



Plant Community Composition and Structure Monitoring for Fort Laramie National Historic Site

2013 Annual Report

Natural Resource Data Series NPS/NGPN/NRDS—2013/585



ON THE COVER

Long-term monitoring plot PCM_070 at Fort Laramie National Historic Site, 2013
Photograph by: NPS

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Introduction

During the last century, much of the prairie within the Northern Great Plains has been plowed for cropland, planted with non-natives to maximize livestock production, or otherwise developed, making it one of the most threatened ecosystems in the United States. 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 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.

Fort Laramie National Historic Site (FOLA), established in 1938 to protect and preserve the well-known military post, covers 833 acres within the northern mixed-grass prairie region (Lauenroth et al. 1999). The park is a mosaic of disturbed old-fields, riparian forests, and native prairie and is host to 376 plant species (Heidel 2004). The Northern Great Plains Inventory & Monitoring Program (NGPN) began vegetation monitoring at FOLA in 2011 (Ashton et al. 2012a). The long-term objectives of the NGPN plant community monitoring effort (Symstad et al. 2012b) in FOLA 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-yr intervals) and long-term trends of tree density by species, height class, and diameter class in lowland areas near targeted perennial streams.
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 FOLA in 2013, our third year of sampling. We visited 6 plots, and it will take 2 more years to visit every plot in the park twice (Figure 1). We expect to produce reports with more in-depth data analysis and interpretation when we complete 5 years of sampling. In the interim, reports, spatial data, and data summaries can be provided for park management and interpretation upon request.



Northern Great Plains Inventory and Monitoring Network Plant Community Monitoring

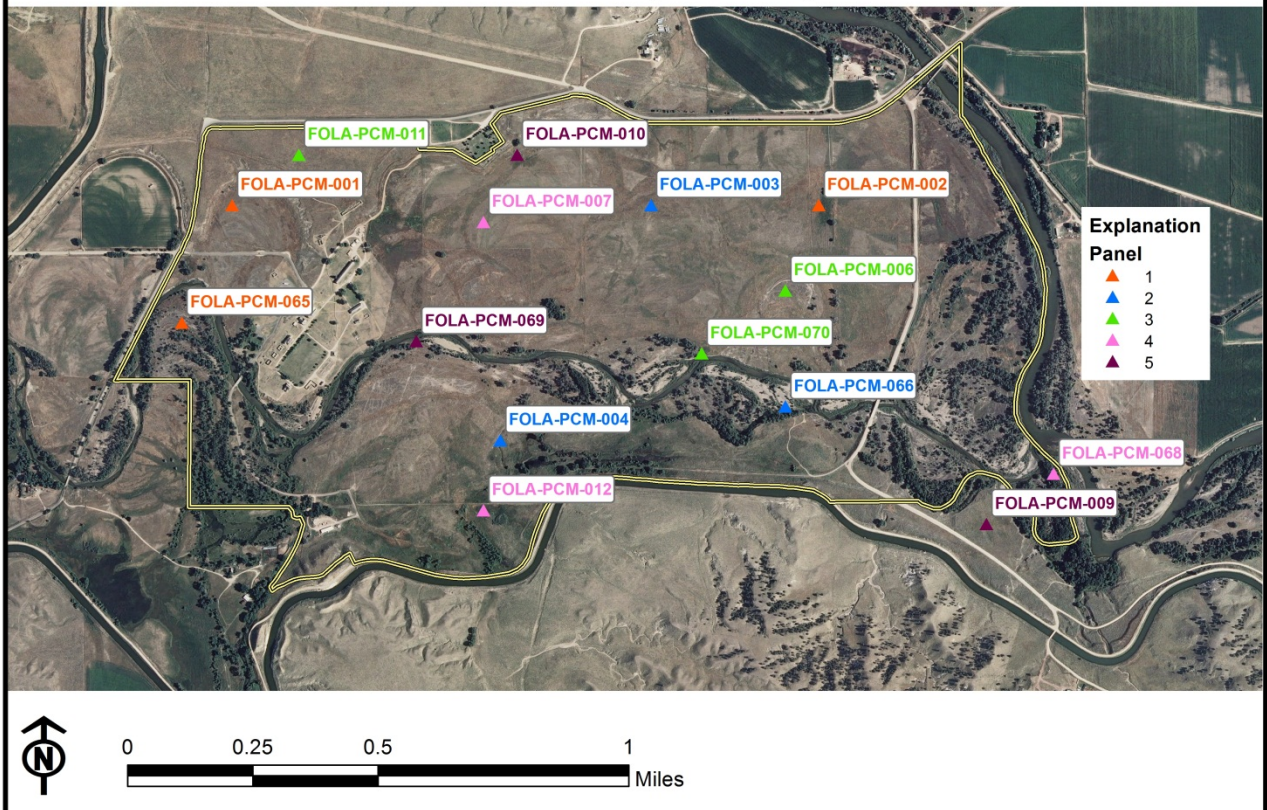


Figure 1. Map of Fort Laramie National Historic Site (FOA) and plant community monitoring (PCM) plots. Plots in panel 2 (blue) and panel 3 (green) were visited in 2013.

