column, “Exotic” indicates that a species is not native to the park or, in the case where only the genus was identified, there are some species within that genus that are exotic. State or county noxious weed species are designated in the Notes column. Species that are not on the NPS species list are indicated in as new. Species considered rare, or of conservation concern, in Wyoming are indicated with their state conservation rank (WYS1, WYS2, or WYS3).

Family	Species Code	Scientific Name	Common Name	Notes
Poaceae	DIOL	<i>Dichanthelium oligosanthos</i>	Heller's rosette grass	–
Poaceae	DIW15	<i>Dichanthelium wilcoxianum</i>	fall rosette grass	WYS2NT
Poaceae	ELCA11	<i>Elymus caninus</i>	bearded wheatgrass	–
Poaceae	ELCA4	<i>Elymus canadensis</i>	Canada wildrye	–
Poaceae	ELRE4	<i>Elymus repens</i>	quackgrass	exotic
Poaceae	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	–
Poaceae	ELVI3	<i>Elymus virginicus</i>	Virginia wildrye	–
Poaceae	ELYMU	<i>Elymus</i>	wildrye	exotic
Poaceae	HECO26	<i>Hesperostipa comata</i>	needle and thread	–
Poaceae	HESP11	<i>Hesperostipa spartea</i>	porcupinegrass	–
Poaceae	KOMA	<i>Koeleria macrantha</i>	prairie Junegrass	–
Poaceae	MUCU3	<i>Muhlenbergia cuspidata</i>	plains muhly	–
Poaceae	NAVI4	<i>Nassella viridula</i>	green needlegrass	–
Poaceae	PASM	<i>Pascopyrum smithii</i>	western wheatgrass	–
Poaceae	PHAR3	<i>Phalaris arundinacea</i>	reed canarygrass	–
Poaceae	PIMI7	<i>Piptatherum micranthum</i>	littleseed ricegrass	–
Poaceae	POPR	<i>Poa pratensis</i>	Kentucky bluegrass	exotic
Poaceae	SCPU	<i>Schizachne purpurascens</i>	false melic	–
Poaceae	SCSC	<i>Schizachyrium scoparium</i>	little bluestem	–
Poaceae	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed	–
Poaceae	SPPE	<i>Spartina pectinata</i>	prairie cordgrass	–
Poaceae	THIN6	<i>Thinopyrum intermedium</i>	intermediate wheatgrass	exotic
Poaceae	VUOC	<i>Vulpia octoflora</i>	sixweeks fescue	–
Polemoniaceae	COLI2	<i>Collomia linearis</i>	tiny trumpet	–
Polemoniaceae	PHHO	<i>Phlox hoodii</i>	spiny phlox	–
Polygalaceae	POAL4	<i>Polygala alba</i>	white milkwort	–
Polygonaceae	ERPA9	<i>Eriogonum pauciflorum</i>	fewflower buckwheat	–
Primulaceae	ANOC2	<i>Androsace occidentalis</i>	western rockjasmine	–

Table 4 (continued). List of all plant species identified in Devils Tower National Monument plant community, fire effects, and forest structure monitoring plots in 2018. In the Notes column, “Exotic” indicates that a species is not native to the park or, in the case where only the genus was identified, there are some species within that genus that are exotic. State or county noxious weed species are designated in the Notes column. Species that are not on the NPS species list are indicated in as new. Species considered rare, or of conservation concern, in Wyoming are indicated with their state conservation rank (WYS1, WYS2, or WYS3).

