



Plant Community Composition and Structure Monitoring for Theodore Roosevelt National Park

2014 Annual Report

Natural Resource Data Series NPS/NGPN/NRDS—2015/763



ON THE COVER

Crew member navigating to a monitoring plot, 2014
Photograph courtesy of the National Park Service

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The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

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.

This report received informal peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data. 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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Abstract

This report presents the results of vegetation monitoring efforts in 2014 at Theodore Roosevelt National Park (THRO) by the Northern Great Plains Inventory and Monitoring Network (NGPN).

During the fourth full year of field work, crew members from NGPN visited 15 plant community monitoring plots to collect data on the vegetation at THRO. This is part of a long-term monitoring effort that aspires to sample 28 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 captured data relating to species richness, herb-layer height, abundance of individual native and non-native species, ground cover, and site disturbance on each of the 15 plots.

Our 2014 findings can be summarized as follows: The crew observed 239 vascular plant species, with an average of 8.8 native species occurring within any given 1 m² quadrat sampled. Grasses, sedges, and forbs made up the bulk of the plant cover, while non-native species represented about 30.7% of cover. Native plant diversity was considerably higher, and exotic plant cover lower, in the upland areas than in the riparian areas. Seven species of tree and tall shrub species were observed infrequently, and woody fuel loads were moderate in the areas where they were found. Overall, the park's vegetation seems to be in good condition, though exotic plants pose a significant challenge to park management.

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Acknowledgments

We thank all the authors of the NGPN Plant Community Monitoring Protocol, particularly A. Symstad, for outstanding guidance on data collection and reporting. Thank you to the staff at THRO for providing logistical support and safety checks, particularly the law enforcement team. The 2014 NGPN vegetation field crew of M. Prowatzke, K. Legner, S. Rockwood, R. Manuel, F. Sewell, L. Mickelson, and D. Pinigis collected all the data included in this report, except for one plot, which was surveyed by the NGP Fire Effects crew of D. Swanson, V. Perreault, and W. Watson.

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 pieces of intact prairies within its boundaries. The stewardship goal of the NPS is to “preserve ecological integrity and cultural and historical authenticity” (NPS 2012); however, resource managers struggle with the grim reality that there have been fundamental changes in the disturbance regimes, such as climate, fire, and large ungulate grazing, that have historically maintained prairies, and there is the continual pressure of exotic invasive species. Long-term monitoring in national parks is essential to sound management of prairie landscapes because it can provide information on environmental quality and condition, benchmarks of ecological integrity, and early warning of declines in ecosystem health.

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 makes 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 (FireEP). 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 5-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 2014, our fourth year of sampling vegetation. NGPN visited 14 plots in the south unit and north unit, and the FireEP visited one of our scheduled plots (Figure 1). We expect to produce reports with more in-depth data analysis and interpretation when we complete five and 10

years of sampling. In the interim, reports, spatial data, and data summaries can be provided for park management and interpretation upon request. In 2015, we will complete a comprehensive survey focused on riparian forest health at 100 sites within the park.

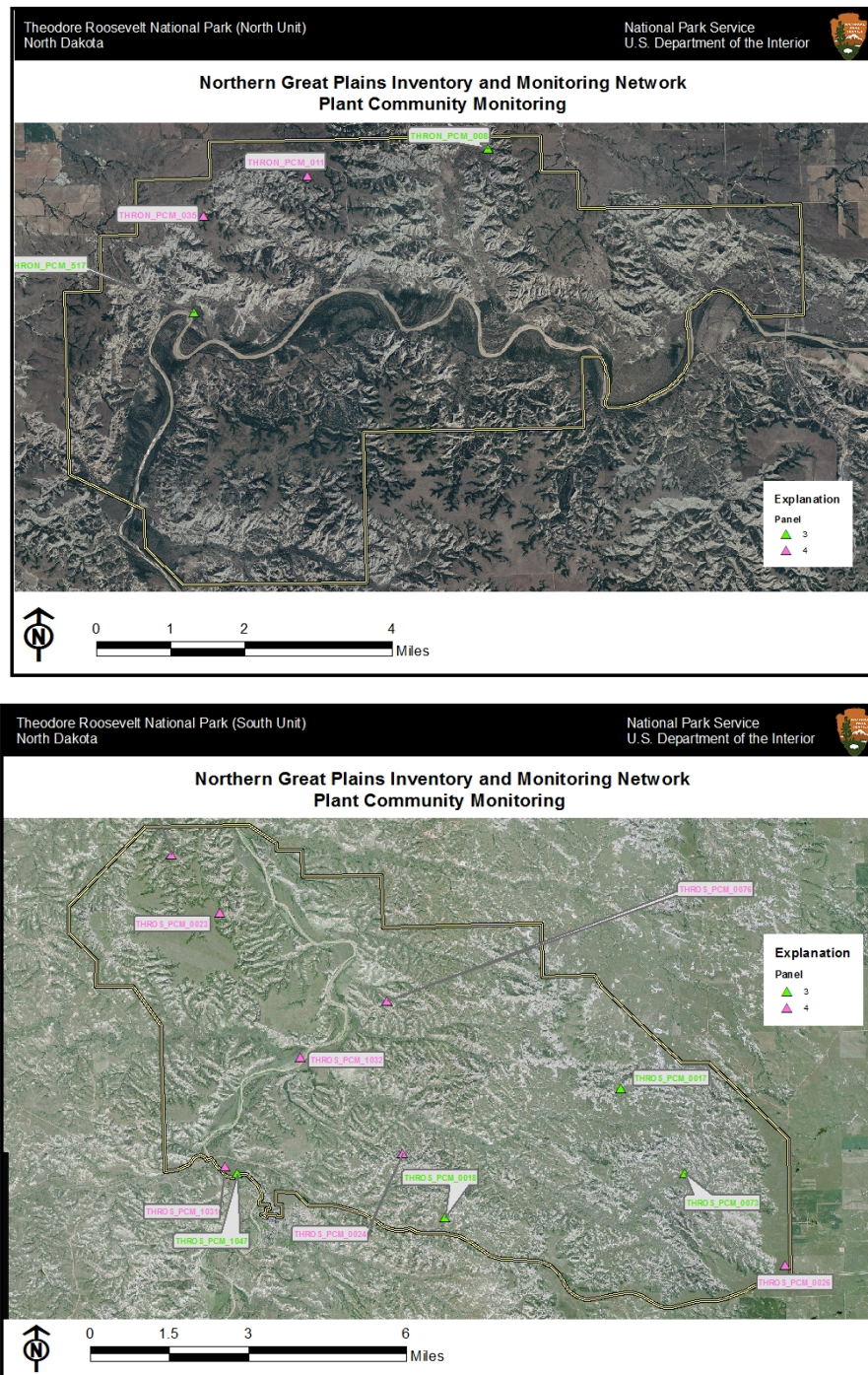


Figure 1. Map of the plant community monitoring plots surveyed in 2014 in the north unit (top) and south unit (bottom) of Theodore Roosevelt National Park. In the south unit, THROS-PCM-0076 was surveyed by the Northern Great Plains Fire Effects Program.

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. Below, we briefly describe the general approach. For those interested in more detail please see Symstad et al. 2012a, available at <http://science.nature.nps.gov/im/units/ngpn/monitor/plants.cfm>.

