



Plant Community Composition and Structure Monitoring at Theodore Roosevelt National Park

2018 Data Report

Natural Resource Data Series NPS/NGPN/NRDS—2019/1210



**ON THIS PAGE**

Plant community composition and structure monitoring plot THRON_PCM_038 at Theodore Roosevelt National Park, July 2018. Photograph courtesy of the National Park Service.

ON THE COVER

Crew members navigating to a monitoring plot 2018.
Photograph courtesy of the National Park Service/ Ryan Manuel.

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March 2019

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

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All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Please cite this publication as:

Manuel, R. M., C. J. Davis, and D. J. Swanson. 2019. Plant community composition and structure monitoring at Theodore Roosevelt National Park: 2018 data report. Natural Resource Data Series NPS/NGPN/NRDS—2019/1210. National Park Service, Fort Collins, Colorado.

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Abstract

This report presents the results of vegetation monitoring work conducted in 2018 at Theodore Roosevelt National Park (THRO) by the Northern Great Plains Inventory and Monitoring Network (NGPN) and the Northern Great Plains Fire Ecology (NGPFire) program.

During the eighth consecutive year of data collection, the NGPN field crew visited twenty long-term plant community monitoring (PCM) plots to collect data to assess plant communities at THRO. The NGPFire crew visited five PCM plots and six long-term fire plant community (FPCM) plots to collect data to assess fire effects following prescribed burns at the park. This monitoring work is part of a long-term monitoring effort with the goal of sampling 20 of 140 randomly located upland plots every year so that each plot is visited for two consecutive years and then rested for eight years on a ten-year rotating basis. NGPN staff collected data relating to species richness, herb-layer height, abundance of native and non-native species, ground cover, and site disturbance in each of the 20 plots. In plots where woody species were present, NGPN measured tree regeneration, tall shrub and tree density, and woody fuel load. The NGPFire crew collected data relating to burn severity, herb-layer height, abundance of native and non-native species, ground cover, and target species.

Monitoring crews identified 223 species in the 31 monitoring plots visited in 2018 at THRO, 34 of which were exotic species. The average absolute cover of exotic species was 32% and 139% for native species. Tree density, health, and seedling regeneration, as well as woody fuel loads, were recorded at 12 plots. The most common disturbances observed were the result of animal activity (e.g., grazing, game trails, and prairie dogs).



Liatris punctata observed in Theodore Roosevelt National Park (NPS /RYAN MANUEL)

Acknowledgments

We thank all the authors of the Northern Great Plains Plant Community Monitoring Protocol, particularly A. Symstad, for outstanding guidance on data collection and reporting. Thank you to the staff at THRO, particularly K. Anderson for their help with data collection. Thank you to U.S. Fish and Wildlife Service employee C. Dixon for assisting NGPfire in the field. The 2018 NGPN vegetation field crew of C. Davis, I. Ashton, M. Davis, R. Manuel, R. Oltjenbruns, S. Rockwood, T. Schaffner, and C. Serratos with the assistance of the Northern Great Plains Fire Ecology crew of D. Swanson, I. Muirhead, K. Ronsoni and J. Roy, collected all the data included in this report.

Introduction

During the last century, much of the prairie within the Northern Great Plains has been plowed for cropland, converted to livestock pasture, or otherwise developed, making it one of the most threatened ecosystems in the United States. Within North Dakota, greater than 71% of the area of native mixed-grass prairie has been lost since European settlement (Samson and Knopf 1994). The National Park Service (NPS) plays an important role in preserving and restoring some of the last vestiges of intact prairie within park 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 to the climate patterns, fire regimes, and large ungulate grazing pressures that have historically maintained prairies, along with the added pressures of exotic invasive species. Long-term monitoring in national parks is essential to sound management of prairie landscapes because it can provide information on environmental quality and condition, benchmarks of ecological integrity, and an early warning of declines in ecosystem health.

Located in southwestern North Dakota, Theodore Roosevelt National Park (THRO) encompasses 70,477 acres in the Little Missouri River Badlands. THRO is composed of three discrete management units, each of which is a patchwork of mixed-grass prairie, clay buttes, bottomland forest, and open shrublands. The three park units (North, South, and Elkhorn Ranch Site) are connected by the Little Missouri River. The park would like more information regarding the condition of native grasslands and woody draws because of the large number of exotic species, but a lack of data in the past made estimates of condition in these and other plant communities difficult (Amberg et al. 2014). The Northern Great Plains Inventory & Monitoring Program (NGPN) began vegetation monitoring efforts in THRO in 2011 (Ashton et al. 2012). Vegetation monitoring protocols and plot locations were chosen to represent the north and south unit and to coordinate efforts with the Northern Great Plains Fire Ecology Program (NGPFire). The long-term objectives of the NGPN plant community monitoring effort (Symstad et al. 2012b) in THRO are to:

1. Determine park-wide status and long-term trends in vegetation species composition (e.g., exotic vs. native) and structure (e.g., cover, height) of herbaceous and shrub species.
2. Determine status (at 10-year intervals) and long-term trends of tree density by species, height class, and diameter class in the riparian forest.
3. Improve our understanding of the effects of external drivers and management actions on plant community species composition and structure by correlating changes in vegetation composition and structure with changes in climate, landscape patterns, atmospheric chemical composition, fire, and invasive plant control.

This report is intended to provide a timely release of basic data sets and data summaries from our sampling efforts at THRO in 2018, NGPN’s eighth year of sampling vegetation. NGPN visited 20 plots in the south unit and north unit, and the NGPFire visited 11 plots in the south unit within the Donut Hole and Jones Creek prescribed fire units (Figure 1). The Jones Creek unit is a subunit within the Donut Hole prescribed burn unit. NGPFire didn’t collect data at plots THROS_PCM_0072 or

THROS_FPCM_0096 after it was determined that the vegetation transects at those plots weren't burned during the Donut Hole prescribed fire (RX) on May 4, 2018.