Family	Species Code	Scientific Name	Common Name	Notes
Rosaceae	AMAL2	<i>Amelanchier alnifolia</i>	Saskatoon serviceberry	–
Rosaceae	MAPU	<i>Malus pumila</i>	paradise apple	exotic
Rosaceae	PRAM	<i>Prunus americana</i>	American plum	–
Rosaceae	PRVI	<i>Prunus virginiana</i>	chokecherry	–
Rosaceae	ROAR3	<i>Rosa arkansana</i>	prairie rose	–
Rubiaceae	GAAP2	<i>Galium aparine</i>	stickywilly	–
Rubiaceae	GABO2	<i>Galium boreale</i>	northern bedstraw	–
Salicaceae	PODE3	<i>Populus deltoides</i>	eastern cottonwood	–
Salicaceae	POTR5	<i>Populus tremuloides</i>	quaking aspen	–
Salicaceae	SAAM2	<i>Salix amygdaloides</i>	peachleaf willow	–
Scrophulariaceae	PEGR5	<i>Penstemon gracilis</i>	lilac penstemon	–
Scrophulariaceae	VEAM2	<i>Veronica americana</i>	American speedwell	–
Scrophulariaceae	VEPE2	<i>Veronica peregrina</i>	neckweed	–
Scrophulariaceae	VETH	<i>Verbascum thapsus</i>	common mullein	exotic
Selaginellaceae	SEDE2	<i>Selaginella densa</i>	lesser spikemoss	–
Solanaceae	PHHE5	<i>Physalis heterophylla</i>	clammy groundcherry	–
Unknown Family	UNKFORB	<i>Unknown forb</i>	unknown forb	exotic
Unknown Family	UNKGRAM	<i>Unknown graminoid</i>	Unknown graminoid	exotic
Unknown Family	UNKGRAMPER	<i>Unknown perennial graminoid</i>	unknown perennial graminoid	exotic
Verbenaceae	VEBR	<i>Verbena bracteata</i>	bigbract verbena	–
Violaceae	VIOLA	<i>Viola</i>	violet	exotic

Based on the number of unique species observed in each plot in 2018, PCM_258 had the greatest species richness with 48 total species (Table 5). Plot PCM_008 had the greatest native species richness with 36 unique native species identified. Absolute cover calculations (Table 5) showed that absolute native species cover was greater than absolute exotic species cover in only four of ten plots where cover data were collected. PCM_018 had the highest native species cover, and PCM_258 had the highest exotic species cover (Table 6). We found exotic species at every plant community plot in DETO and they were abundant in most plots.

Table 5. Total number of plant species identified in each of the 18 monitoring plot visits where herbaceous plant data were collected at Devils Tower National Monument in 2018. This is a count of all unique species identified in the plot using species data from point-intercept, quadrat, woody species, and target species protocols. Note that quadrat data was not collected in plots monitored by the Northern Great Plains Fire Ecology Program (indicated with an asterisk), resulting in lower species counts in those plots.

MacroPlot Name	Native Species	Exotic Species	Total species
DETO_PCM_005	24	10	34
DETO_PCM_006	34	8	42
DETO_PCM_007	21	10	31
DETO_PCM_008	36	11	47
DETO_PCM_009	19	8	27
DETO_PCM_016	31	12	43
DETO_PCM_258	30	18	48
DETO_PCM_259	23	15	38
DETO_PCM_002*	16	7	23
DETO_PCM_014*	21	4	25
DETO_PCM_018*	17	7	24
DETO_PCM_019*	17	7	24
DETO_PCM_030*	15	9	24
DETO_PCM_031*	15	8	23
DETO_PCM_044*	19	10	29
DETO_PCM_045*	11	9	20
DETO_PCM_046*	14	12	26
DETO_PCM_051*	16	3	19

Table 6. Absolute percent cover of native and exotic plant species in plots monitored at Devils Tower National Monument in 2018. Absolute percent cover is calculated using the point-intercept data. This includes overlapping species canopies, which can result in values greater than 100%.

Plot	Absolute % Native Cover	Absolute % Exotic Cover
DETO_PCM_002	145	157
DETO_PCM_005	87	208
DETO_PCM_006	105	191
DETO_PCM_007	63	228
DETO_PCM_008	155	170
DETO_PCM_009	126	146
DETO_PCM_014	152	123
DETO_PCM_016	150	140
DETO_PCM_018	156	121
DETO_PCM_019	113	147
DETO_PCM_030	93	146
DETO_PCM_031	108	157
DETO_PCM_044	125	120
DETO_PCM_045	68	145
DETO_PCM_046	65	166
DETO_PCM_051	98	114
DETO_PCM_258	34	237
DETO_PCM_259	64	180

Monitoring crews visited 75 forest structure monitoring plots, and of these plots, 31 had measurable trees and forests in the park were dominated by ponderosa pine (Table 7). Plot PCM_058 had the greatest tree density with an average 701 trees per hectare (Figure 5). PCM_017 had the greatest seedling density with an average of 2673 ponderosa pine seedlings per hectare. Surface fuels at plots with woody debris present averaged 9.9 tons per acre (Table 8).



