



Theodore Roosevelt National Park Plant Community Composition and Structure Monitoring

2011 Annual Report

Natural Resource Technical Report NPS/NGPN/NRTR—2012/545



ON THE COVER

A view of a Theodore Roosevelt National Park, 2011

Photograph by: Daina Jackson, NGPN, NPS

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Isabel W. Ashton
Michael Prowatzke
Michael R. Bynum
Tim Shepherd
Stephen K. Wilson
Kara Paintner-Green

National Park Service
Northern Great Plains Inventory & Monitoring Network
231 East Saint Joseph St.
Rapid City, SD 57701

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All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

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Executive Summary

The Northern Great Plains Inventory & Monitoring Network (NGPN) was established to develop and provide scientifically credible information on the current status and long-term trends of the composition, structure, and function of ecosystems in thirteen parks located in 5 northern Great Plains states. NGPN identified upland plant communities, exotic plant early detection, and riparian lowland communities as vital signs that can be used to better understand the condition of terrestrial park ecosystems. Upland and riparian ecosystems are important targets for vegetation monitoring because the status and trends in plant communities provide critical insights into the status and trends of other biotic components within those ecosystems.

In 2011, NGPN began plant community monitoring in Theodore Roosevelt National Park (THRO). We sampled herbaceous vegetation at 21 long-term monitoring plots in August, and recorded a total of 250 vascular plant species. We visited an additional 21 plots to establish them for future monitoring efforts. This effort was the first year in a multiple-year venture to understand the status of upland and riparian plant communities in THRO. At the end of 5 years, there will be an in-depth report describing the status of the plant communities in the North (THRON) and South (THROS) Units of the park. In this report, we provide a simple summary of our results from sampling in 2011. We found the following:

- Absolute vascular plant cover was high due to a wet spring and grasses and sedges made up the bulk of vascular plant cover at all sites.
- The upland sites at THRO had a large diversity of vascular plants. Average native species richness in the 10 m² quadrats was 20 species in THROS and 15 species in THRON. Riparian areas were typically less diverse than the upland areas.
- Rocky Mountain juniper was the most common component of the forested plots in THRO. We found a high abundance of chokecherry seedlings in some plots.
- We identified 2 rare plants in our plots in 2011, white locoweed was found at 2 sites in THROS and smooth goosefoot was found at 1 site in THRON.
- The riparian areas of THROS had double the cover of exotic species (35 % cover) compared to THRON and the upland areas of THROS. Leafy spurge, the most ubiquitous exotic target species, was found at 15 of the 43 sites visited in 2011.

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 thank the Northern Great Plains Fire Ecology team for ongoing assistance with fieldwork and development of methods. We greatly appreciate the staff at THRO, particularly Laurie Richardson, for providing logistical support. The 2011 NGPN vegetation field crew of Isabel Ashton, Kara Paintner-Green, Michael Bynum, Michael Prowatzke, Timothy Pine, Lauren Baur, Belinda Lo, Ryan Manuel, Lee Margadant, and Daina Jackson collected and entered the data included in this report. We thank Timothy Shepherd for invaluable support and instruction on managing data in the FFI database and Stephen Wilson for assistance with the GIS data. We thank Laurie Richardson for providing comments on an earlier draft of this report.

Introduction

One of the objectives of the National Park Service (NPS) Inventory & Monitoring (I&M) Program is to develop and provide scientifically credible information on the current status and long-term trends of the composition, structure, and function of park ecosystems, and to determine how well current management practices are sustaining those ecosystems. The Northern Great Plains I&M Network (NGPN) includes 13 parks located in 5 northern Great Plains states across 6 ecoregions (Figure 1) and vary widely in size, amount of visitor use, and management context.

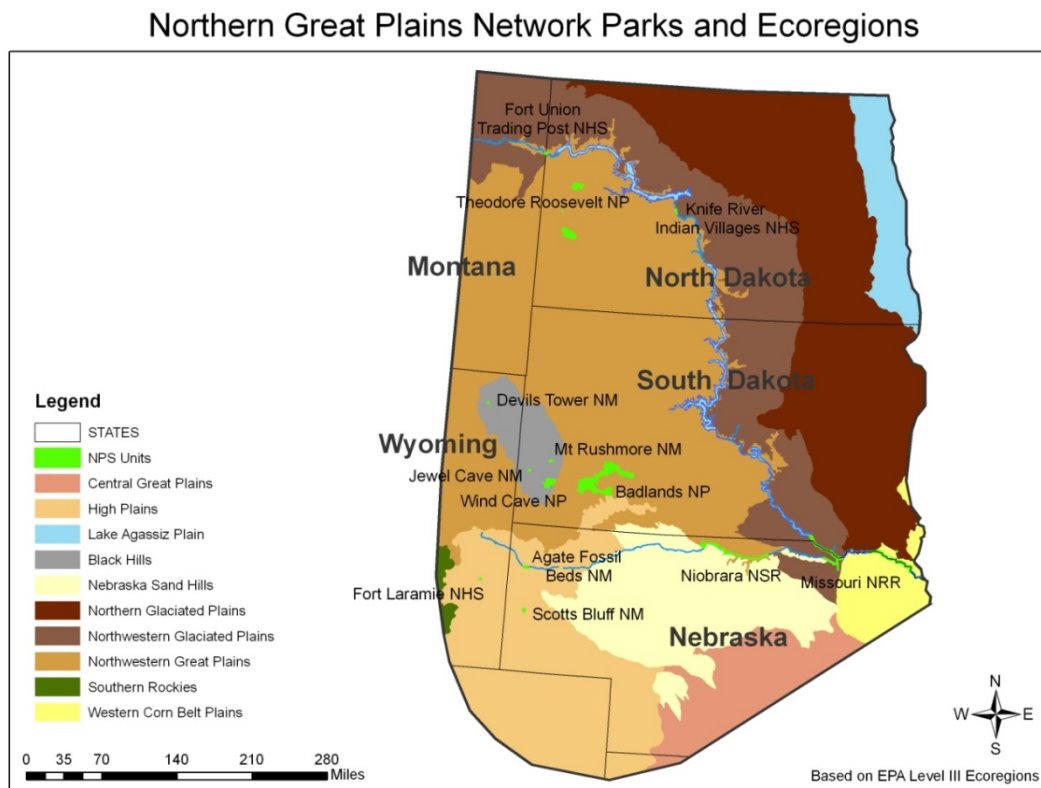


Figure 1. Parks and ecoregions of the Northern Great Plains Network. Based on the U.S. Environmental Protection Agency's Level III ecoregions classes (Omernik 2007).

NGPN identified upland plant communities, exotic plant early detection, and riparian lowland communities as vital signs that can be used to better understand the condition of terrestrial park ecosystems (Gitzen et al. 2010). Network-wide land cover is dominated by native upland grassland, but some small parks are dominated by old fields and recent prairie plantings (Symstad et al. 2011). Other major land cover types include barren or sparsely vegetated areas (Badlands and Theodore Roosevelt national parks) and ponderosa pine forests and woodlands in Black Hills parks. Riparian hardwood forests comprise a small portion of the area but have disproportionately large ecological significance because of their value to wildlife species.

The NGPN selected upland and riparian ecosystems as an important vegetation monitoring target because knowing the status and trends in plant communities of any terrestrial ecosystem is critical to understanding the status and trends in most other biotic components of that ecosystem. Not only are plants the ultimate source of food for all other organisms, but they also provide other organisms cover from predators and the elements, structure for basic life-history processes (e.g., nest sites), and substrate on which to grow. Plant communities influence local, regional, and global climate through evapotranspiration, albedo, and greenhouse gas emissions and absorption (Smith et al. 1997). Fire regimes (D'Antonio and Vitousek 1992) and flood behavior (Anderson et al. 2006) are in part mediated by the species that comprise plant communities and the structure that they create. Plants are the major source of organic inputs into soil and aquatic systems. Finally, vegetation is a large part of the scenery that visitors to NPS units come to enjoy.

The long-term objectives of our plant community monitoring effort (Symstad et al. 2011) in THRO are to:

1. Determine park-wide status and long-term trends in vegetation species composition (e.g., non-native vs. native, forb vs. graminoid vs. shrub) and structure (e.g., cover, height) of herbaceous and shrub species.
2. Determine (at 5-year intervals) and long-term trends of tree density by species, height class, and diameter class in riparian areas.
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 for our initial sampling efforts in 2011 at THRO. We sampled 7 plots in the north unit of THRO and 14 plots in THROS, sampled trees in an additional plot in THRON, and visited an additional 21 plots to establish them for future monitoring. It will take 9 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 2015, we will conduct a large effort to examine forest structure and health in the riparian forests on THRO. Reports, spatial data, and data summaries can also be provided as needed for park management and interpretation.

Methods

The NGPN Plant Community Composition and Structure Monitoring Protocol (Symstad et al. 2011) describes in detail the methods used for sampling upland and riparian vegetation in 11 parks of the network. Below, we briefly describe the general approach, sample frame, plot locations, and sampling methods. For those interested in more detail, please see Symstad et al. 2011, available at <http://science.nature.nps.gov/im/units/ngpn/monitor/plants/plants.cfm>.

Sample design

NGPN has implemented a survey to monitor vegetation in THRO using a Generalized Random Tessellation Stratified (GRTS) sampling design (Stevens and Olsen 2003, 2004). Probability-based surveys provide unbiased estimation of both status and, with repeated visits, trend across a resource (Larsen et al. 1995). 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). The goal of our probability-based design is to determine the *status* of vegetation after 5 years and from then on, the *trend* in vegetation.

The methods for the development of the survey design and site selection are described in detail in Symstad et al. 2011. In brief, a probability-based survey design consists of implementing the following steps prior to field sampling: defining a resource or target population and any subpopulations of interest, creating a sample frame within the target population, selecting sites to visit within the sample frame, and determining when to sample. For THRO, we define the target population as upland and riparian vegetation and the North (THRON) and South Units (THROS) are treated as separate sample frames. The management importance of riparian areas in THRO is disproportionate to area. To allocate a greater number of plots in riparian areas, we stratified the design to treat upland and riparian sites separately in each unit. For all parks, we exclude the following areas from the sample frame: administrative areas, roads, canals, or utility lines and an appropriate buffer, areas within 10 m of a park boundary, paved trails, areas with little to no potential for terrestrial vegetation (e.g. large areas of bare rock), areas that are dangerous or prohibitively difficult to access or work on, and areas that are not owned by the park. In THRO, we also excluded the Elkhorn Ranch Unit. The final design includes 30 upland and 20 riparian sites randomly located in THRON and 70 upland sites and 20 riparian sites in THROS representing the park where vegetation will be sampled close to peak phenology (late July-early August) (Figures 2 and 3).

An ideal revisit design would consist of a large number of sites distributed throughout a park being sampled every year. Limited resources, as well as the danger of plot wear-out (trampling and other effects of sampling), precluded this design. Instead, NGPN intensive plant community composition and structure monitoring uses a connected [2-x] rotating-panel design: every park is visited every year, but sites are grouped into panels where each panel (and the plots therein) is measured for 2 consecutive years followed by three or more years without sampling. Because only a subset of panels (and therefore plots) are visited each year, this allows more sites than can be visited in 1 year to be included in the sample design, while including revisitation of sites to address annual variability. Compared to the always-revisit design, connected panel designs, in which each panel is revisited periodically, sacrifice little power for detecting trend (Urquhart and Kincaid 1999) but provide much greater spatial coverage, and thus improved precision in estimates of status. At THRO, we visit 2 panels, each with 9 sites (THROS; 7 upland and 2

riparian) or 5 sites (THRON; 3 upland and 2 riparian) every year. We use a roll-out design that allows half the plots to be revisited twice in the first 5 years and all plots to be visited at least once in 10 years (Figure 4). In 2011, we visited sites in panel 1 and panel 5 (Figures 2 and 3).