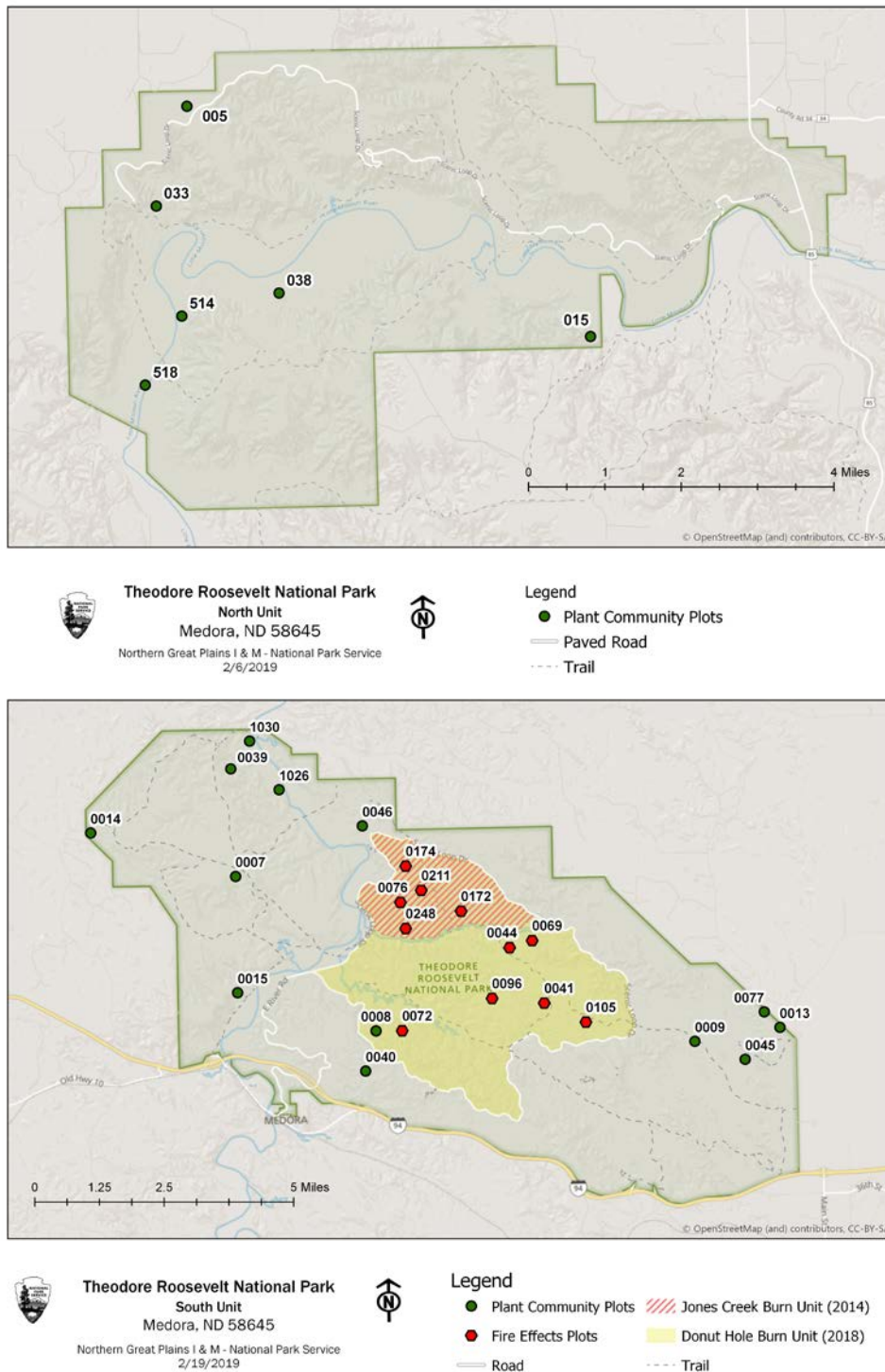


Figure 1. Maps of plant community and fire effects monitoring plots surveyed in 2018 in the north unit (top) and south unit (bottom) of Theodore Roosevelt National Park.

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 <https://www.nps.gov/im/ngpn/protocols.htm>.

Sample Design

The NGPN and NGPFire implemented a survey to monitor plant community structure and composition in THRO using a spatially balanced probability design (Generalized Random Tessellation Stratified [GRTS]; [Stevens and Olsen 2003, 2004](#)). Using the GRTS design, NGPN selected 50 randomly located sites within the north unit of THRO and 90 randomly located sites in the south unit. These 140 sites were divided into 10 monitoring panels with 14 sites each. Originally, NGPN planned on visiting two panels (28 sites) every year. However, due to logistical constraints on the NGPN and Fire Ecology Programs, the number of anticipated site visits per year was reduced to 20 with only 100 total monitoring sites. In 2018, all 20 sites were visited during the last 10 days of July and the second week of August (Table 1). 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.

NGPFire established and monitored a number of new Fire Plant Community monitoring (FPCM) plots focused on active burn units using the same GRTS sampling schema. When a previously installed PCM plot was located within an active burn unit, those plots were monitored as long as they meet specified fire effects monitoring parameters (e.g. minimum distance to burn perimeter, sufficient vegetation to burn, stratum definition). NGPFire visits sites based on a 1, 2, 5, and 10 year sampling schedule. In 2018 NGPFire visited five plots within the Jones Creek unit, however only one plot burned in the Donut Hole RX (2018), which was then monitored as a year 1 read. The remaining four plots were monitored as year 5 reads following the Jones Creek RX (2014). Four additional plots were monitored within the greater Donut Hole unit as year 1 reads following the 2018 Donut Hole prescribed fire (Table 1).

Table 1. Field journal for Northern Great Plains Network (NGPN) and Northern Great Plains Fire Ecology Program (NGPFire) plant community monitoring (PCM and FPCM) visits at Theodore Roosevelt National Park (THRO) in 2018. Four NGPFire crew members visited 11 plots with the assistance of U.S. Fish and Wildlife Service employee Cami Dixon at four of those plots. The burn units associated with the 11 plots visited by NGPFire are included in the field notes along with burn details. Eight NGPN crew members completed 20 plots with the assistance of THRO employee Kurt Anderson at four plots.

Date Visited	Plot Name	Field Notes
7/19/2018	FPCM_0211	Jones Creek; Not burned in Donut Hole RX, but read as year 5 read for Jones Creek RX (May 2014). A line only, 100pts and 5 quads
7/19/2018	FPCM_0248	Jones Creek; burned <5% of plot in Donut Hole RX, but read as year 5 read for Jones Creek RX (May 2014). A line only, 100pts and 5 quads
7/19/2018	PCM_0076	Jones Creek; Not burned in Donut Hole RX, but read as year 5 read for Jones Creek RX (May 2014). A line only, 100pts and 5 quads
7/20/2018	FPCM_0172	Jones Creek; Not burned in Donut Hole RX, but read as year 5 for Jones Creek RX (May 2014). A line only, 100pts and 5 quads
7/20/2018	FPCM_0174	Donut Hole; No post burn, 83% of plot estimated was burned in Donut Hole RX (May 2018). B line only, 100pts and 5 quads; year 1 read
7/21/2018	FPCM_0105	Donut Hole; A line 96% burned, B line 100% burned in Donut Hole RX (May 2018); year 1 read
7/21/2018	PCM_0044	Donut Hole; Burned in Donut Hole RX (May 2018); A&B transects monitored for year 1 read
7/21/2018	PCM_0069	Donut Hole; A line 67% burned, B line 20% burned in Donut Hole RX (May 2018). Only 44% of plot burned; year 1 read
7/22/2018	FPCM_0096	Donut Hole; No read conducted, 0% of A and B Line burned in Donut Hole RX (May 2018)
7/22/2018	PCM_0041	Donut Hole; 38% on A line burned, 70% on B line burned in Donut Hole RX (May 2018); year 1 read
7/22/2018	PCM_0072	Donut Hole; Area did not burn in Donut Hole RX (May 2018), so we did not visit and read the plot
7/23/2018	PCM_033	Fuels data not collected
7/24/2018	PCM_514	Fuels data not collected
7/24/2018	PCM_518	Fuels & Seedling data not collected
7/25/2018	PCM_038	–
7/26/2018	PCM_005	High bison traffic
7/26/2018	PCM_015	–
7/27/2018	PCM_0045	Installed
7/27/2018	PCM_0046	Installed
7/28/2018	PCM_0007	–
7/29/2018	PCM_0077	–
7/30/2018	PCM_0013	–
8/6/2018	PCM_0040	–

Table 1 (continued). Field journal for Northern Great Plains Network (NGPN) and Northern Great Plains Fire Ecology Program (NGPFire) plant community monitoring (PCM and FPCM) visits at Theodore Roosevelt National Park (THRO) in 2018. Four NGPFire crew members visited 11 plots with the assistance of U.S. Fish and Wildlife Service employee Cami Dixon at four of those plots. The burn units associated with the 11 plots visited by NGPFire are included in the field notes along with burn details. Eight NGPN crew members completed 20 plots with the assistance of THRO employee Kurt Anderson at four plots.