Figure 5. Long-term monitoring plot PCM_058 at Devils Tower National Monument is located in the northern portion of the park and had the highest tree density in the park in 2018. Photograph courtesy of the National Park Service.

Table 7. Tree and seedling density and basal area in plots monitored at Devils Tower National Monument in 2018. Seventy-five plots were visited, but only the 31 plots listed below had tree species present.

Plot	Tree density (stems per hectare)	Number of trees	Snag density (stems per hectare)	Basal Area (square meter per hectare)	Ponderosa pine seedling density (stems per hectare)	Other species seedling density (stems per hectare)
DETO_PCM_001	159	5	0	15	64	0
DETO_PCM_003	255	8	32	12	0	32
DETO_PCM_007	150	15	20	13	159	0
DETO_PCM_010	127	4	64	12	95	0
DETO_PCM_011	510	16	96	29	0	0
DETO_PCM_016	10	1	10	1	0	0
DETO_PCM_017	191	6	0	16	2673	191
DETO_PCM_021	32	1	0	3	32	0
DETO_PCM_022	96	3	0	12	95	0
DETO_PCM_023	191	6	0	16	32	1209
DETO_PCM_024	127	4	0	10	0	0
DETO_PCM_025	191	6	0	11	0	0
DETO_PCM_028	191	6	0	11	0	0

Table 7 (continued). Tree and seedling density and basal area in plots monitored at Devils Tower National Monument in 2018. Seventy-five plots were visited, but only the 31 plots listed below had tree species present.

Plot	Tree density (stems per hectare)	Number of trees	Snag density (stems per hectare)	Basal Area (square meter per hectare)	Ponderosa pine seedling density (stems per hectare)	Other species seedling density (stems per hectare)
DETO_PCM_029	350	11	0	23	0	0
DETO_PCM_033	541	17	64	18	0	0
DETO_PCM_034	223	7	32	16	64	318
DETO_PCM_035	32	1	0	9	64	0
DETO_PCM_036	64	2	0	7	0	0
DETO_PCM_038	318	10	32	30	32	95
DETO_PCM_039	223	7	0	15	32	0
DETO_PCM_042	350	11	0	45	95	0
DETO_PCM_047	191	6	32	17	0	477
DETO_PCM_049	96	3	0	22	1910	0
DETO_PCM_052	287	9	96	15	0	127
DETO_PCM_054	191	6	0	5	0	0
DETO_PCM_057	191	6	0	18	1591	0
DETO_PCM_058	701	22	0	29	0	127
DETO_PCM_059	414	13	0	24	127	4901
DETO_PCM_068	382	12	0	24	32	32
DETO_PCM_258	10	1	0	2	0	0
DETO_PCM_273	40	4	0	4	0	0

Table 8. Surface fuels data for wooded plots at Devils Tower National Monument in 2018.

Plot	Average Tons per Acre										Avg. Depth (in.)		
	1-hr	10-hr	100-hr	1-100-hr	1000-hr sound	1000-hr rotten	1-1000-hr	Duff	Litt	Total	Duff	Litt	Total
PCM_001	0.04	0.54	0.00	0.58	1.09	0.00	1.67	5.90	3.03	10.61	0.34	0.76	1.10
PCM_002	0.00	0.14	0.73	0.86	0.00	0.00	0.86	2.29	1.24	4.39	0.13	0.31	0.44
PCM_003	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	2.60	4.09	0.09	0.65	0.74
PCM_005	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PCM_006	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PCM_007	0.02	0.27	4.44	4.73	8.20	5.54	18.47	5.72	1.88	26.07	0.33	0.47	0.80

Table 8 (continued). Surface fuels data for wooded plots at Devils Tower National Monument in 2018.