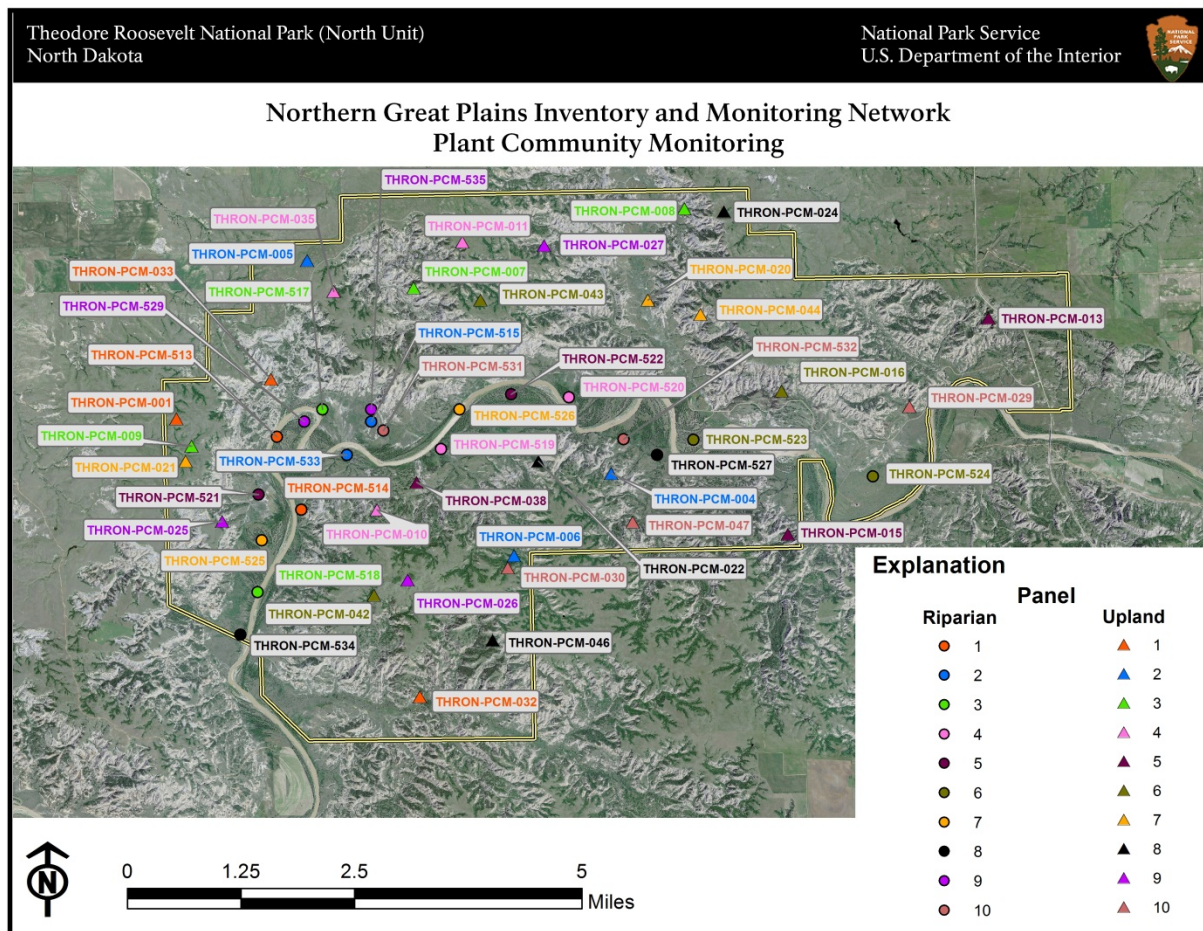


Figure 2. Map of THRON North Unit and plant community monitoring plots. Plots in Panel 1 (orange) and Panel 5 (purple) were visited in 2011.



Northern Great Plains Inventory and Monitoring Network Plant Community Monitoring

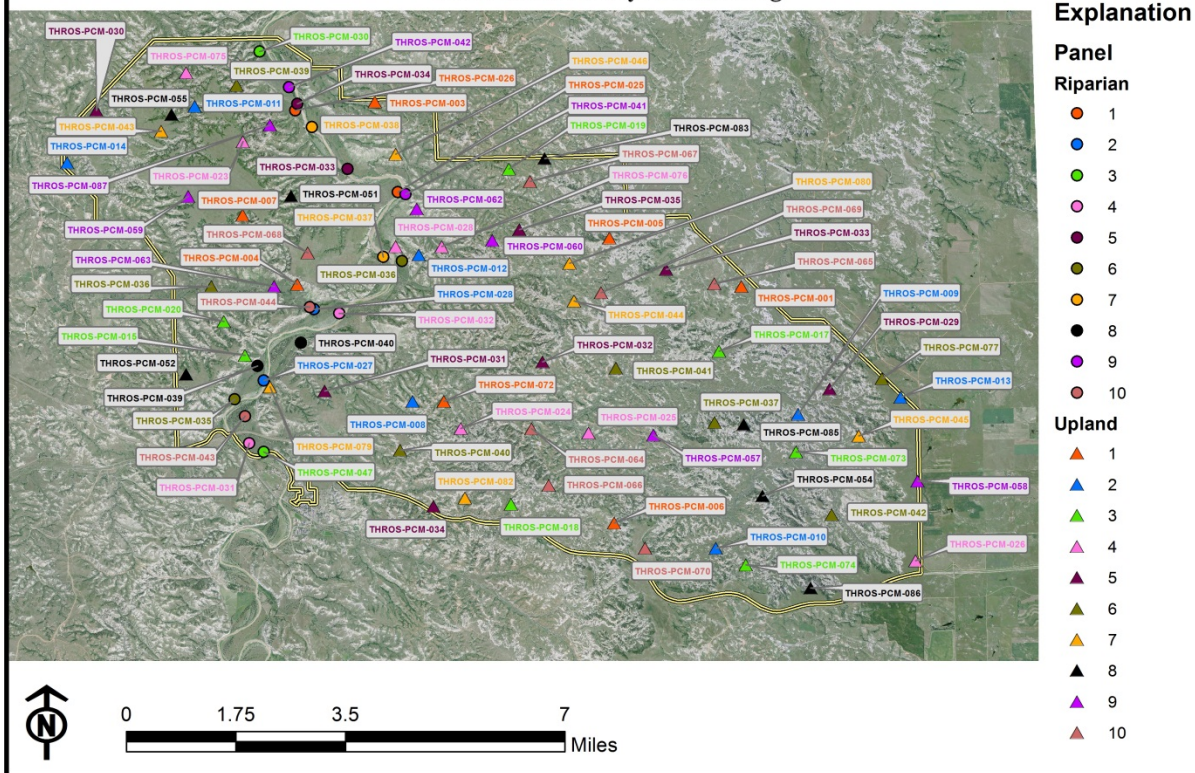


Figure 3. Map of THRO South Unit and plant community monitoring plots. Plots in Panel 1 (orange) and Panel 5 (purple) were visited in 2011.

Year↓ / Panel→	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
2011	A				A					
2012	A	A								
2013		A	A							
2014			A	A						
2015				A	A					
2016	A/2				A	B/2				
2017	A/2	A/2				B/2	B/2			
2018		A/2	A/2				B/2	B/2		
2019			A/2	A/2				B/2	B/2	
2020				A/2	A/2				B/2	B/2
2021	A				A/2					B/2
2022	A	A								
2023		A	A							
2024			A	A						
2025				A	A					
2026					A	B				
2027						B	B			
2028							B	B		
2029								B	B	
2030									B	B
2031	A									B

Figure 4. [2-8] revisit design with [2-3] rollout for intensive plant community composition and structure monitoring at THRO. Ten panels are used in a park or stratum, and these panels are split into 2 groups (A and B). In the first 5 years of monitoring, data are collected in all plots of the panels in group A. The sixth year of monitoring (2016) begins a transition period, when half the plots in 2 group A panels are revisited, and half of the plots in 2 group B panels are visited for the first time (B). The tenth year of monitoring (2021) is the end of the transition period, when supplemental revisits in group A are completed. After this, all plots are visited on a [2-8] schedule. “A” or “B” = number of plots in a panel. For example, at THROS, A = B = 9 (7 upland and 2 riparian). Thus, 18 plots are sampled each year and the total sample size is 90.

The number of plots allocated to each park and to strata within parks is influenced by a combination of factors, including field work logistics, statistical power estimations (see Symstad et al. 2011), and conformity to the desired revisit design. Plot numbers across parks are allocated roughly proportional to the size of the sample frame for that park, although the minimum number of plots per park was set at 15. There are currently 90 monitoring plots at THROS and 50 plots at THRON. An additional 50 forested riparian plots will be monitored in each unit on a separate 5 year schedule starting in 2015.

Plot layout and sampling

The primary sample unit for intensive plant community composition and structure monitoring in the NGPN consists of a rectangular, 50 m x 20 m (0.1 ha), permanent plot (Figure 5). In 2011, sampling at THRON took a 4-5 person crew approximately 80 hours, with travel time, and 120

hours at THROS (see Appendix A for a detail of activities each day). We were scheduled to sample vegetation at 28 plots, but we were able to sample herbaceous vegetation at only 21 plots due to lack of time and flooding in some riparian plots. We were able to sample forest structure in 1 of the plots where herbaceous sampling was missed. We visited an additional 21 plots in the fall to establish them for future monitoring. Below, we briefly describe the methods we used for marking and sampling the plots.

Establishing, Marking, and Photographing Long-term Monitoring Plots

Locations of all plots are determined before monitoring begins in the site evaluation process. At this time, a single plot marker, marked with a metal tag identifying the plot and the marker as the center (C), is driven into the ground at the center of the plot (Figure 6). At plot establishment (which may be done prior to the first visit for data collection), 2 permanent transects are marked by driving rebar markers into the ground at the end points of each transect. A brass tag imprinted with the park code, plot ID, corner name (A0, A50, B0, or B50), and establishment date is attached to each marker, along with an aluminum tag bearing a research number (i.e., NPS 1104) assigned by the park. Each transect is also marked with large nails and washers sunk flush with the ground at 10.92 m, 23.42 m, 35.92 m, and 46.84 m from the 0 end of each transect. Figure 7 is a photographic sample of the tags and washers used by NGPN.

At each transect end, a photograph is taken down the length of the transect. When trees and/or tall shrub species are present in or near the plot, the ends of 2 additional perpendicular, 100-ft (30.48 m) transects centered at the C plot marker are marked with large nails and washers (Figure 5). One of these transects (T1) is parallel to the herb-layer transects and the second (T2) is perpendicular to that transect.

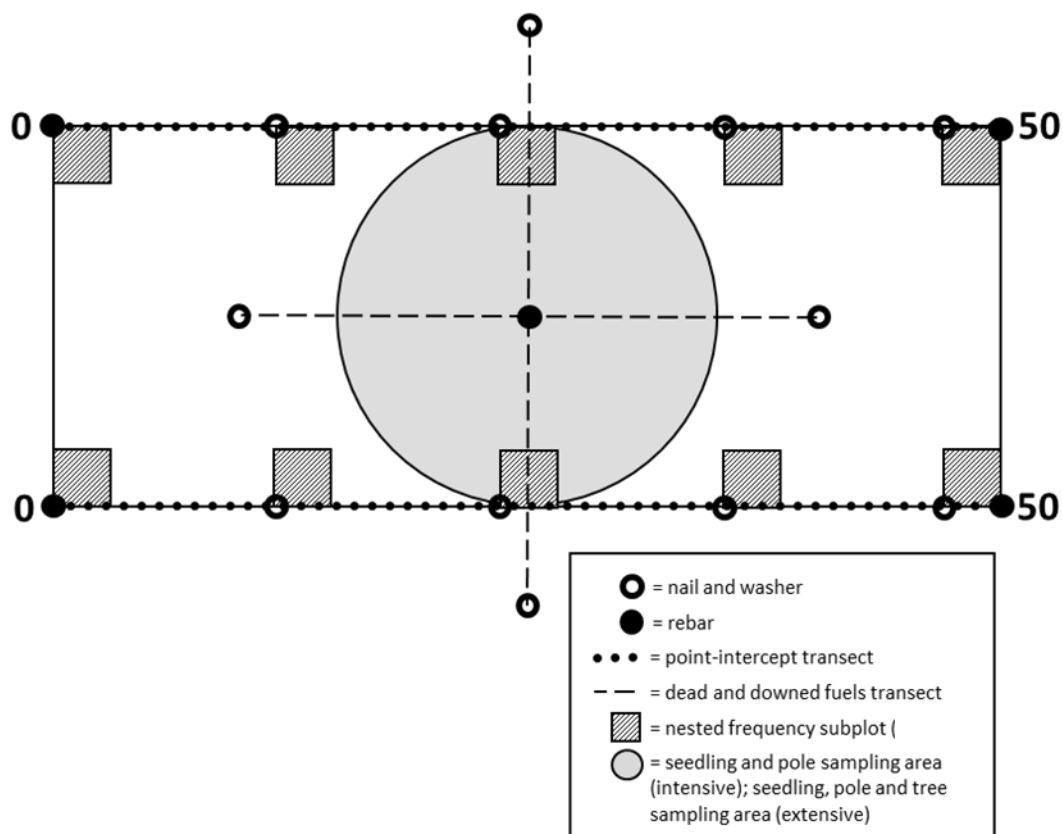


Figure 5. Layout for NGPN intensive plant community composition and structure plots.