Sample Design

We implemented a survey to monitor plant community structure and composition in THRO using a spatially balanced probability design (Generalized Random Tessellation Stratified [GRTS]; Stevens and Olsen 2003, 2004). Using a GRTS design, we selected 50 randomly located sites within the north unit of THRO and 90 randomly located sites in the south unit. We split these 140 sites into 10 panels with 14 sites each. We hoped to visit two panels (28 sites) every year. In 2011, we visited sites in panel 1 and panel 5, and in 2012 we visited sites in panel 1 and panel 2. In 2013, we visited sites in panel 2 and panel 3. Due to constraints on the NGPN and Fire Ecology Program budget and travel, as well as bad weather, flooding, and safety concerns, we only visited 15 plots in panel 3 and panel 4 in 2014 (Figure 1). Two additional plots in the south unit (PCM-0015 and PCM-0025, not shown on map) were visited, but they were not surveyed due to inundation and excessively muddy conditions. We visited all of the sites during the last 10 days of July and first week of August. Data from these randomly selected sites can be used to estimate condition of vegetation communities for the whole park and over time, can be used to discern trends in condition.

Plot Layout and Sampling

At each of the sites we visited, we recorded plant species cover and frequency in a rectangular, 50 m x 20 m (0.1 ha), permanent plot (Figure 2). Data on ground cover, herb-layer height ≤ 2 m, and plant cover were collected on two 50 m transects (the long sides of the plot) using a point-intercept method. Species richness data from the point-intercept method were supplemented with species presence data collected in five sets of nested square quadrats (0.01 m², 0.1 m², 1 m², and 10 m²) located systematically along each transect (Figure 2). In 2014, sampling at THRO took a total of 565¾ hours over a span of 12 days (see Appendix A for a detailed account of activities each day). At the plot surveyed by FireEP (THROS- PCM-0076), only one point-intercept transect was recorded, and only five nested quadrats were surveyed, these only to the 1m² area.

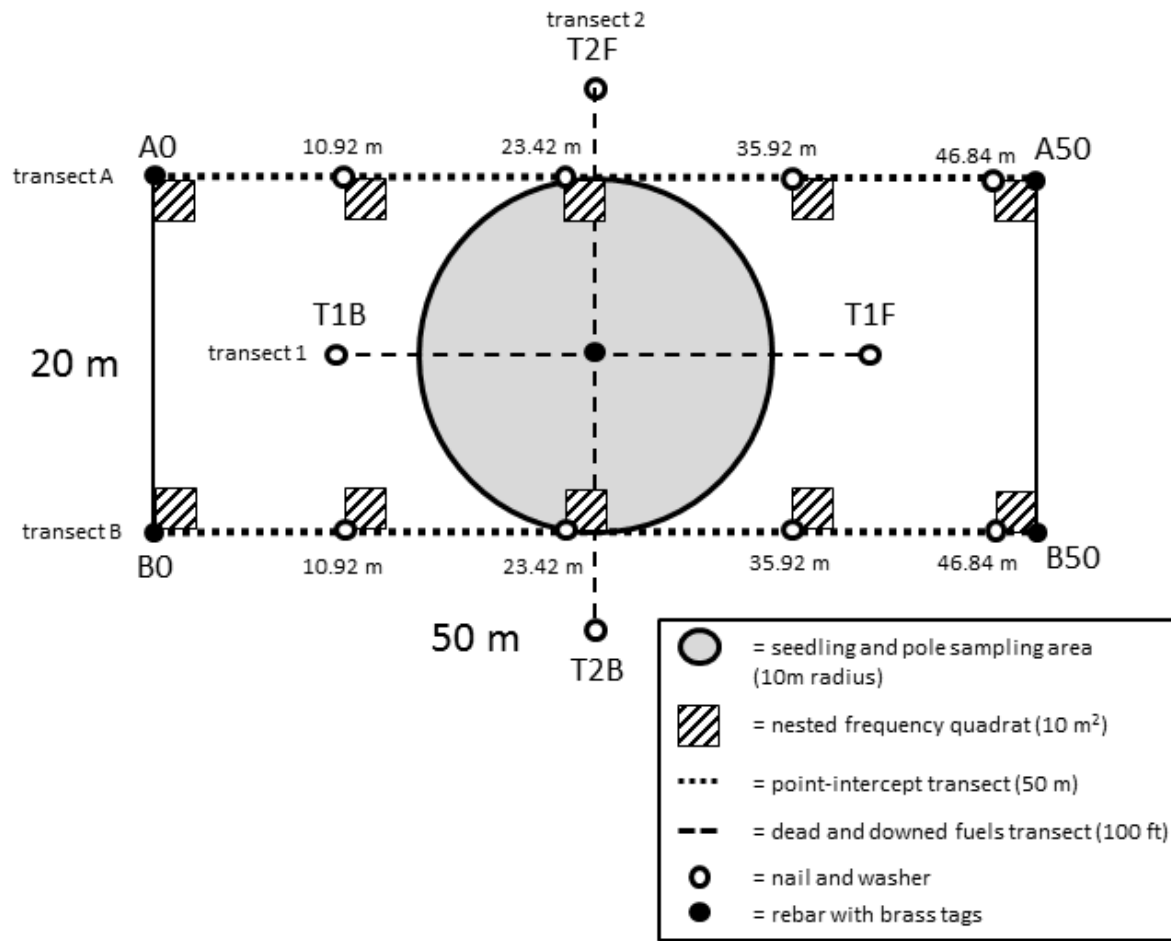


Figure 2. Long-term monitoring plot layout used for sampling vegetation in Theodore Roosevelt National Park.

When woody species were present, tree regeneration and tall shrub density data were collected within a 10 m radius subplot centered in the larger 50 m x 20 m plot (Figure 2). Trees with diameter at breast height (DBH) > 15 cm, located within the entire 0.1 ha plot, were mapped and tagged. For each tree, the species, DBH, status, and condition (e.g., leaf-discoloration, insect-damaged, etc.) were recorded. In juniper and cottonwood forests, dead and downed woody fuel load data were collected on two perpendicular, 100 ft (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). 2013 was the first year that NGPN collected fuels data in THRO.

At all plots, we also surveyed the area for common disturbances and target species of interest to the park. Common disturbances included such things as roads, rodent mounds, animal trails, and fire. For all plots, the type and severity of the disturbances were recorded. We also surveyed the area for exotic species that have the potential to spread into the park and cause significant ecological impacts (Table 1). For each target species that was present at a site, an abundance class was given on a scale from 1-5 where 1 = one individual, 2 = few individuals, 3 = cover of 1-5%, 4 = cover of 5-25%, and 5 = cover > 25% of the plot. The information gathered from this procedure is critical for early

detection and rapid response to such threats. In addition, we noted the presence of plant species that are considered rare or vulnerable to loss in North Dakota, and which may potentially occur in THRO (Table 2) or have been documented in the park (Heidel 1990).