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

We implemented a survey to monitor plant community structure and composition in FOLA using a spatially balanced probability design (Generalized Random Tessellation Stratified [GRTS]; Stevens and Olsen 2003, 2004). Using a GRTS design, we selected 15 randomly located sites within FOLA (Figure 1). We split these 15 sites into 5 panels with 3 sites each. We visit 2 panels (6 sites) every year, and after 5 years (2015) we will have visited all 15 sites twice. In 2011, we visited sites in panel 1 and panel 5, and in 2012 we visited sites in panel 1 and panel 2 (Figure 1). In 2013, we visited sites in panel 2 and panel 3 during the first week of June. Data from these randomly selected sites can be used to estimate condition of vegetation communities for the whole park and overtime, can be used to discern trends in condition.

Plot layout and sampling

At each of the sites we visited, we recorded plant species cover and frequency in a rectangular, 50 m x 20 m (0.1 ha), permanent plot (Figure 2). Data on ground cover, herb-layer height ≤ 2 m, and plant cover were collected on two 50 m transects (the long sides of the plot) using a point-intercept method. Species richness data from the point-intercept method were supplemented with species presence data collected in 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 2013, sampling at FOLA took a 4-person crew approximately 169 hours with travel time (see Appendix A for a detail of activities each day).

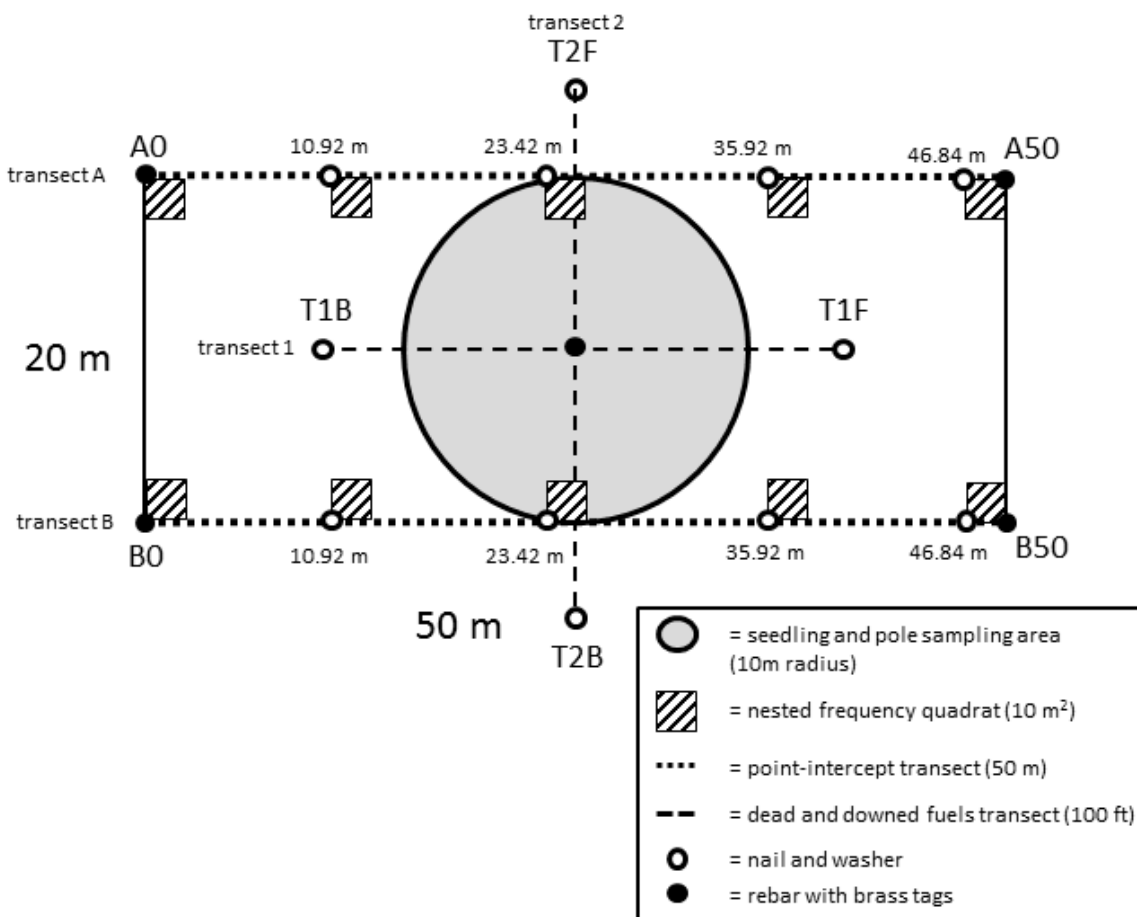


Figure 2. Long-term monitoring plot used for sampling vegetation in Fort Laramie National Historic Site.

