



Plant Community Composition and Structure Monitoring for Theodore Roosevelt National Park

2012 Annual Report

Natural Resource Technical Report NPS/NGPN/NRTR—2013/686



ON THE COVER

Daina Jackson, a biological technician, surveying plants in long-term monitoring plot PCM_0014 in the south unit of Theodore Roosevelt National Park, 2012.

Photograph by: NGPN

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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. 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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Executive Summary

The Northern Great Plains Inventory & Monitoring Network surveyed 27 long-term monitoring plots in Theodore Roosevelt National Park (THRO) in 2012 as part of an effort to better understand the condition of plant communities in the park. We measured plant diversity, vegetative cover, and woody species density; looked for the presence of exotic species that are of concern to park management; and evaluated the amount of human and natural disturbance at all plots. This effort was the second year in a multiple-year venture to document the current status and long-term trends in plant communities in THRO. At the end of five years, there will be an in-depth report describing the status of the plant community. In this report, we provide a simple summary of our results from sampling in 2012.

From the 27 plots we visited in 2012, we found that Theodore Roosevelt National Park has a moderate diversity of native plants. The mixed-grass prairie has a higher diversity than riparian areas in the park. Average cover of exotic species was high with 18 of 27 sites above 10% exotic cover. Kentucky bluegrass was the most widespread and abundant exotic species in the plots we visited. Across all plots, leafy spurge was in low abundance, but some plots in the south unit have cover greater than 10%. To retain ecological integrity in THRO and the high diversity of native plants, 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 at THRO.

Acknowledgments

We thank all the authors of the NGPN Plant Community Monitoring Protocol, particularly Amy Symstad, for outstanding guidance on data collection and reporting. We greatly appreciate the staff at THRO for providing logistical support and safety checks, particularly Laurie Richardson. The 2012 NGPN vegetation field crew consisted of Isabel Ashton, Michael Prowatzke, Timothy Pine, Lauren Baur, Daina Jackson, Ryan Manuel, Anine Smith, and Gretchen Addington. We thank Stephen Wilson for invaluable support and instruction on managing data in the FFI database and for assistance with the GIS data.

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 discreet 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. in review). 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 2012, our second year of sampling vegetation. NGPN visited 17 plots in the south unit and 10 plots in the north unit (Figure 1). Since not all plots are visited every year, it will take 10 more years to visit every plot in the park. We expect to produce reports with more in-depth data analysis and interpretation when we complete 5 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.

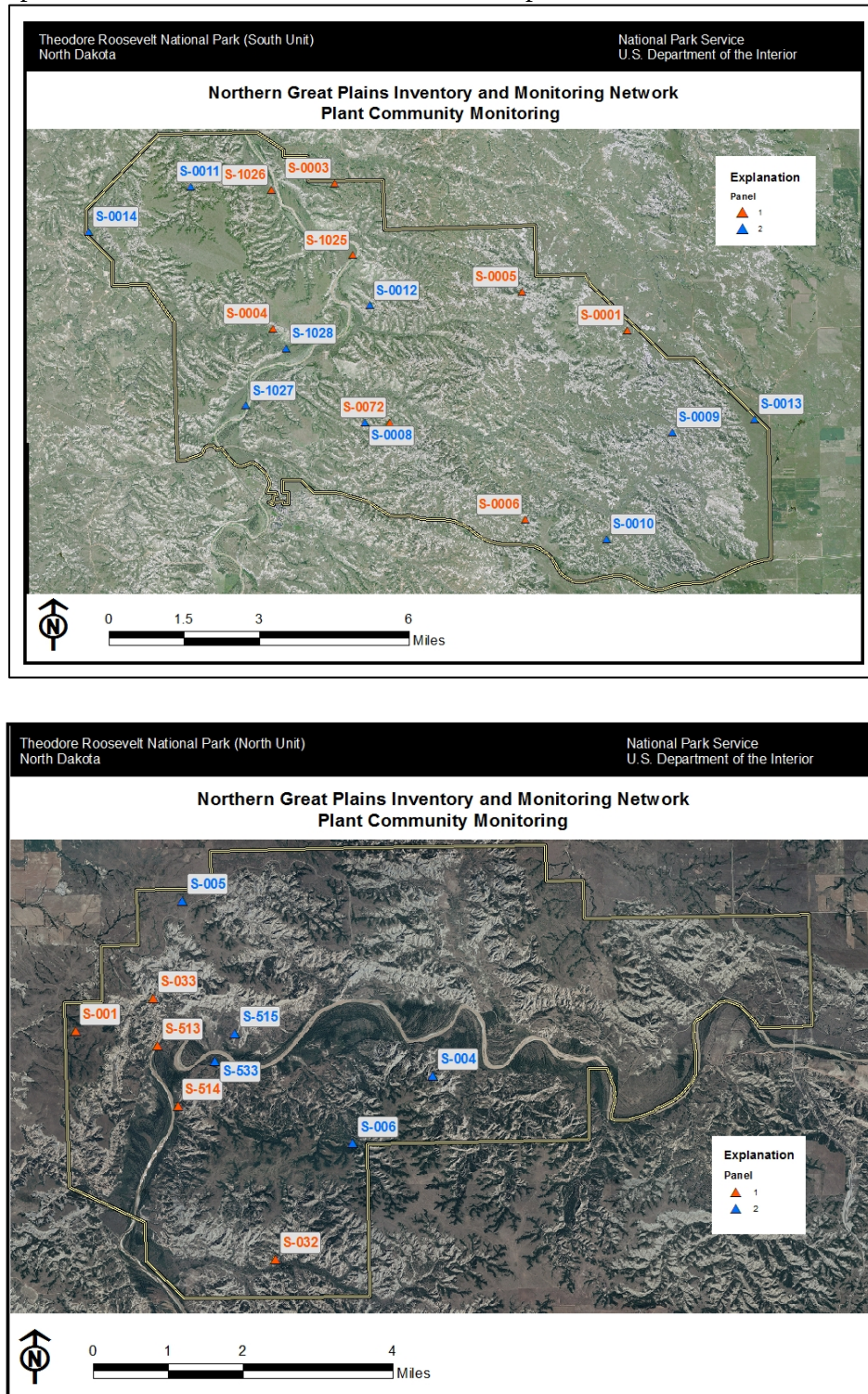


Figure 1. Map of the plant community monitoring plots surveyed in 2012 in the south (top) and north unit (bottom) of Theodore Roosevelt National Park.

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 Symstad et al. 2012, available at <http://science.nature.nps.gov/im/units/ngpn/monitor/plants.cfm>.

Sample design

NGPN 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 visit 2 panels (28 sites) every year. In 2012, we visited 27 of the 28 sites in panel 1 and panel 2 (Figure 1) during the last week of July and first two weeks of August.

When implemented successfully, probability-based survey designs allow for unbiased inference from sampled sites to un-sampled elements of the resource of interest (Hansen et al. 1983), and with repeat visits it allows for discerning trends in that resource (Larsen et al. 1995). In other words, after 5 years, we can use data from our randomly selected sites to estimate the ecological integrity of vegetation communities for the whole park.

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 5 sets of nested square quadrats (0.01 m², 0.1 m², 1 m², and 10 m²) located systematically along each transect (Figure 2). In 2012, sampling at THRO took two 4-person crews approximately 18 10-hour days with travel time (see Appendix A for a detail of activities each day).