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

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

Table 2. Rare species that were surveyed for during the 2014 field season at Theodore Roosevelt National Park

Scientific Name	Common Name
<i>Carex gravida</i>	heavy sedge
<i>Chenopodium subglabrum</i>	smooth goosefoot
<i>Collinsia parviflora</i>	maiden blue-eyed Mary
<i>Dalea enneandra</i>	nineanther (dalea) prairie clover
<i>Dalea villosa</i>	silky prairie clover
<i>Eriogonum cernuum</i>	nodding buckwheat
<i>Eriogonum visherii</i>	Visher's buckwheat
<i>Euphorbia brachycera</i>	horned (Rocky Mountain) spurge
<i>Lobelia spicata</i>	palespike lobelia
<i>Mentzelia nuda</i>	bractless blazing star
<i>Oxytropis sericea</i>	white locoweed
<i>Phlox alyssifolia</i>	alyssumleaf phlox
<i>Physaria brassicoides</i>	double twinpod
<i>Populus x acuminata</i>	lanceleaf cottonwood
<i>Sporobolus airoides</i>	alkali sacaton
<i>Townsendia hookeri</i>	Hooker's Townsend daisy
<i>Viburnum lentago</i>	nannyberry

Data Management and Analysis

We used FFI (FEAT/FIREMON Integrated; <http://frames.gov/ffi/>) as the primary software environment for managing our sampling data. FFI is used by a variety of agencies (e.g., NPS, USDA Forest Service, U.S. Fish and Wildlife Service), has a national-level support system, and generally conforms to the Natural Resource Database Template standards established by the Inventory and Monitoring Program.

Species scientific names, codes, and common names are from the USDA Plants Database (USDA-NRCS 2012). However, nomenclature follows the Integrated Taxonomic Information System (ITIS) (<http://www.itis.gov>). In the few cases where ITIS recognizes a new name that was not in the USDA PLANTS database, the new name was used and a unique plant code was assigned.

After data for the sites were entered, 100% of records were verified to the original data sheet to minimize transcription errors. A further 10% of records were reviewed a second time. After all data were entered and verified, automated queries were developed to check for errors in the data. When errors were caught by the crew or the automated queries, changes were made to the original datasheets and the FFI database as needed.

Plant life forms (e.g., shrub, forb) were based on definitions from the USDA Plants Database (USDA-NRCS 2012). Warm-season grasses were identified primarily using a guide by Skinner (2010). Summaries were produced using the FFI reporting and query tools and statistical summaries, and graphics were generated using R software (version 3.1.2).

We measured diversity at the plots in three ways: species richness, the Shannon Index, and Pielou's Index of Evenness. Species richness is simply a count of the species recorded in an area. The Shannon Index, H' , is a measure of the number of species in an area and how even abundances are across the community. It typically ranges between 0 (low richness and evenness) to 3.5 (high species richness and evenness). Pielou's Index of Evenness, J' , measures how even abundances are across taxa. It ranges between 0 and 1; values near 0 indicate dominance by a single species, and values near 1 indicate nearly equal abundance of all species present.

Disturbances were recorded in square meters and ranged from 0 (not present) to 2290 (the whole plot area) for each type of disturbance. We report the sum of all individual disturbances, so the value can be greater than 2290 m².

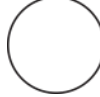
Reporting on Natural Resource Condition

Results were summarized in a Natural Resource Condition Table based on the templates from the State of the Park report series (<http://www.nps.gov/stateoftheparks/>). The goal is to improve park priority setting and to synthesize and communicate complex park condition information to the public in a clear and simple way. By focusing on specific indicators, such as exotic species cover, it will also be possible and straightforward to revisit the metric in subsequent years. The status and trend of each indicator is scored and assigned a corresponding symbol based on the key found in Table 3.

We chose a set of indicators and specific measures that can describe the condition of vegetation in the Northern Great Plains and the status of exotic plant invasions. The measures include: absolute

herb-layer canopy cover, native species richness, evenness, relative cover of exotic species, and annual brome cover. Reference values were based on descriptions of historic condition and variation, past studies, and/or management targets. Current park condition was compared to a reference value, and status was scored as good condition, warrants moderate concern, or warrants significant concern based on this comparison (Table 3). Good condition was applied to values that fell within the range of the reference value, and significant concern was applied to conditions that fell outside the bounds of the reference value. In some cases, reference conditions can be determined only after we have accumulated more years of data. When this is the case, we refer to these as “To be determined” and estimate condition based on our professional judgment.

Table 3. Key to the symbols used in the Natural Resource Condition Table. The background color represents the current status, the arrow summarizes the trend, and the thickness of the outside line represents the degree of confidence in the assessment. A symbol that does not contain an arrow indicates that there is insufficient information to assess a trend. Based on the State of the Park reports (<http://www.nps.gov/stateoftheparks/>).

Condition Status		Trend in Condition		Confidence in Assessment	
	Warrants Significant Concern		Condition is Improving		High
	Warrants Moderate Concern		Condition is Unchanging		Medium
	Resource is in Good Condition		Condition is Deteriorating		Low

Results and Discussion

Theodore Roosevelt NP experienced near normal precipitation in 2014, but ended the year above average

(<http://www.ncdc.noaa.gov/cdo-web/datasets/GHCND/stations/GHCND:USC00325813/detail>; Figure 3). When NGPN visited the park in late July and early August, precipitation was near normal at the south unit. Precipitation was somewhat lower at the north unit of the park.

Average canopy cover was 208% (Table 4) in 2014, which was about a 10% relative increase from the previous year (Ashton and Prowatzke 2014). There was a large amount of litter on the ground with ground cover at the sites averaging 81% plant litter.

We found 239 plant species in 2014 at THRO (Appendix B). Graminoids, which includes grasses, sedges, and rushes, accounted for most of the vegetative cover at THRO, but forbs, trees, shrubs, and subshrubs (defined as a low-growing shrub usually under 0.5m) were also present (Figure 4). We found 38 exotic species at the park. No exotic target species were found at any sites in 2014.

The most common species in the sites we visited were largely graminoids, and most were native species (Figure 5). However, the non-native Kentucky bluegrass (*Poa pratensis*) and yellow sweetclover (*Melilotus officinalis*) were found in 15 and 14 (out of 15) plots, respectively.

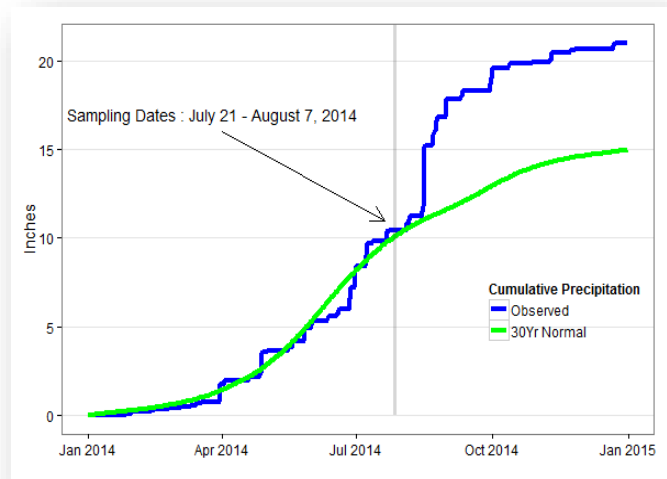


Figure 3. Observed and 30-year (1981-2010) normal precipitation near Theodore Roosevelt National Park south unit. Timing of NGPN visit is shown by vertical gray bar.