Figure 6. A sample of the center marker at an NGPN long-term vegetation monitoring plot. The rebar is bent in the field with a brass tag noting the plot number, date of installation, and location. A compass is used for scale.



Figure 7. A sample of tags and washers used to mark long-term vegetation monitoring plots in the NGPN. From the top left and working clockwise: a center tag from PCM-08 in SCBL evaluated on May 5, 2009; a tag used to mark the end of the A transect at WICA PCM-01; a tag used to mark the center of an extensive plot in MORU; and a washer used to mark the beginning of the second tree transect. In all cases, the tags are close or flush to the ground. The brass tags are fixed to rebar with wire, and the washer is held in place by a large nail.

Plant Sampling

Data on ground cover and herb-layer (≤ 2 m height) height and foliar cover were collected on 2 50 m transects (the long sides of the plot) using a point-intercept method at each plot. Starting at the 0 end of each transect, a 50 m tape was stretched over the length of the transect, ensuring that it followed the path marked by the nails and washers (Figure 5). At 100 locations along the transects (every 0.5 m) a pole was dropped to the ground and all species that touched the pole were recorded, along with ground cover, and the height of the canopy (Figure 8).

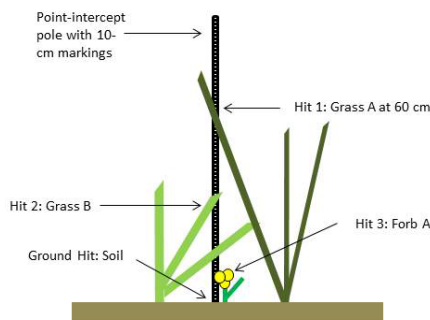


Figure 8. The NGPN point-intercept method captures multiple layers of the plant canopy.

Species richness data from this point-intercept method are supplemented with species presence data collected in 5 sets of nested square quadrats (0.01 m^2 , 0.1 m^2 , 1 m^2 , and 10 m^2 ; Figure 9) located systematically along each transect. Nested quadrats are located so that they occur inside the $20 \text{ m} \times 50 \text{ m}$ plot (Figure 5). Beginning with the 0.01 m^2 quadrat, all species rooted in the quadrat are identified and recorded. Once all species in this quadrat are recorded, the observer moves onto the 0.1 m^2 quadrat, listing only species not observed in the 0.01 m^2 quadrat. This is repeated in the 1.0 m^2 and 10 m^2 quadrats. Only species rooted in a quadrat are included in the species list for that quadrat.

Unknown species were recorded in the field using a unique identifier and collected or photographed. Most of these unknowns were subsequently identified by M. Bynum. However, in some cases the plant was too small or difficult to identify. In these cases, the species was classified by growth form and, where possible, lifecycle (e.g., annual graminoid).

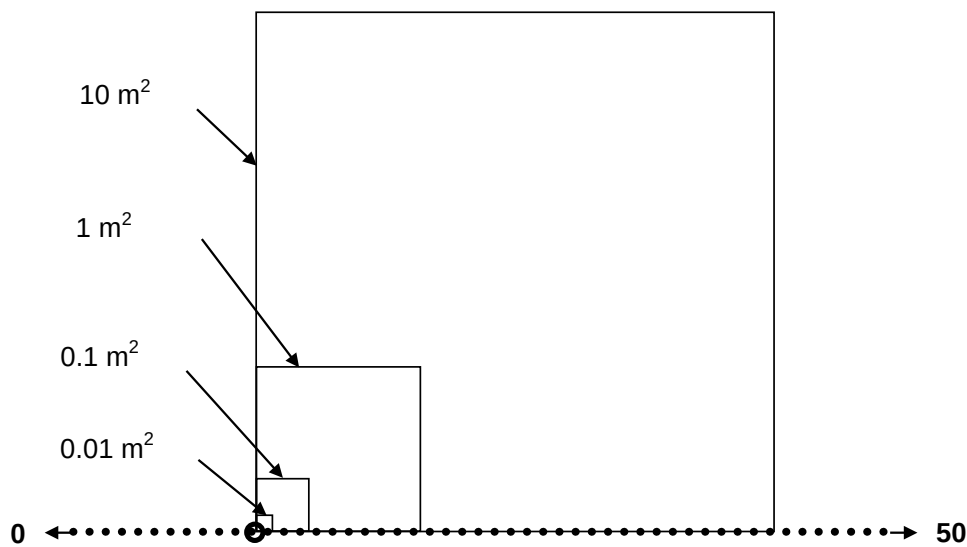


Figure 9. Arrangement of nested quadrats along tape used for point-intercept sampling. Open circle indicates permanent marker (nail and washer or, at 0 end of transect, rebar).

Where applicable, tree regeneration and tall shrub density data are collected within a 10 m-radius, circular subplot centered at the center of the $50 \text{ m} \times 20 \text{ m}$ plot. In this subplot or a subset thereof, tree and targeted tall shrub seedlings are tallied by species and size class. Size classes are defined as follows. A tree has a diameter at breast height (DBH) of greater than 15 cm. A pole has a DBH of $> 2.54 \text{ cm}$ but $< 15 \text{ cm}$. A sapling has a DBH $< 2.54 \text{ cm}$ but is $>$ than 1.37 cm tall. A seedling is $< 1.37 \text{ cm}$ tall. DBH, status (live or dead), and species are recorded for all poles and trees and targeted tall shrubs. Trees with DBH $> 15 \text{ cm}$, within the entire 0.1 ha plot, are mapped and tagged, and species, DBH, status, and condition (e.g., leaf-discoloration, insect-damaged, etc.) are recorded for each tree.

At all plots, we also surveyed the area for common disturbances and target species of interest. 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/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 1-5% of site, 4 = cover 5-25% of site, and 5 = cover > 25% of site. 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 of concern to the park. The THRO target species list for 2011 can be found in Table 1.

Table 1. Target species of concern at THRO for the 2011 field season.

Invasives/noxious weeds/exotics		
Species Code	Scientific Name	Common Name
ACRE3	<i>Acroptilon repens</i>	Russian knapweed/hardheads
ARAB3	<i>Artemisia absinthium</i>	Absinth wormwood
BRTE	<i>Bromus tectorum</i>	Cheatgrass
CADR	<i>Cardaria draba</i>	whitetop/hoary cress
CANU4	<i>Carduus nutans</i>	Nodding plumeless (musk) thistle
CESTM	<i>Centaurea biebersteinii</i>	spotted knapweed
CIAR4	<i>Cirsium arvense</i>	Canada thistle
COAR4	<i>Convolvulus arvensis</i>	Field bindweed
CYOF	<i>Cynoglossum officinale</i>	Hounds tongue/gypsyflower
EUES	<i>Euphorbia esula</i>	Leafy spurge
HYNI	<i>Hyoscyamus niger</i>	Black henbane
TARA	<i>Tamarix ramossima</i>	saltcedar
VETH	<i>Verbascum thapsus</i>	common mullein
At risk/rare		
Species Code	Scientific Name	Common Name
CHSU2	<i>Chenopodium subglabrum</i>	smooth goosefoot
DAEN	<i>Dalea enneandra</i>	nineanther (dalea) prairie clover
EUBR	<i>Euphorbia brachycera</i>	horned (Rocky Mountain) spurge
OXSE	<i>Oxytropis sericea</i>	white locoweed
POAC5	<i>Populus x acuminata</i>	lanceleaf cottonwood
SPAI	<i>Sporobolus airoides</i>	alkali sacaton

Data Management and Analysis

After the field work was completed, field sheets were scanned and stored in fire-proof cabinets, and the data were entered by the NGPN seasonal vegetation crew. FFI (FEAT/FIREMON Integrated; <http://frames.gov/ffi/>) is the primary software environment used for managing NGPN plant community data. NGPN uses its components for data entry, data storage, and basic summary reports. 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 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, the data were verified. This was done by comparing the entered data to the original field data sheets, and detected errors were corrected immediately. To minimize transcription errors, 100% of records were verified to their original source. A further 10% of records were reviewed a second time by I. Ashton or M. Prowatzke. When errors were found in the reviews, the entire data set was verified again. After all data were entered and verified, automated queries were developed to check for errors in the data. For instance, a query was developed that noted all plots where a species appeared twice within 1 nested quadrat. When errors were caught by the crew or the automated queries, changes were made to the original datasheets and the FFI database.

For analysis of data from intensive plots, the plot is used as the unit of replication and quadrats or transects are pooled or averaged. Data from each plot are summarized for a variety of variables including: relative cover of growth forms (shrubs, grasses, forbs), absolute cover of bare soil, total herb-layer foliar cover, density and basal area of trees, species richness and diversity, relative abundance of functional groups, and proportions of foliar cover and species richness that are non-native. Growth forms were based on definitions from the USDA Plants Database. Warm-season grasses were identified primarily using a guide by Skinner (2010). Summaries were done using FFI reports and statistical summaries were done using R software (version 2.11.0).

Results

In the 21 plots where we sampled herbaceous vegetation in THRO during 2011, we recorded 250 vascular plant species (Appendix B). We found an additional 8 plants that could be identified only to genera. The most common families were Asteraceae and Poaceae. Riparian and upland areas in THROS were separated in the results presented below. Since we sampled only 1 riparian area in THRON, all results for THRON include 6 upland plots and the 1 riparian plot.

Absolute percent and relative cover

From the point-intercept data, we found that total herb layer cover was upland and riparian areas in THRON and the riparian areas of THROS ($209 \pm 56.7\%$ and $206 \pm 61.6\%$, respectively; mean $\pm$ standard deviation), but lower in the upland areas of THROS ($190 \pm 48.1\%$). The absolute canopy cover can be greater than 100% because we record multiple layers of plants and it was a fairly wet year with abundant growth. Bareground cover was about the same across all units and averaged 28%.

Graminoids, which includes grasses, sedges, and rushes, had an average cover of $113 \pm 57.3\%$ in THRON. The cover of graminoids was higher in the riparian ($141 \pm 61.6\%$) and upland areas ($137 \pm 43.9\%$) of THROS. Graminoids were more abundant than other plant life-forms (Figure 10), but shrubs and forbs were also abundant, particularly in THRON. The most common species in the park was western wheatgrass (*Pascopyrum smithii*). It occurred in all but 1 plot in THRON and 1 plot in THROS with an absolute cover that averaged around 30%. Blue grama (*Bouteloua gracilis*), silver sagebrush (*Artemisia cana*) and western snowberry (*Symphoricarpos occidentalis*) were also common across most of the plots.

The riparian areas of THROS had double the average relative percent cover of exotic species; $35 \pm 9.2\%$ compared to $17 \pm 12.4\%$ in THRON and $16 \pm 15.7\%$ in upland areas. The average relative percent cover of warm season graminoids was similar in THRON ($14 \pm 12.2\%$) and riparian areas of THROS ($17 \pm 22.7\%$). The upland areas of THROS had a much higher cover of warm season graminoids ($40 \pm 24.2\%$).

Species richness, diversity, and evenness

We measured diversity at the plots in 2 ways: the Shannon Index and Pielou's Index of Evenness. 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 another aspect of diversity-- how even abundances are across taxa. It ranges between 0 and 1, where higher numbers indicate that a community is not even or that just a few species make up the majority of the total cover.