Plant species were identified in the field to species level and not to lower taxonomic groupings (e.g., subspecies or variety). This was a change from the data collected in 2011 by NGPN where plants were identified to the lowest taxonomic level possible. The change was made in coordination with the FireEP because it better reflects the botanical skills of the crew and simplifies data management and analysis. When we were unable to identify a plant, the plant was assigned a unique identifier and collected or photographed. Most of these unknowns were subsequently identified in the office; however, in some cases identification was impossible. In these cases, the species was classified by growth form and, where possible, lifecycle (e.g., annual graminoid).

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 were mapped and tagged. For each tree, the species, DBH, status, and condition (e.g., leaf-discoloration, insect-damaged, etc.) were recorded. In 2015, a more comprehensive survey of riparian forests will be completed using these methods.

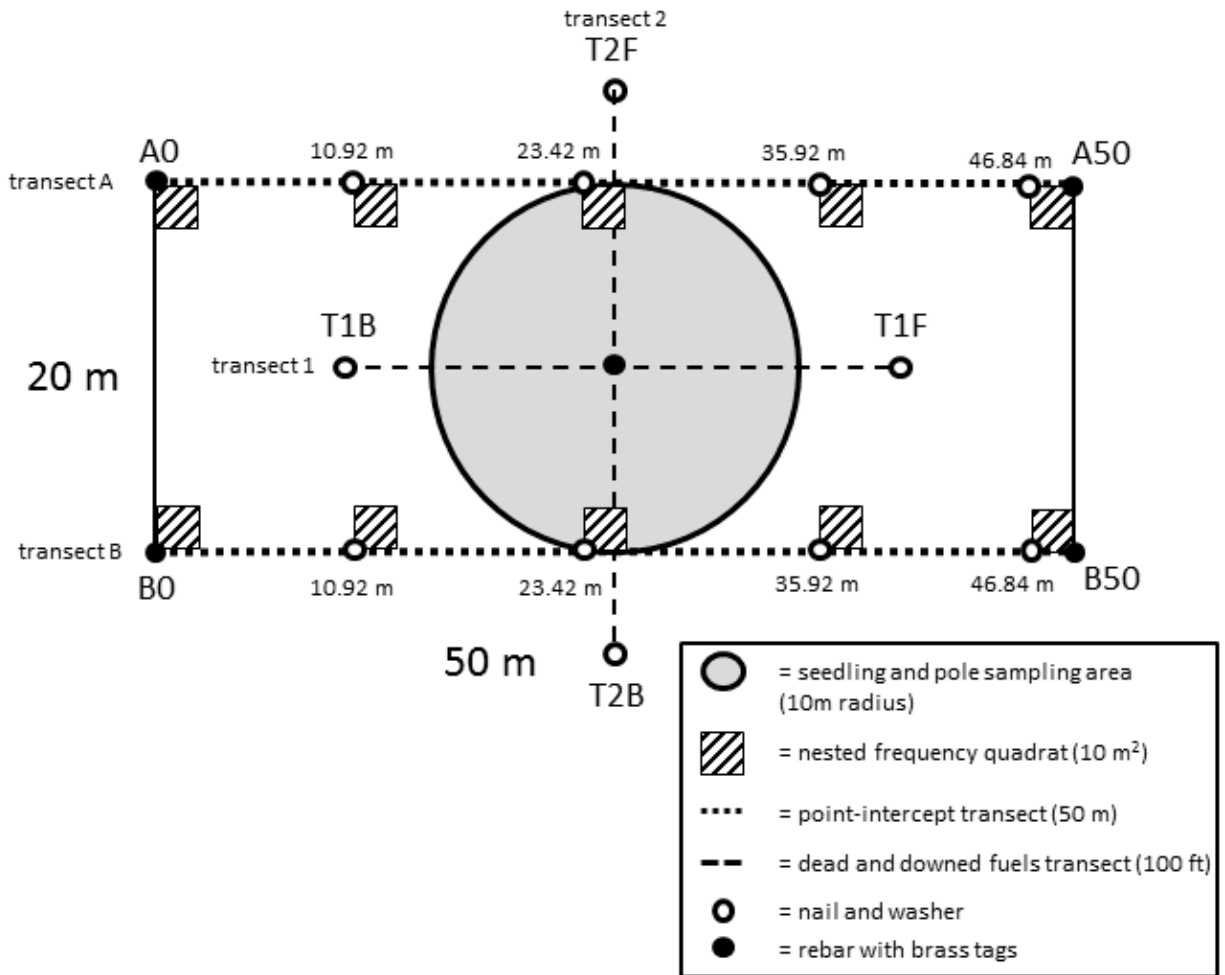


Figure 2. Long-term monitoring plot used for sampling vegetation in Theodore Roosevelt National Park.

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. The target species lists were developed in cooperation with the park and NGPN staff during the winter and spring prior to the field season. Usually, these are invasive and/or exotic species that are not currently widespread in the park but pose a significant threat if allowed to establish. 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, this method tracks the presence of plant species that are considered rare or vulnerable to loss in North Dakota, and may occur in THRO. The THRO target species list for 2012 can be found in Table 1.

Table 1. Exotic species of management concern at Theodore Roosevelt National Park and rare species that were surveyed for during the 2012 field season.

Exotic Species		Rare species	
Scientific Name	Common Name	Scientific Name	Common Name
<i>Artemisia absinthium</i>	absinth wormwood	<i>Carex gravida</i>	heavy sedge
<i>Arctium minus</i>	common burdock	<i>Chenopodium subglabrum</i>	smooth goosefoot
<i>Bromus tectorum</i>	cheatgrass	<i>Collinsia parviflora</i>	maiden blue-eyed Mary
<i>Bromus japonicus</i>	Japanese brome	<i>Dalea enneandra</i>	nineanther prairie clover
<i>Carduus acanthoides</i>	plumeless thistle	<i>Dalea villosa</i>	silky prairie clover
<i>Carduus nutans</i>	musk thistle	<i>Eriogonum cernuum</i>	nodding buckwheat
<i>Centaurea stoebe</i>	spotted knapweed	<i>Eriogonum visherii</i>	Visher's buckwheat
<i>Centaurea solstitialis</i>	yellow star thistle	<i>Euphorbia brachycera</i>	Horned spurge
<i>Cirsium arvense</i>	Canada thistle	<i>Fritillaria pudica</i>	yellow fritillary
<i>Cirsium vulgare</i>	bull thistle	<i>Leucocrinum montanum</i>	common starlily
<i>Convolvulus arvensis</i>	field bindweed	<i>Lobelia spicata</i>	palespike lobelia
<i>Cynoglossum officinale</i>	houndstongue	<i>Mentzelia nuda</i>	bractless blazing star
<i>Elaeagnus angustifolia</i>	Russian olive	<i>Oxytropis sericea</i>	white locoweed
<i>Euphorbia esula</i>	leafy spurge	<i>Phlox alyssifolia</i>	alyssumleaf phlox
<i>Halogeton glomeratus</i>	saltlover	<i>Physaria brassicoides</i>	double twinpod
<i>Hyoscyamus niger</i>	black henbane	<i>Populus x acuminata</i>	lanceleaf cottonwood
<i>Lepidium draba</i>	hoary cress	<i>Solidago ptarmicoides</i>	prairie goldenrod
<i>Linaria dalmatica</i>	Dalmatian toadflax	<i>Sporobolus airoides</i>	alkali sacaton
<i>Linaria vulgaris</i>	yellow toadflax	<i>Townsendia hookeri</i>	Hooker's Townsend daisy
<i>Lythrum salicaria</i>	purple loosestrife	<i>Viburnum lentago</i>	nannyberry
<i>Melilotus officinalis</i>	yellow sweetclover		
<i>Poa bulbosa</i>	bulbous bluegrass		
<i>Rhaponticum repens</i>	Russian knapweed		
<i>Tamarix spp.</i>	tamarisk		
<i>Tanacetum vulgare</i>	common tansy		
<i>Verbascum thapsus</i>	common mullein		

Data Management and Analysis

NGPN 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 datasheet 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). Summaries were produced using the FFI reporting and query tools, and statistical summaries and graphics were generated using R software (version 2.15.1).