When woody species were present, tree regeneration and tall shrub density data were collected within a 10 m radius subplot centered in the larger 50 m x 20 m plot (Figure 2). Trees with diameter at breast height (DBH) > 15 cm, located within the entire 0.1 ha plot, are mapped and tagged. For each tree, the species, DBH, status, and condition (e.g., leaf-discoloration, insect-damaged, etc.) are recorded. An assessment of forest structure and health will be conducted in 2014 when NGPN is scheduled to complete a survey of riparian forests in FOLA.

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

Table 1. Exotic species surveyed for at Fort Laramie National Historic Site as part of the early detection and rapid response program within the Northern Great Plains Network.

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

Table 2. Rare species that were surveyed for during the 2013 field season at Fort Laramie National Historic Site.

Scientific Name	Common Name
<i>Agalinis tenuifolia</i>	slender flase foxglove
<i>Cyperus acuminatus</i>	short point flat sedge
<i>Cyperus bipartitus</i>	shining flatsedge
<i>Dalea aurea</i>	golden prairie clover
<i>Dalea cylindriceps</i>	Andean prairie clover
<i>Euphorbia hexagona</i>	six-angle spurge
<i>Eustoma exaltatum</i> ssp. <i>russellianum</i> / <i>Eustoma russellianum</i> / <i>Eustoma grandiflorum</i>	showy prairie gentian
<i>Gaura neomexicana</i> ssp. <i>coloradensis</i>	Colorado butterfly plant
<i>Lipocarpus drummondii</i>	dwarf bulrush
<i>Lithospermum multiflorum</i>	many flowered puccoon
<i>Lobelia siphilitica</i>	great blue lobelia
<i>Paronychia jamesii</i>	James's nailwort
<i>Shinnersoseris rostrata</i>	beaked skeletonweed
<i>Sorghastrum nutans</i>	Indiangrass
<i>Spiranthes diluvialis</i>	Ute lady's tresses

Data Management and Analysis

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

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

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

Plant life forms (e.g., shrub, forb) were based on definitions from the USDA Plants Database (USDA-NRCS 2012). Warm-season grasses were identified primarily using a guide by Skinner (2010). Summaries were produced using the FFI reporting and query tools and statistical summaries and graphics were generated using R software (version 2.15.1).

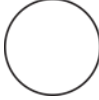
We measured diversity at the plots in 3 ways: species richness, the Shannon Index, and Pielou's Index of Evenness. Species richness is simply a count of the species recorded in an area. The Shannon Index, H' , is a measure of the number of species in an area and how even abundances are across the community. 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; values near 0 indicate dominance by a single species, and values near 1 indicate nearly equal abundance of all species present.

Reporting on Natural Resource Condition

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

We chose a set of indicators and specific measures that can describe the condition of vegetation in the Northern Great Plains and the status of exotic plant invasions. The measures include: absolute herb-layer canopy cover, native species richness, evenness, relative cover of exotic species, and annual brome cover. Reference values were based on descriptions of historic condition and variation, past studies, and/or management targets. Current park condition was compared to a reference value, and status was scored as good condition, warrants moderate caution, or warrants significant concern based on this comparison (Table 3). Good condition was applied to values that fell within the range of the reference value, and significant concern was applied to conditions that fell outside the bounds of the reference value. In some case, reference conditions can be determined only after we have accumulated more years of data. When this is the case, we refer to these as "To be determined" and estimate condition based on our professional judgment.

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

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

Results and Discussion

Fort Laramie NHS experienced severe to extreme drought conditions throughout the winter and into the spring of 2013 (Figure 3). When the NGPN visited the park in June, recent wet weather allowed for some green-up, but overall the park was still experiencing drought conditions. Average canopy cover was 75% (Table 4) in 2013, which was much higher than the previous year (Ashton et al. 2012b). There was a large amount of standing litter on the ground with ground cover at the sites averaging 80% plant litter.

We found 94 plant species in 2013 at FOLA (Appendix B). Graminoids, which includes grasses, sedges, and rushes, accounted for most of the vegetative cover at FOLA, but trees, forbs, shrubs and subshrubs (defined as a low-growing shrub usually under 0.5m) were also abundant (Figure 4). We found 24 exotic species at the park, all of which were either forbs or graminoids. The shrubs, subshrubs, and trees were all native species.