From the point-transect data, we found average plot diversity, H' , to be 2.6 in the THRON and THROS upland areas. Evenness, J' , was also similar and averaged 0.79 ± 0.05 in THRON and 0.80 ± 0.04 in THROS. When including only native species, average diversity and evenness were 2.4 ± 0.63 and 0.78 ± 0.07 in THRON and 2.5 ± 0.31 and 0.79 ± 0.04 , in THROS. Diversity in the riparian units of THROS was lower. We found average plot diversity to be 2.1 ± 0.25 and evenness averaged 0.76 ± 0.04 . When including only native species, average diversity and evenness were 1.6 ± 0.30 and 0.69 ± 0.05 , respectively.

Species richness varies by the scale that it is examined. Table 2 presents average species richness for the point-intercept, 1 m² quadrats, and 10 m² quadrats for the plots in 2011. In general, richness increases in the larger quadrat size. The riparian areas in THROS were less diverse than the upland areas of THROS or than THRON. THROS tended to be more diverse than THRON at the scale of the quadrat, but when looking at point-intercept they were equivalent. Exotic species were particularly common in the riparian areas of THROS and on average we found 6 exotics along each set of point-intercept transects.

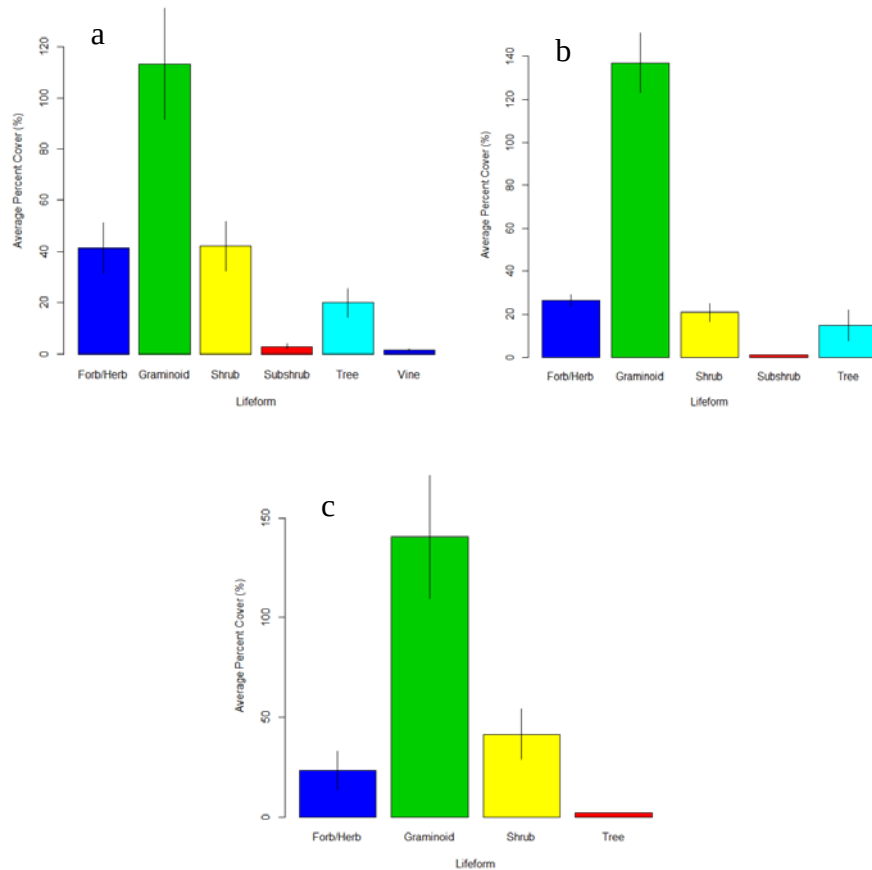


Figure 10. Absolute percent cover of different life-forms in plant community monitoring plots in (a) THRON, (b) upland areas of THROS and (c) riparian areas of THROS in 2011. Bars represent means across the 7, 10, and 4 plots $\pm$ standard errors. Graminoids were the most abundant plant life-form across all plots at THRO.

Table 2. Average plant species richness at plant community monitoring plots at THRO in 2011. Values represent means $\pm$ standard deviation.

	Unit	Number of plots	Species richness	Native species richness	Exotic species richness	Graminoid species richness	Forb species richness
Point-intercept	THRON	7	29.1 (11.80)	24.7 (10.93)	4.4 (1.81)	11.4 (3.31)	11.0 (6.32)
	THROS	10	27.3 (6.02)	24.5 (5.60)	2.8 (1.69)	12.3 (2.06)	10.8 (3.46)
	THROS Riparian	4	15.8 (3.77)	9.8 (3.10)	6.0 (0.82)	7.0 (1.15)	5.8 (3.59)
10 m ² quadrats	THRON	7	18.3 (6.72)	15.3 (5.89)	3.2 (1.13)	5.3 (1.72)	9.8 (4.48)
	THROS	10	22.3 (5.18)	19.7 (6.26)	2.9 (0.86)	7.1 (1.46)	12.6 (4.49)
	THROS Riparian	4	11.6 (0.88)	7.3 (0.86)	4.3 (0.19)	4.5 (0.69)	5.3 (1.34)
1 m ² quadrats	THRON	7	10.4 (3.97)	8.8 (3.47)	2.0 (0.67)	3.8 (1.34)	5.3 (2.49)
	THROS	10	12.3 (3.68)	10.7 (4.00)	1.9 (0.55)	4.6 (1.19)	6.5 (2.64)
	THROS Riparian	4	7.3 (1.51)	4.7 (1.08)	2.7 (0.78)	3.3 (0.53)	3.0 (1.37)

Forest structure

In 2011, we sampled herbaceous vegetation and any trees that were present in 21 plots in THRO. We were able to sample trees, but not herbaceous vegetation, in 1 additional plot for a total of 22 plots. Sixteen of the 22 plots we visited had trees or tall shrub species. 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 3. While we did not measure any mature chokecherry, there was a high density of seedlings in some plots, particularly in THRON. THRON also had a higher density of Rocky mountain juniper seedlings, but the density of mature junipers was fairly consistent across the units (Table 3).

Table 3. Tree density of forested plots in THRO in 2011.

THRO South Unit				
Size Class	Juniper (5 plots; stems hectare ⁻¹)	Green Ash (3 plots; stems hectare ⁻¹)	Chokecherry (5 plots; stems hectare ⁻¹)	Snags (1 plot; stems hectare ⁻¹)
Seedlings	968	207	3444	n/a
Saplings	382	32	149	n/a
Poles	442	-	-	287
Trees	207	-	-	40
THRO North Unit				
Size Class	Juniper (4 plots; stems hectare ⁻¹)	Green Ash (2 plots; stems hectare ⁻¹)	Chokecherry (2 plot; stems hectare ⁻¹)	Snag (5 plots; stems hectare ⁻¹)
Seedlings	2666	1814	17781	n/a
Saplings	111	446	1910	n/a
Poles	297	478	-	143
Trees	303	50	-	30

Target species assessments and disturbance

We recorded disturbance and rare and exotic target species occurrence at 14 plots in THRON and 29 plots in THROS (7 riparian and 22 upland) in 2011. Twenty-one plots were from Panel 1 and 5 and described above. The additional plots are from other panels but were visited as part of an effort to establish long-term monitoring plots prior to reading vegetation.



Figure 11. White locoweed, a rare plant found in THROS in 2011 during plant community monitoring.

We identified 2 rare plants in our plots in 2011. White locoweed (*Oxytropis sericea*; Figure 11) was found at PCM_0033 and PCM_0003 in THROS and smooth goosefoot (*Chenopodium subglabrum*) was found at PCM_0033 in THRON.

Five exotic target species appeared in the plots we visited in 2011 (Table 4): cheatgrass (*Bromus tectorum*), Canada thistle (*Cirsium arvense*), leafy spurge (*Euphorbia esula*), houndstongue (*Cynoglossum officinale*), and field bindweed (*Convolvulus arvensis*). We found at least 1 of these species in 20 of the 43 plots we visited in both parks. Leafy spurge was the most ubiquitous and was found in 15 plots and all the riparian sites in THROS.

Natural disturbances were common in THRON and riparian areas of THROS but less common in the THROS uplands. Only 2 plots in THRON and 1 plot in THROS riparian areas had no evidence of disturbance, but in the upland areas of THROS we surveyed 8 sites where disturbances were not evident. All 5 riparian plots we visited in THRON showed evidence of extensive flooding, while at THROS this was true of only 3 of 7 riparian sites we visited. Another common disturbance to sites was from large animal trails. We found 15 plots with bison trails in THROS.

Table 4. Cover class of target species at 20 plots at THRO in 2011 where target exotic species occurred. 1 = one individual, 2 = few individuals, 3 = cover 1-5% of site, 4 = cover 5-25% of site, 5 = cover > 25% of site, present = present at site but cover was not assessed. The shading indicates riparian sites.

Site	Cheatgrass	Canada Thistle	Houndstongue	Leafy spurge	Field bindweed
THRO-NU_PCM_0013	-	2	-	-	-
THRO-NU_PCM_0015	-	4	-	-	-
THRO-NU_PCM_0033	-	2	2	-	-
THRO-NU_PCM_0038	-	present	present	-	-
THRO-NU_PCM_0513	-	-	-	2	-
THRO-SU_PCM_0004	-	2	-	4	-
THRO-SU_PCM_0005	-	-	-	2	-
THRO-SU_PCM_0018	-	-	-	2	-
THRO-SU_PCM_0020	4	-	-		-
THRO-SU_PCM_0025	-	-	-	3	-
THRO-SU_PCM_0030	-	-	-	2	-
THRO-SU_PCM_0031	-	-	-	present	-
THRO-SU_PCM_0074	-	2	-	2	-
THRO-SU_PCM_1025	-	-	-	4	-
THRO-SU_PCM_1026	-	-	-	2	-
THRO-SU_PCM_1027	-	-	-	4	-
THRO-SU_PCM_1028	-	-	-	4	-
THRO-SU_PCM_1032	-	2	-	3	-
THRO-SU_PCM_1033	present		-	4	-
THRO-SU_PCM_1034	2	2	-	2	present

Discussion

The goal of our plant community monitoring efforts in THRO is to determine the status and trend in vegetation composition and structure and to understand how natural and anthropogenic disturbance and management decisions influence vegetation. As of 2011, we have completed the first year of field work; while we have increased our understanding of vegetation composition and structure, we cannot yet describe park-wide status or trends. Below, we summarize the results from above and highlight some of the most interesting aspects of the plant community monitoring.

There was considerable variation among plots, but on average absolute vascular plant cover was about 200%; productivity was high due to a wet spring. Upland sites at THRO had a notably large diversity of vascular plants. Average native species richness in the 10 m² quadrats was 18 species in THRON and 22 species in THROS (Table 2). Richness was lower in the riparian areas. We found an average of 3 exotic plants in every 10 m² quadrat in upland areas and 4 in the riparian areas of the south unit. Graminoids, which includes all grasses, sedges, and rushes, made up the bulk of cover at all sites (Figure 10). Forbs, or broad-leaved herbaceous plants, were less abundant but more diverse than graminoids at the scale of the 10 m² plots. Shrubs were a larger component of the cover in THRON than at THROS (Figure 10).

Graminoids can be further classified by their photosynthetic pathway. Warm season graminoids have a photosynthetic pathway (C4) that particularly adapts them to hot climates and an atmosphere low in carbon dioxide. These warm season graminoids grow primarily during the hot summer months and tend to be very drought tolerant. Cool season graminoids are C3 plants that tend to grow best in cooler temperatures. For example, junegrass (*Koeleria macrantha*) is a cool season grass and blue grama (*Bouteloua gracilis*) is a warm season grass. The cover of warm season graminoids in upland areas of THROS was more than twice as high in THRON. Examining the trend over time in warm-season graminoid cover and climate trends may elucidate whether warm-season grasses are increasing in abundance due to warmer and drier conditions.