We measured diversity at the plots in 3 ways: species richness, the Shannon Index, and Pielou's Index of Evenness. Species richness is simply a count of the species recorded in an area. The Shannon Index, H' , is a measure of the number of species in an area and how even abundances are across the community. It typically ranges between 0 (low richness and evenness) to 3.5 (high species richness and evenness). Pielou's Index of Evenness, J' , measures how even abundances are across taxa. It ranges between 0 and 1, where lower numbers indicate that a community is not even or that just a few species make up the majority of the total cover.

Reporting on Natural Resource Condition

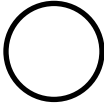
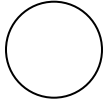
Results were summarized in a Natural Resource Condition Table based on the templates from the State of the Park report series (<http://www1.nrintra.nps.gov/im/stateoftheparks/index.cfm>).

The goal of the Natural Resource Condition Table is to improve park priority settings 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 or total fuel loads, it will be possible and straightforward to compare conditions in subsequent years. The status, trend, and confidence of assessments for each indicator is scored and assigned a corresponding symbol based on the key found in Table 2.

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, and relative cover of exotic species. 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, caution, or significant concern based on this comparison (Table 2). 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. Trend was scored in a similar fashion and categorized as improving, unchanging, deteriorating, or insufficient information.

Confidence in status and trend assessments within the Natural Resource Condition Table was scored as high, medium, or low. Confidence primarily reflects the quality of the data collected, rather than the quality of the reference condition. Confidence in the data summarizes three aspects of data quality: how well data represent the resource, quality of methods, and the length of the record.

Table 2. 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://www1.nrintra.nps.gov/im/stateoftheparks/index.cfm>).

Condition Status		Trend in Condition		Confidence in Assessment	
	Condition of resource warrants significant concern		Condition is Improving		High confidence in the assessment
	Condition of resource warrants moderate concern		Condition is Unchanging		Medium confidence in the assessment
	Resource is in good condition		Condition is Deteriorating		Low confidence in the assessment

Results and Discussion

After a fairly dry winter and summer there was less green vegetation than in previous years when the field crews visited the park in July and August, (Figure 3). Average absolute canopy cover was 122% (Table 3) in 2012 (it can be over 100% because we record multiple layers of vegetation). The productive summer in 2011 contributed to a large amount of standing litter on the ground (ground cover at sites averaged 78% plant litter). Despite the fairly dry conditions, NGPN found 228 plant species at THRO in 2012 (Appendix B). Graminoids, which includes grasses, sedges, and rushes, accounted for most of the vegetative cover at THRO, but forbs and shrubs were also abundant (Figure 4).



Figure 3. A vegetation transect at plot THRON_PCM_032 in Theodore Roosevelt National Park in 2011 (top panel) and 2012 (bottom panel). Both photographs were taken in late July and show the reduction in moisture available in 2012.

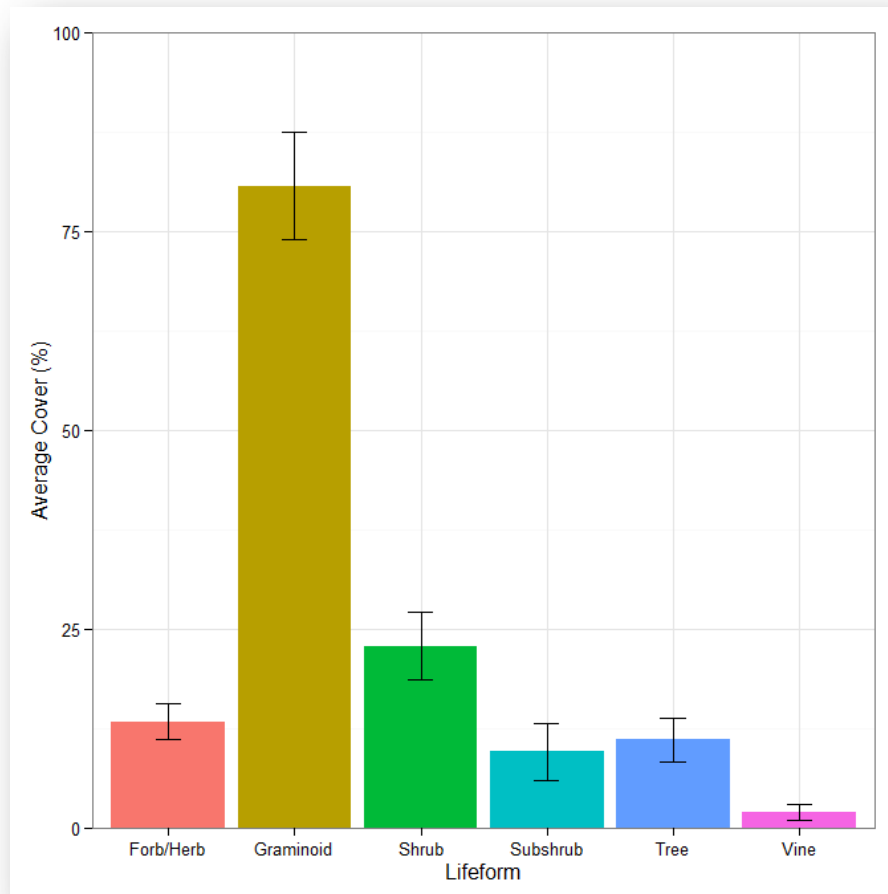
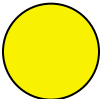
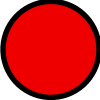


Figure 4. Average cover by life forms in 27 plant community monitoring plots in Theodore Roosevelt National Park in 2012. Bars represent means $\pm$ standard errors. Graminoids were the most abundant life-form across all the plots at Theodore Roosevelt National Park.

There was a great deal of variation in species composition across the 14 sites. Of the top ten most common species found from the point-intercept method (Figure 5), eight were graminoids, with the two other common species being shrubs: western snowberry (*Symphoricarpos occidentalis*) and silver sagebrush (*Artemisia cana*). We found only 1 rare plant in the 2012 field effort. White locoweed, (*Oxytropis sericea*) was found in THROS_PCM_003.

Species richness varies with respect to the scale on which it is examined. Table 4 presents average species richness, taken from the point-intercept method, 1 m² quadrats, and 10 m² quadrats for the monitoring plots in 2012. On average, there were about 13 native and 2 exotic species found in each 10 m² quadrat (Table 4). We tended to find a higher number of graminoid species along transects when compared to surveying the 10 m² plot (Table 4). From the point-intercept data, we found average plot diversity, H' , to be 2.2 ± 0.07 . Evenness, J' , averaged 0.79 ± 0.01 across the plots (Table 3). When including only native species, average diversity and evenness were 2.1 ± 0.10 and 0.78 ± 0.01 , respectively.