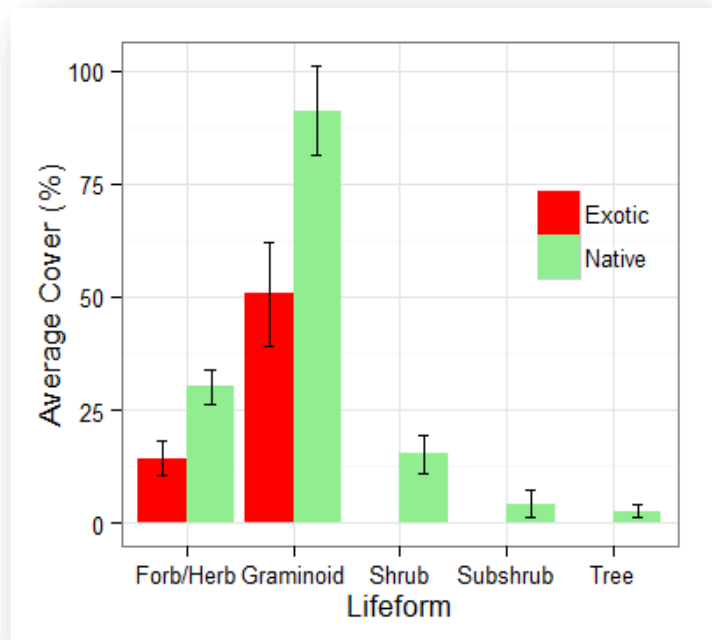


Figure 4. Average cover by lifeform in 15 plant community monitoring plots in Theodore Roosevelt National Park in 2014. Graminoids and forbs were the most abundant lifeforms found in the understory across the plots. Bars represent means $\pm$ standard errors.

We identified one targeted rare species in our monitoring—white locoweed (*Oxytropis sericea*)—in two south unit plots, PCM-0018 and PCM-0023. This species is not considered rare at the global scale, but it is considered critically imperiled (S1) in the state of North Dakota (Heidel 1990). THRO has a high concentration of rare plant species (Heidel 1990); as such, the park has an important role to play in the preservation of natural processes and species diversity in North Dakota. While our monitoring is not designed to replace rare plant surveys, it can provide some additional data on the distribution and abundance of these species in the park.

Indicator of Condition	Specific Measures	2014 Value (mean $\pm$ SE)	Reference Condition and Data Source	Condition Status/Trend	Rationale for Resource Condition
Plant Community Structure and Composition	Absolute herb-layer canopy cover	208 $\pm$ 13%	TBD ⁽¹⁾		THRO has a high herbaceous canopy cover and a high diversity of native plants overall. Native species richness is considerably lower in the riparian areas, which do not meet the reference condition. The condition assessment for canopy cover and evenness is based on professional judgment, but as we collect more data and understand the natural range of variability our confidence in these assessments will increase.
	Native species richness (based on average of 10 1m ² quadrats per plot)	8.8 $\pm$ 1.1 species	8-18 species ⁽²⁾		
	Evenness (based on point-intercept of 2-50m transects per plot)	0.76 $\pm$ 0.02	TBD ⁽¹⁾		
Exotic Plant Early Detection and Management	Relative cover of exotic species	30.7 $\pm$ 6.6%	$\leq$ 10 % cover		In general, the sites in THRO had a high cover of exotic species. Over half of sites surveyed had >25% exotic cover. Annual brome cover remains low, but Kentucky bluegrass and smooth brome are common.
	Leafy spurge cover	1.3 $\pm$ 0.9%	$\leq$ 10 % cover		

Table 4. Natural resource condition summary table for plant communities in Theodore Roosevelt National Park (THRO).

References, Notes, and Data Sources: 1. To be determined when more data are available. 2. Symstad, A. J. and J. L. Jonas. 2014. Using natural range of variation to set decision thresholds: a case study for Great Plains grasslands. in G. R. Gutenspergen, editor. Application of threshold concepts in natural resource decision making. Springer Verlag.

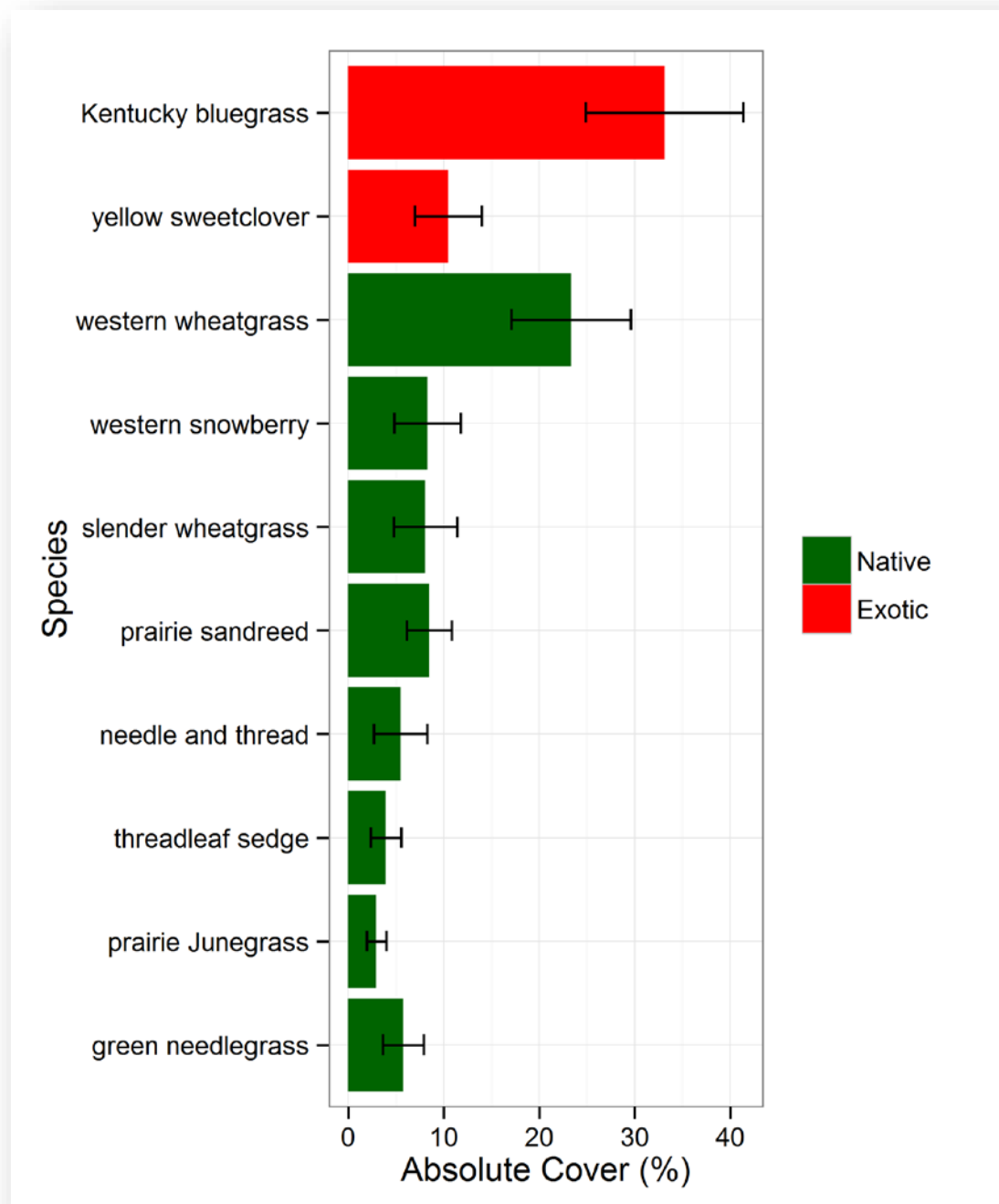


Figure 5. The average absolute cover of the 10 most common plants recorded at Theodore Roosevelt National Park in 2014. Bars represent means $\pm$ standard errors.