There was some variation in species composition across the 6 sites. The most common species in the sites we visited were graminoids, and most were native species (Figure 5). Russian thistle (*Salsola tragus*), an exotic forb, was found at all 6 sites and was more abundant in 2013 than it had been in previous years.

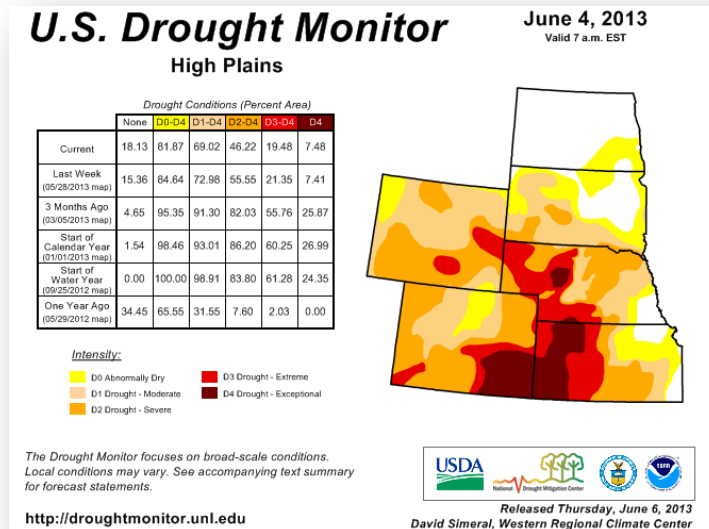


Figure 3. Drought conditions in early June 2013 in the Northern Great Plains. Fort Laramie National Historic Site experienced severe to extreme drought at that time.

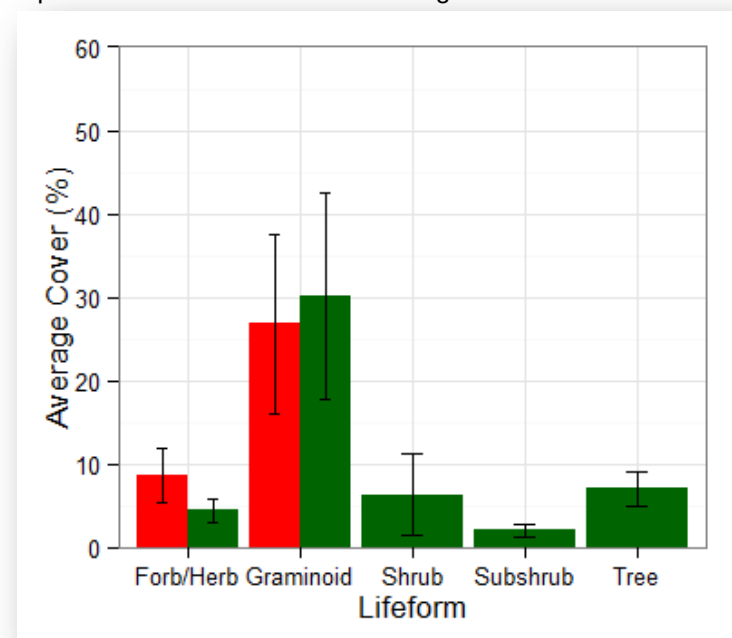


Figure 4. Average cover by lifeform and nativity in 6 plant community monitoring plots in Fort Laramie National Historic Site in 2013. Native (green) and exotic (red) graminoids were the most abundant lifeform across the plots. Bars represent means $\pm$ standard errors.

Table 4. Natural resource condition summary table for upland plant communities in Fort Laramie National Historic Site (FOLA).

Indicator of Condition	Specific Measures	2013 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	75 $\pm$ 14.7 %	TBD ⁽¹⁾		FOLA plays a vital role in protecting and managing some of the last remnants of native mixed-grass prairie and riparian forests in the region. The park is characterized by low native species richness, but average richness is within a natural range of variability.
	Native species richness (based on average of 10 1m ² quadrats per plot)	4 $\pm$ 0.6 species	3-15 species ⁽²⁾		
	Evenness (based on point-intercept of 2-50m transects per plot)	0.76 $\pm$ 0.07	TBD ⁽¹⁾		
Exotic Plant Early Detection and Management	Relative cover of exotic species	40 $\pm$ 12 %	< 10 % cover		In general, the sites in FOLA had a high cover of exotic species. Only one site had <10% cover. Cheatgrass was the most abundant exotic species, and more research on effective management strategies in the mixed-grass prairie is greatly needed.
	Annual Brome cover	28 $\pm$ 12.2 %	< 10 % cover		
Riparian Plant Community Structure and Composition	Cottonwood seedling density	25143 stems per hectare (data from only 1 site)	TBD		Some areas of the riparian forest in FOLA are healthy and contain numerous trees of all size classes, while others are more typical of old cottonwood forests where only large old trees are present and there is no significant regeneration. Exotic species such as Russian olive and tamarisk are in low abundance in the riparian corridor, but active management will be needed to maintain this condition.