Table 3. Natural resource condition summary table for plant communities in Theodore Roosevelt National Park.

Indicator of Condition	Specific Measures	2012 Value (mean $\pm$ SE)	Reference Condition and Data Source	Condition Status/Trend	Rationale for Resource Condition
Upland Plant Community Structure and Composition	Absolute herb-layer canopy cover	122 $\pm$ 8.4 %	TBD		Theodore Roosevelt National Park has a moderate diversity of native plants. The upland mixed-grass prairie has a higher diversity than riparian areas. Overall, native diversity falls within the range of natural variability for northern mixed-grass prairie. This condition warrants moderate concern because over 1/3 of the upland plots had fewer native species per meter square than the reference condition. Larger sample sizes and longer time periods will increase our confidence in this assessment. Future monitoring will allow us to determine baseline or reference conditions and have more confidence in condition estimates for evenness and canopy cover.
	Native species richness (based on average of 10 1m ² quadrats per plot)	8 $\pm$ 0.7 species	8 -18 species ⁽¹⁾		
	Evenness (based on point-intercept of 2-50m transects per plot)	0.80 $\pm$ 0.02	TBD		
Exotic Plant Early Detection and Management	Relative cover of exotic species	23 $\pm$ 3.5 %	$\leq$ 10 % cover		Average cover of exotic species was high, and 18 of 27 sites were above 10% exotic cover. Kentucky bluegrass was the most widespread and abundant exotic species. Across all the sites visited in 2012, leafy spurge was in low abundance but some plots in the south unit have a high cover.
	Leafy spurge cover	2 $\pm$ 0.8 %	$\leq$ 10 % cover		

References and Data Sources: 1. Symstad, A. J. and J. L. Jonas. *in press*. Using natural range of variation to set decision thresholds: a case study for Great Plains grasslands. in G. R. Gutenspergen, editor. Application of threshold concepts in natural resource decision making. Springer Verlag

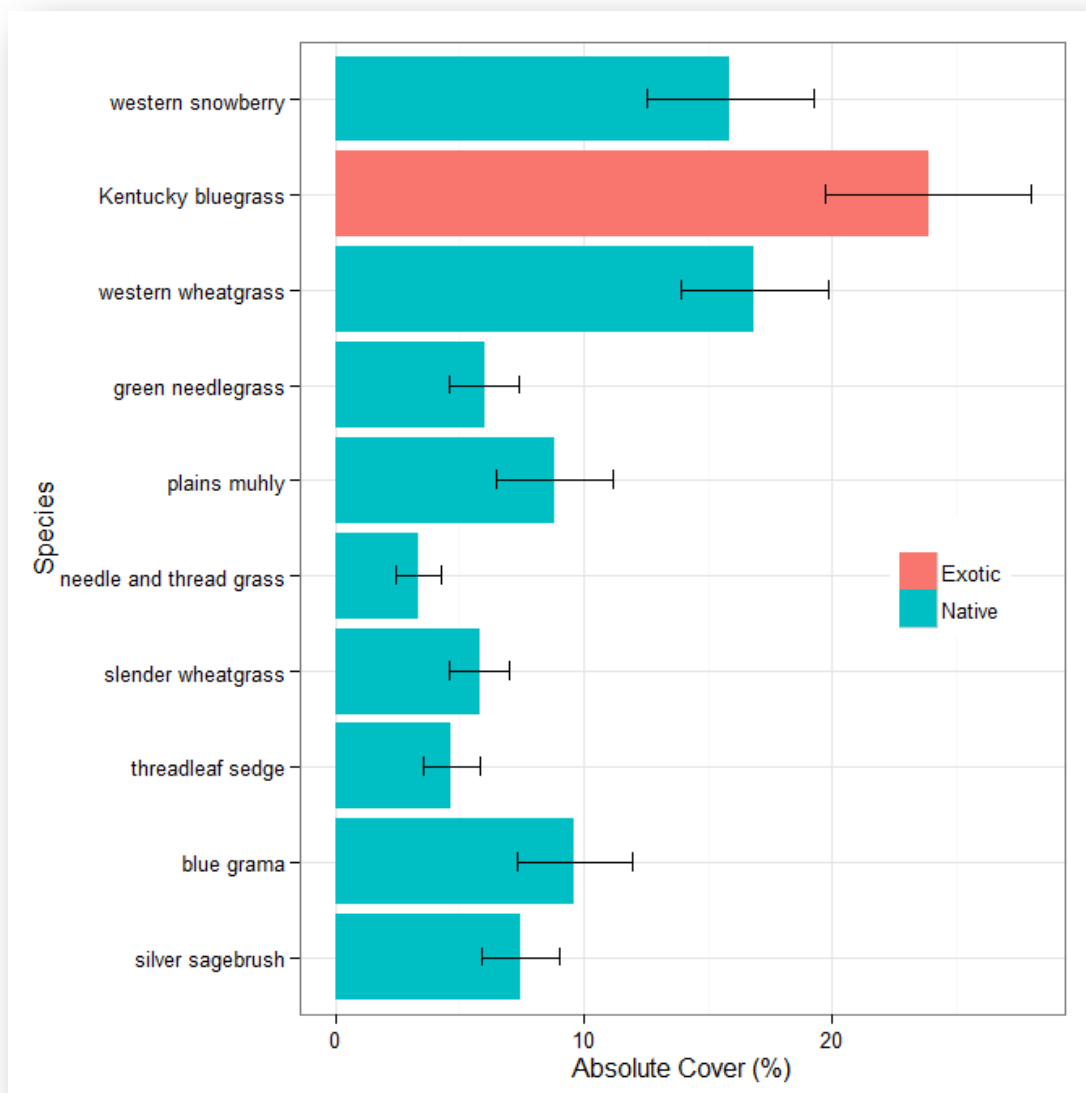


Figure 5. The average absolute cover of the 10 most common native (blue) and exotic (red) plants recorded at 27 sites at Theodore Roosevelt National Park in 2012. Bars represent means $\pm$ standard errors. Kentucky bluegrass was the only common exotic species.

Species richness in the mixed-grass prairie is determined by numerous factors including fire regime, large ungulate grazing, prairie dog disturbance, and weather fluctuations (Symstad and Jonas 2011). Species richness varied across sites and ranged from 15 species per m^2 in plot THROS_PCM_0003 to 3 species per m^2 in 6 plots (Table 5, Figure 6). In general, upland sites had higher native species richness than riparian sites (Table 5). While it is difficult to define a reference condition for species richness that can vary so much spatially and temporally, the natural range of variation over long time periods may be a good starting point (Symstad and Jonas *in press*). Long-term records of species diversity in mixed-grass prairie in a moderately grazed site in Montana ranged between 8 and 18 species per square meter (10-90th percentile range) between 1933-1945 (Symstad and Jonas *in press*). The species richness in the upland sites

fell within this range of natural variability (Table 3). At this point, we do not have a good reference condition for species richness in the riparian areas of THRO, but with continued monitoring we will be able to evaluate whether native species richness is increasing or decreasing.

Table 4. Average plant species richness of plant community monitoring plots at Theodore Roosevelt National Park in 2012. Values represent means $\pm$ standard errors, n=27.