Plot	Average Tons per Acre										Avg. Depth (in.)		
	1-hr	10-hr	100-hr	1-100-hr	1000-hr sound	1000-hr rotten	1-1000-hr	Duff	Litt	Total	Duff	Litt	Total
PCM_008	0.00	0.15	0.75	0.90	0.00	6.71	7.61	0.26	1.08	8.95	0.02	0.27	0.29
PCM_010	0.04	0.00	0.00	0.04	16.97	0.00	17.01	2.99	1.12	21.12	0.17	0.28	0.45
PCM_011	0.02	0.14	1.45	1.61	2.01	0.20	3.82	2.38	1.94	8.13	0.14	0.49	0.62
PCM_013	0.00	0.00	0.73	0.73	0.00	1.66	2.39	1.85	1.48	5.71	0.11	0.37	0.48
PCM_014	0.06	0.27	0.00	0.33	0.00	0.00	0.33	1.14	0.58	2.06	0.07	0.15	0.21
PCM_016	0.00	0.41	1.45	1.86	0.00	0.00	1.86	0.00	2.30	4.15	0.00	0.58	0.58
PCM_017	0.02	0.14	0.00	0.16	6.78	3.20	10.13	1.85	2.76	14.74	0.11	0.69	0.80
PCM_018	0.08	0.28	0.00	0.36	2.43	0.00	2.79	1.23	0.84	4.86	0.07	0.21	0.28
PCM_019	0.00	0.54	2.92	3.46	1.19	9.29	13.94	0.79	0.80	15.54	0.05	0.20	0.25
PCM_021	0.02	0.14	0.00	0.16	0.00	0.00	0.16	3.08	2.14	5.37	0.18	0.54	0.71
PCM_022	0.00	0.27	0.00	0.27	0.00	0.48	0.76	3.79	3.13	7.68	0.22	0.79	1.00
PCM_023	0.22	2.58	0.73	3.53	0.00	0.00	3.53	2.99	2.12	8.64	0.17	0.53	0.70
PCM_024	0.06	0.84	1.52	2.42	0.00	0.00	2.42	0.97	1.42	4.81	0.06	0.36	0.41
PCM_025	0.10	0.81	0.00	0.91	0.00	0.00	0.91	0.97	2.60	4.48	0.06	0.65	0.71
PCM_026	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PCM_028	0.00	0.41	1.53	1.94	0.00	0.00	1.94	0.00	0.74	2.68	0.00	0.19	0.19
PCM_029	0.00	0.28	2.22	2.50	0.00	0.38	2.88	2.20	2.52	7.59	0.13	0.63	0.76
PCM_030	0.06	0.82	1.48	2.35	24.40	8.37	35.13	5.11	1.64	41.87	0.29	0.41	0.70
PCM_031	0.00	0.54	1.45	1.99	7.07	0.54	9.60	1.58	0.86	12.04	0.09	0.22	0.31
PCM_032	0.00	0.14	0.00	0.14	0.00	0.36	0.50	0.00	0.98	1.48	0.00	0.25	0.25
PCM_033	0.00	0.14	0.73	0.87	4.35	8.34	13.56	4.49	2.14	20.18	0.26	0.54	0.79
PCM_034	0.06	0.00	0.00	0.06	0.00	0.00	0.06	1.58	1.96	3.61	0.09	0.49	0.58
PCM_035	0.00	0.43	1.52	1.95	0.89	0.61	3.45	0.09	0.44	3.98	0.01	0.11	0.12
PCM_036	0.00	0.28	0.00	0.28	0.54	0.00	0.82	0.44	1.60	2.86	0.03	0.40	0.43
PCM_038	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.02	2.14	4.16	0.12	0.54	0.65
PCM_039	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.54	0.89	0.02	0.14	0.16
PCM_041	0.00	0.27	1.45	1.72	2.57	21.07	25.36	6.16	1.86	33.38	0.35	0.47	0.82
PCM_042	0.02	0.82	0.00	0.84	4.23	0.00	5.07	10.56	2.22	17.85	0.60	0.56	1.16
PCM_044	0.06	0.69	1.48	2.23	0.64	0.00	2.87	1.67	0.54	5.08	0.10	0.14	0.23
PCM_045	0.00	0.95	2.18	3.13	13.42	1.15	17.70	0.97	0.74	19.41	0.06	0.19	0.24
PCM_046	0.08	0.41	2.23	2.72	10.62	2.61	15.95	5.63	1.04	22.62	0.32	0.26	0.58
PCM_047	0.00	0.41	1.45	1.86	13.78	0.00	15.65	3.96	1.04	20.65	0.23	0.26	0.49
PCM_049	0.04	0.95	2.18	3.17	0.00	11.54	14.71	8.54	3.33	26.58	0.49	0.84	1.32
PCM_050	0.08	0.43	8.50	9.01	0.71	0.00	9.72	3.08	0.60	13.40	0.18	0.15	0.33
PCM_051	0.04	0.14	0.00	0.17	0.22	0.00	0.40	0.00	0.28	0.68	0.00	0.07	0.07