Forest structure and composition varied considerably among the plots (Table 3). Not surprisingly, Rocky Mountain juniper was the most common tree species across the plots. Some plots had a high density of chokecherry seedlings.

While the sites had fairly few exotic species, their cover was disproportionately high. Relative cover of exotics species was much higher in the riparian areas of THROS than in upland areas. In the 43 plots we visited for plant sampling and plot establishment, target exotic species were found in 20 (Table 4). Leafy spurge was the most ubiquitous, occurring at 15 sites and all the riparian sites.

Results from our vegetation monitoring can be summarized in a “connect-the-dots” or a resource condition summary table (Table 5). These tables can be used to describe the status and trend in vital signs or other indicators of ecosystem health. We chose a handful of the key metrics representing 2 vital signs, which we will continue to monitor over time at THRO. The current value is based on sampling in 2011 and the level of inference is simply the number of sites where we sampled that attribute. After 1 complete rotation in the THRO sampling design (10 years), a

current value will represent a 10-year mean and the level of inference will be unit-wide. At such time, we will also be able to estimate baseline reference values and begin to estimate trends in these key metrics. Over time, the vegetation data collected at these sites will greatly add to our understanding and documentation of change in the upland plant communities at THRO.

Table 5. Natural resource condition summary table for plant communities in THRO.

Vital Sign	Metric	THRO North Unit Current Value (mean $\pm$ SD)	THRO South Upland Current Value (mean $\pm$ SD)	THRO South Riparian Current Value (mean $\pm$ SD)	Reference Value	Rationale
Exotic Plant Early Detection	% of sites where target species were encountered	36%	36%	100%	TBD	Early detection of exotic species
	Number of sites where leafy spruce > 5% cover	0	1	4	TBD	Effectiveness of exotic species management
Upland Plant Communities	Mean absolute herb-layer cover	209 $\pm$ 56.7 %	190 $\pm$ 48.1 %	206 $\pm$ 61.6 %	TBD	Forage availability, climatic trends, erosion potential, habitat for small mammals and birds
	Ground-layer bare soil cover	28 $\pm$ 26.2 %	29 $\pm$ 14.5 %	27 $\pm$ 27.4 %	TBD	
	Mean relative percent cover of exotic species	17 $\pm$ 12.4 %	16 $\pm$ 15.7 %	35 $\pm$ 9.2 %	TBD	Effectiveness of exotic species management
	Percent of graminoid cover that is warm season	14 $\pm$ 12.2 %	40 $\pm$ 24.2 %	17 $\pm$ 22.7%	TBD	Climatic trends
	Mean native species richness in 10 m ² quadrats	15 $\pm$ 5.9 species	20 $\pm$ 6.3 species	7 $\pm$ 0.9 species	TBD	Diversity maintenance

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Appendix A: Field journal for plant community monitoring in THRO for the 2011 season

Plant community composition monitoring in THRO was completed using a crew of either 4 or 5 people working 10-hour days. The crew drove three vehicles at various times during the summer and the total mileage for all the trips was 3792 miles. We spent a total of 1,172 crew hours in THRO in 2011.

We worked 8 days in July at THRON, but were only able to complete 8 of 10 monitoring plots. We returned to THRON in September (9/12-9/14) to establish 6 plots for future monitoring and we sampled trees at 1 of the plots where we were not able to sample herbaceous vegetation.

THRO- North Unit

Date	Day of week	Approximate Travel Time (hrs)	Housing	Sites Completed	Notes
Jul 25, 2011	Monday	5	Park campground	PCM_0001	
Jul 26, 2011	Tuesday	NA	Park campground	PCM_0033	
Jul 27, 2011	Wednesday	NA	Park campground	PCM_0038	
Jul 28, 2011	Thursday	NA	Park campground	PCM_0032	
Jul 29, 2011	Friday	NA	Park campground	PCM_0013	Switched crews
Jul 30, 2011	Saturday	NA	Park campground	PCM_0015	
Jul 31, 2011	Sunday	NA	Park campground	PCM_0521	
Aug 1, 2011	Monday	5	N/A		
Sep 12-14, 2011	Mon-Wed	10	Park campground	PCM_0513	Read trees on 0513, installed 6 plots

We worked 8 days in August at THROS, but were only able to complete 14 of 18 monitoring plots. We had 2 crews working the first week (Aug 8) but only 1 crew the second week (Aug 15). We returned to THROS for 4 days in September (9/12-9/15) to establish 15 plots for future monitoring.

THRO- South Unit

Date	Day of week	Approximate Travel Time (hrs)	Housing	Sites Completed	Notes
Aug 8, 2011	Monday	4.5	Sully Creek campground	PCM_0031	
Aug 9, 2011	Tuesday	N/A	Sully Creek campground	PCM_0003 PCM_0006 PCM_0034	
Aug 10, 2011	Wednesday	N/A	Sully Creek campground	PCM_0005 PCM_0033 PCM_0035	
Aug 11, 2011	Thursday	4.5	N/A	PCM_0001 PCM_0030	
Aug 15, 2011	Monday	4.5	Sully Creek campground	PCM_1033	
Aug 16, 2011	Tuesday	N/A	Sully Creek campground	PCM_1025	
Aug 17, 2011	Wednesday	N/A	Sully Creek campground	PCM_1026 PCM_1034	
Aug 18, 2011	Thursday	4.5	N/A	PCM_0004	

Appendix B: List of plant species found in 2011 at THRO

THRO North Unit			
Family	Code	Scientific Name	Common Names
Anacardiaceae	RHTR	<i>Rhus trilobata</i>	Skunkbush, skunkbush sumac
	TORY	<i>Toxicodendron rydbergii</i>	poison ivy, W. Poison ivy, western poison ivy, western poison-ivy
Apocynaceae	APAN2	<i>Apocynum androsaemifolium</i>	bitterroot, flytrap dogbane, spreading dogbane
	APCA	<i>Apocynum cannabinum</i>	common dogbane, dogbane, hemp dogbane, Indian hemp, Indian-hemp, Indianhemp, prairie dogbane
Asclepiadaceae	ASVE	<i>Asclepias verticillata</i>	eastern whorled milkweed, whorled milkweed
	ASVI	<i>Asclepias viridiflora</i>	green antelopehorn milkweed, green comet milkweed, green milkweed
Asteraceae	ACMI2	<i>Achillea millefolium</i>	bloodwort, carpenters weed, common yarrow, hierba de las cortaduras, milfoil, plumajillo, western yarrow, yarrow (common)
	ANPA4	<i>Antennaria parvifolia</i>	little-leaf pussytoes, Rocky Mountain pussytoes, small leaf pussytoes, small-leaf pussytoes, smalleaf pussytoes, smallleaf pussytoes
	ARCA13	<i>Artemisia cana</i>	silver sagebrush
	ARDR4	<i>Artemisia dracunculus</i>	false tarragon, green sagewort, silky wormwood, tarragon, wormwood
	ARFR4	<i>Artemisia frigida</i>	fringed sagebrush, fringed sagewort, prairie sagewort
	ARLO7	<i>Artemisia longifolia</i>	longleaf sagebrush, longleaf wormwood
	ARLU	<i>Artemisia ludoviciana</i>	cudweed sagewort, gray sagewort, Louisiana sagewort, Louisiana wormwood, mugwort wormwood, prairie sage, white sagebrush
	ARTR2	<i>Artemisia tridentata</i>	big sagebrush, big sagebush
	CIAR4	<i>Cirsium arvense</i>	Californian thistle, Canada thistle, Canadian thistle, creeping thistle, field thistle
	CIUN	<i>Cirsium undulatum</i>	gray thistle, wavy-leaf thistle, wavyleaf thistle
	COCA5	<i>Conyza canadensis</i>	Canada horseweed, Canadian horseweed, horseweed, horseweed fleabane, mares tail, marestail
	CRRU3	<i>Crepis runcinata</i>	fiddleleaf hawksbeard
	ECAN2	<i>Echinacea angustifolia</i>	Blacksamson, blacksamson echinacea
	ERNAN3	<i>Ericameria nauseosa</i> ssp. <i>nauseosa</i>	rubber rabbitbrush
	ERNAG3	<i>Ericameria nauseosa</i> var. <i>graveolens</i>	rubber rabbitbrush, green rubber rabbitbrush
	ERIGE2	<i>Erigeron</i>	daisy, fleabane, fleabane species, fleabane spp. (common)
	ERST3	<i>Erigeron strigosus</i>	Daisy Fleabane, prairie fleabane, rough fleabane
	GRSQ	<i>Grindelia squarrosa</i>	Curleycup gumweed, curlycup gumweed, curlytop gumweed, gumweed, rosinweed, tarweed
	GUSA2	<i>Gutierrezia sarothrae</i>	broom snakeweed, Broomsnakeweed, broomweed, perennial snakeweed, stinkweed, turpentine weed, yellow top
	HEAN3	<i>Helianthus annuus</i>	annual sunflower, common sunflower, sunflower, wild sunflower
	HEPAP2	<i>Helianthus pauciflorus</i> ssp. <i>pauciflorus</i>	stiff sunflower
	HEPE	<i>Helianthus petiolaris</i>	prairie sunflower
	HEVIV	<i>Heterotheca villosa</i> var. <i>villosa</i>	hairy false goldenaster
	HYFI	<i>Hymenopappus filifolius</i>	cutleaf, fine-leaf woollywhite, fineleaf hymenopappus

THRO North Unit			
Family	Code	Scientific Name	Common Names
	LASE	<i>Lactuca serriola</i>	China lettuce, prickly lettuce, wild lettuce
	LIPU	<i>Liatis punctata</i>	dotted blazing star, Dotted gayfeather
	LYJU	<i>Lygodesmia juncea</i>	rush skeleton-plant, rush skeletonplant, rush skeletonweed, skeletonplant, skeletonweed
	MUOB	<i>Mulgedium oblongifolium</i>	blue lettuce
	PACA15	<i>Packera cana</i>	woolly groundsel
	RACO3	<i>Ratibida columnifera</i>	Prairie coneflower, prairie coneflower (upright), prairieconeflower, redspike Mexican hat, upright prairie coneflower
	SOMI2	<i>Solidago missouriensis</i>	Missouri goldenrod, prairie goldenrod
	SOMO	<i>Solidago mollis</i>	ashy goldenrod, soft goldenrod, velvety goldenrod, woolly goldenrod
	SONE	<i>Solidago nemoralis</i>	dyersweed goldenrod, gray goldenrod
	SOPT4	<i>Solidago ptarmicoides</i>	prairie goldenrod, upland white aster, white flat-top goldenrod
	SOAR2	<i>Sonchus arvensis</i>	creeping sowthistle, field sow-thistle, field sowthistle, perennial sowthistle, sowthistle
	SYER	<i>Symphyotrichum ericoides</i>	white heath aster
	SYFAF	<i>Symphyotrichum falcatum</i> var. <i>falcatum</i>	white prairie aster
	SYLA3	<i>Symphyotrichum laeve</i>	smooth blue aster
	SYLAL3	<i>Symphyotrichum laeve</i> var. <i>laeve</i>	smooth blue aster
	SYOB	<i>Symphyotrichum oblongifolium</i>	aromatic aster
	TAOF	<i>Taraxacum officinale</i>	blowball, common dandelion, dandelion, faceclock
	TEACA2	<i>Tetraneuris acaulis</i> var. <i>acaulis</i>	stemless four-nerve daisy
			common salsify, goat's beard, goatsbeard, meadow goat's-beard, salsifis majeur, salsify, Western goat's beard, western salsify, wild oysterplant, yellow goat's beard, yellow salsify
	TRDU	<i>Tragopogon dubius</i>	
Boraginaceae	CYOF	<i>Cynoglossum officinale</i>	gypsyflower
	LIIN2	<i>Lithospermum incisum</i>	fringed gromwell, Fringed puccoon, narrowleaf gromwell, narrowleaf pucoon, narrowleaf stoneseed, trumpet stoneseed
Brassicaceae	BOHO2	<i>Boechera holboellii</i>	Holboell rockcress, Holboell's rockcress
			false flax, little-pod false flax, littlepod false flax, littlepod falseflax, littleseed falseflax, small fruited falseflax, smallseed falseflax
	CAMI2	<i>Camelina microcarpa</i>	
	DEPI	<i>Descurainia pinnata</i>	green tansymustard, pinnate tansy mustard, pinnate tansymustard, tansymustard, western tansymustard
	DRRE2	<i>Draba reptans</i>	Carolina draba
	ERCAC	<i>Erysimum capitatum</i> var. <i>capitatum</i>	plains wallflower, prairie rocket, sanddune wallflower, western wallflower
	ERIN7	<i>Erysimum inconspicuum</i>	shy wallflower, smallflower wallflower
	LEDE	<i>Lepidium densiflorum</i>	common pepperweed, greenflower pepperweed, miner's pepperwort, miners pepperweed, peppergrass, pepperweed, prairie pepperweed
	PHLU6	<i>Physaria ludoviciana</i>	foothill bladderpod, Louisiana bladderpod, silver bladderpod
	PHRE8	<i>Physaria reediana</i>	alkaline bladderpod, alpine bladderpod
Cactaceae	ESVIV	<i>Escobaria vivipara</i> var. <i>vivipara</i>	pink pincushioncactus, spinystar, spinystar cactus
	OPFR	<i>Opuntia fragilis</i>	brittle cactus, brittle pricklypear, fragile cactus, jumping