References and Data Sources:

1. To be determined when more data are available. 2. 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.

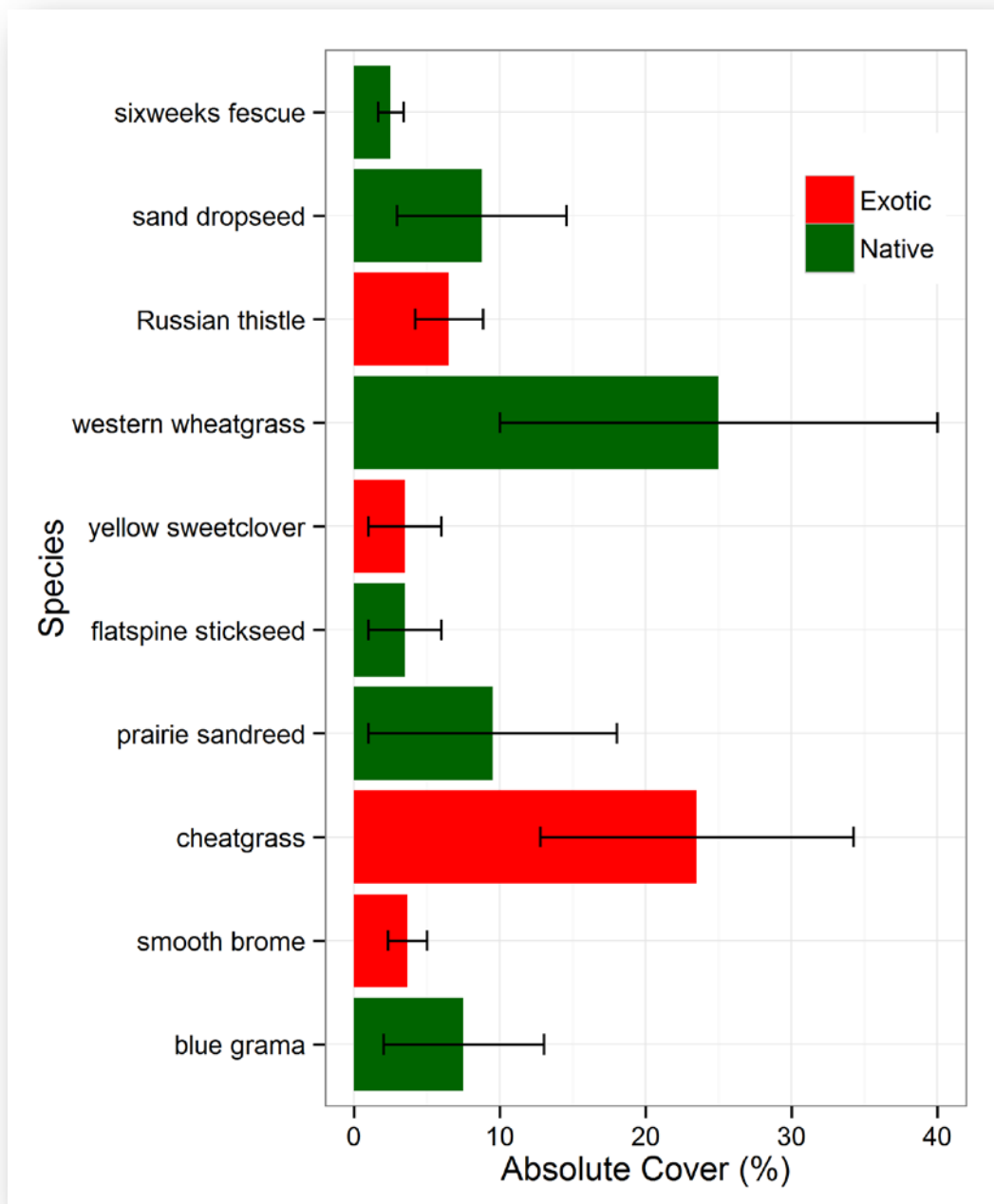


Figure 5. The average absolute cover of the 10 most common native (green) and exotic (red) plants recorded at Fort Laramie National Historic Site in 2013. Bars represent means $\pm$ standard errors.

