



Plant Community Composition and Structure Monitoring for Devils Tower National Monument *2017 Data Report*

Natural Resource Data Series NPS/NGPN/NRDS—2018/1148



ON THE COVER

Plant Community Composition and Structure Monitoring plot PCM-016 at Devils Tower National Monument, July 2017.
Photograph courtesy of the National Park Service.

Plant Community Composition and Structure Monitoring for Devils Tower National Monument

2017 Data Report

Natural Resource Data Series NPS/NGPN/NRDS—2018/1148

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Contents

	Page
Figures.....	iv
Tables.....	iv
Abstract.....	vi
Acknowledgments.....	vii
Introduction.....	1
Methods.....	1
NGPN Monitoring Plots 2017	1
Plot Layout and Sampling	3
Data Management and Analysis	5
Results.....	7
Literature Cited	15

Figures

	Page
Figure 1. Map of Devils Tower National Monument plant community monitoring (PCM) plots visited in 2017.	2
Figure 2. Long-term monitoring plot layout used for sampling vegetation in Devils Tower National Monument.	4
Figure 3. The Northern Great Plains Inventory & Monitoring vegetation crew used point-intercept, and 1m ² quadrats to document plant diversity and abundance.	4
Figure 4. Photograph of long-term monitoring plot PCM_016 at Devils Tower National Monument, 2017, depicting a grassland to ponderosa pine forest transition with signs of prescribed fire.	14

Tables

	Page
Table 1. Field journal for Northern Great Plains Network plant community monitoring in Devils Tower National Monument in 2017.	3
Table 2. 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.	5
Table 3. Definitions of state and global species conservation status ranks.....	6
Table 4. A list of all plant species identified in Devils Tower National Monument long-term plant community monitoring plots in 2017.	7
Table 5. Total number of plant species identified in each of the eight plots monitored at Devils Tower National Monument in 2017.	11
Table 6. Absolute percent cover of native and exotic plant species in plots monitored at Devils Tower National Monument in 2017.	12
Table 7. Density and number of trees and poles observed at six of eight plots visited at Devils Tower National Monument in 2017.	12
Table 8. Seedling density observed from two of eight plots visited at Devils Tower National Monument in 2017.	13
Table 9. Surface fuels observed in five of eight plots visited in 2017 at Devils Tower National Monument by NGPN monitoring crews.	13

Tables (continued)

	Page
Table 10. Disturbance types and area sizes observed in seven plots visited at Devils Tower National Monument in 2017.....	13

Abstract

This report presents the results of the Northern Great Plains Inventory and Monitoring Network's vegetation monitoring at Devils Tower National Monument (DETO) in 2017. This was the seventh year that the Northern Great Plains Inventory and Monitoring Network (NGPN) conducted field work at DETO.

The NGPN field crew visited eight long-term plant community monitoring (PCM) plots to collect data on the plant communities at DETO. This work is part of a long-term monitoring effort designed to provide a better understanding of the condition of the vegetation community at DETO and how it changes over time. NGPN staff measured species richness, herb-layer height, native and non-native species abundance, ground cover, and site disturbance at each of the eight plots. In plots where woody species were present, tree regeneration, tall shrub density, tree density, and woody fuel loads were also measured.

Monitoring crews identified 107 species in eight monitoring plots visited in 2017. Of those species, 19 were exotic species. Generally, upland PCM plots had higher native species diversity than riparian PCM plots, however, exotic species were common in all eight plots. None of the exotic species identified in 2017 were on the target list for the early detection and rapid response program in the Northern Great Plains Network parks. Tree regeneration was observed at two of the eight plots. The most common disturbances observed were the results of prescribed fire and animal use.

Acknowledgments

We thank 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, particularly R. Ohms and law enforcement staff for providing logistical support and safety checks. We also thank P. Knecht, A. Mandanna, K. Ronsani, and A. Burhans from DETO for assistance in the field. The 2017 NGPN vegetation field crew of I. Ashton, R. Manuel, M. Davis, and R. Oltjenbruns, with the assistance of the Northern Great Plains Fire Effects crew of D. Swanson, M. Whitman, I. Muirhead, and T. Schaffner, collected all the data included in this report.