	Point-intercept	1 m ² quadrats	10 m ² quadrats
Total species richness	18 $\pm$ 1.3	8 $\pm$ 0.6	15 $\pm$ 1.0
Native species richness	16 $\pm$ 1.4	7 $\pm$ 0.7	13 $\pm$ 1.1
Exotic species richness	2 $\pm$ 0.2	1 $\pm$ 0.9	2 $\pm$ 0.1
Graminoid species richness	9 $\pm$ 0.6	4 $\pm$ 0.2	6 $\pm$ 0.3
Forb species richness	5 $\pm$ 0.8	3 $\pm$ 0.4	7 $\pm$ 0.7

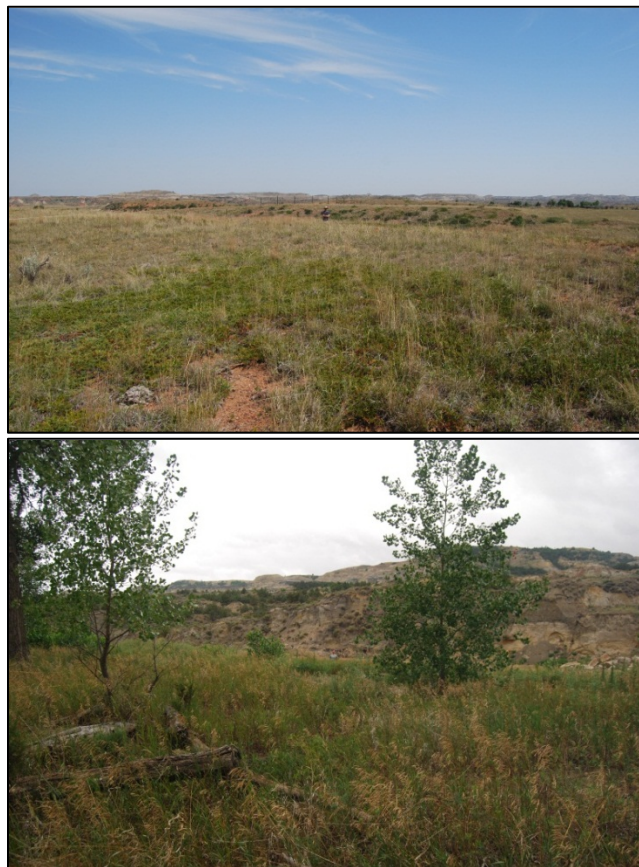


Figure 6. Two long-term monitoring plots in Theodore Roosevelt National Park that represent a gradient from high native species richness to low native species richness. Plot THROS_PCM_0003 (top) is a diverse native mixed-grass prairie, and plot THRON_PCM_513 (bottom) is a riparian site with a high cover of exotic species and low native richness.

Table 5. Characteristics of the plant community in 27 plots at Theodore Roosevelt National Park in 2012 including average native species richness, exotic plant cover, cover of leafy spurge and Kentucky bluegrass bromes, and area of disturbance.

Plot	Average native species richness 1 m ² plots	Exotic cover (%)	Leafy spurge cover (%)	Kentucky bluegrass cover (%)	Disturbance within site (m ²)
THRON_PCM_001	10	13	0	11	36
THRON_PCM_004	9	17	0	15	30
THRON_PCM_005	10	47	0	46	647
THRON_PCM_006	6	26	0	26	20
THRON_PCM_032	9	19	0	18	800
THRON_PCM_033	6	1	0	0	80
<i>Average North Unit Upland</i>	<i>8 ± 0.8 species</i>	<i>21 ± 6.3%</i>	<i>0%</i>	<i>19 ± 6.4%</i>	<i>269 ± 145 m²</i>
THROS_PCM_0001	9	40	0	40	1010
THROS_PCM_0003	15	2	0	2	0
THROS_PCM_0004	3	30	7	20	850
THROS_PCM_0005	6	8	0	8	1500
THROS_PCM_0006	9	12	0	12	55
THROS_PCM_0008	9	29	0	25	27
THROS_PCM_0009	7	10	0	6	1550
THROS_PCM_0010	6	19	0	19	50
THROS_PCM_0011	12	5	0	4	0
THROS_PCM_0012	11	6	0	6	12
THROS_PCM_0013	3	65	0	24	113
THROS_PCM_0014	13	5	0	5	250
THROS_PCM_0072	8	0	0	0	2
<i>Average South Unit Upland</i>	<i>9 ± 1.0 species</i>	<i>18 ± 5.2%</i>	<i><1%</i>	<i>13 ± 3.2%</i>	<i>417 ± 164 m²</i>
THRON_PCM_513	3	35	9	0	10
THRON_PCM_514	7	19	0	17	70
THRON_PCM_515	3	8	0	7	920
THRON_PCM_533	-	43	0	10	1155
<i>Average North Unit Riparian</i>	<i>4 ± 1.3 species</i>	<i>26 ± 7.9%</i>	<i>2 ± 2.3%</i>	<i>9 ± 3.5%</i>	<i>539 ± 292 m²</i>
THROS_PCM_1025	5	45	12	29	210
THROS_PCM_1026	3	34	0	16	760
THROS_PCM_1027	4	48	8	0	1010
THROS_PCM_1028	3	46	13	33	35
<i>Average South Unit Riparian</i>	<i>4 ± 0.5 species</i>	<i>43 ± 3.1%</i>	<i>8 ± 3.0%</i>	<i>20 ± 7.4%</i>	<i>504 ± 229 m²</i>

Overall, the average relative cover of exotic species at sites in THRO was high (23%; Table 3), and riparian sites tended to have higher exotic cover than upland sites (Table 5). Much of the exotic cover at sites in THRO was due to the presence of Kentucky bluegrass (Table 5). We found 6 targeted exotic species in the 27 plots surveyed (Table 6) with leafy spurge and Japanese brome being the most common. Leafy spurge is more abundant in the south unit, where it is found in both riparian and upland plots.

Table 6. Cover class of target species at 27 plots at THRO in 2012. 1 = one individual, 2 = few individuals, 3 = cover 1-5% of site, 4 = cover 5-25% of site, 5 = cover > 25% of site.

Plot	Leafy spurge	Japanese brome	Yellow sweetclover	Canada thistle	Field bindweed	Absinth wormwood
North Unit Upland						
THRON_PCM_001		present				
THRON_PCM_004				3		
THRON_PCM_005						
THRON_PCM_006		present				
THRON_PCM_032		present	present			
THRON_PCM_033				2		
South Unit Upland						
THROS_PCM_0001		2				
THROS_PCM_0003						
THROS_PCM_0004	3					
THROS_PCM_0005	2					
THROS_PCM_0006		2	2			
THROS_PCM_0008	2	2				
THROS_PCM_0009		present	present			
THROS_PCM_0010	2	2	present			
THROS_PCM_0011	2	1	2			
THROS_PCM_0012		2			2	
THROS_PCM_0013						
THROS_PCM_0014	2					
THROS_PCM_0072	2	present				
North Unit Riparian						
THRON_PCM_513	3					
THRON_PCM_514		1				
THRON_PCM_515		2	2	2		
THRON_PCM_533						
South Unit Riparian						
THROS_PCM_1025	4	present				
THROS_PCM_1026	2					
THROS_PCM_1027	3			2	2	1
THROS_PCM_1028	3			2		

Disturbance from grazing, rodents, 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 2012, the type of disturbance and the area affected varied across the plots (Table 5). The most common disturbances were grazing (16 plots), animal trails (15 plots), erosion (8 plots) and small mammal excavations (4 plots). In the future, when we have collected more data from the park, we will examine how disturbances affect species diversity and exotic cover. Understanding how human disturbances affect plant community composition and structure is particularly important to park management.