Average species richness at each of the 6 plots was measured by point-intercept and in 1 m² and 10 m² quadrats (Table 5). On average, there are about 3 exotic species within the 1 m² quadrat (Table 5). From the point-intersect data, we found average plot diversity, H' , to be 1.8 ± 0.23 . Evenness, J' , averaged 0.76 ± 0.07 across the plots (Table 4). When including only native species, average diversity and evenness were 1.6 ± 0.2 and 0.80 ± 0.05 , respectively.

Table 5. Average plant species richness in 6 plots at Fort Laramie National Historic Site in 2013. Values represent means $\pm$ standard errors, n=6.

	Point-intercept	1 m ² quadrats	10 m ² quadrats
Species richness	12 $\pm$ 1.7	6 $\pm$ 0.5	12 $\pm$ 1.5
Native species richness	8 $\pm$ 1.2	4 $\pm$ 0.6	8 $\pm$ 1.3
Exotic species richness	4 $\pm$ 0.8	3 $\pm$ 0.4	5 $\pm$ 0.6
Graminoid species richness	6 $\pm$ 0.5	3 $\pm$ 0.3	5 $\pm$ 0.5
Forb species richness	4 $\pm$ 1.2	3 $\pm$ 0.6	6 $\pm$ 1.1

While there was some variation across sites, the plots we visited in FOLA tended to have a low diversity of native plants compared to other mixed-grass prairies. Species richness in the mixed-grass prairie is determined by numerous factors including fire regime, grazing, prairie dog disturbance, and weather fluctuations (Symstad and Jonas 2011). While it is difficult to define a reference condition for species richness that can vary so much spatially and temporally, the natural range of variation over long-time periods may be a good starting point (Symstad and Jonas in press). Long-term records of species diversity in mixed-grass prairie from a relatively undisturbed site in Kansas vary between 3 and 15 species per square meter over the course of



Figure 6. Long-term monitoring site PCM_004 at Fort Laramie Historic Site. In 2013, we found it to have a high native plant diversity and low exotic cover relative to the other sites in the park.

30 years (Symstad and Jonas, in press). Compared to this, FOLA is within the natural range (Table 4, native richness in the 1 m² quadrat and Table 5). The highest diversity was seen in site PCM_004 (Figure 6), in the south-central portion of the park (Table 1). Species diversity is enhanced at this site by the presence of an old river oxbow and a semi-permanent pool within the plot. Resident species at this plot include several facultative wetland species which are only rarely found in a mixed-grass prairie.

The average relative cover of exotic species at sites in FOLA was high (40 $\pm$ 12%; Table 4). However, like species richness, cover of exotic species varied considerably among sites (Table 6). Site PCM_011 had a low cover of exotic species. The highest cover of exotic species was 82%, found at PCM_006. Cheatgrass accounted for a majority of the exotic cover in all plots but other exotics such as Russian thistle and smooth brome were also abundant (Table 6). The presence of

annual bromes in mixed grass prairie is associated with decreased productivity and altered nutrient cycling (Ogle et al. 2003), and there is strong evidence from regions further west that cheatgrass alters fire regimes and the persistence of native species (D'Antonio and Vitousek 2003). Reducing the cover of annual bromes remains a major challenge for the park.

Table 6. Characteristics of the plant community at 6 plots in Fort Laramie National Historic Site in 2013 including average cover of annual bromes, exotic plant cover, and area of disturbance.

Plot	Native species richness in 1 m ²	Exotic cover (%)	Annual brome cover (%)	Disturbance within site (m ²)
FOLA_PCM_003	3	62	54	20
FOLA_PCM_004	6	15	4	1000
FOLA_PCM_006	4	82	75	650
FOLA_PCM_011	5	5	5	200
FOLA_PCM_066	4	23	7	1500
FOLA_PCM_070	3	55	22	250
<i>Park Average</i>	<i>4 ± 0.6</i>	<i>40 ± 12</i>	<i>28 ± 12.2</i>	-

Disturbance from grazing, prairie dogs, 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 2013, the most common disturbance was from small rodents, but there was also evidence of erosion and flooding as well as signs of former land use as a campground. With this small sample size, we found no correlation with disturbance and native richness or exotic cover. However, the site with the highest exotic cover (PCM_006) lies in the footprint of a former campground. When sampling across the park is complete in 2015 and we have a larger data set, we hope to compare diversity in pastures with and without horses.

Trees and seedlings were present in only 2 of the 6 sites we visited in 2013 (PCM_066 and PCM_070). In 2014, NGPN is scheduled to complete a more thorough assessment of riparian forest structure and health in FOLA where we plan to have data from 20 locations. Green ash (*Fraxinus pennsylvanica*), eastern cottonwood (*Populus deltoides*), narrowleaf willow (*Salix exigua*), and peachleaf willow (*S. amygdaloides*) were common in 2013. We did not find any seedlings at site PCM_070, but there was a dense layer of seedlings at PCM_006 (37,078 seedlings per hectare). We found one Russian olive (*Eleagnus angustifolia*) seedling at site PCM_066.