Introduction

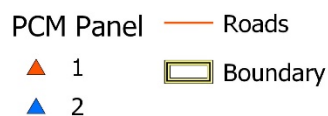
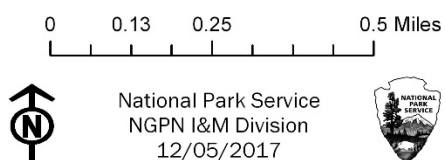
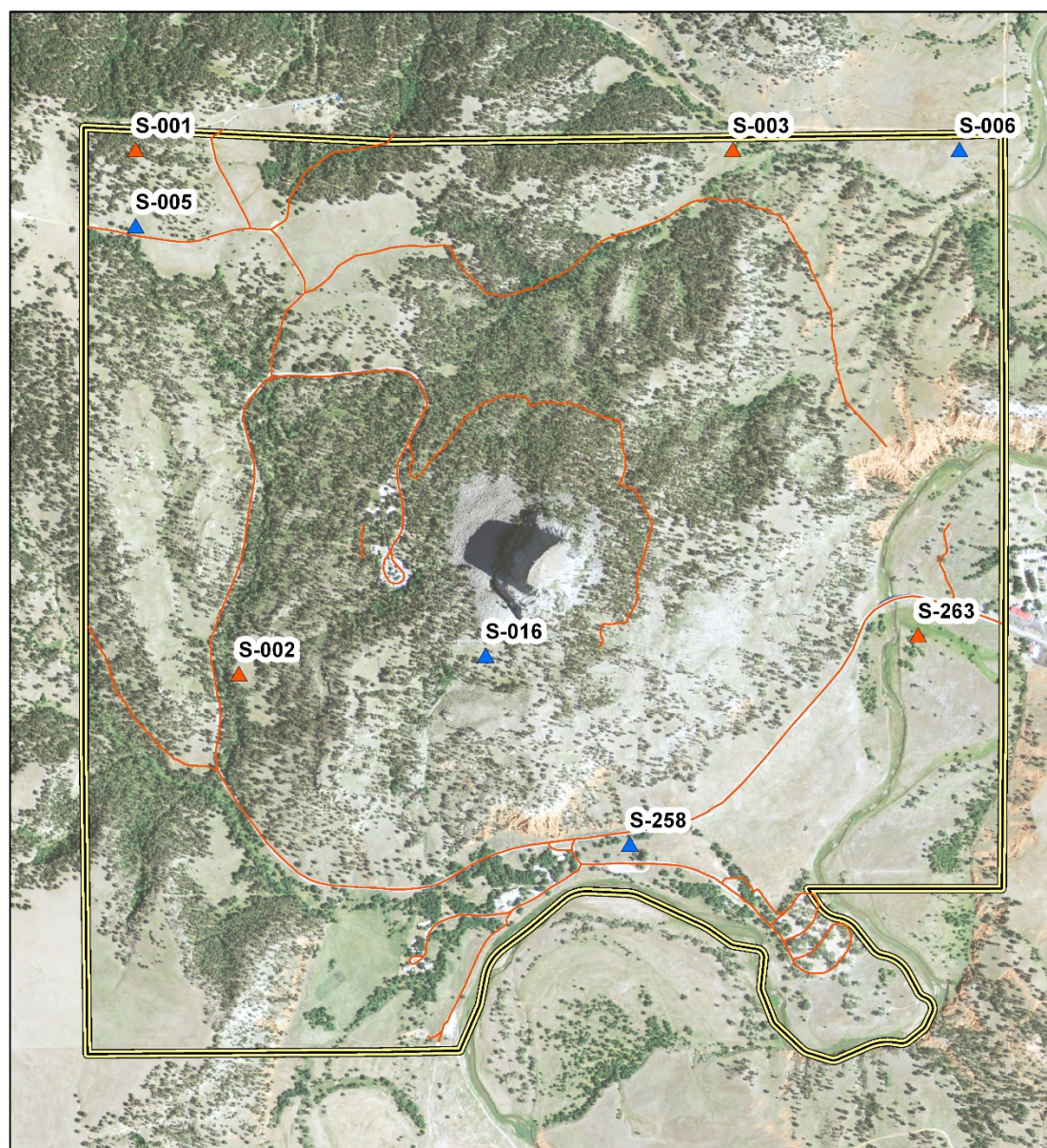
Devils Tower National Monument (DETO) was established in 1906 as America's first national monument, with a mission to protect and preserve the impressive rock tower and the lands around it. It is located in northeastern Wyoming on the edge of the Black Hills. The vegetation is a mosaic of ponderosa pine 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). Combined sampling efforts began in 2011 (Ashton et al. 2012). In this report, we provide summaries of the data collected at eight plots in 2017.

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 the protocol publications cited above, and available at <http://science.nature.nps.gov/im/units/ngpn/monitor/plants.cfm>.

NGPN Monitoring Plots 2017

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 2017, the NGPN crew visited PCM plots in panels 1 and 2 during the week of July 10-12 (Table 1). Of the eight plots, six were in upland habitat and two were in the riparian corridor (PCM_258 and PCM_263). The Fire Effects program also visited monitoring plots in 2017, but the data were not available in time to include in this report.