Date Visited	Plot Name	Field Notes
8/7/2018	PCM_0009	–
8/7/2018	PCM_0039	–
8/7/2018	PCM_0044	Rejected for PCM reads due to steep slopes
8/7/2018	PCM_1030	–
8/8/2018	PCM_0008	–
8/8/2018	PCM_0015	–
8/8/2018	PCM_1026	–
8/9/2018	PCM_0014	–

Plot Layout and Sampling

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 2). Data on ground cover, herb-layer height (≤ 2 m), and plant cover were collected on two 50 m transects (the long sides of the plot) using a point-intercept method (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). The NGPN crew measured species presence at ten quadrats per plot. 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.

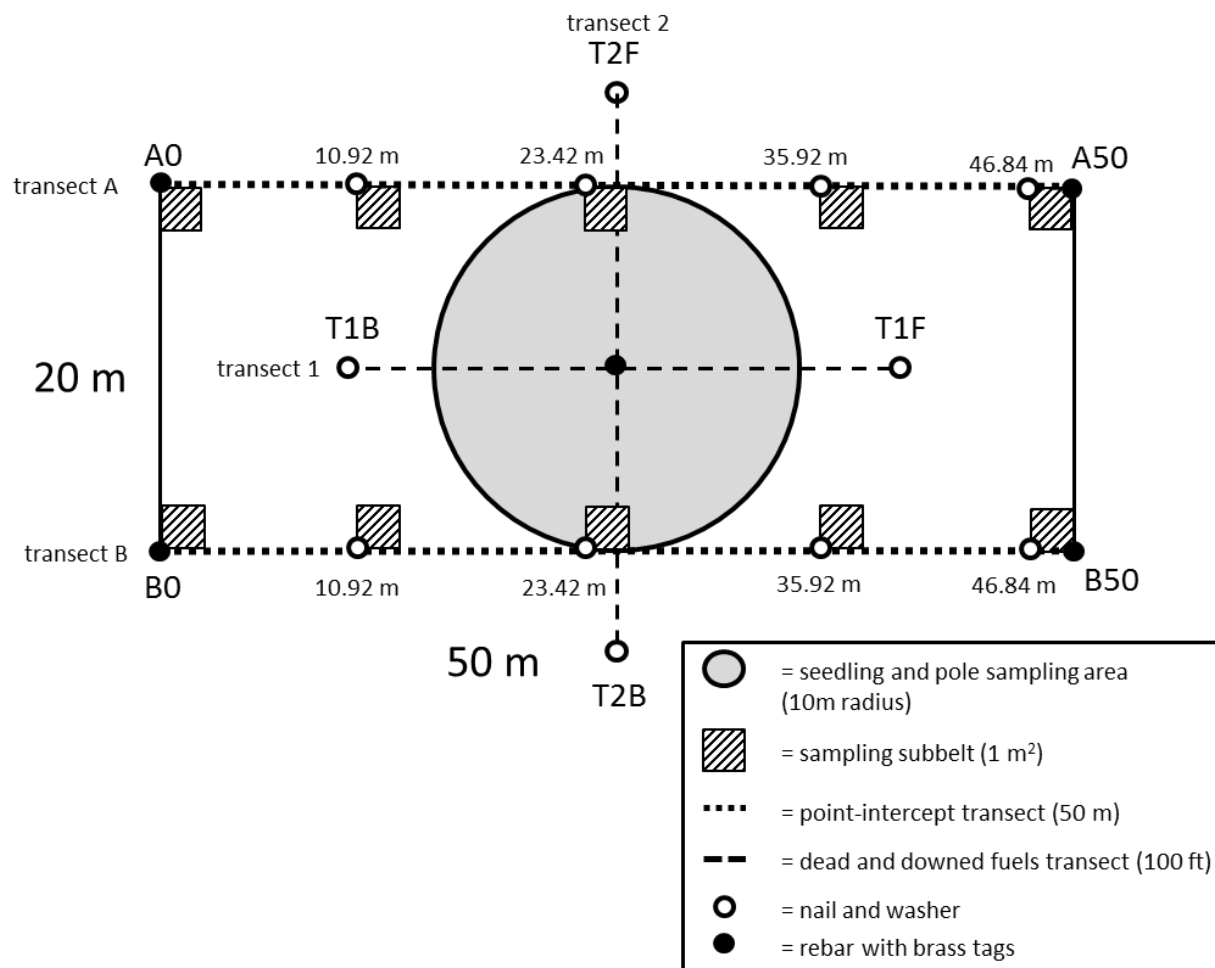


Figure 2. Long-term monitoring plot layout used for sampling vegetation used by the Northern Great Plains Inventory and Monitoring and Fire Ecology programs.

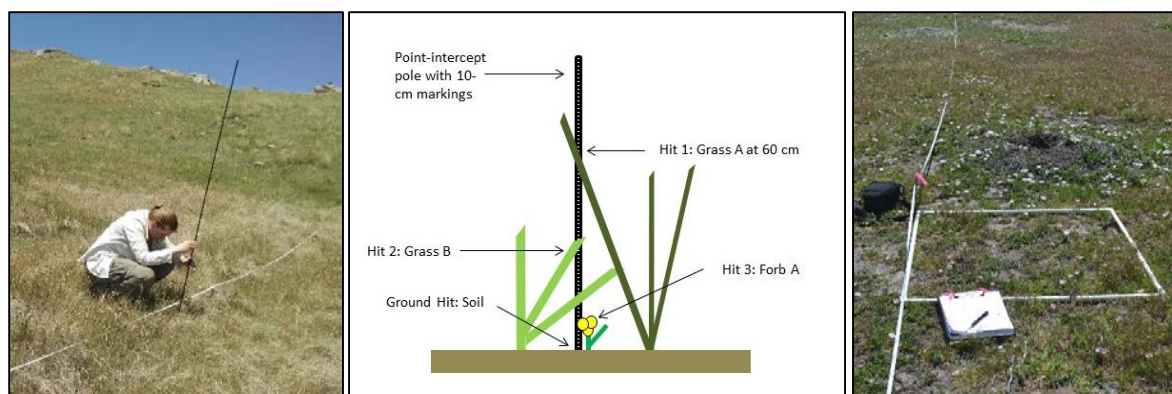


Figure 3. The Northern Great Plains Inventory & Monitoring vegetation crew used point-intercept (left and center panel) and quadrats (right panel) to document plant diversity and abundance.

When woody species were present within 38 m of plot center, monitoring crews collected tree regeneration and tall shrub density data within a 10 m radius subplot centered in the larger 50 m x 20 m (0.1 ha) plot. Trees with diameter at breast height (DBH) > 15 cm, present within the 0.1 ha plot were mapped and tagged. For each tree, the species, DBH, status (live or dead), and condition (e.g., leaf-discoloration, insect-damaged, etc.) 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. 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 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.