Summary

In conclusion, FOLA plays a vital role in protecting and managing some of the last remnants of native mixed-grass prairie in the area. While some areas of the park are highly impacted and have a high cover of exotic species, there are other areas that have relatively low exotic cover and a moderate diversity of native plants. To retain ecological integrity it is important to continue efforts to reduce the cover of invasive plants. Annual bromes present the largest challenge to FOLA, and more research on effective management strategies in the mixed-grass prairie is greatly needed. Continued monitoring efforts will be critical to track changes in the condition of the vegetation communities in FOLA.

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Appendix A: Field journal for plant community monitoring in FOLA for the 2013 season

Plant community composition monitoring in Fort Laramie National Historic Site was completed using a crew of 4 people working 4, 10-hour days. We spent 169 total crew hours. We also had assistance from park employees for approximately 10 hours.

Date	Day of week	Approximate Travel Time (hrs)	Housing	Sites Completed
June 3, 2013	Monday	5	Holiday Inn, Torrington	PCM-004
June 4, 2013	Tuesday	1	Holiday Inn, Torrington	PCM-004 PCM-003 PCM-011
June 5, 2013	Wednesday	1	Holiday Inn, Torrington	PCM-066 PCM-006
June 6, 2013	Thursday	5	N/A	PCM-070

Appendix B: List of plant species found in 2013 at FOLA

Family	Code	Scientific Name	Common Name	Exotic
Aceraceae	ACNE2	<i>Acer negundo</i>	boxelder	
Agavaceae	YUGL	<i>Yucca glauca</i>	soapweed yucca	
Apiaceae	LOFO	<i>Lomatium foeniculaceum</i>	desert biscuitroot	
Asclepiadaceae	ASSP	<i>Asclepias speciosa</i>	showy milkweed	
	ASVI	<i>Asclepias viridiflora</i>	green comet milkweed	
Asteraceae	AMPS	<i>Ambrosia psilostachya</i>	Cuman ragweed	
	ARBI2	<i>Artemisia biennis</i>	biennial wormwood	*
	ARCA12	<i>Artemisia campestris</i>	field sagewort	
	ARFI2	<i>Artemisia filifolia</i>	sand sagebrush	
	ARFR4	<i>Artemisia frigida</i>	prairie sagewort	
	ARLU	<i>Artemisia ludoviciana</i>	white sagebrush	
	CIVU	<i>Cirsium vulgare</i>	bull thistle	*
	GRSQ	<i>Grindelia squarrosa</i>	curlycup gumweed	
	HEAN3	<i>Helianthus annuus</i>	common sunflower	
	HEVI4	<i>Heterotheca villosa</i>	hairy false goldenaster	
	LASE	<i>Lactuca serriola</i>	prickly lettuce	*
	ONAC	<i>Onopordum acanthium</i>	Scotch cottonthistle	*
	PAPL12	<i>Packera plattensis</i>	prairie groundsel	
	SYER	<i>Symphyotrichum ericoides</i>	white heath aster	
	SYLA6	<i>Symphyotrichum lanceolatum</i>	white panicle aster	
	TAOF	<i>Taraxacum officinale</i>	common dandelion	*
	TRDU	<i>Tragopogon dubius</i>	yellow salsify	*
Boraginaceae	CRCE	<i>Cryptantha celosioides</i>	buttecandle	
	LAOC3	<i>Lappula occidentalis</i>	flatspine stickseed	
	LIIN2	<i>Lithospermum incisum</i>	narrowleaf stoneseed	
Brassicaceae	ALDE	<i>Alyssum desertorum</i>	desert madwort	*
	CAMI2	<i>Camelina microcarpa</i>	littlepod false flax	*
	DEPI	<i>Descurainia pinnata</i>	western tansymustard	
	DESO2	<i>Descurainia sophia</i>	herb sophia	*
	DRRE2	<i>Draba reptans</i>	Carolina draba	
	LEDE	<i>Lepidium densiflorum</i>	common pepperweed	
	SIAL2	<i>Sisymbrium altissimum</i>	tall tumbledmustard	*