Average species richness at each of the 15 plots was measured by point-intercept and in 1 m² and 10 m² quadrats. On average, there are about two exotic species within the 1 m² quadrat (Table 5). From the point-intersect data, we found average plot diversity, H' , to be 2.37 ± 0.16 . Evenness, J' , averaged 0.76 ± 0.02 across the plots (Table 4). When including only native species, average diversity and evenness were 2.15 ± 0.21 and 0.71 ± 0.06 , respectively.

Table 5. Average plant species richness in 15 plots at Theodore Roosevelt National Park in 2014. Values represent means $\pm$ standard errors, $n=15$ for point-intercept and 1 m² quadrats; $n=14$ for the 10 m² quadrats.

	Point-intercept	1 m ² quadrats	10 m ² quadrats
Species richness	25 $\pm$ 2.5	11 $\pm$ 1.1	19 $\pm$ 2.1
Native species richness	21 $\pm$ 2.6	9 $\pm$ 1.1	16 $\pm$ 2.1
Exotic species richness	4 $\pm$ 0.5	2 $\pm$ 0.3	4 $\pm$ 0.4
Graminoid species richness	10 $\pm$ 1.0	4 $\pm$ 0.3	6 $\pm$ 0.5
Forb species richness	12 $\pm$ 1.2	6 $\pm$ 0.7	11 $\pm$ 1.4

While there was some variation across sites, the upland plots we visited in THRO tended to have a high diversity of native plants compared to other mixed-grass prairies. Species richness in the mixed-grass prairie is determined by numerous factors including fire regime, grazing, prairie dog disturbance, and weather fluctuations (Symstad and Jonas 2011). While it is difficult to define a reference condition for species richness that can vary so much spatially and temporally, the natural range of variation over long-time periods may be a good starting point (Symstad and Jonas 2014). Long-term records of species diversity in mixed-grass prairie from a relatively undisturbed site in eastern Montana vary between 8 and 18 species per square meter over the course of 13 years. Compared to the nearby mixed-grass prairie, THRO is within the natural range (Table 4). However, riparian sites exhibited much lower diversity than upland sites (Table 5). THROS-PCM-1047, dominated by non-native smooth brome (*Bromus inermis*), recorded only 0.3 native species per square meter, while the highest diversity, 16.4 native species/m², was recorded at THROS-PCM-0076 (Figure 6). This site contained an open juniper woods and a variety of shrubs in addition to the grassland species common to the area and had been subject to a prescribed burn approximately two months prior to our visit.



Figure 6. THROS-PCM-0076 had been part of a prescribed burn on May 9, 2014. This site recorded the highest native diversity (16.4 species/m²) among sites surveyed in 2014. Photo courtesy of FireEP.

Table 6. Characteristics of the plant community at 15 plots in Theodore Roosevelt National Park in 2014 including native species richness, exotic plant cover, and area of disturbance.

Plot	Average native species richness per m ²	Exotic cover (%)	Leafy spurge cover (%)	Kentucky bluegrass cover (%)	Disturbance within site (m ²)
THRON-PCM-008	10	24	0	23	0
THRON-PCM-011	6	44	0	30	1000
THRON-PCM-035	11	28	0	15	150
Average North Unit Upland	<i>9.1 ± 1.5 species</i>	<i>32.0 ± 6.2%</i>	<i>0 ± 0.0%</i>	<i>22.8 ± 4.4%</i>	-
THROS-PCM-0017	10	32	0	11	270
THROS-PCM-0018	14	15	0	0	00
THROS-PCM-0023	16	3	0	1	0
THROS-PCM-0024	10	8	0	4	0
THROS-PCM-0026	5	60	0	34	2291
THROS-PCM-0073	7	26	0	5	0
THROS-PCM-0075	8	9	1	1	5
THROS-PCM-0076	16	2	0	1	-
Average South Unit Upland	<i>10.7 ± 1.5 species</i>	<i>19.4 ± 7.0%</i>	<i>0.2 ± 0.2%</i>	<i>7.2 ± 4.1%</i>	-
THRON-PCM-517	6	47	1	33	750
Average North Unit Riparian	<i>6.1 species</i>	<i>47.3%</i>	<i>1.1%</i>	<i>33.3%</i>	-
THROS-PCM-1031	6	47	13	31	0
THROS-PCM-1032	6	16	4	3	4580
THROS-PCM-1047	0	98	0	31	4
Average South Unit Riparian	<i>4.3 ± 2.0 species</i>	<i>53.8 ± 23.8%</i>	<i>5.7 ± 3.9%</i>	<i>21.8 ± 9.6%</i>	-

The average relative cover of exotic species at sites in THRO was high, averaging $30.7 \pm 6.6\%$. However, like species richness, cover of exotic species varied considerably among sites (Table 6). Exotic cover ranged from 2% to 98% across the park. The majority of sites surveyed had exotic cover above 25%, and sites in the riparian areas generally had higher exotic cover than those in upland areas. Park-wide, Kentucky bluegrass accounted for a large portion of the exotic plant cover (Table 6), but yellow sweetclover, smooth brome, Japanese brome (*B. japonicus*), and leafy spurge (*Euphorbia esula*) were also common, each being found in at least four of the plots surveyed. Kentucky bluegrass is common throughout North Dakota, and management has proved challenging. Recent work suggests that controlled-burning is the most effective control (<http://www.fws.gov/midwest/news/nativeprairies.html>).

Disturbance from grazing, prairie dogs, bison, fire, and humans affects plant community structure and composition in mixed-grass prairie. For this reason, we measured the approximate area affected by natural and human disturbances at each site we visited. In 2014, the most common disturbance was from grazing (six plots), but evidence of flooding, animal trails, small mammal activity, erosion,

and prescribed fire were also recorded. No disturbances of human origin were noted, except for the intentional prescribed fire management action.

Trees and/or seedlings were present in many of the sites we visited in 2014. A more thorough assessment of forest structure in the riparian areas will be conducted in 2015; it will include 50 plots in each of the north and south units. The 2013 data provide a much smaller snapshot of condition. Rocky Mountain juniper (*Juniperus scopulorum*) was the most common woody species we found, while chokecherry (*Prunus virginiana*) seedlings were very abundant when they were found (Table 7). Five other species were found, often without mature trees or shrubs recorded in the same plot. This is likely due to long seed dispersal distances or random location of the plot near, but not within, wooded areas.

Table 7. Tree and tall shrub density in Theodore Roosevelt National Park in 2014.

Size Class	Juniper (four plots; stems/ hectare)	Green Ash (one plot; stems/ hectare)	American Elm (one plot; stems/ hectare)	Aspen (one plot; stems/ hectare)	Chokecherry (two plots; stems/ hectare)	Buffaloberry (two plots; stems/ hectare)	Serviceberry (one plot; stems/ hectare)
Seedlings	47.7	95.5	159.1	63.7	3039.5	350.1	95.5
Poles	175.2	0	0	0	0	31.9	0
Trees	67.5	0	0	0	n/a	n/a	n/a
Snags	10	41.9	30	0	n/a	n/a	n/a

We measured surface fuels at six sites within the park; these varied in fuel type, including Rocky Mountain juniper, green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), and cottonwood (*Populus deltoides*). Total downed fuel loads were moderate, averaging 10.8 tons/acre (Table 8).