In 2012, we measured the density of tall shrubs and trees present in 27 plots in THRO. Rocky Mountain juniper (*Juniperus scopulorum*) was the most common woody species. The density of tree species that were encountered in more than 1 plot is given by size class in Table 7. While we did not measure any mature chokecherry, there was a high density of seedlings in some plots. A more complete survey of forest health will be completed in 2015 that will include 100 plots in the riparian forests.

Table 7. Tree and tall shrub density in THRO in 2012.

Size Class	Juniper (10 plots; stems hectare ⁻¹)	Green Ash (6 plots; stems hectare ⁻¹)	Cottonwood (4 plots; stems hectare ⁻¹)	Chokecherry (8 plots; stems hectare ⁻¹)	Buffaloberry (3 plots; stems hectare ⁻¹)	Snags (1 plot; stems hectare ⁻¹)
Seedlings	1,461	2,011	621	2,351	424	n/a
Saplings	143	159	541	111	0	n/a
Poles	435	117	303	0	32	42
Trees	89	50	120	0	0	10

Conclusions

In conclusion, Theodore Roosevelt National Park has a moderate diversity of native plants that appears to be within the range of natural variability northern mixed-grass prairie. The mixed-grass prairie sites had higher diversity than those in riparian areas. Average cover of exotic species was high with 18 of 27 sites were above 10% exotic cover. Kentucky bluegrass was the most widespread and abundant exotic species. For the sites surveyed, leafy spurge was in low abundance, but some plots in the south unit have cover >10%. 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 2012 season

Plant community composition monitoring in THRON was completed using a crew of 4 people working 6.25 10-hour days. We spent 275 total crew hours at THRON.

Date	Day of week	Approximate Travel Time (hrs)	Housing	Sites Completed	Notes
Jul 23, 2012	Monday	5	THRON campground	PCM-005	1 plot read 1 establishment
Jul 24, 2012	Tuesday	N/A	THRON campground	PCM-001 PCM-033	2 plots read
Jul 25, 2012	Wednesday	N/A	THRON campground	PCM-004	1 plot read
Jul 26, 2012	Thursday	N/A	THRON campground	PCM-005 PCM-032	2 plots read
Jul, 27, 2012	Friday	2	N/A	PCM-006	1 plot read
Aug 14, 2012	Tuesday	N/A	THRON campground	PCM-515 PCM-533	2 plots read
Aug 15, 2012	Wednesday	N/A	THRON campground	PCM-513 PCM-514	2 plots read 1 establishment

Plant community composition monitoring in THROS was completed using a crew of 4 people working 12.75 10-hour days. We spent 536 total crew hours at THROS.

Date	Day of week	Approximate Travel Time (hrs)	Housing	Sites Completed	Notes
Jul 27, 2012	Friday	2.5	Sully Creek Campground Medora, ND	PCM-0003	Travel from KNRI 1 plot read
Jul 28, 2012	Saturday	N/A	Sully Creek Campground Medora, ND	PCM-0001 PCM-0013	2 plots read
Jul 29, 2012	Sunday	N/A	Sully Creek Campground Medora, ND	PCM-0006 PCM-0008	2 plots read
Jul 30, 2012	Monday	5	N/A	PCM-0012	1 plot read
Aug 6, 2012	Monday	5	Sully Creek Campground Medora, ND	N/A	Travel day
Aug 7, 2012	Tuesday	N/A	Sully Creek Campground Medora, ND	PCM-0005 PCM-0009 PCM-0072 PCM-1027	4 plots read
Aug 8, 2012	Wednesday	N/A	Sully Creek Campground Medora, ND	PCM-0004 PCM-0011 PCM-1028	3 plots read 1 establishment
Aug 9, 2012	Thursday	5	N/A	PCM-0010 PCM-1025	2 plots read
Aug 13, 2012	Monday	5	Sully Creek Campground Medora, ND	PCM-1026	1 plot read
Aug 14, 2012	Tuesday	N/A	Sully Creek Campground Medora, ND	PCM-0014	1 plot read
Aug 15, 2012	Wednesday	5	N/A		Travel Day

Appendix B: List of plant species found in 2012 at THRO

Species found in monitoring plots at Theodore Roosevelt National Park in 2012. Species in bold are not on the park's certified species list.

Family	Species Code	Scientific Name	Common Name	Exotic
Agavaceae	YUGL	<i>Yucca glauca</i>	yucca	
Anacardiaceae	RHTR	<i>Rhus trilobata</i>	skunkbush sumac	
	TORY	<i>Toxicodendron rydbergii</i>	western poison ivy	
Apocynaceae	APCA	<i>Apocynum cannabinum</i>	common dogbane	
Asclepiadaceae	ASPU	<i>Asclepias pumila</i>	plains milkweed	
	ASSP	<i>Asclepias speciosa</i>	showy milkweed	
	ASVE	<i>Asclepias verticillata</i>	whorled milkweed	
	ASVI	<i>Asclepias viridiflora</i>	green comet milkweed	
Asteraceae	ACMI2	<i>Achillea millefolium</i>	common yarrow	
	AMAR2	<i>Ambrosia artemisiifolia</i>	annual ragweed	*
	AMPS	<i>Ambrosia psilostachya</i>	western ragweed	
	ANMI3	<i>Antennaria microphylla</i>	littleleaf pussytoes	
	ANPA9	<i>Antennaria parlinii</i>	Parlin's pussytoes	
	ANPA4	<i>Antennaria parvifolia</i>	small-leaf pussytoes	
	ARAB3	<i>Artemisia absinthium</i>	absinth wormwood	*
	ARCA12	<i>Artemisia campestris</i>	common sagewort	
	ARCA13	<i>Artemisia cana</i>	silver sagebrush	
	ARDR4	<i>Artemisia dracunculus</i>	tarragon	
	ARFR4	<i>Artemisia frigida</i>	fringed sagebrush	
	ARLU	<i>Artemisia ludoviciana</i>	white sagebrush	
	ARTR2	<i>Artemisia tridentata</i>	big sagebrush	
	BREU	<i>Brickellia eupatorioides</i>	false boneset	
	CIAR4	<i>Cirsium arvense</i>	Canada thistle	*
	CIUN	<i>Cirsium undulatum</i>	wavyleaf thistle	
	COCA5	<i>Conyza canadensis</i>	horseweed	
	DICA18	<i>Dieteria canescens</i>	hoary tansyaster	
	ECAN2	<i>Echinacea angustifolia</i>	blacksamson echinacea	
	ERNA10	<i>Ericameria nauseosa</i>	rubber rabbitbrush	
	ERCA4	<i>Erigeron canus</i>	hoary fleabane	
	ERST3	<i>Erigeron strigosus</i>	rough fleabane	
	GRSQ	<i>Grindelia squarrosa</i>	curlycup gumweed	
	GUSA2	<i>Gutierrezia sarothrae</i>	broom snakeweed	
	HEMA2	<i>Helianthus maximiliani</i>	Maximillian sunflower	
	HEPA19	<i>Helianthus pauciflorus</i>	stiff sunflower	
	HEVI4	<i>Heterotheca villosa</i>	hairy goldenaster	
	HYFI	<i>Hymenopappus filifolius</i>	cutleaf	
	LASE	<i>Lactuca serriola</i>	prickly lettuce	*
	LIPU	<i>Liatris punctata</i>	dotted blazing star	
	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>	prairie coneflower	
Asteraceae	SOGI	<i>Solidago gigantea</i>	giant goldenrod	