Devils Tower National Mounment
Crook County, WY 82714

Figure 1. Map of Devils Tower National Monument plant community monitoring (PCM) plots visited in 2017. Long-term vegetation monitoring plots were established by the Northern Great Plains Inventory & Monitoring Program (NGPN) and the Fire Effects Program (NGPFire) between 2011 and 2015. Four Panel 1 plots (in red), and four Panel 2 plots (in blue) were monitored in 2017 by NGPN.

Table 1. Field journal for Northern Great Plains Network plant community monitoring (PCM) in Devils Tower National Monument in 2017. A crew of four people completed 8 PCM plots, along with the assistance of Devils Tower staff.

Date	Travel time	Housing	Plots Read	Notes
Monday July 10, 2017	1.5 hrs	Park campground	PCM_002 PCM_258	Both plots completed by 4 person NGPN crew
Tuesday July 11, 2017	0.0 hrs	Park campground	PCM_001 PCM_005 PCM_016	Completed PCM_016 in the morning with assistance from Alonzo Mandanna and Phil Knecht. They also helped with PCM_005. The 4 person NGPN crew completed both PCM_005 & PCM_001 in the afternoon.
Wednesday July 12, 2017	1.5 hrs	Park campground	PCM_003 PCM_006 PCM_263	Completed all three plots with the assistance of Kayla Ronsani and Alanna Burhans.

Plot Layout and Sampling

The NGPN crew recorded plant species cover and frequency in each 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 along two 50 m transects (the long sides of the plot) using a point-intercept method. At 50 points along each transect at one meter intervals, a pole was dropped to the ground and all species that touched the pole were recorded, along with ground cover and canopy height (Figure 3). 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 (Figure 2 & Figure 3).

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 plot (Figure 2). Trees within the 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 $\text{DBH} < 2.54$ cm (seedlings) were tallied by species within the 10 m radius subplot. Dead and downed woody fuel load data were also collected at these forested plots along two perpendicular, 100 foot (30.49 m) transects with midpoints at the center of the plot (Figure 2), 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.

Common disturbances, including impacts from grazing, rodent burrowing, animal trails, and flooding, were assessed and documented at each plot. The disturbance type and area of each of the disturbances were recorded in square meters and ranged from 0 m² (not present) to 1000 m² (the whole plot area).

The NGPN crew also surveyed plots for early-detection exotic species that have the potential to spread into the park and cause significant ecological impacts (Table 2). These species were chosen in collaboration with the Midwest Invasive Plant Network, the Exotic Plant Management Team, park

managers, and local weed experts. For each target species present, 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.

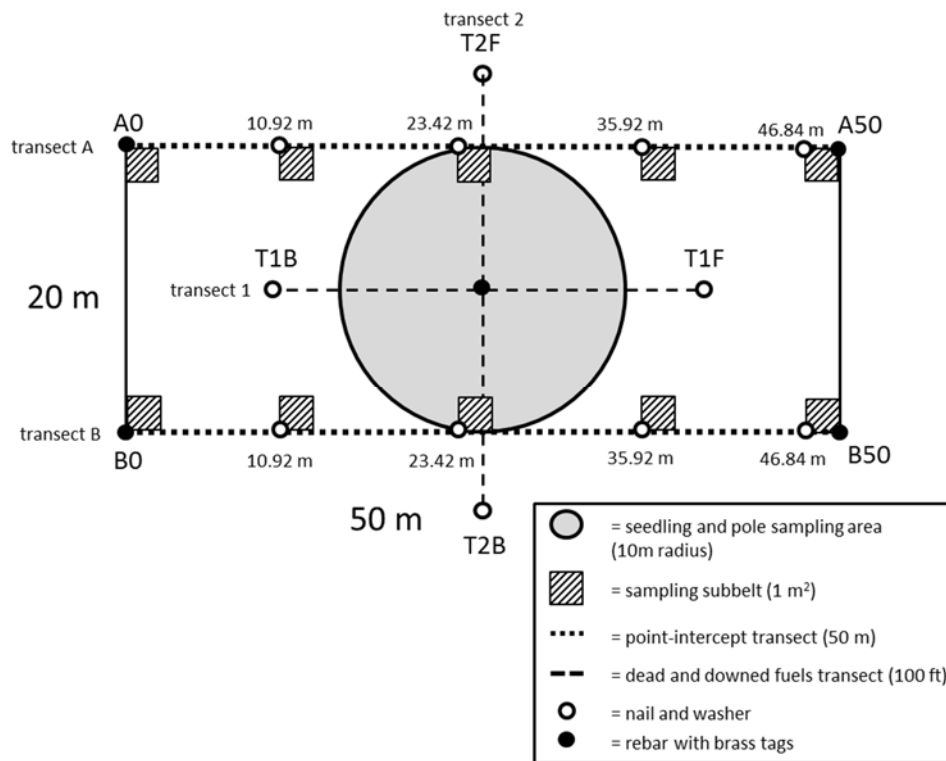


Figure 2. Long-term monitoring plot layout used for sampling vegetation in Devils Tower National Monument.