Table 8 (continued). Surface fuels data for wooded plots at Devils Tower National Monument in 2018.

Plot	Average Tons per Acre										Avg. Depth (in.)		
	1-hr	10-hr	100-hr	1-100-hr	1000-hr sound	1000-hr rotten	1-1000-hr	Duff	Litt	Total	Duff	Litt	Total
PCM_052	0.00	0.29	0.73	1.02	0.00	19.10	20.12	0.62	1.46	22.19	0.04	0.37	0.40
PCM_054	0.10	0.14	0.00	0.23	0.00	0.00	0.23	2.29	1.24	3.76	0.13	0.31	0.44
PCM_057	0.00	0.27	4.44	4.71	11.45	3.17	19.33	5.99	2.40	27.72	0.34	0.60	0.94
PCM_058	0.14	2.88	5.89	8.92	12.92	7.05	28.89	12.41	4.59	45.90	0.71	1.15	1.86
PCM_059	0.06	0.68	0.00	0.74	1.86	5.19	7.78	12.32	1.60	21.71	0.70	0.40	1.10
PCM_060	0.02	0.69	1.48	2.19	4.89	0.00	7.08	0.18	0.82	8.08	0.01	0.21	0.22
PCM_061	0.13	1.22	2.36	3.72	5.30	5.98	15.01	0.53	2.04	17.57	0.03	0.51	0.54
PCM_062	0.06	0.98	1.53	2.57	3.29	3.21	9.07	10.30	2.30	21.66	0.59	0.58	1.16
PCM_063	0.08	0.42	2.29	2.78	10.83	9.33	22.95	0.00	0.60	23.54	0.00	0.15	0.15
PCM_064	0.00	0.55	0.73	1.28	2.12	1.01	4.41	0.44	0.52	5.36	0.03	0.13	0.16
PCM_065	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PCM_066	0.12	0.41	0.00	0.53	1.13	5.83	7.50	2.64	1.76	11.89	0.15	0.44	0.59
PCM_067	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.32	1.76	3.08	0.08	0.44	0.52
PCM_068	0.04	0.69	0.73	1.46	7.64	0.00	9.10	8.80	3.09	21.00	0.50	0.78	1.28
PCM_258	0.12	0.81	0.73	1.66	0.27	0.00	1.93	8.71	1.74	12.38	0.50	0.44	0.93
PCM_260	0.01	0.12	0.00	0.14	0.00	0.00	0.14	0.11	0.23	0.48	0.01	0.14	0.15
PCM_263	0.00	0.00	1.90	1.90	0.00	0.37	2.27	0.00	0.24	2.51	0.00	0.15	0.15
PCM_264	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PCM_265	0.04	0.13	0.00	0.17	0.00	0.00	0.17	1.09	0.72	1.98	0.10	0.44	0.54
PCM_271	0.00	0.00	0.00	0.00	0.00	1.41	1.41	1.25	0.87	3.53	0.12	0.53	0.65
PCM_272	0.04	0.37	0.00	0.42	0.00	0.59	1.00	0.00	0.37	1.37	0.00	0.23	0.23
PCM_273	0.02	0.06	3.10	3.18	3.94	4.36	11.48	0.87	1.33	13.69	0.08	0.82	0.90
PCM_274	0.02	0.13	0.00	0.15	0.00	0.00	0.15	0.05	0.80	1.00	0.01	0.49	0.50
PCM_276	0.00	0.00	1.27	1.27	2.88	3.67	7.81	0.05	0.38	8.24	0.01	0.23	0.24
PCM_278	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PCM_279	0.00	0.12	0.00	0.12	0.00	0.00	0.12	0.05	0.42	0.60	0.01	0.26	0.26
PCM_280	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PCM_281	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PCM_284	0.04	0.12	0.00	0.17	0.00	4.42	4.59	0.11	1.39	6.09	0.01	0.85	0.86
PCM_286	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.37	0.42	0.01	0.23	0.23
PCM_288	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PCM_289	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PCM_290	0.06	0.06	1.55	1.67	0.00	3.36	5.03	4.63	0.92	10.58	0.43	0.57	0.99
PCM_292	0.07	0.87	0.63	1.58	6.03	13.30	20.91	1.96	1.16	24.03	0.18	0.71	0.89
Average	0.03	0.37	0.97	1.37	2.62	2.31	6.30	2.33	1.27	9.90	0.14	0.36	0.50