Family	Species Code	Scientific Name	Common Name	Exotic
	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	
	SOSP2	<i>Solidago speciosa</i>	showy goldenrod	
	SYER	<i>Symphyotrichum ericoides</i>	white heath aster	
	SYLA3	<i>Symphyotrichum laeve</i>	smooth blue aster	
	SYOB	<i>Symphyotrichum oblongifolium</i>	aromatic aster	
	TAOF	<i>Taraxacum officinale</i>	dandelion	*
	TEAC	<i>Tetraneuris acaulis</i>	stemless four-nerve daisy	
	TRDU	<i>Tragopogon dubius</i>	common salsify, goatsbeard	*
	XASP99	<i>Xanthisma spinulosum</i>	lacy tansyaster	
	XAST	<i>Xanthium strumarium</i>	cocklebur	
Betulaceae	OSVI	<i>Ostrya virginiana</i>	eastern hophornbeam	
Boraginaceae	CRCE	<i>Cryptantha celosioides</i>	buttecandle	
	HADE	<i>Hackelia deflexa</i>	nodding stickseed	
	LIIN2	<i>Lithospermum incisum</i>	fringed puccoon	
	ONBE	<i>Onosmodium bejariense</i>	soft-hair marbleseed	
Brassicaceae	BODI4	<i>Boechera divaricarpa</i>	spreadingpod rockcress	
	DESO2	<i>Descurainia sophia</i>	tansymustard	*
	ERAS2	<i>Erysimum asperum</i>	western wallflower	
	ERIN7	<i>Erysimum inconspicuum</i>	smallflower wallflower	
	LEDE	<i>Lepidium densiflorum</i>	common pepperweed	
	PHBR5	<i>Physaria brassicoides</i>	double twinpod	
	PHLU99	<i>Physaria ludoviciana</i>	silver bladderpod	
	SIAL2	<i>Sisymbrium altissimum</i>	tumbleweed mustard	*
Cactaceae	ESCOB	<i>Escobaria</i>	foxtail cactus	
	ESVI2	<i>Escobaria vivipara</i>	spinystar	
	OPFR	<i>Opuntia fragilis</i>	brittle pricklypear	
	OPPO	<i>Opuntia polyacantha</i>	plains pricklypear	
Campanulaceae	CARO2	<i>Campanula rotundifolia</i>	bluebell	
Caprifoliaceae	SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry	
Caryophyllaceae	CEAR4	<i>Cerastium arvense</i>	field chickweed	
Celastraceae	CESC	<i>Celastrus scandens</i>	American bittersweet	
Chenopodiaceae	ATCA2	<i>Atriplex canescens</i>	fourwing saltbush	
	ATCO	<i>Atriplex confertifolia</i>	spiny saltbush	
	CHENO	<i>Chenopodium</i>	goosefoot	*
	CHBE4	<i>Chenopodium berlandieri</i>	pitseed goosefoot	
	CHPR5	<i>Chenopodium pratericola</i>	desert goosefoot	
	KRLA2	<i>Krascheninnikovia lanata</i>	winterfat	
	KOSC	<i>Kochia scoparia</i>	common kochia	*
	SATR12	<i>Salsola tragus</i>	prickly Russian thistle	*
	SAVE4	<i>Sarcobatus vermiculatus</i>	greasewood	
Commelinaceae	TRBR	<i>Tradescantia bracteata</i>	bracted spiderwort	
Convolvulaceae	COAR4	<i>Convolvulus arvensis</i>	field bindweed	*
Cupressaceae	JUCO6	<i>Juniperus communis</i>	common juniper	

Family	Species Code	Scientific Name	Common Name	Exotic
	JUHO2	<i>Juniperus horizontalis</i>	creeping juniper	
	JUSC2	<i>Juniperus scopulorum</i>	Rocky Mountain juniper	
Cyperaceae	CAREX	<i>Carex</i>	sedge	
	CABR10	<i>Carex brevior</i>	shortbeak sedge	
	CADU6	<i>Carex duriuscula</i>	needleleaf sedge	
	CAEB2	<i>Carex eburnea</i>	bristleleaf sedge	
	CAFI	<i>Carex filifolia</i>	threadleaf sedge	
	CAIN9	<i>Carex inops</i>	long-stolon sedge	
	CASP7	<i>Carex sprengelii</i>	Sprengel's sedge	
Dryopteridaceae	CYFR2	<i>Cystopteris fragilis</i>	fragile fern	
Elaeagnaceae	SHAR	<i>Shepherdia argentea</i>	silver buffaloberry	
Equisetaceae	EQAR	<i>Equisetum arvense</i>	western 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	
Fabaceae	ASTRA	<i>Astragalus</i>	milkvetch	
	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>	Laxmanns milkvetch	
	ASMI10	<i>Astragalus missouriensis</i>	Missouri milkvetch	
	DACA7	<i>Dalea candida</i>	white prairie clover	
	DAPU5	<i>Dalea purpurea</i>	violet prairie clover	
	GLLE3	<i>Glycyrrhiza lepidota</i>	licorice	
	HEBO	<i>Hedysarum boreale</i>	sweetvetch	
	LAOC2	<i>Lathyrus ochroleucus</i>	cream pea	
	MELU	<i>Medicago lupulina</i>	black medic	*
	MEOF	<i>Melilotus officinalis</i>	yellow sweetclover	*
	OXLA3	<i>Oxytropis lambertii</i>	purple locoweed	
	OXSE	<i>Oxytropis sericea</i>	white locoweed	
	PEAR6	<i>Pedimelum argophyllum</i>	silverleaf scurfpea	
	PEES	<i>Pedimelum esculentum</i>	breadroot scurfpea	
	THRH	<i>Thermopsis rhombifolia</i>	goldenpea	
	VIAM	<i>Vicia americana</i>	American vetch	
Gentianaceae	GEAM3	<i>Gentianella amarella</i>	annual gentian	
Grossulariaceae	RIAU	<i>Ribes aureum</i>	golden currant	
	RIOX	<i>Ribes oxycanthoides</i>	Canadian gooseberry	
Iridaceae	SIMO2	<i>Sisyrinchium montanum</i>	mountain blue-eyed grass	
Lamiaceae	HEDR	<i>Hedeoma drummondii</i>	Drummond's false pennyroyal	
	HEHI	<i>Hedeoma hispida</i>	false pennyroyal	
	MOFI	<i>Monarda fistulosa</i>	wild bergamot	
Liliaceae	ALTE	<i>Allium textile</i>	prairie onion	
	MAST4	<i>Maianthemum stellatum</i>	false Solomon's seal	
Linaceae	LILE3	<i>Linum lewisii</i>	blue flax	
	LIRI	<i>Linum rigidum</i>	orange flax	
Loasaceae	MEDE2	<i>Mentzelia decapetala</i>	tenpetal blazingstar	
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	scarlet globemallow	