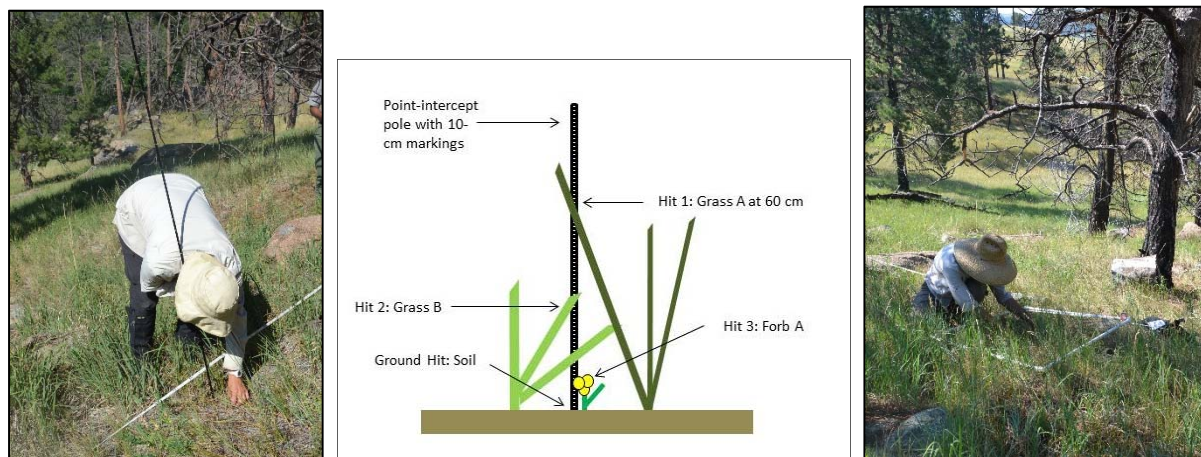


Figure 3. The Northern Great Plains Inventory & Monitoring vegetation crew used point-intercept (left and center panel), and 1m² quadrats (right panel) to document plant diversity and abundance.

Table 2. 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
<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 aethiopsis</i>	Mediterranean sage	Upland
<i>Ventenata dubia</i>	African wiregrass	Upland

Data Management and Analysis

The FFI (FEAT/FIREMON Integrated; <http://frames.gov/ffi/>) database was used 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, common names, and native status are from the USDA Plants Database (USDA-NRCS 2017). However, nomenclature follows the Integrated Taxonomic Information System (ITIS; <http://www.itis.gov>). 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 monitoring data were entered in the database, 100% of records were verified with the original data sheets to minimize transcription errors and a further 10% of records were reviewed a second

time. After all data were entered and verified, automated data checks were used to locate any remaining errors in the data. When errors were identified by the crew or the automated checks, corrections were made to the original datasheets and the FFI database as needed.

Data summaries were produced using the FFI reporting and query tools. The number of species per plot is a count of all unique species encountered in the plot, 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 along the transects. This is often greater than 100% because more than one species can be intercepted per point due to overlapping vegetation. Tree density is derived from a count of individual trees within the 0.1 ha plot. Pole and seedling densities are derived from counts of poles and seedlings within the smaller circular 0.314 ha subplot. Tree, pole, and seedling densities are all expressed as the number of individuals per hectare.

The list of species observed at DETO in 2017 was cross-referenced with the Wyoming rare plant species list maintained by the Wyoming Natural Diversity Database (WYNDD; <https://www.uwyo.edu/wyndd/species-of-concern/>). For the purpose of this report, a species was considered rare or of conservation concern if it had a conservation status rank of S1, S2, or S3 (Table 3). More information on conservation ranks can be found at the NatureServe website (<http://www.natureserve.org/conservation-tools/conservation-status-assessment>.) Finally, the species list was cross-referenced with the list of Wyoming Designated Noxious Weeds to check for state-listed exotic plants (<https://www.wyoweed.org/weeds/state-designated-weeds>).