Table 8. Surface fuel loads in six wooded plots in Theodore Roosevelt National Park in 2014.

Fine Woody Debris	Course Woody Debris (sound)	Course Woody Debris (rotten)	Duff	Litter	Total
0.3 ± 0.1 tons acre ⁻¹	1.2 ± 0.8 tons acre ⁻¹	0.3 ± 0.3 tons acre ⁻¹	5.1 ± 3.6 tons acre ⁻¹	3.9 ± 1.3 tons acre ⁻¹	10.8 ± 4.7 tons acre ⁻¹

Summary

Understory plant community plots measure in 2014 at THRO had a high diversity of native plants that appears to be within the range of natural variability for northern mixed-grass prairie. The upland mixed-grass prairie sites had higher diversity than those in riparian areas. Average cover of exotic species was high, particularly in the riparian areas. Kentucky bluegrass was the most widespread and abundant exotic species. Woodlands of various types are common throughout the park and characterized by moderate fuel loads. To retain ecological integrity and the high diversity of native plants in THRO, it is important to continue efforts to reduce the cover of invasive plants. Continued monitoring efforts will be critical to track changes in the condition of the vegetation communities in THRO.

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Appendix A: Field journal for plant community monitoring in THRO for the 2014 season

Plant community composition monitoring in Theodore Roosevelt National Park was completed using two crews of 3-4 people working 12 10-hour days with some overtime. Additionally, 32¾ hours of overtime were incurred. Total hours worked were 562¾, not including the time FireEP spent on one plot.

Date	Day of week	Approximate Travel Time (hrs)	Housing	Sites Completed/Notes
July 17, 2014	Thursday	N/A	N/A	THROS PCM-0076 completed by FireEP
July 21, 2014	Monday	5	Juniper Campground	THRON PCM-011 (started)
July 22, 2014	Tuesday	N/A	Juniper Campground	THRON PCM-011 (finished) THRON PCM-035 (started)
July 23, 2014	Wednesday	1	Juniper Campground	THRON PCM-035 (finished) THRON PCM-517 (started) Thunderstorm delay
July 24, 2014	Thursday	1	Juniper Campground	THRON PCM-517 (finished) THRON PCM-008 (started) Thunderstorm delay
July 25, 2014	Friday	2 (first team) 3 (second team)	Sully Creek State Park Campground	THRON PCM-008 (finished, team departed to FOUS) THROS PCM-1047 (team arrived from KNRI)
July 26, 2014	Saturday	1	Sully Creek State Park Campground	THROS PCM-0017 THROS PCM-1031 (started)
July 27, 2014	Sunday	0.5	Sully Creek State Park Campground	THROS PCM-1031 (finished) THROS PCM-0018 (except trees/fuels/seedlings)
July 28, 2014	Monday	4	N/A	THROS PCM-0018 (trees/fuels/seedlings) Returned to Rapid City
August 4, 2014	Monday	4	Sully Creek State Park Campground	THROS PCM-0024 (both crews)
August 5, 2014	Tuesday	1	Sully Creek State Park Campground	THROS PCM-0023 THROS PCM-0075
August 6, 2014	Wednesday	1	Sully Creek State Park Campground	THROS PCM-0073 THROS PCM-1032 Attempted THROS PCM-0025 but site was flooded. Attempted THROS PCM-0015 but approach across bentonite was hazardous.
August 7, 2014	Thursday	4	N/A	THROS PCM-0016 (both crews)

Appendix B: List of plant species found in 2014 at THRO

Family	Code	Scientific Name	Common Name	Exotic
Agavaceae	YUGL	<i>Yucca glauca</i>	soapweed yucca	
Anacardiaceae	RHTR	<i>Rhus trilobata</i>	skunkbush sumac	
	TORY	<i>Toxicodendron rydbergii</i>	western poison ivy	
Apocynaceae	APAN2	<i>Apocynum androsaemifolium</i>	spreading dogbane	
Asclepiadaceae	ASPU	<i>Asclepias pumila</i>	plains milkweed	
	ASSP	<i>Asclepias speciosa</i>	showy milkweed	
	ASVE	<i>Asclepias verticillata</i>	whorled milkweed	
Asteraceae	ACMI2	<i>Achillea millefolium</i>	common yarrow	
	AMPS	<i>Ambrosia psilostachya</i>	Cuman ragweed	
	AMTR	<i>Ambrosia trifida</i>	great ragweed	
	ANMI3	<i>Antennaria microphylla</i>	littleleaf pussytoes	
	ANPA4	<i>Antennaria parvifolia</i>	small-leaf pussytoes	
	ANPA9	<i>Antennaria parlinii</i>	Parlin's pussytoes	
	ARBI2	<i>Artemisia biennis</i>	biennial wormwood	*
	ARCA12	<i>Artemisia campestris</i>	field sagewort	
	ARCA13	<i>Artemisia cana</i>	silver sagebrush	
	ARDR4	<i>Artemisia dracunculus</i>	tarragon	
	ARFR4	<i>Artemisia frigida</i>	prairie sagewort	
	ARLO7	<i>Artemisia longifolia</i>	longleaf wormwood	
	ARLU	<i>Artemisia ludoviciana</i>	white sagebrush	
	ARTR2	<i>Artemisia tridentata</i>	big sagebrush	
	CIAR4	<i>Cirsium arvense</i>	Canada thistle	*
	CIFL	<i>Cirsium flodmanii</i>	Flodman's thistle	
	CIUN	<i>Cirsium undulatum</i>	wavyleaf thistle	
	COCA5	<i>Conyza canadensis</i>	Canadian horseweed	
	CORA4	<i>Conyza ramosissima</i>	dwarf horseweed	
	DYPA	<i>Dyssodia papposa</i>	fetid marigold	
	ECAN2	<i>Echinacea angustifolia</i>	blacksamson echinacea	
	ERCA4	<i>Erigeron canus</i>	hoary fleabane	
	ERIGE2	<i>Erigeron sp.</i>	fleabane	
	ERNA10	<i>Ericameria nauseosa</i>	rubber rabbitbrush	
	ERST3	<i>Erigeron strigosus</i>	prairie fleabane	
	ERSU2	<i>Erigeron subtrinervis</i>	threenerve fleabane	
	GRSQ	<i>Grindelia squarrosa</i>	curlycup gumweed	
	GUSA2	<i>Gutierrezia sarothrae</i>	broom snakeweed	
	HEPA19	<i>Helianthus pauciflorus</i>	stiff sunflower	
	HEPE	<i>Helianthus petiolaris</i>	prairie sunflower	
	HEVI4	<i>Heterotheca villosa</i>	hairy false goldenaster	
	LASE	<i>Lactuca serriola</i>	prickly lettuce	*
	LIPU	<i>Liatris punctata</i>	dotted blazing star	
	LOAR5	<i>Logfia arvensis</i>	field cottonrose	*
	LYJU	<i>Lygodesmia juncea</i>	rush skeletonplant	
	MUOB99	<i>Mulgedium oblongifolium</i>	blue lettuce	
	PAPL12	<i>Packera plattensis</i>	prairie groundsel	
	RACO3	<i>Ratibida columnifera</i>	upright prairie coneflower	
	SENEC	<i>Senecio sp.</i>	ragwort, groundsel	*