The NGPN crew assessed and documented common disturbances at each plot. The disturbance type, which included rodent mounds, animal trails, and fire, as well as the approximate area (m^2) of each disturbance was recorded. Plots were also assessed for the presence and abundance of target exotic species (Table 2), a critical step in the early detection and rapid response to exotic species threats. These target 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.

Table 2. Exotic species included in the Northern Great Plains Network’s early detection and rapid response program.

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

In 2018, several changes were made to the protocol to avoid inconsistent density calculations. First, seedlings (i.e. trees and tall shrubs with DBH < 2.54 cm) were always counted or estimated in all four quarters of the 10 m radius subplot. Previously, once the count for a species had reached 100, seedlings were not counted in the following quarters. Additionally, a new category of disturbance, “Soil Disturbance”, was added in 2018. Soil Disturbance is defined as loose, exposed soil from all sources.

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 2017). However, nomenclature follows the [Integrated Taxonomic Information System](#) (ITIS). 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. In the case where there is not enough evidence for genus and species identification, a special code for the unknown species was created. These are then designated as an exotic species in the total count, but omitted from the species list.

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. After all data were entered and verified, 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 THRO in 2018 was determined by cross-referencing with the NatureServe conservation status list, as well as the North Dakota rare plant species list. For the purpose of this report, a species was considered rare or of conservation concern if its state or global conservation status rank was critically imperiled (S1/G1), imperiled (S1/G2), or vulnerable (S3/G3). More information on conservation ranks can be found at the [NatureServe](#) website. The 2018 species list was also cross-referenced with the list of noxious weeds maintained by the [North Dakota Department of Agriculture](#).

Results

There are 680 vascular plant species on the verified THRO species list, and monitoring crews observed 223 of these species in 2018 (Table 3). Of these plant species, 34 are exotic species at THRO. A majority of exotic plants identified were either forbs or graminoids (grasses, sedges, and rushes).

Table 3. A list of all plant species identified in Theodore Roosevelt National Park's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. Species considered rare are marked with the appropriate state conservation ranks. If a species is noxious in the state of North Dakota, it is indicated in the notes column as Noxious - ND. If a species is noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name.

Family	Symbol	Scientific Name	Common Name	Notes
Agavaceae	YUGL	<i>Yucca glauca</i>	soapweed yucca	–
Anacardiaceae	RHTR	<i>Rhus trilobata</i>	skunkbush sumac	–
Anacardiaceae	TORY	<i>Toxicodendron rydbergii</i>	western poison ivy	–
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	ANMI3	<i>Antennaria microphylla</i>	littleleaf pussytoes	–
Asteraceae	ANNE	<i>Antennaria neglecta</i>	field pussytoes	–
Asteraceae	ANPA4	<i>Antennaria parvifolia</i>	small-leaf pussytoes	–
Asteraceae	ANTEN	<i>Antennaria</i>	pussytoes	–
Asteraceae	ARBI2	<i>Artemisia biennis</i>	biennial wormwood	Exotic
Asteraceae	ARCA12	<i>Artemisia campestris</i>	field sagewort	–
Asteraceae	ARCA13	<i>Artemisia cana</i>	silver sagebrush	–
Asteraceae	ARDR4	<i>Artemisia dracunculus</i>	tarragon	–
Asteraceae	ARFR4	<i>Artemisia frigida</i>	prairie sagewort	–
Asteraceae	ARLU	<i>Artemisia ludoviciana</i>	white sagebrush	–
Asteraceae	ARTR2	<i>Artemisia tridentata</i>	big sagebrush	–
Asteraceae	CIAR4	<i>Cirsium arvense</i>	Canada thistle	Noxious-ND
Asteraceae	CIFL	<i>Cirsium flodmanii</i>	Flodman's thistle	–
Asteraceae	CIUN	<i>Cirsium undulatum</i>	wavyleaf thistle	–
Asteraceae	COCA5	<i>Conyza canadensis</i>	Canadian horseweed	–
Asteraceae	ECAN2	<i>Echinacea angustifolia</i>	blacksamson echinacea	–
Asteraceae	ERCA4	<i>Erigeron canus</i>	hoary fleabane	–
Asteraceae	ERGL2	<i>Erigeron glabellus</i>	streamside fleabane	–
Asteraceae	ERIGE2	<i>Erigeron</i>	fleabane	–
Asteraceae	ERNA10	<i>Ericameria nauseosa</i>	rubber rabbitbrush	–

Table 3 (continued). A list of all plant species identified in Theodore Roosevelt National Park's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. Species considered rare are marked with the appropriate state conservation ranks. If a species is noxious in the state of North Dakota, it is indicated in the notes column as Noxious - ND. If a species is noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name.

Family	Symbol	Scientific Name	Common Name	Notes
Asteraceae	ERST3	<i>Erigeron strigosus</i>	prairie fleabane	–
Asteraceae	GRSQ	<i>Grindelia squarrosa</i>	curlycup gumweed	–
Asteraceae	GUSA2	<i>Gutierrezia sarothrae</i>	broom snakeweed	–
Asteraceae	HEAN3	<i>Helianthus annuus</i>	common sunflower	–
Asteraceae	HELIA3	<i>Helianthus</i>	sunflower	–
Asteraceae	HEPA19	<i>Helianthus pauciflorus</i>	stiff sunflower	–
Asteraceae	HEVI4	<i>Heterotheca villosa</i>	hairy false goldenaster	–
Asteraceae	HYFI	<i>Hymenopappus filifolius</i>	fineleaf hymenopappus	–
Asteraceae	IVAX	<i>Iva axillaris</i>	povertyweed	–
Asteraceae	LASE	<i>Lactuca serriola</i>	prickly lettuce	Exotic
Asteraceae	LIPU	<i>Liatris punctata</i>	dotted blazing star	–
Asteraceae	LYJU	<i>Lygodesmia juncea</i>	rush skeletonplant	–
Asteraceae	MUOB99	<i>Mulgedium oblongifolium</i>	blue lettuce	–
Asteraceae	PAPL12	<i>Packera plattensis</i>	prairie groundsel	–
Asteraceae	RACO3	<i>Ratibida columnifera</i>	upright prairie coneflower	–
Asteraceae	RUHI2	<i>Rudbeckia hirta</i>	blackeyed Susan	–
Asteraceae	SOCA6	<i>Solidago canadensis</i>	Canada goldenrod	–
Asteraceae	SOLID	<i>Solidago</i>	goldenrod	–
Asteraceae	SOMI2	<i>Solidago missouriensis</i>	Missouri goldenrod	–
Asteraceae	SOMO	<i>Solidago mollis</i>	velvety goldenrod	–
Asteraceae	SONE	<i>Solidago nemoralis</i>	gray goldenrod	–
Asteraceae	SOPT4	<i>Solidago ptarmicoides</i>	prairie goldenrod	–
Asteraceae	SORI2	<i>Solidago rigida</i>	stiff goldenrod	–
Asteraceae	SYER	<i>Symphyotrichum ericoides</i>	white heath aster	–
Asteraceae	SYLA3	<i>Symphyotrichum laeve</i>	smooth blue aster	–
Asteraceae	SYLA6	<i>Symphyotrichum lanceolatum</i>	white panicle aster	–
Asteraceae	SYMPH4	<i>Symphyotrichum</i>	aster	–
Asteraceae	SYOB	<i>Symphyotrichum oblongifolium</i>	aromatic aster	–
Asteraceae	TAOF	<i>Taraxacum officinale</i>	common dandelion	Exotic
Asteraceae	TEAC	<i>Tetaneuris acaulis</i>	stemless four-nerve daisy	–
Asteraceae	TRDU	<i>Tragopogon dubius</i>	yellow salsify	Exotic
Boraginaceae	CRCE	<i>Cryptantha celosioides</i>	buttecandle	–
Boraginaceae	HADE	<i>Hackelia deflexa</i>	nodding stickseed	–

Table 3 (continued). A list of all plant species identified in Theodore Roosevelt National Park's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. Species considered rare are marked with the appropriate state conservation ranks. If a species is noxious in the state of North Dakota, it is indicated in the notes column as Noxious - ND. If a species is noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name.