THRO North Unit			
Family	Code	Scientific Name	Common Names
			cactus, little pricklypear, little pricklypear cactus
	OPPO	<i>Opuntia polyacantha</i>	plains pricklypear
Campanulaceae	CARO2	<i>Campanula rotundifolia</i>	bluebell, bluebell bellflower, bluebell-of-Scotland, roundleaf harebell
	TRLE3	<i>Triodanis leptocarpa</i>	slimpod Venus' looking-glass, venus lookingglass, venuslookingglass
Caprifoliaceae	SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry, wolfberry
Caryophyllaceae	SILA21	<i>Silene latifolia</i>	bladder campion
Chenopodiaceae	ATCA2	<i>Atriplex canescens</i>	fourwing saltbush
	ATCO	<i>Atriplex confertifolia</i>	shadscale, shadscale saltbush, spiny saltbush
	ATNU2	<i>Atriplex nuttallii</i>	Nuttall's saltbush
	CHENO	<i>Chenopodium</i>	goosefoot, goosefoot spp.
	CHAL7	<i>Chenopodium album</i>	common lambsquarters, lambsquarters, lambsquarters goosefoot, white goosefoot
	CHFR3	<i>Chenopodium fremontii</i>	Fremont's goosefoot
	CHPR5	<i>Chenopodium pratericola</i>	desert goosefoot
	CHSU2	<i>Chenopodium subglabrum</i>	smooth goosefoot
	KRLA2	<i>Krascheninnikovia lanata</i>	winterfat
	MONU	<i>Monolepis nuttalliana</i>	monolepis, nuttall monolepis, Nuttall's poverty weed, Nuttall's poverty-weed, Nuttall's povertyweed, patata, patota, povertyweed
	SAVE4	<i>Sarcobatus vermiculatus</i>	black greasewood, greasewood
Cupressaceae	JUCO6	<i>Juniperus communis</i>	common juniper, dwarf juniper
	JUHO2	<i>Juniperus horizontalis</i>	creeping juniper
	JUSC2	<i>Juniperus scopulorum</i>	rocky mountain juniper, Rocky Mountain juniper
Cyperaceae	CAREX	<i>Carex</i>	carex, sedge, sedge species, sedges
	CABR10	<i>Carex brevior</i>	brevior sedge, fescue sedge, shortbeak sedge
	CAEB2	<i>Carex eburnea</i>	bristleleaf sedge
	CAFI	<i>Carex filifolia</i>	threadleaf sedge
	CAINH2	<i>Carex inops</i> ssp. <i>heliophila</i>	sun sedge
	CASA9	<i>Carex saximontana</i>	Rocky Mountain sedge
Dryopteridaceae	CYFR2	<i>Cystopteris fragilis</i>	brittle bladder fern, brittle bladderfern, fragile fern
Euphorbiaceae	CHSE4	<i>Chamaesyce serpens</i>	matted sandmat
	EUES	<i>Euphorbia esula</i>	leafy spurge, spurge, wolf's milk, wolf's-milk
	EUSP	<i>Euphorbia spathulata</i>	roughpod spurge, warty spurge
Fabaceae	ASMI10	<i>Astragalus missouriensis</i>	Missouri milk-vetch, Missouri milkvetch
	DACA7	<i>Dalea candida</i>	slender white prairieclover, white dalea, white prairie clover, white prairie-clover, white prairieclover
	DAPU5	<i>Dalea purpurea</i>	Purple prairieclover, violet dalea, violet prairie clover, violet prairie-clover
	MELU	<i>Medicago lupulina</i>	black medic, black medic clover, black medick, hop clover, hop medic, nonesuch, yellow trefoil
	MEOF	<i>Melilotus officinalis</i>	yellow sweet-clover, yellow sweetclover
	OXMO2	<i>Oxytropis monticola</i>	yellow-flower locoweed, yellowflower locoweed

THRO North Unit			
Family	Code	Scientific Name	Common Names
	PEAR6	<i>Pedimelum argophyllum</i>	silverleaf Indian breadroot, silverleaf scurfpea
	PEES	<i>Pedimelum esculentum</i>	breadroot scurfpea, Indian breadroot, large Indian breadroot
	PSTE5	<i>Psoraleum tenuiflorum</i>	slimflower scurfpea
	VICIA	<i>Vicia</i>	vetch
	VIAM	<i>Vicia americana</i>	American deervetch, American vetch
Fumariaceae	COAU2	<i>Corydalis aurea</i>	scrambled eggs
Grossulariaceae	RIAUV	<i>Ribes aureum</i> var. <i>villosum</i>	golden currant
	RIOXS	<i>Ribes oxycanthoides</i> ssp. <i>setosum</i>	Canadian gooseberry, inland gooseberry, redshoot gooseberries
Iridaceae	SIMO2	<i>Sisyrinchium montanum</i>	mountain blue eyedgrass, mountain blueeyed grass, strict blue-eyed grass, strict blue-eyed-grass
Lamiaceae	HEHI	<i>Hedeoma hispida</i>	false pennyroyal, falsepennyroyal, rough false pennyroyal, rough falsepennyroyal, rough pennyroyal
	MOFI	<i>Monarda fistulosa</i>	mintleaf beebalm, Oswego-tea, wild bergamot, wildbergamot beebalm, wildbergamot horsemint
	NECA2	<i>Nepeta cataria</i>	catmint, catnip, catwort, field balm
Liliaceae	ALTE	<i>Allium textile</i>	prairie onion, textile onion, wild onion
	MAST4	<i>Maianthemum stellatum</i>	false Solomons seal, starry false lily of the vally, starry false Solomons seal, Starry false solomons-seal, starry Solomons-seal
	PRTR4	<i>Prosartes trachycarpa</i>	roughfruit fairybells
Linaceae	LILE3	<i>Linum lewisii</i>	blue flax, Lewis blue flax, Lewis flax, Lewis flax, prairie flax
	LIRI	<i>Linum rigidum</i>	orange flax, Stiff flax, stiffstem flax
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	copper mallow, orange globemallow, red falsemallow, scarlet globemallow
Oleaceae	FRPE	<i>Fraxinus pennsylvanica</i>	green ash
Onagraceae	GACO5	<i>Gaura coccinea</i>	scarlet beeblossom, scarlet gaura, Scarlet guara
	OECA10	<i>Oenothera caespitosa</i>	tufted evening-primrose
Plantaginaceae	PLPA2	<i>Plantago patagonica</i>	woolly Indianwheat, woolly plantain, woolly plantian, woolly Indianwheat, woolly plantain
Poaceae	AGSC5	<i>Agrostis scabra</i>	rough bent, rough bentgrass, ticklegrass
	ANGE	<i>Andropogon gerardii</i>	big bluestem, bluejoint, turkeyfoot
	ARPUL	<i>Aristida purpurea</i> var. <i>longiseta</i>	Fendler threeawn
	BOCU	<i>Bouteloua curtipendula</i>	sideoats grama
	BOGR2	<i>Bouteloua gracilis</i>	blue grama
	BRIN2	<i>Bromus inermis</i>	awnless brome, smooth brome
	BRJA	<i>Bromus japonicus</i>	Japanese brome, Japanese brome grass, Japanese chess
	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed
	DIOL	<i>Dichanthelium oligosanthos</i>	Heller's rosette grass
	DISP	<i>Distichlis spicata</i>	Saltgrass, Green, Beetle
	ELCA4	<i>Elymus canadensis</i>	Canada wildrye
	ELELE	<i>Elymus elymoides</i> ssp. <i>elymoides</i>	squirreltail
	ELRE4	<i>Elymus repens</i>	quackgrass
	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass, slender wild rye

THRO North Unit			
Family	Code	Scientific Name	Common Names
	ELTRT	<i>Elymus trachycaulus</i> ssp. <i>trachycaulus</i>	slender wheatgrass
	ELVI3	<i>Elymus virginicus</i>	Virginia wild rye, Virginia wildrye
	HECOC8	<i>Hesperostipa comata</i> ssp. <i>comata</i>	needle and thread
	HESP11	<i>Hesperostipa spartea</i>	porcupinegrass
	KOMA	<i>Koeleria macrantha</i>	junegrass, prairie Junegrass
	MUCU3	<i>Muhlenbergia cuspidata</i>	plains muhly
	NAVI4	<i>Nassella viridula</i>	green needlegrass
	PASM	<i>Pascopyrum smithii</i>	pubescent wheatgrass, western wheatgrass
	PIMI7	<i>Piptatherum micranthum</i>	little-seed mountain-rice grass, littleseed ricegrass, <i>Piptatherum micranthum</i>
	POIN	<i>Poa interior</i>	inland bluegrass
	POPA2	<i>Poa palustris</i>	fowl blue grass, fowl bluegrass
	POPR	<i>Poa pratensis</i>	Kentucky bluegrass
	POSE	<i>Poa secunda</i>	Sandberg bluegrass
	PSSPS	<i>Pseudoroegneria spicata</i> ssp. <i>spicata</i>	bluebunch wheatgrass
	SCSCS	<i>Schizachyrium scoparium</i> var. <i>scoparium</i>	little bluestem
	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed
Polemoniaceae	PHHO	<i>Phlox hoodii</i>	Hood's phlox, spiny phlox
Polygalaceae	POAL4	<i>Polygala alba</i>	milkwoart (White), white milkwort
Polygonaceae	ERPA9	<i>Eriogonum pauciflorum</i>	few-flower wild buckwheat, fewflower buckwheat, manybranch eriogonum
	POCO10	<i>Polygonum convolvulus</i>	black bindweed, black-bindweed, climbing buckwheat, climbing knotweed, cornbind, dullseed cornbind, pink smartweed, wild buckwheat
Primulaceae	ANOC2	<i>Androsace occidentalis</i>	western rock jasmine, western rock-jasmine, western rockjasmine
Ranunculaceae	ANCA8	<i>Anemone canadensis</i>	Canada anemone, Canadian anemone
	ANCY	<i>Anemone cylindrica</i>	candle anemone, cottonweed
	ANMUM3	<i>Anemone multifida</i> var. <i>multifida</i>	Pacific anemone
	CLLI2	<i>Clematis ligusticifolia</i>	virgin'sbower, virgins bower, virginsbower, western white clematis
	THDA	<i>Thalictrum dasycarpum</i>	purple meadow-rue, purple meadowrue
Rosaceae	AMAL2	<i>Amelanchier alnifolia</i>	juneberry, pacific serviceberry, saskatoon serviceberry, Saskatoon serviceberry, western serviceberry, western shadbush
	FRVE	<i>Fragaria vesca</i>	woodland strawberry
	FRVI	<i>Fragaria virginiana</i>	thickleaved wild strawberry, Virginia strawberry, wild strawberry
	GETR	<i>Geum triflorum</i>	old man's whiskers, prairie smoke, prairiesmoke
	POPE8	<i>Potentilla pensylvanica</i>	Pennsylvania cinquefoil, prairie cinquefoil
	PRVI	<i>Prunus virginiana</i>	chokecherry, chokecherry (common), common chokecherry, Virginia chokecherry
	ROAR3	<i>Rosa arkansana</i>	Arkansas rose, prairie rose, prairie wildrose, wild rose, wildrose (prairie)
	ROWO	<i>Rosa woodsii</i>	Wood's rose, woods rose, Woods' rose