Table 3. Definitions of state and global species conservation status ranks.*

Status Rank	Category	Definition
S1/G1	Critically imperiled	Due to extreme rarity (5 or fewer occurrences) or other factor(s) making it especially vulnerable to extirpation.
S2/G2	Imperiled	Due to rarity resulting from a very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation.
S3/G3	Vulnerable	Due to a restricted range, relatively few populations (often 80 or fewer), recent widespread declines, or other factors making it vulnerable to extirpation.
S4/G4	Apparently secure	Uncommon but not rare; some cause for concern due to declines or other factors.
S5/G5	Secure	Common, widespread and abundant.
S#S#/ G#G#	Range rank (e.g. S2S3)	Used to indicate uncertainty about the status of the species or community. Ranges cannot skip more than one rank.

* Adapted from NatureServe status assessment table (<http://www.natureserve.org/conservation-tools/conservation-status-assessment>), NT following a rank indicates “not tracked” by the state of WY.

Results

There are 471 vascular plant species on the DETO species list (<https://irma.nps.gov/NPSpecies/Search/SpeciesList/DETO>), and the NGPN monitoring crew identified 107 of those species in eight monitoring plots visited in 2017 at DETO (Table 4). Of those plant species, 19 are exotic species at DETO. All exotics identified were either forbs or graminoids (grasses, sedges, and rushes).

Based on all species data collected in 2017, plots PCM_016 and PCM_258 were the most botanically diverse (Table 5). Plot PCM_016, located in a transition zone between forest and grassland, had both the highest total number of native species and absolute cover of native species (Tables 5 & 6).

Vegetation in plot PCM_016 was primarily composed of western wheatgrass (*Pascopyrum smithii*) and big bluestem (*Andropogon gerardii*). Plot PCM_258, a roadside riparian plot, had the highest total number of exotic species and absolute cover of exotic species. Vegetation in plot PCM_258 was primarily composed of crested wheatgrass (*Agropyron cristatum*) and Kentucky bluegrass (*Poa pratensis*).

Two rare species, Emory's sedge (*Carex emoryii*, S1), and false rosette grass (*Dicanthelium wilcoxianum*, S2NT), were identified in 2017. Three species on the Wyoming noxious species list were identified: Canada thistle (*Cirsium arvense*), houndstongue (*Cynoglossum officinale*), and leafy spurge (*Euphorbia esula*) (Table 4, notes column). No early detection exotic species were observed in any of the eight plots visited in 2017.

Table 4. A list of all plant species identified in Devils Tower National Monument long-term plant community monitoring plots in 2017. The species are grouped by plant family. In the Notes column, "Exotic" indicates that 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 in the United States. A "Noxious" in the Notes column indicates the species is on Wyoming's list of designated noxious weeds. An "S1", "S2", or "S3" indicates the conservation rank of a species that is rare or of conservation concern in Wyoming. Conservation rank definitions are in Table 4 of the report.

Family	Code	Scientific	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	-
	ASSP	<i>Asclepias speciosa</i>	showy milkweed	-
	ASVI	<i>Asclepias viridiflora</i>	green comet milkweed	-
Asteraceae	ACMI2	<i>Achillea millefolium</i>	common yarrow	-
	AMPS	<i>Ambrosia psilostachya</i>	Cuman ragweed	-
	ANMI3	<i>Antennaria microphylla</i>	littleleaf pussytoes	-
	ANPA4	<i>Antennaria parvifolia</i>	small-leaf pussytoes	-
	ARCA12	<i>Artemisia campestris</i>	field sagewort	-

Table 4 (continued). A list of all plant species identified in Devils Tower National Monument long-term plant community monitoring plots in 2017. The species are grouped by plant family. In the Notes column, “Exotic” indicates that 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 in the United States. A “Noxious” in the Notes column indicates the species is on Wyoming’s list of designated noxious weeds. An “S1”, “S2”, or “S3” indicates the conservation rank of a species that is rare or of conservation concern in Wyoming. Conservation rank definitions are in Table 4 of the report.

