



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

2016 Data Report

Natural Resource Data Series NPS/NGPN/NRDS—2016/1075





ON THIS PAGE

Photograph of long-term monitoring plot PCM_007 at Fort Laramie National Historic Site, 2015.
Photograph courtesy of the National Park Service.

ON THE COVER

Fort Laramie National Historic Site, 2005
Photograph courtesy of the National Park Service

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Contents

	Page
Figures.....	iv
Tables.....	iv
Abstract.....	v
Acknowledgments.....	1
Introduction.....	1
Methods.....	1
NGPN Monitoring Plots 2016.....	1
Plot Layout and Sampling	2
Data Management and Analysis	6
Results.....	7
Literature Cited	13

Figures

	Page
Figure 1. Map of Fort Laramie National Historic Site (FOLA) and plant community monitoring plots visited in 2016	2
Figure 2. Long-term monitoring plot layout used for sampling vegetation at Fort Laramie National Historic Site.....	4
Figure 3. The Northern Great Plains Inventory & Monitoring vegetation crew used point-intercept and 1m ² quadrats to document plant diversity and abundance.	4

Tables

	Page
Table 1. 2016 FOLA Plot Activity Journal.	2
Table 2. Exotic species surveyed for at Fort Laramie National Historic Site	5
Table 3. Definitions of state and global species conservation status ranks.....	5
Table 4. List of all plant species identified in FOLA long-term plant community monitoring plots in 2016.....	7
Table 5. Number of plant species per plot identified in six plots at Fort Laramie National Historic Site in 2016.	10
Table 6. Woody species data from two plots visited at Fort Laramie National Historic Site in 2016.	10
Table 7. Surface fuels summary for two plots visited in 2016 at Fort Laramie National Historic Site.	12
Table 8. Disturbance types and area sizes identified in five plots visited at Fort Laramie National Historic Site in 2016.....	12

Abstract

This report presents the results of vegetation monitoring efforts in 2016 at Fort Laramie National Historic Site (FOLA) by the Northern Great Plains Inventory and Monitoring Network (NGPN).

During the sixth full year of field work, crew members from NGPN visited six long-term monitoring plots to collect data on the plant communities at FOLA. This is part of a long-term monitoring effort to better understand the condition of the riparian and upland forests and prairie at FOLA. NGPN staff captured data relating to species richness, herb-layer height, abundance of individual native and non-native species, ground cover, and site disturbance on each of the six plots. In plots where woody species were present, tree regeneration, tall shrub and tree density, and woody fuel load were also measured.

Our 2016 findings can be summarized as follows: The NGPN monitoring crew identified 98 plant species in six monitoring plots visited in 2016 at FOLA, of which 27 were exotic species. Generally, the three upland plots were more exotic and less diverse than the three plots in and around the riparian zone. Tree regeneration and woody fuel loads were observed at two of the six plots. The most common disturbances observed were flooding in the riparian zones and animal use.

Acknowledgments

We thank the authors of the NGPN Plant Community Monitoring Protocol, particularly A. Symstad, for outstanding guidance on data collection and reporting. Thank you to the staff at FOLA, particularly M. Evans and D. Boley, for their help in the field. The 2016 NGPN vegetation field crew collected all the data included in this report.

Introduction

Fort Laramie National Historic Site (FOLA) was established in 1938 to protect and preserve the well-known military post and covers 833 acres on the boundary of the northern mixed-grass and short-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. 2012). A total of 30 plots were established in FOLA (**Error! Reference source not found.**); 15 lots were randomly distributed throughout the park to better study herbaceous plant communities, 15 plots were established in the riparian forest to assess forest condition, and 5 plots were used to study both forest condition and herbaceous plant communities (Ashton & Davis 2016). In this report, we provide summaries of the data collected from six plots in 2016.

Methods

The NGPN Plant Community Composition and Structure Monitoring Protocol (Symstad et al. 2012b, a) describes in detail the methods used for sampling long-term plots. Below, we briefly describe the general approach. For those interested in more detail, please see the protocol publications cited above, and available at <http://science.nature.nps.gov/im/units/ngpn/monitor/plants.cfm>.

NGPN Monitoring Plots 2016

The NGPN and NGPFire 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 the GRTS design, NGPN selected 15 randomly located sites within FOLA. These 15 sites are split into five panels containing three sites each. The NGPN visits six PCM plots (two panels) every year using a rotating sampling scheme where three sites were visited in the previous year and three sites were most recently visited four years previous. In a full five-year rotation, each plot will have been visited twice. In 2016, the NGPN crew visited PCM plots in panel 1 and panel 5 during the first week of June (Figure 1). Two of the riparian plots were revisited in late August due to late spring flooding (Table 1).