THRO North Unit			
Family	Code	Scientific Name	Common Names
Rubiaceae	GAAP2	<i>Galium aparine</i>	bedstraw, catchweed bedstraw, cleavers, cleaverwort, goose grass, scarthgrass, sticky-willy, stickywilly, white hedge
	GABO2	<i>Galium boreale</i>	northern bedstraw
Salicaceae	PODE3	<i>Populus deltoides</i>	common cottonwood, cottonwood, eastern cottonwood, plains cottonwood
	SALIX	<i>Salix</i>	willow
Saxifragaceae	HERI	<i>Heuchera richardsonii</i>	alumroot, Richardson's alumroot
Scrophulariaceae	ORLU2	<i>Orthocarpus luteus</i>	golden-tongue owl-clover, yellow owl's-clover, yellow owlclover
	PEAL2	<i>Penstemon albidus</i>	white penstemon
	PEGR5	<i>Penstemon gracilis</i>	lilac penstemon, slender penstemon
Selaginellaceae	SEDE2	<i>Selaginella densa</i>	dense clubmoss, dense spike-moss, lesser spikemoss, small clubmoss
Smilacaceae	SMLA3	<i>Smilax lasioneura</i>	Blue Ridge carrionflower
Solanaceae	PHVIV3	<i>Physalis virginiana</i> var. <i>virginiana</i>	Virginia groundcherry
Ulmaceae	ULAM	<i>Ulmus americana</i>	american elm, American elm
Unknown Family	UNKFORBANN	<i>Unknown annual forb</i>	Unknown annual forb
	UNKFORB	<i>Unknown forb</i>	Unknown forb
	UNKGRAM	<i>Unknown graminoid</i>	Unknown graminoid
	UNKFORBPER	<i>Unknown perennial forb</i>	Unknown perennial forb
	UNKSHRUB	<i>Unknown shrub</i>	Unknown shrub
	UNKVINE	<i>Unknown vine</i>	Unknown vine
Urticaceae	PAPE5	<i>Parietaria pensylvanica</i>	Pennsylvania pellitory
Violaceae	VINU2	<i>Viola nuttallii</i>	Nuttall violet, Nuttall's violet, yellow prairie violet
Vitaceae	PAVI5	<i>Parthenocissus vitacea</i>	thicket creeper, Virginia creeper, woodbine

THRO South Unit			
Family	Code	Scientific Name	Common Names
Anacardiaceae	RHTR	<i>Rhus trilobata</i>	Skunkbush, skunkbush sumac
	TORY	<i>Toxicodendron rydbergii</i>	poison ivy, W. Poison ivy, western poison ivy, western poison-ivy
Apocynaceae	APAN2	<i>Apocynum androsaemifolium</i>	bitterroot, flytrap dogbane, spreading dogbane
	APCA	<i>Apocynum cannabinum</i>	common dogbane, dogbane, hemp dogbane, Indian hemp, Indian-hemp, Indianhemp, prairie dogbane
Asclepiadaceae	ASVE	<i>Asclepias verticillata</i>	eastern whorled milkweed, whorled milkweed
	ASVI	<i>Asclepias viridiflora</i>	green antelopehorn milkweed, green comet milkweed, green milkweed
Asteraceae	ACMI2	<i>Achillea millefolium</i>	bloodwort, carpenters weed, common yarrow, hierba de las cortaduras, milfoil, plumajillo, western yarrow, yarrow (common)
	ANPA4	<i>Antennaria parvifolia</i>	little-leaf pussytoes, Rocky Mountain pussytoes, small leaf pussytoes, small-leaf pussytoes, smalleaf pussytoes, smallleaf pussytoes
	ARCA13	<i>Artemisia cana</i>	silver sagebrush
	ARDR4	<i>Artemisia dracunculus</i>	false tarragon, green sagewort, silky wormwood, tarragon, wormwood
	ARFR4	<i>Artemisia frigida</i>	fringed sagebrush, fringed sagewort, prairie sagewort
	ARLO7	<i>Artemisia longifolia</i>	longleaf sagebrush, longleaf wormwood
	ARLU	<i>Artemisia ludoviciana</i>	cudweed sagewort, gray sagewort, Louisiana sagewort, Louisiana wormwood, mugwort wormwood, prairie sage, white sagebrush
	ARTR2	<i>Artemisia tridentata</i>	big sagebrush, big sagebush
	CIAR4	<i>Cirsium arvense</i>	Californian thistle, Canada thistle, Canadian thistle, creeping thistle, field thistle
	CIUN	<i>Cirsium undulatum</i>	gray thistle, wavy-leaf thistle, wavyleaf thistle
	COCA5	<i>Conyza canadensis</i>	Canada horseweed, Canadian horseweed, horseweed, horseweed fleabane, mares tail, marestail
	CRRU3	<i>Crepis runcinata</i>	fiddleleaf hawksbeard
	ECAN2	<i>Echinacea angustifolia</i>	Blacksamson, blacksamson echinacea
	ERNAN3	<i>Ericameria nauseosa</i> ssp. <i>nauseosa</i>	rubber rabbitbrush
	ERNAG3	<i>Ericameria nauseosa</i> var. <i>graveolens</i>	rubber rabbitbrush, green rubber rabbitbrush
	ERIGE2	<i>Erigeron</i>	daisy, fleabane, fleabane species, fleabane spp. (common)
	ERST3	<i>Erigeron strigosus</i>	Daisy Fleabane, prairie fleabane, rough fleabane
	GRSQ	<i>Grindelia squarrosa</i>	Curleycup gumweed, curlycup gumweed, curlytop gumweed, gumweed, rosinweed, tarweed
	GUSA2	<i>Gutierrezia sarothrae</i>	broom snakeweed, Broomsnakeweed, broomweed, perennial snakeweed, stinkweed, turpentine weed, yellow top
	HEAN3	<i>Helianthus annuus</i>	annual sunflower, common sunflower, sunflower, wild sunflower
	HEPAP2	<i>Helianthus pauciflorus</i> ssp. <i>pauciflorus</i>	stiff sunflower
	HEPE	<i>Helianthus petiolaris</i>	prairie sunflower
	HEVIV	<i>Heterotheca villosa</i> var. <i>villosa</i>	hairy false goldenaster
	HYFI	<i>Hymenopappus filifolius</i>	cutleaf, fine-leaf woollywhite, fineleaf hymenopappus
	LASE	<i>Lactuca serriola</i>	China lettuce, prickly lettuce, wild lettuce

THRO South Unit			
Family	Code	Scientific Name	Common Names
	LIPU	<i>Liatris punctata</i>	dotted blazing star, Dotted gayfeather
	LYJU	<i>Lygodesmia juncea</i>	rush skeleton-plant, rush skeletonplant, rush skeletonweed, skeletonplant, skeletonweed
	MUOB	<i>Mulgedium oblongifolium</i>	blue lettuce
	PACA15	<i>Packera cana</i>	woolly groundsel
	RACO3	<i>Ratibida columnifera</i>	Prairie coneflower, prairie coneflower (upright), prairieconeflower, redspike Mexican hat, upright prairie coneflower
	SOMI2	<i>Solidago missouriensis</i>	Missouri goldenrod, prairie goldenrod
	SOMO	<i>Solidago mollis</i>	ashy goldenrod, soft goldenrod, velvety goldenrod, woolly goldenrod
	SONE	<i>Solidago nemoralis</i>	dyersweed goldenrod, gray goldenrod
	SOPT4	<i>Solidago ptarmicoides</i>	prairie goldenrod, upland white aster, white flat-top goldenrod
	SOAR2	<i>Sonchus arvensis</i>	creeping sowthistle, field sow-thistle, field sowthistle, perennial sowthistle, sowthistle
	SYER	<i>Symphyotrichum ericoides</i>	white heath aster
	SYFAF	<i>Symphyotrichum falcatum</i> var. <i>falcatum</i>	white prairie aster
	SYLA3	<i>Symphyotrichum laeve</i>	smooth blue aster
	SYLAL3	<i>Symphyotrichum laeve</i> var. <i>laeve</i>	smooth blue aster
	SYOB	<i>Symphyotrichum oblongifolium</i>	aromatic aster
	TAOF	<i>Taraxacum officinale</i>	blowball, common dandelion, dandelion, faceclock
	TEACA2	<i>Tetraneuris acaulis</i> var. <i>acaulis</i>	stemless four-nerve daisy
	TRDU	<i>Tragopogon dubius</i>	common salsify, goat's beard, goatsbeard, meadow goat's-beard, salsifis majeur, salsify, Western goat's beard, western salsify, wild oysterplant, yellow goat's beard, yellow salsify
Boraginaceae	CYOF	<i>Cynoglossum officinale</i>	gypsyflower
	LIIN2	<i>Lithospermum incisum</i>	fringed gromwell, Fringed puccoon, narrowleaf gromwell, narrowleaf pucoon, narrowleaf stoneseed, trumpet stoneseed
Brassicaceae	BOHO2	<i>Boechera holboellii</i>	Holboell rockcress, Holboell's rockcress
	CAMI2	<i>Camelina microcarpa</i>	false flax, little-pod false flax, littlepod false flax, littlepod falseflax, littleseed falseflax, small fruited falseflax, smallseed falseflax
	DEPI	<i>Descurainia pinnata</i>	green tansymustard, pinnate tansy mustard, pinnate tansymustard, tansymustard, western tansymustard
	DRRE2	<i>Draba reptans</i>	Carolina draba
	ERCAC	<i>Erysimum capitatum</i> var. <i>capitatum</i>	plains wallflower, prairie rocket, sanddune wallflower, western wallflower
	ERIN7	<i>Erysimum inconspicuum</i>	shy wallflower, smallflower wallflower
	LEDE	<i>Lepidium densiflorum</i>	common pepperweed, greenflower pepperweed, miner's pepperwort, miners pepperweed, peppergrass, pepperweed, prairie pepperweed
	PHLU6	<i>Physaria ludoviciana</i>	foothill bladderpod, Louisiana bladderpod, silver bladderpod
	PHRE8	<i>Physaria reediana</i>	alkaline bladderpod, alpine bladderpod