Family	Code	Scientific Name	Common Name	Exotic
Cactaceae	OPMA2	<i>Opuntia macrorhiza</i>	twistspine pricklypear	
	OPPO	<i>Opuntia polyacantha</i>	plains pricklypear	
Caprifoliaceae	SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry	
Chenopodiaceae	CHENO	<i>Chenopodium</i>	goosefoot	*
	KRLA2	<i>Krascheninnikovia lanata</i>	winterfat	
	SATR12	<i>Salsola tragus</i>	prickly Russian thistle	*
Commelinaceae	TROC	<i>Tradescantia occidentalis</i>	prairie spiderwort	
Cyperaceae	CAREX	<i>Carex</i>	sedge	
	CADU6	<i>Carex duriuscula</i>	needleleaf sedge	
	CAEM2	<i>Carex emoryi</i>	Emory's sedge	
	CANE2	<i>Carex nebrascensis</i>	Nebraska sedge	
	CAPE42	<i>Carex pellita</i>	woolly sedge	
	CAPR5	<i>Carex praegracilis</i>	clustered field sedge	
	ELPA3	<i>Eleocharis palustris</i>	common spikerush	
	SCPU10	<i>Schoenoplectus pungens</i>	common threesquare	
	SCTA2	<i>Schoenoplectus tabernaemontani</i>	softstem bulrush	
Elaeagnaceae	ELAN	<i>Elaeagnus angustifolia</i>	Russian olive	*
Equisetaceae	EQLA	<i>Equisetum laevigatum</i>	smooth horsetail	
Euphorbiaceae	CRTE4	<i>Croton texensis</i>	Texas croton	
	EUPHO	<i>Euphorbia</i>	spurge	*
Fabaceae	AMFR	<i>Amorpha fruticosa</i>	desert false indigo	
	MEOF	<i>Melilotus officinalis</i>	yellow sweetclover	*
	PSTE5	<i>Psoraleidium tenuiflorum</i>	slimflower scurfpea	
Grossulariaceae	RIAU	<i>Ribes aureum</i>	golden currant	
Hydrophyllaceae	ELNY	<i>Ellisia nyctelea</i>	Aunt Lucy	
Lamiaceae	LYAM	<i>Lycopus americanus</i>	American water horehound	
	LYAS	<i>Lycopus asper</i>	rough bugleweed	
	NECA2	<i>Nepeta cataria</i>	catnip	*
Loasaceae	MEDE2	<i>Mentzelia decapetala</i>	tenpetal blazingstar	
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	scarlet globemallow	
Nyctaginaceae	MIHI	<i>Mirabilis hirsuta</i>	hairy four o'clock	
Oleaceae	FRPE	<i>Fraxinus pennsylvanica</i>	green ash	
Plantaginaceae	PLMA2	<i>Plantago major</i>	common plantain	

Family	Code	Scientific Name	Common Name	Exotic
Plantaginaceae	PLPA2	<i>Plantago patagonica</i>	woolly plantain	
Poaceae	AGST2	<i>Agrostis stolonifera</i>	creeping bentgrass	
	BOGR2	<i>Bouteloua gracilis</i>	blue grama	
	BRIN2	<i>Bromus inermis</i>	smooth brome	*
	BRTE	<i>Bromus tectorum</i>	cheatgrass	*
	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed	
	ELCA4	<i>Elymus canadensis</i>	Canada wildrye	
	ELRE4	<i>Elymus repens</i>	quackgrass	*
	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	
	HECO26	<i>Hesperostipa comata</i>	needle and thread	
	PAVI2	<i>Panicum virgatum</i>	switchgrass	
	PASM	<i>Pascopyrum smithii</i>	western wheatgrass	
	PHPR3	<i>Phleum pratense</i>	timothy	*
	POCO	<i>Poa compressa</i>	Canada bluegrass	*
	POPR	<i>Poa pratensis</i>	Kentucky bluegrass	*
	SCSC	<i>Schizachyrium scoparium</i>	little bluestem	
	SPPE	<i>Spartina pectinata</i>	prairie cordgrass	
	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed	
	VUOC	<i>Vulpia octoflora</i>	sixweeks fescue	
Polygonaceae	RUCR	<i>Rumex crispus</i>	curly dock	*
Rosaceae	ROAR3	<i>Rosa arkansana</i>	prairie rose	
Salicaceae	PODE3	<i>Populus deltoides</i>	eastern cottonwood	
	SAAM2	<i>Salix amygdaloides</i>	peachleaf willow	
	SAEX	<i>Salix exigua</i>	narrowleaf willow	
Scrophulariaceae	VEAN2	<i>Veronica anagallis-aquatica</i>	water speedwell	
Solanaceae	SORO	<i>Solanum rostratum</i>	buffalobur nightshade	
Typhaceae	TYAN	<i>Typha angustifolia</i>	narrowleaf cattail	*
Verbenaceae	VEBR	<i>Verbena bracteata</i>	bigbract verbena	
Vitaceae	PAVI5	<i>Parthenocissus vitacea</i>	woodbine	