Family	Symbol	Scientific Name	Common Name	Notes
Boraginaceae	LAOC3	<i>Lappula occidentalis</i>	flatspine stickseed	–
Boraginaceae	LAPPU	<i>Lappula</i>	stickseed	Exotic
Boraginaceae	LASQ	<i>Lappula squarrosa</i>	European stickseed	Exotic
Boraginaceae	LIIN2	<i>Lithospermum incisum</i>	narrowleaf stone seed	–
Brassicaceae	ALDE	<i>Alyssum desertorum</i>	desert madwort	Exotic
Brassicaceae	ARDR	<i>Arabis drummondii</i>	Drummond's rockcress	–
Brassicaceae	BOHO99	<i>Boechera holboellii</i>	Holboell's rockcress	–
Brassicaceae	CAMI2	<i>Camelina microcarpa</i>	littlepod false flax	Exotic
Brassicaceae	DEPI	<i>Descurainia pinnata</i>	western tansymustard	–
Brassicaceae	DESO2	<i>Descurainia sophia</i>	herb sophia	Exotic
Brassicaceae	DRRE2	<i>Draba reptans</i>	Carolina draba	–
Brassicaceae	ERYSI	<i>Erysimum</i>	wallflower	Exotic
Brassicaceae	LEDE	<i>Lepidium densiflorum</i>	common pepperweed	–
Brassicaceae	PHLU99	<i>Physaria ludoviciana</i>	foothill bladderpod	–
Cactaceae	ESVI2	<i>Escobaria vivipara</i>	spinystar	–
Cactaceae	OPFR	<i>Opuntia fragilis</i>	brittle pricklypear	–
Cactaceae	OPPO	<i>Opuntia polyacantha</i>	plains pricklypear	–
Campanulaceae	CARO2	<i>Campanula rotundifolia</i>	bluebell bellflower	–
Caprifoliaceae	SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry	–
Caryophyllaceae	SIAN2	<i>Silene antirrhina</i>	sleepy silene	–
Chenopodiaceae	ATCA2	<i>Atriplex canescens</i>	fourwing saltbush	–
Chenopodiaceae	ATCO	<i>Atriplex confertifolia</i>	shadscale saltbush	–
Chenopodiaceae	CHENO	<i>Chenopodium</i>	goosefoot	Exotic
Chenopodiaceae	CHFR3	<i>Chenopodium fremontii</i>	Fremont's goosefoot	–
Chenopodiaceae	KRLA2	<i>Krascheninnikovia lanata</i>	winterfat	–
Chenopodiaceae	MONU	<i>Monolepis nuttalliana</i>	Nuttall's povertyweed	–
Chenopodiaceae	SALSO	<i>Salsola</i>	Russian thistle	Exotic
Chenopodiaceae	SATR12	<i>Salsola tragus</i>	prickly Russian thistle	Exotic
Chenopodiaceae	SAVE4	<i>Sarcobatus vermiculatus</i>	greasewood	–
Chenopodiaceae	SUNI	<i>Suaeda nigra</i>	Mojave seablite	–
Commelinaceae	TRBR	<i>Tradescantia bracteata</i>	longbract spiderwort	–
Cupressaceae	JUCO6	<i>Juniperus communis</i>	common juniper	–
Cupressaceae	JUHO2	<i>Juniperus horizontalis</i>	creeping juniper	–
Cupressaceae	JUSC2	<i>Juniperus scopulorum</i>	Rocky Mountain juniper	–

Table 3 (continued). A list of all plant species identified in Theodore Roosevelt National Park's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. Species considered rare are marked with the appropriate state conservation ranks. If a species is noxious in the state of North Dakota, it is indicated in the notes column as Noxious - ND. If a species is noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name.

Family	Symbol	Scientific Name	Common Name	Notes
Cyperaceae	BOMA7	<i>Bolboschoenus maritimus</i>	cosmopolitan bulrush	–
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	CAREX	<i>Carex</i>	sedge	–
Cyperaceae	CASA9	<i>Carex saximontana</i>	Rocky Mountain sedge	–
Dryopteridaceae	CYFR2	<i>Cystopteris fragilis</i>	brittle bladderfern	–
Elaeagnaceae	SHAR	<i>Shepherdia argentea</i>	silver buffaloberry	–
Equisetaceae	EQLA	<i>Equisetum laevigatum</i>	smooth horsetail	–
Euphorbiaceae	EUES	<i>Euphorbia esula</i>	leafy spurge	Noxious-ND
Fabaceae	AMCA6	<i>Amorpha canescens</i>	leadplant	–
Fabaceae	ASAG2	<i>Astragalus agrestis</i>	purple milkvetch	–
Fabaceae	ASFL2	<i>Astragalus flexuosus</i>	flexile milkvetch	–
Fabaceae	ASGI5	<i>Astragalus gilviflorus</i>	plains milkvetch	–
Fabaceae	ASLA27	<i>Astragalus laxmannii</i>	Laxmann's 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	HEBO	<i>Hedysarum boreale</i>	Utah sweetvetch	–
Fabaceae	LUPU	<i>Lupinus pusillus</i>	rusty lupine	–
Fabaceae	MELU	<i>Medicago lupulina</i>	black medick	Exotic
Fabaceae	MEOF	<i>Melilotus officinalis</i>	yellow sweetclover	Exotic
Fabaceae	MESA	<i>Medicago sativa</i>	alfalfa	Exotic
Fabaceae	OXLA3	<i>Oxytropis lambertii</i>	purple locoweed	–
Fabaceae	OXYTR	<i>Oxytropis</i>	locoweed	–
Fabaceae	PEAR6	<i>Pedimelum argophyllum</i>	silverleaf Indian breadroot	–
Fabaceae	PEES	<i>Pedimelum esculentum</i>	large Indian breadroot	–
Fabaceae	PSLA3	<i>Psoraleidum lanceolatum</i>	lemon scurfpea	–
Fabaceae	THRH	<i>Thermopsis rhombifolia</i>	prairie thermopsis	–
Fabaceae	VIAM	<i>Vicia americana</i>	American vetch	–
Grossulariaceae	RIAU	<i>Ribes aureum</i>	golden currant	–
Grossulariaceae	RIOX	<i>Ribes oxycanthoides</i>	Canadian gooseberry	–
Juncaginaceae	TRMA20	<i>Triglochin maritima</i>	seaside arrowgrass	–

Table 3 (continued). A list of all plant species identified in Theodore Roosevelt National Park's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. Species considered rare are marked with the appropriate state conservation ranks. If a species is noxious in the state of North Dakota, it is indicated in the notes column as Noxious - ND. If a species is noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name.