Family	Code	Scientific Name	Common Name	Exotic
Asteraceae	SOAR2	<i>Sonchus arvensis</i>	field sowthistle	*
	SOCA6	<i>Solidago canadensis</i>	Canada goldenrod	
	SOLID	<i>Solidago</i> sp.	goldenrod	
	SOMI2	<i>Solidago missouriensis</i>	Missouri goldenrod	
	SOMO	<i>Solidago mollis</i>	velvety goldenrod	
	SONE	<i>Solidago nemoralis</i>	gray goldenrod	
	SOPT4	<i>Solidago ptarmicoides</i>	prairie goldenrod	
	SORI2	<i>Solidago rigida</i>	stiff goldenrod	
	SYER	<i>Symphotrichum ericoides</i>	white heath aster	
	SYLA3	<i>Symphotrichum laeve</i>	smooth blue aster	
	SYMPH4	<i>Symphotrichum</i> sp.	aster	
	SYOB	<i>Symphotrichum oblongifolium</i>	aromatic aster	
	TAOF	<i>Taraxacum officinale</i>	common dandelion	*
	TRDU	<i>Tragopogon dubius</i>	yellow salsify	*
	XASP99	<i>Xanthisma spinulosum</i>	lacy tansyaster	
	XAST	<i>Xanthium strumarium</i>	rough cocklebur	
Boraginaceae	HADE	<i>Hackelia deflexa</i>	nodding stickseed	
	LAOC3	<i>Lappula occidentalis</i>	flatspine stickseed	
	LIIN2	<i>Lithospermum incisum</i>	narrowleaf stoneseed	
Brassicaceae	ALDE	<i>Alyssum desertorum</i>	desert madwort	*
	ARHI	<i>Arabis hirsuta</i>	hairy rockcress	
	BOHO99	<i>Boechera holboellii</i>	Holboell's rockcress	
	CAMI2	<i>Camelina microcarpa</i>	littlepod false flax	*
	DEPI	<i>Descurainia pinnata</i>	western tansymustard	
	DESO2	<i>Descurainia sophia</i>	herb sophia	*
	DRRE2	<i>Draba reptans</i>	Carolina draba	
	ERYSI	<i>Erysimum</i> sp.	wallflower	*
	LEDE	<i>Lepidium densiflorum</i>	common pepperweed	
	PHLU99	<i>Physaria ludoviciana</i>	foothill bladderpod	
	THAR5	<i>Thlaspi arvense</i>	field pennycress	*
Cactaceae	ESVI2	<i>Escobaria vivipara</i>	spinystar	
	OPMA2	<i>Opuntia macrorhiza</i>	twistspine pricklypear	
	OPPO	<i>Opuntia polyacantha</i>	plains pricklypear	
Campanulaceae	CARO2	<i>Campanula rotundifolia</i>	bluebell bellflower	
	TRLE3	<i>Triodanis leptocarpa</i>	slimpod Venus' looking-glass	
Caprifoliaceae	SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry	
Caryophyllaceae	CEAR4	<i>Cerastium arvense</i>	field chickweed	
	CENU2	<i>Cerastium nutans</i>	nodding chickweed	
	SIAN2	<i>Silene antirrhina</i>	sleepy silene	
	SILA21	<i>Silene latifolia</i>	bladder campion	*
Celastraceae	CESC	<i>Celastrus scandens</i>	American bittersweet	
Chenopodiaceae	ATCA2	<i>Atriplex canescens</i>	fourwing saltbush	
	ATCO	<i>Atriplex confertifolia</i>	shadscale saltbush	
	CHAL7	<i>Chenopodium album</i>	lambsquarters	*
	CHENO	<i>Chenopodium</i> sp.	goosefoot	*
	CHFR3	<i>Chenopodium fremontii</i>	Fremont's goosefoot	
	CHPR5	<i>Chenopodium pratericola</i>	desert goosefoot	
	CHSI2	<i>Chenopodium simplex</i>	mapleleaf goosefoot	
	KOSC	<i>Kochia scoparia</i>	burningbush, kochia	*

Family	Code	Scientific Name	Common Name	Exotic
	KRLA2	<i>Krascheninnikovia lanata</i>	winterfat	
Chenopodiaceae	SATR12	<i>Salsola tragus</i>	prickly Russian thistle	*
	SAVE4	<i>Sarcobatus vermiculatus</i>	greasewood	
Convolvulaceae	COAR4	<i>Convolvulus arvensis</i>	field bindweed	*
Cornaceae	COSE16	<i>Cornus sericea</i>	redosier dogwood	
Cupressaceae	JUCO6	<i>Juniperus communis</i>	common juniper	
	JUHO2	<i>Juniperus horizontalis</i>	creeping juniper	
	JUSC2	<i>Juniperus scopulorum</i>	Rocky Mountain juniper	
Cyperaceae	CABR10	<i>Carex brevior</i>	shortbeak sedge	
	CADU6	<i>Carex duriuscula</i>	needleleaf sedge	
	CAFI	<i>Carex filifolia</i>	threadleaf sedge	
	CAIN9	<i>Carex inops</i>	long-stolon sedge	
	CAREX	<i>Carex</i> sp.	sedge	
	CASP7	<i>Carex sprengelii</i>	Sprengel's sedge	
Dryopteridaceae	WOOR	<i>Woodsia oregana</i>	Oregon cliff fern	
Elaeagnaceae	SHAR	<i>Shepherdia argentea</i>	silver buffaloberry	
Equisetaceae	EQHY	<i>Equisetum hyemale</i>	scouringrush horsetail	
	EQLA	<i>Equisetum laevigatum</i>	smooth horsetail	
Euphorbiaceae	EUES	<i>Euphorbia esula</i>	leafy spurge	*
	EUGL3	<i>Euphorbia glyptosperma</i>	ribseed sandmat	
	EUSE4	<i>Euphorbia serpens</i>	matted sandmat	
	EUSP	<i>Euphorbia spathulata</i>	warty spurge	
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	
	ASGI5	<i>Astragalus gilviflorus</i>	plains milkvetch	
	ASLA27	<i>Astragalus laxmannii</i>	Laxmann's milkvetch	
	ASMI10	<i>Astragalus missouriensis</i>	Missouri milkvetch	
	ASTRA	<i>Astragalus</i> sp.	milkvetch	
	DACA7	<i>Dalea candida</i>	white prairie clover	
	DAPU5	<i>Dalea purpurea</i>	purple prairie clover	
	GLLE3	<i>Glycyrrhiza lepidota</i>	American licorice	
	HEBO	<i>Hedysarum boreale</i>	Utah sweetvetch	
	MELU	<i>Medicago lupulina</i>	black medick	*
	MEOF	<i>Melilotus officinalis</i>	yellow sweetclover	*
	MESA	<i>Medicago sativa</i>	alfalfa	*
	OXSE	<i>Oxytropis sericea</i>	white locoweed	
	OXYTR	<i>Oxytropis</i> sp.	locoweed	
	PEAR6	<i>Pedimelum argophyllum</i>	silverleaf Indian breadroot	
	PEES	<i>Pedimelum esculentum</i>	large Indian breadroot	
	PSLA3	<i>Psoralidium lanceolatum</i>	lemon scurfpea	
	PSTE5	<i>Psoralidium tenuiflorum</i>	slimflower scurfpea	
	THRH	<i>Thermopsis rhombifolia</i>	prairie thermopsis	
	VIAM	<i>Vicia americana</i>	American vetch	
Fagaceae	QUMA2	<i>Quercus macrocarpa</i>	bur oak	
Gentianaceae	GEAM3	<i>Gentianella amarella</i>	autumn dwarf gentian	
Grossulariaceae	RIAU	<i>Ribes aureum</i>	golden currant	
	RIOX	<i>Ribes oxycanthoides</i>	Canadian gooseberry	
Lamiaceae	AGFO	<i>Agastache foeniculum</i>	blue giant hyssop	