Family	Code	Scientific	Common Name	Notes
	ARFR4	<i>Artemisia frigida</i>	prairie sagewort	-
	ARLU	<i>Artemisia ludoviciana</i>	white sagebrush	-
	BREU	<i>Brickellia eupatorioides</i>	false boneset	-
	CIAR4	<i>Cirsium arvense</i>	Canada thistle	Noxious, Exotic
	CIUN	<i>Cirsium undulatum</i>	wavyleaf thistle	-
	COCA5	<i>Conyza canadensis</i>	Canadian horseweed	-
	ECAN2	<i>Echinacea angustifolia</i>	blacksamson echinacea	-
	ERST3	<i>Erigeron strigosus</i>	prairie fleabane	-
	LASE	<i>Lactuca serriola</i>	prickly lettuce	Exotic
	LYJU	<i>Lygodesmia juncea</i>	rush skeletonplant	-
	RACO3	<i>Ratibida columnifera</i>	upright prairie coneflower	-
	SORI2	<i>Solidago rigida</i>	stiff goldenrod	-
	SYFA	<i>Symphyotrichum falcatum</i>	white prairie aster	-
	SYOB	<i>Symphyotrichum oblongifolium</i>	aromatic aster	-
	TAOF	<i>Taraxacum officinale</i>	common dandelion	Exotic
	TEAC	<i>Tetaneuris acaulis</i>	stemless four-nerve daisy	-
	TRDU	<i>Tragopogon dubius</i>	yellow salsify	Exotic
	XASP99	<i>Xanthisma spinulosum</i>	lacy tansyaster	-
Berberidaceae	BERE	<i>Berberis repens</i>	Oregon grape	-
Boraginaceae	CYOF	<i>Cynoglossum officinale</i>	houndstongue	Noxious, Exotic
	LIIN2	<i>Lithospermum incisum</i>	narrowleaf stoneseed	-
Brassicaceae	ALDE	<i>Alyssum desertorum</i>	desert madwort	Exotic
	CAMI2	<i>Camelina microcarpa</i>	littlepod false flax	Exotic
	DEPI	<i>Descurainia pinnata</i>	western tansymustard	-
	ERYSI	<i>Erysimum</i>	wallflower	Exotic
	THAR5	<i>Thlaspi arvense</i>	field pennycress	Exotic
Cactaceae	OPFR	<i>Opuntia fragilis</i>	brittle pricklypear	-
Campanulaceae	CARO2	<i>Campanula rotundifolia</i>	bluebell bellflower	-
	TRPE4	<i>Triodanis perfoliata</i>	clasping Venus' looking-glass	-
Caprifoliaceae	SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry	-

Table 4 (continued). A list of all plant species identified in Devils Tower National Monument long-term plant community monitoring plots in 2017. The species are grouped by plant family. In the Notes column, “Exotic” indicates that 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 in the United States. A “Noxious” in the Notes column indicates the species is on Wyoming’s list of designated noxious weeds. An “S1”, “S2”, or “S3” indicates the conservation rank of a species that is rare or of conservation concern in Wyoming. Conservation rank definitions are in Table 4 of the report.

Family	Code	Scientific	Common Name	Notes
Caryophyllaceae	CEAR4	<i>Cerastium arvense</i>	field chickweed	-
	SIAN2	<i>Silene antirrhina</i>	sleepy silene	-
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	-
	CADU6	<i>Carex duriuscula</i>	needleleaf sedge	-
	CAEM2	<i>Carex emoryi</i>	Emory's sedge	S1
	CAIN9	<i>Carex inops</i>	long-stolon sedge	-
	CAREX	<i>Carex</i>	sedge	-
Equisetaceae	EQLA	<i>Equisetum laevigatum</i>	smooth horsetail	-
Euphorbiaceae	EUES	<i>Euphorbia esula</i>	leafy spurge	Noxious, Exotic
Fabaceae	ACAM99	<i>Acmispon americanus</i>	American bird's-foot trefoil	-
	ASAG2	<i>Astragalus agrestis</i>	purple milkvetch	-
	ASFL2	<i>Astragalus flexuosus</i>	flexile milkvetch	-
	DAPU5	<i>Dalea purpurea</i>	purple prairie clover	-
	GLLE3	<i>Glycyrrhiza lepidota</i>	American licorice	-
	MELU	<i>Medicago lupulina</i>	black medick	Exotic
	MEOF	<i>Melilotus officinalis</i>	yellow sweetclover	Exotic
	PEAR6	<i>Pedimelum argophyllum</i>	silverleaf Indian breadroot	-
	PSLA3	<i>Psoralegium lanceolatum</i>	lemon scurfpea	-
	THRH	<i>Thermopsis rhombifolia</i>	prairie thermopsis	-
	VIAM	<i>Vicia americana</i>	American vetch	-
Fagaceae	QUMA2	<i>Quercus macrocarpa</i>	bur oak	-
Lamiaceae	HEHI	<i>Hedeoma hispida</i>	rough false pennyroyal	-
	MEAR4	<i>Mentha arvensis</i>	wild mint	-
Liliaceae	CANU3	<i>Calochortus nuttallii</i>	sego lily	-
Linaceae	LINUM	<i>Linum</i>	flax	-
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	scarlet globemallow	-
Oleaceae	FRPE	<i>Fraxinus pennsylvanica</i>	green ash	-
Onagraceae	OESU99	<i>Oenothera suffrutescens</i>	scarlet beeblossom	-

Table 4 (continued). A list of all plant species identified in Devils Tower National Monument long-term plant community monitoring plots in 2017. The species are grouped by plant family. In the Notes column, “Exotic” indicates that 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 in the United States. A “Noxious” in the Notes column indicates the species is on Wyoming’s list of designated noxious weeds. An “S1”, “S2”, or “S3” indicates the conservation rank of a species that is rare or of conservation concern in Wyoming. Conservation rank definitions are in Table 4 of the report.