Family	Symbol	Scientific Name	Common Name	Notes
Lamiaceae	HEHI	<i>Hedeoma hispida</i>	rough false pennyroyal	–
Lamiaceae	MOFI	<i>Monarda fistulosa</i>	wild bergamot	–
Liliaceae	CANU3	<i>Calochortus nuttallii</i>	sego lily	–
Liliaceae	MAST4	<i>Maianthemum stellatum</i>	starry false lily of the valley	–
Linaceae	LILE3	<i>Linum lewisii</i>	Lewis flax	–
Linaceae	LIRI	<i>Linum rigidum</i>	stiffstem flax	–
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	scarlet globemallow	–
Nyctaginaceae	MILI3	<i>Mirabilis linearis</i>	narrowleaf four o'clock	–
Oleaceae	FRPE	<i>Fraxinus pennsylvanica</i>	green ash	–
Onagraceae	EPCI	<i>Epilobium ciliatum</i>	fringed willowherb	–
Onagraceae	OESE3	<i>Oenothera serrulata</i>	yellow sundrops	–
Onagraceae	OESU99	<i>Oenothera suffrutescens</i>	scarlet beeblossom	–
Orobanchaceae	ORLU	<i>Orobanche ludoviciana</i>	Louisiana broomrape	–
Plantaginaceae	PLPA2	<i>Plantago patagonica</i>	woolly plantain	–
Poaceae	ACHY	<i>Achnatherum hymenoides</i>	Indian ricegrass	–
Poaceae	AGCR	<i>Agropyron cristatum</i>	crested wheatgrass	Exotic
Poaceae	AGSC5	<i>Agrostis scabra</i>	rough bentgrass	–
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	BOHI2	<i>Bouteloua hirsuta</i>	hairy grama	–
Poaceae	BRIN2	<i>Bromus inermis</i>	smooth brome	Exotic
Poaceae	BRJA	<i>Bromus japonicus</i>	Japanese brome	Exotic
Poaceae	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed	–
Poaceae	DISP	<i>Distichlis spicata</i>	saltgrass	–
Poaceae	DIWI5	<i>Dichanthelium wilcoxianum</i>	fall rosette grass	–
Poaceae	ECCR	<i>Echinochloa crus-galli</i>	barnyardgrass	Exotic
Poaceae	ELCA4	<i>Elymus canadensis</i>	Canada wildrye	–
Poaceae	ELEL5	<i>Elymus elymoides</i>	squirreltail	–
Poaceae	ELLA3	<i>Elymus lanceolatus</i>	thickspike wheatgrass	–
Poaceae	ELRE4	<i>Elymus repens</i>	quackgrass	Exotic

Table 3 (continued). A list of all plant species identified in Theodore Roosevelt National Park's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. Species considered rare are marked with the appropriate state conservation ranks. If a species is noxious in the state of North Dakota, it is indicated in the notes column as Noxious - ND. If a species is noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name.

Family	Symbol	Scientific Name	Common Name	Notes
Poaceae	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	–
Poaceae	HECO26	<i>Hesperostipa comata</i>	needle and thread	–
Poaceae	HESP11	<i>Hesperostipa spartea</i>	porcupinegrass	–
Poaceae	HOJU	<i>Hordeum jubatum</i>	foxtail barley	–
Poaceae	KOMA	<i>Koeleria macrantha</i>	prairie Junegrass	–
Poaceae	MUCU3	<i>Muhlenbergia cuspidata</i>	plains muhly	–
Poaceae	MUPA99	<i>Muhlenbergia paniculata</i>	tumblegrass	–
Poaceae	MURA	<i>Muhlenbergia racemosa</i>	marsh muhly	–
Poaceae	NAVI4	<i>Nassella viridula</i>	green needlegrass	–
Poaceae	PASM	<i>Pascopyrum smithii</i>	western wheatgrass	–
Poaceae	PIMI7	<i>Piptatherum micranthum</i>	littleseed ricegrass	–
Poaceae	POCO	<i>Poa compressa</i>	Canada bluegrass	Exotic
Poaceae	POPR	<i>Poa pratensis</i>	Kentucky bluegrass	Exotic
Poaceae	POSE	<i>Poa secunda</i>	Sandberg bluegrass	–
Poaceae	PSSP6	<i>Pseudoroegneria spicata</i>	bluebunch wheatgrass	–
Poaceae	PUNU2	<i>Puccinellia nuttalliana</i>	Nuttall's alkaligrass	–
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	VUOC	<i>Vulpia octoflora</i>	sixweeks fescue	–
Polemoniaceae	COLI2	<i>Collomia linearis</i>	tiny trumpet	–
Polemoniaceae	PHHO	<i>Phlox hoodii</i>	spiny phlox	–
Polemoniaceae	PHLOX	<i>Phlox</i>	phlox	Exotic
Polygalaceae	POAL4	<i>Polygala alba</i>	white milkwort	–
Polygonaceae	ERIOG	<i>Eriogonum</i>	buckwheat	–
Polygonaceae	ERPA9	<i>Eriogonum pauciflorum</i>	fewflower buckwheat	–
Polygonaceae	FACO	<i>Fallopia convolvulus</i>	black bindweed	Exotic
Polygonaceae	POAV	<i>Polygonum aviculare</i>	prostrate knotweed	Exotic
Ranunculaceae	ANCY	<i>Anemone cylindrica</i>	candle anemone	–
Ranunculaceae	ANPA19	<i>Anemone patens</i>	eastern pasqueflower	–
Ranunculaceae	CLLI2	<i>Clematis ligusticifolia</i>	western white clematis	–
Ranunculaceae	DELPH	<i>Delphinium</i>	larkspur	–
Ranunculaceae	RACY	<i>Ranunculus cymbalaria</i>	alkali buttercup	–
Rosaceae	AMAL2	<i>Amelanchier alnifolia</i>	Saskatoon serviceberry	–

Table 3 (continued). A list of all plant species identified in Theodore Roosevelt National Park's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. Species considered rare are marked with the appropriate state conservation ranks. If a species is noxious in the state of North Dakota, it is indicated in the notes column as Noxious - ND. If a species is noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name.