Family	Species Code	Scientific Name	Common Name	Exotic
Nyctaginaceae	MILI3	<i>Mirabilis linearis</i>	narrowleaf four-o'clock	
Oleaceae	FRPE	<i>Fraxinus pennsylvanica</i>	green ash	
Onagraceae	OEBI	<i>Oenothera biennis</i>	common evening primrose	
	OECE2	<i>Oenothera cespitosa</i>	tufted evening primrose	
	OENU	<i>Oenothera nuttallii</i>	Nuttall's evening primrose	
	OESE3	<i>Oenothera serrulata</i>	yellow sundrops	
	OESU99	<i>Oenothera suffrutescens</i>	scarlet beeblossom	
Poaceae	ACHY	<i>Achnatherum hymenoides</i>	Indian ricegrass	
	AGCR	<i>Agropyron cristatum</i>	crested wheatgrass	*
	AGSC5	<i>Agrostis scabra</i>	tickleggrass	
	ANGE	<i>Andropogon gerardii</i>	big bluestem	
	ARPU9	<i>Aristida purpurea</i>	purple threeawn	
	BOCU	<i>Bouteloua curtipendula</i>	sideoats grama	
	BOGR2	<i>Bouteloua gracilis</i>	blue grama	
	BOHI2	<i>Bouteloua hirsuta</i>	hairy grama	
	BRIN2	<i>Bromus inermis</i>	smooth brome	*
	BRJA	<i>Bromus japonicus</i>	Japanese brome	*
	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed	
	CELO3	<i>Cenchrus longispinus</i>	longspine sandbur	
	DASP2	<i>Danthonia spicata</i>	poverty oatgrass	
	DIOL	<i>Dichanthelium oligosanthos</i>	Heller's rosette grass	
	DIWI5	<i>Dichanthelium wilcoxianum</i>	fall panicum	
	DISP	<i>Distichlis spicata</i>	saltgrass	
	ELCA4	<i>Elymus canadensis</i>	Canada wildrye	
	ELEL5	<i>Elymus elymoides</i>	squirreltail	
	ELRE4	<i>Elymus repens</i>	quackgrass	*
	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	
	HECO26	<i>Hesperostipa comata</i>	needle and thread	
	KOMA	<i>Koeleria macrantha</i>	junegrass	
	MUCU3	<i>Muhlenbergia cuspidata</i>	plains muhly	
	MUPA99	<i>Muhlenbergia paniculata</i>	tumblegrass	
	MURA	<i>Muhlenbergia racemosa</i>	green muhly	
	NAVI4	<i>Nassella viridula</i>	green needlegrass	
	PACA6	<i>Panicum capillare</i>	annual witchgrass	
	PASM	<i>Pascopyrum smithii</i>	western wheatgrass	
	PIMI7	<i>Piptatherum micranthum</i>	littleseed ricegrass	
	POCO	<i>Poa compressa</i>	Canada bluegrass	*
	POIN	<i>Poa interior</i>	inland bluegrass	
	POPR	<i>Poa pratensis</i>	Kentucky bluegrass	*
	POSE	<i>Poa secunda</i>	Sandberg bluegrass	
	PSSP6	<i>Pseudoroegneria spicata</i>	bluebunch wheatgrass	
	PUNU2	<i>Puccinellia nuttalliana</i>	Nuttall's alkaligrass	
	SCSC	<i>Schizachyrium scoparium</i>	little bluestem	
	SEVI4	<i>Setaria viridis</i>	green bristlegrass	*
	SPPE	<i>Spartina pectinata</i>	prairie cordgrass	
	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed	
	SPHE	<i>Sporobolus heterolepis</i>	prairie dropseed	
Polemoniaceae	PHAN4	<i>Phlox andicola</i>	prairie phlox	

Family	Species Code	Scientific Name	Common Name	Exotic
	PHHO	<i>Phlox hoodii</i>	Hood's phlox, spiny phlox	
Polygalaceae	POAL4	<i>Polygala alba</i>	white milkwort	
	POVE	<i>Polygala verticillata</i>	whorled milkwort	
Polygonaceae	ERFL4	<i>Eriogonum flavum</i>	yellow wild buckwheat	
	ERPA9	<i>Eriogonum pauciflorum</i>	fewflower buckwheat	
	RUCR	<i>Rumex crispus</i>	curly dock	*
Primulaceae	LYCI	<i>Lysimachia ciliata</i>	fringed loosestrife	
Ranunculaceae	ANEMO	<i>Anemone</i>	anemone	
	ANCA8	<i>Anemone canadensis</i>	Canada anemone	
	ANCY	<i>Anemone cylindrica</i>	candle anemone	
	ANPA19	<i>Anemone patens</i>	eastern pasqueflower	
	CLLI2	<i>Clematis ligusticifolia</i>	western white clematis	
	DEBI	<i>Delphinium bicolor</i>	little larkspur	
	THDA	<i>Thalictrum dasycarpum</i>	purple meadowrue	
	THVE	<i>Thalictrum venulosum</i>	veiny meadowrue	
Rosaceae	AMAL2	<i>Amelanchier alnifolia</i>	western serviceberry	
	DAFR3	<i>Dasiphora fruticosa</i>	shrubby cinquefoil	
	DRAR8	<i>Drymocallis arguta</i>	tall cinquefoil	
	FRVI	<i>Fragaria virginiana</i>	wild strawberry	
	GETR	<i>Geum triflorum</i>	prairie smoke	
	POPE8	<i>Potentilla pensylvanica</i>	prairie cinquefoil	
	PRAM	<i>Prunus americana</i>	American plum	
	PRVI	<i>Prunus virginiana</i>	chokecherry	
	ROAR3	<i>Rosa arkansana</i>	prairie wildrose	
	ROWO	<i>Rosa woodsii</i>	Woods' rose	
Rubiaceae	GABO2	<i>Galium boreale</i>	northern bedstraw	
Salicaceae	PODE3	<i>Populus deltoides</i>	plains cottonwood	
	SAEX	<i>Salix exigua</i>	sandbar willow	
	SALU2	<i>Salix lutea</i>	yellow 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 owlclover	
	PEAL2	<i>Penstemon albidus</i>	white penstemon	
	SYWY99	<i>Synthyris wyomingensis</i>	Wyoming kittentails	
Selaginellaceae	SEDE2	<i>Selaginella densa</i>	dense clubmoss	
Smilacaceae	SMHE	<i>Smilax herbacea</i>	herbaceous greenbriar	
Smilacaceae	SMLA3	<i>Smilax lasioneura</i>	Blue Ridge carrionflower	
Solanaceae	PHHE5	<i>Physalis heterophylla</i>	clammy groundcherry	
	PHVI5	<i>Physalis virginiana</i>	Virginia groundcherry	
Typhaceae	TYLA	<i>Typha latifolia</i>	broadleaf cattail	
Ulmaceae	ULAM	<i>Ulmus americana</i>	American elm	
Unknown family	UNKFORB	<i>Unknown forb</i>	unknown forb	*
	UNKGRAM	<i>Unknown graminoid</i>	unknown graminoid	*
Urticaceae	PAPE5	<i>Parietaria pensylvanica</i>	Pennsylvania pellitory	
Verbenaceae	PHCU3	<i>Phyla cuneifolia</i>	wedgeleaf	
	VEST	<i>Verbena stricta</i>	hoary verbena	
Violaceae	VIOLA	<i>Viola</i>	violet	
Violaceae	VICA4	<i>Viola canadensis</i>	Canada violet	

Family	Species Code	Scientific Name	Common Name	Exotic
Vitaceae	PAQU2	<i>Parthenocissus quinquefolia</i>	Virginia creeper	
	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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