Family	Code	Scientific	Common Name	Notes
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
	ANGE	<i>Andropogon gerardii</i>	big bluestem	-
	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	Exotic
	BRJA	<i>Bromus japonicus</i>	Japanese brome	Exotic
	BRTE	<i>Bromus tectorum</i>	cheatgrass	Exotic
	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed	-
	DASP2	<i>Danthonia spicata</i>	poverty oatgrass	-
	DIWI5	<i>Dichanthelium wilcoxianum</i>	fall rosette grass	S2NT
	ELRE4	<i>Elymus repens</i>	quackgrass	Exotic
	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	-
	ELVI3	<i>Elymus virginicus</i>	Virginia wildrye	-
	FEID	<i>Festuca idahoensis</i>	Idaho fescue	-
	HECO26	<i>Hesperostipa comata</i>	needle and thread	-
	HESP11	<i>Hesperostipa spartea</i>	porcupinegrass	-
	KOMA	<i>Koeleria macrantha</i>	prairie Junegrass	-
	MUCU3	<i>Muhlenbergia cuspidata</i>	plains muhly	-
	NAVI4	<i>Nassella viridula</i>	green needlegrass	-
	PASM	<i>Pascopyrum smithii</i>	western wheatgrass	-
	POPR	<i>Poa pratensis</i>	Kentucky bluegrass	Exotic
	SCSC	<i>Schizachyrium scoparium</i>	little bluestem	-
	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed	-
Polemoniaceae	COLI2	<i>Collomia linearis</i>	tiny trumpet	-
	PHAL3	<i>Phlox alyssifolia</i>	alyssumleaf phlox	-
	PHHO	<i>Phlox hoodii</i>	spiny phlox	-

Table 4 (continued). A list of all plant species identified in Devils Tower National Monument long-term plant community monitoring plots in 2017. The species are grouped by plant family. In the Notes column, “Exotic” indicates that 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 in the United States. A “Noxious” in the Notes column indicates the species is on Wyoming’s list of designated noxious weeds. An “S1”, “S2”, or “S3” indicates the conservation rank of a species that is rare or of conservation concern in Wyoming. Conservation rank definitions are in Table 4 of the report.

Family	Code	Scientific	Common Name	Notes
Primulaceae	ANOC2	Androsace occidentalis	western rockjasmine	-
Rosaceae	PRAM	Prunus americana	American plum	-
	PRVI	Prunus virginiana	chokecherry	-
	ROAR3	Rosa arkansana	prairie rose	-
Rubiaceae	GABO2	Galium boreale	northern bedstraw	-
Salicaceae	PODE3	Populus deltoides	eastern cottonwood	-
	SAAM2	Salix amygdaloides	peachleaf willow	-
Scrophulariaceae	SYWY99	Synthyris wyomingensis	Wyoming kittentails	-
	VEPE2	Veronica peregrina	neckweed	-
	VETH	Verbascum thapsus	common mullein	Exotic
Selaginellaceae	SEDE2	Selaginella densa	lesser spikemoss	-
Solanaceae	PHHE5	Physalis heterophylla	clammy groundcherry	-

Table 5. Total number of plant species identified in each of the eight plots monitored at Devils Tower National Monument in 2017. The number of species per plot is a count of all unique species identified in the plot, using species data from point-intercept, quadrat, woody species, and target species protocols.

MacroPlot Name	Native (number of plant species)	Invasive (number of plant species)	Total (number of species)
PCM_001	27	2	29
PCM_002	25	9	34
PCM_003	27	3	30
PCM_005	25	9	34
PCM_006	33	6	39
PCM_016	34	9	43
PCM_258	27	15	42
PCM_263	16	8	24

Table 6. Absolute percent cover of native and exotic plant species in plots monitored at Devils Tower National Monument in 2017. Absolute percent cover is measured using the point-intercept method which includes overlapping species canopies, resulting in some cover values greater than 100%.