Family	Symbol	Scientific Name	Common Name	Notes
Rosaceae	DAFR6	<i>Dasiphora fruticosa</i>	shrubby cinquefoil	–
Rosaceae	DRAR8	<i>Dryocallis arguta</i>	tall cinquefoil	–
Rosaceae	POPE8	<i>Potentilla pensylvanica</i>	Pennsylvania cinquefoil	–
Rosaceae	POTEN	<i>Potentilla</i>	cinquefoil	Exotic
Rosaceae	PRVI	<i>Prunus virginiana</i>	chokecherry	–
Rosaceae	ROAR3	<i>Rosa arkansana</i>	prairie rose	–
Rosaceae	ROWO	<i>Rosa woodsii</i>	Woods' rose	–
Rubiaceae	GABO2	<i>Galium boreale</i>	northern bedstraw	–
Salicaceae	PODE3	<i>Populus deltoides</i>	eastern cottonwood	–
Salicaceae	SAER	<i>Salix eriocephala</i>	Missouri River willow	–
Salicaceae	SAEX	<i>Salix exigua</i>	narrowleaf willow	–
Santalaceae	COUM	<i>Comandra umbellata</i>	bastard toadflax	–
Saxifragaceae	HERI	<i>Heuchera richardsonii</i>	Richardson's alumroot	–
Scrophulariaceae	ORLU2	<i>Orthocarpus luteus</i>	yellow owl's-clover	–
Scrophulariaceae	PEAL2	<i>Penstemon albidus</i>	white penstemon	–
Scrophulariaceae	PEER	<i>Penstemon eriantherus</i>	fuzzytongue penstemon	–
Scrophulariaceae	PENST	<i>Penstemon</i>	beardtongue	–
Scrophulariaceae	VETH	<i>Verbascum thapsus</i>	common mullein	Exotic
Selaginellaceae	SEDE2	<i>Selaginella densa</i>	lesser spikemoss	–
Solanaceae	PHVI5	<i>Physalis virginiana</i>	Virginia groundcherry	–
Unknown family	UNKFORB	Unknown forb	unknown forb	Exotic
Unknown family	UNKFORBANN	Unknown annual forb	unknown annual forb	Exotic
Unknown family	UNKGRAM	Unknown graminoid	unknown graminoid	Exotic
Unknown family	UNKGRAMPER	Unknown perennial graminoid	unknown perennial graminoid	Exotic
Urticaceae	PAPE5	<i>Parietaria pensylvanica</i>	Pennsylvania pellitory	–
Violaceae	VIAD	<i>Viola adunca</i>	hookedspur violet	–
Violaceae	VIOLA	<i>Viola</i>	violet	Exotic
Violaceae	VIPE2	<i>Viola pedatifida</i>	prairie violet	–

Based on the total count of unique species observed in all plots in 2018, PCM_0015 had the highest number with 70 total species, followed by PCM_0046 with 64 species (Table 4). PCM_0015 and PCM_0046 had the most native species, both totaling 61. Five plots visited in 2018 each had more than 50 unique species identified within the plot. Absolute cover calculations (Table 5) showed that plots visited by NGPN and NGPFire had greater native species cover compared with exotic species

cover. Plot FPCM_0105, had no exotic species recorded using the point-intercept method. Plot PCM_0077 had the highest absolute cover of exotic species (114%), and PCM_0076 had the highest absolute cover of native species at 215%, with an exotic species absolute cover of 3%.

Table 4. Total number of plant species identified in plots monitored at Theodore Roosevelt National Park in 2018. This is a count of all unique species identified in the plot using species data from point-intercept, quadrat, woody species, and early detection exotic species protocols. Note that quadrat data were not collected from plots with *, resulting in a lower total species count.

Plot	Native Species	Exotic Species	Total Species
THRON_PCM_005	34	3	37
THRON_PCM_015	38	9	47
THRON_PCM_033	32	3	35
THRON_PCM_038	51	8	59
THRON_PCM_514	35	7	42
THRON_PCM_518	36	12	48
THROS_FPCM_0105*	23	0	23
THROS_FPCM_0172	32	9	41
THROS_FPCM_0174	54	6	60
THROS_FPCM_0211	57	3	60
THROS_FPCM_0248	30	8	38
THROS_PCM_0007	21	4	25
THROS_PCM_0008	46	9	55
THROS_PCM_0009	30	9	39
THROS_PCM_0013	21	9	30
THROS_PCM_0014	48	3	51
THROS_PCM_0015	61	9	70
THROS_PCM_0039	38	5	43
THROS_PCM_0040	39	4	43
THROS_PCM_0041*	28	1	29
THROS_PCM_0044*	31	2	33
THROS_PCM_0045	23	4	27
THROS_PCM_0046	61	3	64
THROS_PCM_0069*	29	5	34
THROS_PCM_0076	48	3	51
THROS_PCM_0077	32	9	41
THROS_PCM_1026	14	7	21
THROS_PCM_1030	24	3	27

Table 5. Absolute percent cover of native and exotic plant species in plots monitored at Theodore Roosevelt National Park in 2018. Absolute percent cover was calculated using the point-intercept data. This includes overlapping species canopies, which can result in values greater than 100%.

Plot	Absolute Cover %	
	Native Species	Exotic Species
THRON_PCM_005	119	91
THRON_PCM_015	141	39
THRON_PCM_033	83	0
THRON_PCM_038	189	30
THRON_PCM_514	158	33
THRON_PCM_518	140	65
THROS_FPCM_0105	133	0
THROS_FPCM_0172	146	9
THROS_FPCM_0174	146	27
THROS_FPCM_0211	182	8
THROS_FPCM_0248	210	10
THROS_PCM_0007	88	9
THROS_PCM_0008	159	74
THROS_PCM_0009	103	21
THROS_PCM_0013	25	103
THROS_PCM_0014	157	5
THROS_PCM_0015	182	33
THROS_PCM_0039	121	20
THROS_PCM_0040	146	15
THROS_PCM_0041	161	30
THROS_PCM_0044	142	2
THROS_PCM_0045	49	4
THROS_PCM_0046	197	3
THROS_PCM_0069	176	15
THROS_PCM_0076	215	3
THROS_PCM_0077	99	114
THROS_PCM_1026	121	90
THROS_PCM_1030	115	53

The NGPN crew collected woody species data at 12 plots in 2018. Six unique species of trees and shrubs were identified, with Rocky Mountain juniper (*Juniperus scopulorum*) being the most frequently observed species.

Table 6. Woody species densities from 12 long-term monitoring plots visited at Theodore Roosevelt National Park in 2018. DBH categories are tree (DBH > 15 cm), pole (2.54 cm ≤ DBH ≤ 15 cm), and seedling (DBH < 2.54 cm).