THRO South Unit			
Family	Code	Scientific Name	Common Names
Cactaceae	ESVIV	<i>Escobaria vivipara</i> var. <i>vivipara</i>	pink pincushioncactus, spinystar, spinystar cactus
	OPFR	<i>Opuntia fragilis</i>	brittle cactus, brittle pricklypear, fragile cactus, jumping cactus, little pricklypear, little pricklypear cactus
	OPPO	<i>Opuntia polyacantha</i>	plains pricklypear
Campanulaceae	CARO2	<i>Campanula rotundifolia</i>	bluebell, bluebell bellflower, bluebell-of-Scotland, roundleaf harebell
	TRLE3	<i>Triodanis leptocarpa</i>	slimpod Venus' looking-glass, venus lookingglass, venuslookingglass
Caprifoliaceae	SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry, wolfberry
Caryophyllaceae	SILA21	<i>Silene latifolia</i>	bladder campion
Chenopodiaceae	ATCA2	<i>Atriplex canescens</i>	fourwing saltbush
	ATCO	<i>Atriplex confertifolia</i>	shadscale, shadscale saltbush, spiny saltbush
	ATNU2	<i>Atriplex nuttallii</i>	Nuttall's saltbush
	CHENO	<i>Chenopodium</i>	goosefoot, goosefoot spp.
	CHAL7	<i>Chenopodium album</i>	common lambsquarters, lambsquarters, lambsquarters goosefoot, white goosefoot
	CHFR3	<i>Chenopodium fremontii</i>	Fremont's goosefoot
	CHPR5	<i>Chenopodium pratericola</i>	desert goosefoot
	CHSU2	<i>Chenopodium subglabrum</i>	smooth goosefoot
	KRLA2	<i>Krascheninnikovia lanata</i>	winterfat
	MONU	<i>Monolepis nuttalliana</i>	monolepis, nuttall monolepis, Nuttall's poverty weed, Nuttall's poverty-weed, Nuttall's povertyweed, patata, patota, povertyweed
	SAVE4	<i>Sarcobatus vermiculatus</i>	black greasewood, greasewood
Cupressaceae	JUCO6	<i>Juniperus communis</i>	common juniper, dwarf juniper
	JUHO2	<i>Juniperus horizontalis</i>	creeping juniper
	JUSC2	<i>Juniperus scopulorum</i>	rocky mountain juniper, Rocky Mountain juniper
Cyperaceae	CAREX	<i>Carex</i>	carex, sedge, sedge species, sedges
	CABR10	<i>Carex brevior</i>	brevior sedge, fescue sedge, shortbeak sedge
	CAEB2	<i>Carex eburnea</i>	bristleleaf sedge
	CAFI	<i>Carex filifolia</i>	threadleaf sedge
	CAINH2	<i>Carex inops</i> ssp. <i>heliophila</i>	sun sedge
	CASA9	<i>Carex saximontana</i>	Rocky Mountain sedge
Dryopteridaceae	CYFR2	<i>Cystopteris fragilis</i>	brittle bladder fern, brittle bladderfern, fragile fern
Euphorbiaceae	CHSE4	<i>Chamaesyce serpens</i>	matted sandmat
	EUES	<i>Euphorbia esula</i>	leafy spurge, spurge, wolf's milk, wolf's-milk
	EUSP	<i>Euphorbia spathulata</i>	roughpod spurge, warty spurge
Fabaceae	ASMI10	<i>Astragalus missouriensis</i>	Missouri milk-vetch, Missouri milkvetch
	DACA7	<i>Dalea candida</i>	slender white prairieclover, white dalea, white prairie clover, white prairie-clover, white prairieclover
	DAPU5	<i>Dalea purpurea</i>	Purple prairieclover, violet dalea, violet prairie clover, violet

THRO South Unit			
Family	Code	Scientific Name	Common Names
			prairie-clover
	MELU	<i>Medicago lupulina</i>	black medic, black medic clover, black medick, hop clover, hop medic, nonesuch, yellow trefoil
	MEOF	<i>Melilotus officinalis</i>	yellow sweet-clover, yellow sweetclover
	OXMO2	<i>Oxytropis monticola</i>	yellow-flower locoweed, yellowflower locoweed
	PEAR6	<i>Pedimelum argophyllum</i>	silverleaf Indian breadroot, silverleaf scurfpea
	PEES	<i>Pedimelum esculentum</i>	breadroot scurfpea, Indian breadroot, large Indian breadroot
	PSTE5	<i>Psoralidium tenuiflorum</i>	slimflower scurfpea
	VICIA	<i>Vicia</i>	vetch
	VIAM	<i>Vicia americana</i>	American deervetch, American vetch
Fumariaceae	COAU2	<i>Corydalis aurea</i>	scrambled eggs
Grossulariaceae	RIAUV	<i>Ribes aureum</i> var. <i>villosum</i>	golden currant
	RIOXS	<i>Ribes oxyacanthoides</i> ssp. <i>setosum</i>	Canadian gooseberry, inland gooseberry, redshoot gooseberries
Iridaceae	SIMO2	<i>Sisyrinchium montanum</i>	mountain blue eyedgrass, mountain blueeyed grass, strict blue-eyed grass, strict blue-eyed-grass
Lamiaceae	HEHI	<i>Hedeoma hispida</i>	false pennyroyal, falsepennyroyal, rough false pennyroyal, rough falsepennyroyal, rough pennyroyal
	MOFI	<i>Monarda fistulosa</i>	mintleaf beebalm, Oswego-tea, wild bergamot, wildbergamot beebalm, wildbergamot horsemint
	NECA2	<i>Nepeta cataria</i>	catmint, catnip, catwort, field balm
Liliaceae	ALTE	<i>Allium textile</i>	prairie onion, textile onion, wild onion
	MAST4	<i>Maianthemum stellatum</i>	false Solomons seal, starry false lily of the vally, starry false Solomons seal, Starry false solomons-seal, starry Solomons-seal
	PRTR4	<i>Prosartes trachycarpa</i>	roughfruit fairybells
Linaceae	LILE3	<i>Linum lewisii</i>	blue flax, Lewis blue flax, Lewis flax, Lewis flax, prairie flax
	LIRI	<i>Linum rigidum</i>	orange flax, Stiff flax, stiffstem flax
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	copper mallow, orange globemallow, red falsemallow, scarlet globemallow
Oleaceae	FRPE	<i>Fraxinus pennsylvanica</i>	green ash
Onagraceae	GACO5	<i>Gaura coccinea</i>	scarlet beeblossom, scarlet gaura, Scarlet guara
	OECA10	<i>Oenothera caespitosa</i>	tufted evening-primrose
Plantaginaceae	PLPA2	<i>Plantago patagonica</i>	woolly Indianwheat, woolly plantain, woolly plantian, woolly Indianwheat, woolly plantain
Poaceae	AGSC5	<i>Agrostis scabra</i>	rough bent, rough bentgrass, ticklegrass
	ANGE	<i>Andropogon gerardii</i>	big bluestem, bluejoint, turkeyfoot
	ARPUL	<i>Aristida purpurea</i> var. <i>longiseta</i>	Fendler threeawn
	BOCU	<i>Bouteloua curtipendula</i>	sideoats grama
	BOGR2	<i>Bouteloua gracilis</i>	blue grama
	BRIN2	<i>Bromus inermis</i>	awnless brome, smooth brome
	BRJA	<i>Bromus japonicus</i>	Japanese brome, Japanese brome grass, Japanese chess
	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed
	DIOL	<i>Dichanthelium</i>	Heller's rosette grass

THRO South Unit			
Family	Code	Scientific Name	Common Names
		<i>oligosanthes</i>	
	DISP	<i>Distichlis spicata</i>	Saltgrass, Green, Beetle
	ELCA4	<i>Elymus canadensis</i>	Canada wildrye
	ELELE	<i>Elymus elymoides</i> ssp. <i>elymoides</i>	squirreltail
	ELRE4	<i>Elymus repens</i>	quackgrass
	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass, slender wild rye
	ELTRT	<i>Elymus trachycaulus</i> ssp. <i>trachycaulus</i>	slender wheatgrass
	ELVI3	<i>Elymus virginicus</i>	Virginia wild rye, Virginia wildrye
	HECOC8	<i>Hesperostipa comata</i> ssp. <i>comata</i>	needle and thread
	HESP11	<i>Hesperostipa spartea</i>	porcupinegrass
	KOMA	<i>Koeleria macrantha</i>	junegrass, prairie Junegrass
	MUCU3	<i>Muhlenbergia cuspidata</i>	plains muhly
	NAVI4	<i>Nassella viridula</i>	green needlegrass
	PASM	<i>Pascopyrum smithii</i>	pubescent wheatgrass, western wheatgrass
	PIMI7	<i>Piptatherum micranthum</i>	little-seed mountain-rice grass, littleseed ricegrass, <i>Piptatherum micranthum</i>
	POIN	<i>Poa interior</i>	inland bluegrass
	POPA2	<i>Poa palustris</i>	fowl blue grass, fowl bluegrass
	POPR	<i>Poa pratensis</i>	Kentucky bluegrass
	POSE	<i>Poa secunda</i>	Sandberg bluegrass
	PSSPS	<i>Pseudoroegneria spicata</i> ssp. <i>spicata</i>	bluebunch wheatgrass
	SCSCS	<i>Schizachyrium scoparium</i> var. <i>scoparium</i>	little bluestem
	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed
Polemoniaceae	PHHO	<i>Phlox hoodii</i>	Hood's phlox, spiny phlox
Polygalaceae	POAL4	<i>Polygala alba</i>	milkwoart (White), white milkwort
Polygonaceae	ERPA9	<i>Eriogonum pauciflorum</i>	few-flower wild buckwheat, fewflower buckwheat, manybranch eriogonum
	POCO10	<i>Polygonum convolvulus</i>	black bindweed, black-bindweed, climbing buckwheat, climbing knotweed, cornbind, dullseed cornbind, pink smartweed, wild buckwheat
Primulaceae	ANOC2	<i>Androsace occidentalis</i>	western rock jasmine, western rock-jasmine, western rockjasmine
Ranunculaceae	ANCA8	<i>Anemone canadensis</i>	Canada anemone, Canadian anemone
	ANCY	<i>Anemone cylindrica</i>	candle anemone, cottonweed
	ANMUM3	<i>Anemone multifida</i> var. <i>multifida</i>	Pacific anemone
	CLLI2	<i>Clematis ligusticifolia</i>	virgin'sbower, virgins bower, virginsbower, western white clematis
	THDA	<i>Thalictrum dasycarpum</i>	purple meadow-rue, purple meadowrue
Rosaceae	AMAL2	<i>Amelanchier alnifolia</i>	juneberry, pacific serviceberry, saskatoon serviceberry, Saskatoon serviceberry, western serviceberry, western shadbush

THRO South Unit			
Family	Code	Scientific Name	Common Names
	FRVE	<i>Fragaria vesca</i>	woodland strawberry
	FRVI	<i>Fragaria virginiana</i>	thickleaved wild strawberry, Virginia strawberry, wild strawberry
	GETR	<i>Geum triflorum</i>	old man's whiskers, prairie smoke, prairiesmoke
	POPE8	<i>Potentilla pensylvanica</i>	Pennsylvania cinquefoil, prairie cinquefoil
	PRVI	<i>Prunus virginiana</i>	chokecherry, chokecherry (common), common chokecherry, Virginia chokecherry
	ROAR3	<i>Rosa arkansana</i>	Arkansas rose, prairie rose, prairie wildrose, wild rose, wildrose (prairie)
	ROWO	<i>Rosa woodsii</i>	Wood's rose, woods rose, Woods' rose
Rubiaceae	GAAP2	<i>Galium aparine</i>	bedstraw, catchweed bedstraw, cleavers, cleaverwort, goose grass, scarthgrass, sticky-willy, stickywilly, white hedge
	GABO2	<i>Galium boreale</i>	northern bedstraw
Salicaceae	PODE3	<i>Populus deltoides</i>	common cottonwood, cottonwood, eastern cottonwood, plains cottonwood
	SALIX	<i>Salix</i>	willow
Saxifragaceae	HERI	<i>Heuchera richardsonii</i>	alumroot, Richardson's alumroot
Scrophulariaceae	ORLU2	<i>Orthocarpus luteus</i>	golden-tongue owl-clover, yellow owl's-clover, yellow owlclover
	PEAL2	<i>Penstemon albidus</i>	white penstemon
	PEGR5	<i>Penstemon gracilis</i>	lilac penstemon, slender penstemon
Selaginellaceae	SEDE2	<i>Selaginella densa</i>	dense clubmoss, dense spike-moss, lesser spikemoss, small clubmoss
Smilacaceae	SMLA3	<i>Smilax lasioneura</i>	Blue Ridge carrionflower
Solanaceae	PHVIV3	<i>Physalis virginiana</i> var. <i>virginiana</i>	Virginia groundcherry
Ulmaceae	ULAM	<i>Ulmus americana</i>	american elm, American elm
Unknown Family	UNKFORBANN	<i>Unknown annual forb</i>	Unknown annual forb
	UNKFORB	<i>Unknown forb</i>	Unknown forb
	UNKGRAM	<i>Unknown graminoid</i>	Unknown graminoid
	UNKFORBPER	<i>Unknown perennial forb</i>	Unknown perennial forb
	UNKSHRUB	<i>Unknown shrub</i>	Unknown shrub
	UNKVINE	<i>Unknown vine</i>	Unknown vine
Urticaceae	PAPE5	<i>Parietaria pensylvanica</i>	Pennsylvania pellitory
Violaceae	VINU2	<i>Viola nuttallii</i>	Nuttall violet, Nuttall's violet, yellow prairie violet
Vitaceae	PAVI5	<i>Parthenocissus vitacea</i>	thicket creeper, Virginia creeper, 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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Natural Resource Stewardship and Science

1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

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