Plot	Absolute Cover (%)	
	Native	Exotic
PCM_001	91	28
PCM_002	82	43
PCM_003	32	110
PCM_005	63	90
PCM_006	70	73
PCM_016	124	43
PCM_258	28	134
PCM_263	60	75

Woody species were observed in six of eight plots visited in 2017. Seedlings were present in two of six wooded plots. Surface fuels were collected in five of six wooded plots. Plots PCM_005, PCM_006 and PCM_258 contained no measurable woody fuels and were grassland plots (Table – 9).

Table 7. Density and number of trees and poles observed at six of eight plots visited at Devils Tower National Monument in 2017. Size class categories are tree (DBH > 15 cm) and pole (2.54 cm ≤ DBH ≤ 15 cm).

Plot Name	Common Name	Scientific Name	DBH	Status	Density (stems/hectare)
PCM_001	Ponderosa Pine	<i>Pinus ponderosa</i>	Tree	Dead	10.00
PCM_001	Ponderosa Pine	<i>Pinus ponderosa</i>	Tree	Alive	180.00
PCM_001	Ponderosa Pine	<i>Pinus ponderosa</i>	Pole	Alive	31.85
PCM_002	Ponderosa Pine	<i>Pinus ponderosa</i>	Tree	Alive	110.00
PCM_003	Bur Oak	<i>Quercus macrocarpa</i>	Tree	Dead	10.00
PCM_003	Bur Oak	<i>Quercus macrocarpa</i>	Tree	Alive	80.00
PCM_016	Ponderosa Pine	<i>Pinus ponderosa</i>	Tree	Dead	10.00
PCM_016	Ponderosa Pine	<i>Pinus ponderosa</i>	Tree	Alive	10.00
PCM_258	Ponderosa Pine	<i>Pinus ponderosa</i>	Tree	Alive	10.00
PCM_263	Box Elder	<i>Acer negundo</i>	Tree	Alive	30.00

Table 8. Seedling density observed from two of eight plots visited at Devils Tower National Monument in 2017. Seedlings have a DBH < 2.54 cm.

Plot	Common name	Scientific name	Density (seedlings/hectare)
PCM_001	Ponderosa pine	<i>Pinus ponderosa</i>	95.48
PCM_001	Chokecherry	<i>Prunus virginiana</i>	63.65
PCM_263	Eastern cottonwood	<i>Populus deltoides</i>	700.19
PCM_263	Boxelder	<i>Acer negundo</i>	732.01
PCM_263	Peachleaf willow	<i>Salix amygdaloides</i>	190.96

Table 9. Surface fuels observed in five of eight plots visited in 2017 at Devils Tower National Monument by NGPN monitoring crews.

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	Litter	Total	Duff	Litt	Total
PCM_001	0.00	0.14	0.00	0.14	1.22	0.00	1.36	8.27	4.33	13.96	0.5	1.1	1.6
PCM_002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.74	3.49	14.23	0.6	0.9	1.5
PCM_003	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.98	0.69	1.67	0.1	0.4	0.5
PCM_016	0.00	0.54	0.73	1.27	0.00	0.00	1.27	0.00	2.56	3.82	0.0	0.6	0.6
PCM_263	0.00	0.00	1.27	1.27	0.00	0.63	1.90	0.00	0.92	2.82	0.0	0.6	0.6

Disturbances were observed in seven of eight plant community monitoring plots at DETO in 2017 (Table 10). The most common disturbance types observed were: animal use, which includes trails and trampled or missing vegetation, and prescribed fire signs, which was most noticeable as char and scars on trees.

Table 10. Disturbance types and area sizes observed in seven plots visited at Devils Tower National Monument in 2017. The size was approximated, and out of a total area of 1000 m².

Plot	Disturbance Type	Size (m ²)
PCM_001	Animal Trail	20
	Rx Fire	1000
PCM_002	Small Mammal	5
	Rx Fire	1000
PCM_003	Animal Trail	30
	Grazing	10
	Rx Fire	1000
PCM_005	Grazing	10
PCM_016	Rx Fire	1000

Table 10 (continued). Disturbance types and area sizes observed in seven plots visited at Devils Tower National Monument in 2017. The size was approximated, and out of a total area of 1000 m².

Plot	Disturbance Type	Size (m ²)
PCM_258	Animal Trail	45
PCM_263	Animal Trail	25
	Mammal Exclosure	100



Figure 4. Photograph of long-term monitoring plot PCM_016 at Devils Tower National Monument, 2017, depicting a grassland to ponderosa pine forest transition with signs of prescribed fire. Of the plots monitored in 2017, plot PCM_016 had the greatest number of native species and was the most botanically diverse. Photograph courtesy of the National Park Service.

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