Plot Name	Species Symbol	DBH	Status	Density/ha
THRON_PCM_005	chokecherry	Seedling	Live	1527.69
THRON_PCM_015	chokecherry	Seedling	Live	7988.54
THRON_PCM_015	green ash	Seedling	Live	63.65
THRON_PCM_015	Rocky Mountain juniper	Seedling	Live	31.83
THRON_PCM_015	Rocky Mountain juniper	Pole	Live	127.39
THRON_PCM_015	Rocky Mountain juniper	Tree	Live	230.00
THRON_PCM_033	green ash	Seedling	Live	190.96
THRON_PCM_033	Rocky Mountain juniper	Seedling	Live	4742.20
THRON_PCM_033	Rocky Mountain juniper	Pole	Live	636.94
THRON_PCM_033	Rocky Mountain juniper	Tree	Dead	10.00
THRON_PCM_033	Rocky Mountain juniper	Tree	Live	360.00
THRON_PCM_038	Rocky Mountain juniper	Seedling	Live	604.71
THRON_PCM_038	Rocky Mountain juniper	Pole	Live	318.47
THRON_PCM_038	green ash	Tree	Dead	10.00
THRON_PCM_038	Rocky Mountain juniper	Tree	Live	50.00
THRON_PCM_514	chokecherry	Seedling	Live	254.61
THRON_PCM_514	green ash	Seedling	Live	604.71
THRON_PCM_514	Rocky Mountain juniper	Seedling	Live	31.83
THRON_PCM_514	green ash	Pole	Live	31.85
THRON_PCM_518	Rocky Mountain juniper	Pole	Live	31.85
THRON_PCM_518	cottonwood	Tree	Live	20.00
THRON_PCM_518	Rocky Mountain juniper	Tree	Dead	10.00
THRON_PCM_518	Rocky Mountain juniper	Tree	Live	120.00
THROS_PCM_0008	green ash	Seedling	Live	6715.47
THROS_PCM_0008	Rocky Mountain juniper	Seedling	Live	190.96
THROS_PCM_0008	green ash	Pole	Live	31.85
THROS_PCM_0008	Rocky Mountain juniper	Pole	Live	63.69
THROS_PCM_0008	green ash	Tree	Dead	10.00
THROS_PCM_0008	green ash	Tree	Live	60.00
THROS_PCM_0008	Rocky Mountain juniper	Tree	Live	30.00
THROS_PCM_0014	silver buffaloberry	Seedling	Live	318.27
THROS_PCM_0014	Rocky Mountain juniper	Pole	Live	31.85
THROS_PCM_0014	Rocky Mountain juniper	Tree	Live	10.00
THROS_PCM_0015	chokecherry	Seedling	Live	22024.19
THROS_PCM_0015	green ash	Seedling	Live	1782.30
THROS_PCM_0015	Rocky Mountain juniper	Seedling	Live	190.96

Table 6 (continued). Woody species densities from 12 long-term monitoring plots visited at Theodore Roosevelt National Park in 2018. DBH categories are tree (DBH > 15 cm), pole (2.54 cm ≤ DBH ≤ 15 cm), and seedling (DBH < 2.54 cm).

Plot Name	Species Symbol	DBH	Status	Density/ha
THROS_PCM_0015	Saskatoon serviceberry	Seedling	Live	12571.61
THROS_PCM_0015	chokecherry	Pole	Live	636.94
THROS_PCM_0015	green ash	Pole	Live	31.85
THROS_PCM_0015	Rocky Mountain juniper	Tree	Live	80.00
THROS_PCM_0039	Rocky Mountain juniper	Seedling	Live	190.96
THROS_PCM_0039	silver buffaloberry	Pole	Dead	63.69
THROS_PCM_0039	Rocky Mountain juniper	Tree	Live	30.00
THROS_PCM_0040	Rocky Mountain juniper	Pole	Live	31.85
THROS_PCM_0046	chokecherry	Seedling	Live	63.65
THROS_PCM_0046	Rocky Mountain juniper	Pole	Live	31.85
THROS_PCM_0046	Rocky Mountain juniper	Tree	Live	20.00

Dead and downed wood and surface fuels provide foraging habitat and refugia for small wildlife species, as well as substrate for mosses and fungi. Downed wood sometimes also provides “nursery” logs for vascular plant establishment. However, when surface fuels are too abundant in a forest they can increase the risk of high intensity fires. NGPN observed measurable surface fuels in three plots at THRO in 2018 (Table 7).

Table 7. Surface fuels summary for three plots visited in 2018 at Theodore Roosevelt National Park by Northern Great Plains Network.

Macroplot	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
THRON_PCM_015	0.11	0.33	0.00	0.44	0.00	0.00	0.44	10.68	3.83	14.95	0.5	0.5	1.0
THRON_PCM_038	0.02	0.17	0.00	0.20	0.00	0.00	0.20	0.00	2.40	2.59	0.0	0.3	0.3
THROS_PCM_0015	0.03	0.34	0.69	1.06	0.35	0.00	1.41	2.72	5.87	10.00	0.1	0.7	0.9

Disturbances were observed in 16 of the 20 plots visited at THRO by NGPN in 2018 (Table 8). NGPFire did not collect disturbance data at the 11 plots they visited. The most common disturbances were the results of animal activity, including grazing, animal trails, bison wallows, and prairie dog mounds. All 20 plots visited by NGPN were also assessed for the presence of early detection exotic species, and none were observed in 2018.

Table 8. Disturbance type and size (area in m²) observed in 16 plots visited at Theodore Roosevelt National Park by Northern Great Plains Network in 2018. The disturbance area was approximated as a proportion of the total plot area of 1000 m².

Plot	Disturbance Type	Area (m ²)
THRON_PCM_005	Animal Trail	15
THRON_PCM_005	Soil Disturbance	15
THRON_PCM_005	Small Mammal	10
THRON_PCM_005	Wallow	5
THRON_PCM_015	Animal Trail	25
THRON_PCM_015	Wallow	1
THRON_PCM_015	Soil Disturbance	1
THRON_PCM_033	Animal Trail	10
THRON_PCM_033	Soil Disturbance	10
THRON_PCM_038	Animal Trail	40
THRON_PCM_038	Soil Disturbance	5
THRON_PCM_514	Animal Trail	50
THRON_PCM_518	Animal Trail	20
THRON_PCM_518	Soil Disturbance	20
THRON_PCM_518	Grazing	5
THRON_PCM_518	Flood	0
THROS_PCM_0007	Soil Disturbance	45
THROS_PCM_0007	Animal Trail	40
THROS_PCM_0007	Erosion	25
THROS_PCM_0007	Flood	20
THROS_PCM_0008	Erosion	1
THROS_PCM_0008	Soil Disturbance	1
THROS_PCM_0009	Soil Disturbance	400
THROS_PCM_0009	Erosion	250
THROS_PCM_0009	Flood	150
THROS_PCM_0009	Animal Trail	30
THROS_PCM_0009	Grazing	2
THROS_PCM_0013	Wallow	5
THROS_PCM_0013	Soil Disturbance	2
THROS_PCM_0015	Soil Disturbance	60
THROS_PCM_0015	Erosion	50
THROS_PCM_0015	Animal Trail	10
THROS_PCM_0039	Erosion	5
THROS_PCM_0039	Soil Disturbance	5
THROS_PCM_0040	Small Mammal	1
THROS_PCM_0040	Soil Disturbance	1

Table 8 (continued). Disturbance type and size (area in m²) observed in 16 plots visited at Theodore Roosevelt National Park by Northern Great Plains Network in 2018. The disturbance area was approximated as a proportion of the total plot area of 1000 m².

Plot	Disturbance Type	Area (m ²)
THROS_PCM_0045	Erosion	100
THROS_PCM_0045	Soil Disturbance	100
THROS_PCM_0045	Wallow	16
THROS_PCM_0046	Animal Trail	15
THROS_PCM_0046	Soil Disturbance	6
THROS_PCM_0046	Grazing	5
THROS_PCM_0046	Erosion	5
THROS_PCM_0046	Small Mammal	1
THROS_PCM_1026	Animal Trail	20
THROS_PCM_1026	Wallow	2
THROS_PCM_1026	Soil Disturbance	2

Further Analysis

This 2018 Data Summary Report is intended to provide a basic review of the data collected during the NGPN team's 2018 visit to Theodore Roosevelt National Park. All data included in this report is available upon request from the Northern Great Plains Inventory and Monitoring Network, and it is archived at <https://irma.nps.gov/DataStore>.

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NPS 387/150744, March 2019

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