Family	Code	Scientific Name	Common Name	Exotic
	HEHI	<i>Hedeoma hispida</i>	rough false pennyroyal	
	MOFI	<i>Monarda fistulosa</i>	wild bergamot	
Liliaceae	ALTE	<i>Allium textile</i>	textile onion	
	CANU3	<i>Calochortus nuttallii</i>	sego lily	
	MAST4	<i>Maianthemum stellatum</i>	starry false lily of the valley	
Linaceae	LILE3	<i>Linum lewisii</i>	Lewis flax	
	LIRI	<i>Linum rigidum</i>	stiffstem flax	
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	scarlet globemallow	
Melanthiaceae	TOVE2	<i>Toxicoscordion venenosum</i>	meadow deathcamas	
Oleaceae	FRPE	<i>Fraxinus pennsylvanica</i>	green ash	
Onagraceae	OESU99	<i>Oenothera suffrutescens</i>	scarlet beeblossom	
	OEVI	<i>Oenothera villosa</i>	hairy evening-primrose	
Plantaginaceae	PLPA2	<i>Plantago patagonica</i>	woolly plantain	
Poaceae	AGCR	<i>Agropyron cristatum</i>	crested wheatgrass	*
	AGSC5	<i>Agrostis scabra</i>	rough bentgrass	
	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	*
	BRJA	<i>Bromus japonicus</i>	Japanese brome	*
	BRTE	<i>Bromus tectorum</i>	cheatgrass	*
	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed	
	DISP	<i>Distichlis spicata</i>	saltgrass	
	DIWI5	<i>Dichanthelium wilcoxianum</i>	fall rosette grass	
	ELCA4	<i>Elymus canadensis</i>	Canada wildrye	
	ELLA3	<i>Elymus lanceolatus</i>	thickspike wheatgrass	
	ELRE4	<i>Elymus repens</i>	quackgrass	*
	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	
	HECO26	<i>Hesperostipa comata</i>	needle and thread	
	HESP11	<i>Hesperostipa spartea</i>	porcupinegrass	
	HOJU	<i>Hordeum jubatum</i>	foxtail barley	
	KOMA	<i>Koeleria macrantha</i>	prairie Junegrass	
	MUCU3	<i>Muhlenbergia cuspidata</i>	plains muhly	
	MUPA99	<i>Muhlenbergia paniculata</i>	tumblegrass	
	MURA	<i>Muhlenbergia racemosa</i>	marsh muhly	
	NAVI4	<i>Nassella viridula</i>	green needlegrass	
	PASM	<i>Pascopyrum smithii</i>	western wheatgrass	
	PAVI2	<i>Panicum virgatum</i>	switchgrass	
	PIMI7	<i>Piptatherum micranthum</i>	littleseed ricegrass	
	POCO	<i>Poa compressa</i>	Canada bluegrass	*
	POPR	<i>Poa pratensis</i>	Kentucky bluegrass	*
	POSE	<i>Poa secunda</i>	Sandberg bluegrass	
	SCSC	<i>Schizachyrium scoparium</i>	little bluestem	
	SEVI4	<i>Setaria viridis</i>	green bristlegrass	*
	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed	
	SPPE	<i>Spartina pectinata</i>	prairie cordgrass	
	THIN6	<i>Thinopyrum intermedium</i>	intermediate wheatgrass	*

Family	Code	Scientific Name	Common Name	Exotic
	VUOC	<i>Vulpia octoflora</i>	sixweeks fescue	
Polemoniaceae	COLI2	<i>Collomia linearis</i>	tiny trumpet	
	PHHO	<i>Phlox hoodii</i>	spiny phlox	
Polygalaceae	POAL4	<i>Polygala alba</i>	white milkwort	
	POVE	<i>Polygala verticillata</i>	whorled milkwort	
Polygonaceae	ERPA9	<i>Eriogonum pauciflorum</i>	fewflower buckwheat	
	FACO	<i>Fallopia convolvulus</i>	black bindweed	*
	POER2	<i>Polygonum erectum</i>	erect knotweed	
	RUMEX	<i>Rumex</i> sp.	dock	*
Primulaceae	ANOC2	<i>Androsace occidentalis</i>	western rockjasmine	
	LYCI	<i>Lysimachia ciliata</i>	fringed loosestrife	
Ranunculaceae	ANCY	<i>Anemone cylindrica</i>	candle anemone	
	ANEMO	<i>Anemone</i> sp.	anemone	
	ANPA19	<i>Anemone patens</i>	eastern pasqueflower	
	AQCA	<i>Aquilegia canadensis</i>	red columbine	
Rosaceae	AMAL2	<i>Amelanchier alnifolia</i>	Saskatoon serviceberry	
	DAFR6	<i>Dasiphora fruticosa</i>	shrubby cinquefoil	
	DRAR8	<i>Drymocallis arguta</i>	tall cinquefoil	
	FRVE	<i>Fragaria vesca</i>	woodland strawberry	
	GETR	<i>Geum triflorum</i>	old man's whiskers	
	POPE8	<i>Potentilla pensylvanica</i>	Pennsylvania cinquefoil	
	PRPE2	<i>Prunus pensylvanica</i>	pin cherry	
	PRVI	<i>Prunus virginiana</i>	chokecherry	
	ROAR3	<i>Rosa arkansana</i>	prairie rose	
	ROSA5	<i>Rosa</i> sp.	rose, wildrose	
	ROWO	<i>Rosa woodsii</i>	Woods' rose	
Rubiaceae	GABO2	<i>Galium boreale</i>	northern bedstraw	
Salicaceae	PODE3	<i>Populus deltoides</i>	eastern cottonwood	
	POTR5	<i>Populus tremuloides</i>	quaking aspen	
	SAAM2	<i>Salix amygdaloides</i>	peachleaf 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	
	PEGR5	<i>Penstemon gracilis</i>	lilac penstemon	
Selaginellaceae	SEDE2	<i>Selaginella densa</i>	lesser spikemoss	
Smilacaceae	SMLA3	<i>Smilax lasioneura</i>	Blue Ridge carrionflower	
Solanaceae	PHVI5	<i>Physalis virginiana</i>	Virginia groundcherry	
Ulmaceae	ULAM	<i>Ulmus americana</i>	American elm	
Unknown family	UNKFORB	Unknown forb	unknown forb	*
	UNKFORBANN	Unknown annual forb	unknown annual forb	*
	UNKFORBPER	Unknown perennial forb	unknown perennial forb	*
	UNKGRAM	Unknown graminoid	unknown graminoid	*
Urticaceae	PAPE5	<i>Parietaria pensylvanica</i>	Pennsylvania pellitory	
Violaceae	VIAD	<i>Viola adunca</i>	hookedspur violet	
	VICA4	<i>Viola canadensis</i>	Canadian white violet	
Vitaceae	PAVI5	<i>Parthenocissus vitacea</i>	woodbine	

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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