Disturbances were observed at many of the plots visited in 2018. A variety of disturbance types were recorded, including grazing, animal trails, a road, and erosion. This year, NGPN also began recording the total area of exposed soil disturbance. The most commonly observed disturbance was animal trails and bedding, while herbicide application, prescribed fire, and tree removal occupied the greatest area due to the nature of those disturbances extending over entire plots (Table 9).

Table 9. Disturbance types, frequency, and mean area of disturbance in plant community and forest structure monitoring plots visited in 2018 at Devils Tower National Monument. Mean areas are calculated across plots where each disturbance type was observed rather than all 77 plots visited.

Disturbance type	# Plots Where Observed	Mean area (m ²)
Animal Trail/Beds	37	49
Soil Disturbance	24	11
Prescribed Fire	15	766
Small Mammal Excavation	13	5
Herbicide	8	730
Erosion	6	13
Off-Road (trails & roads)	3	25
Tree Removal/Thinning	2	730
Elk Exclosure	1	90
Flood	1	60

Target exotic species of management concern were observed at all 77 plots visited in 2018 (Table 10). None of the target species included on the early detection and rapid response target species list were identified during these plot visits. Leafy spurge was the most commonly observed target species, occurring in 64 of 77 plots, and smooth brome had the greatest average cover in plots where it was observed, with 14% cover across 35 plots (Table 10).

Table 10. Target exotic species cover recorded in plant community and forest structure plots occurrence in plant community and forest structure monitoring plots visited in 2018 at Devils Tower National Monument. Mean cover values are calculated across plots where each target species was observed rather than all 77 plots visited.

Scientific Name	Common Name	# Plots Where Observed	Mean % Cover
<i>Euphorbia esula</i>	leafy spurge	64	4.70
<i>Melilotus officinalis</i>	yellow sweetclover	45	2.38
<i>Bromus japonicus</i>	Japanese brome	42	1.73
<i>Cynoglossum officinale</i>	houndstongue	39	1.71
<i>Bromus inermis</i>	smooth brome	35	14.04
<i>Cirsium arvense</i>	Canada thistle	31	6.77
<i>Verbascum thapsus</i>	common mullein	27	0.74
<i>Thlaspi arvense</i>	field pennycress	17	0.65
<i>Bromus tectorum</i>	cheatgrass	11	3.14
<i>Cirsium vulgare</i>	bull thistle	7	0.43
<i>Carduus nutans</i>	musk thistle	3	0.50
<i>Hesperis matronalis</i>	dames rocket	2	0.50
<i>Agropyron cristatum</i>	crested wheatgrass	1	< 0.10
<i>Onopordum acanthium</i>	Scotch cottonthistle	1	0.50
<i>Salsola tragus</i>	prickly Russian thistle	1	0.50

Further Analysis

This Data Report is intended to provide a basic review of the data collected during the NGPN and NGPFire monitoring team's 2018 visit to Devils Tower National Monument. All data included in this report is available upon request from the Northern Great Plains Inventory and Monitoring Network, as well as in the archives found in the [IRMA Data Store](#).

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