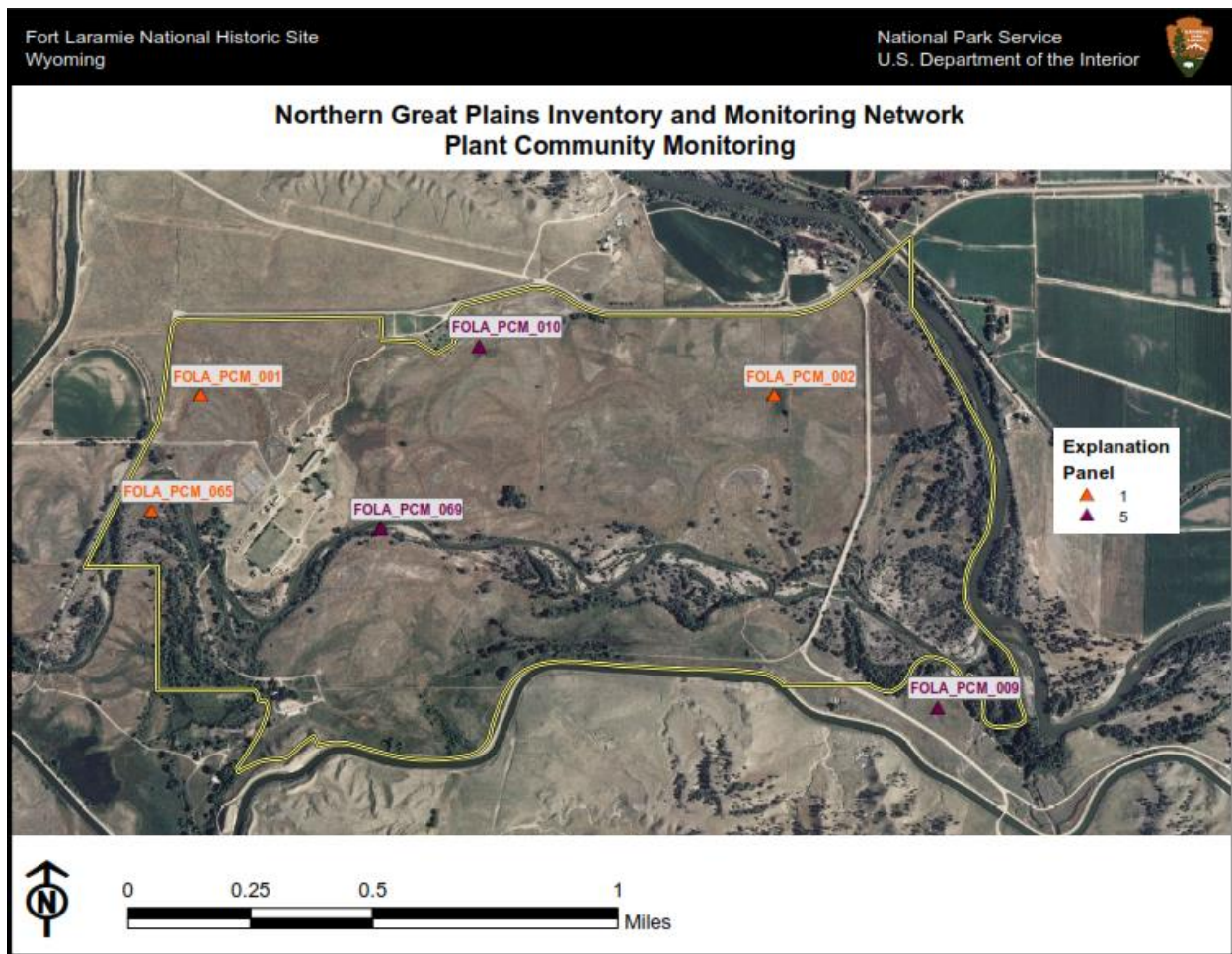


Figure 1. Map of Fort Laramie National Historic Site (FOLA) and plant community monitoring plots visited in 2016. The six long-term plots were established by the Northern Great Plains Inventory and Monitoring Program (NGPN) and the Fire Effects Program (NGPFire) between 2011 and 2015. Three Panel 1 plots (in orange), and three Panel 5 plots (in purple) were monitored in 2016 by NGPN.

Table 1. 2016 Fort Laramie National Historic Site plot activity journal.

Date	Travel Time (Hrs)	Housing	Plots Read/Activity	Plot Notes
6/6/16	6	Holiday Inn Express, Torrington WY	FOLA_PCM_001	(2 hrs) crew of 4; visited riparian area, just flooded
6/7/16	1	Holiday Inn Express, Torrington WY	FOLA_PCM_002	(2 hrs) crew of 4, installed tree transects
			FOLA_PCM_009	(1.5 hrs) crew of 4 + M. Evans
			FOLA_PCM_010	(2 hrs) crew of 4; another plot w/ a tree nearby - didn't add tree transects
6/8/16	6	-	Travel Day	Return to Rapid City
8/22/16	1	Holiday Inn Express, Torrington WY	FOLA_PCM_069	(4 hrs) crew of 5
8/23/16	5.5	AGFO Park Housing	FOLA_PCM_065	(3.5 hrs) crew of 5 + M. Evans & D. Boley

Plot Layout and Sampling

At each of the sites visited the NGPN crew recorded plant species cover and frequency in a rectangular, 50 m x 20 m (0.1 ha), permanent plot (Figure 2). Data on ground cover, herb-layer height ≤ 2 m, and plant cover were collected along two 50 m transects (the long sides of the plot) using a point-intercept method. At 50 locations along each transect, once every 1 meter, a pole was dropped to the ground and all species that touched the pole were recorded, along with ground cover and canopy height. Species richness data from the point-intercept method were supplemented with species presence data collected in five 1 m² quadrats located systematically along each transect (Figure 3). When woody species were also present, tree regeneration and tall shrub density data were collected within a 10 m radius subplot centered in the larger 50 m x 20 m plot (Figure 2). Trees with diameter at breast height (DBH) > 15 cm, located within the entire 0.1 ha plot, were mapped and tagged. For each tree, the species, DBH, status (live or dead), and condition (e.g., leaf-discoloration, insect-damaged, etc.) were recorded. Dead and downed woody fuel load data were also collected at these forested plots along two perpendicular, 100 foot (30.49 m) transects with midpoints at the center of the plot (Figure), following Brown's Line methods (Brown 1974, Brown et al. 1982).

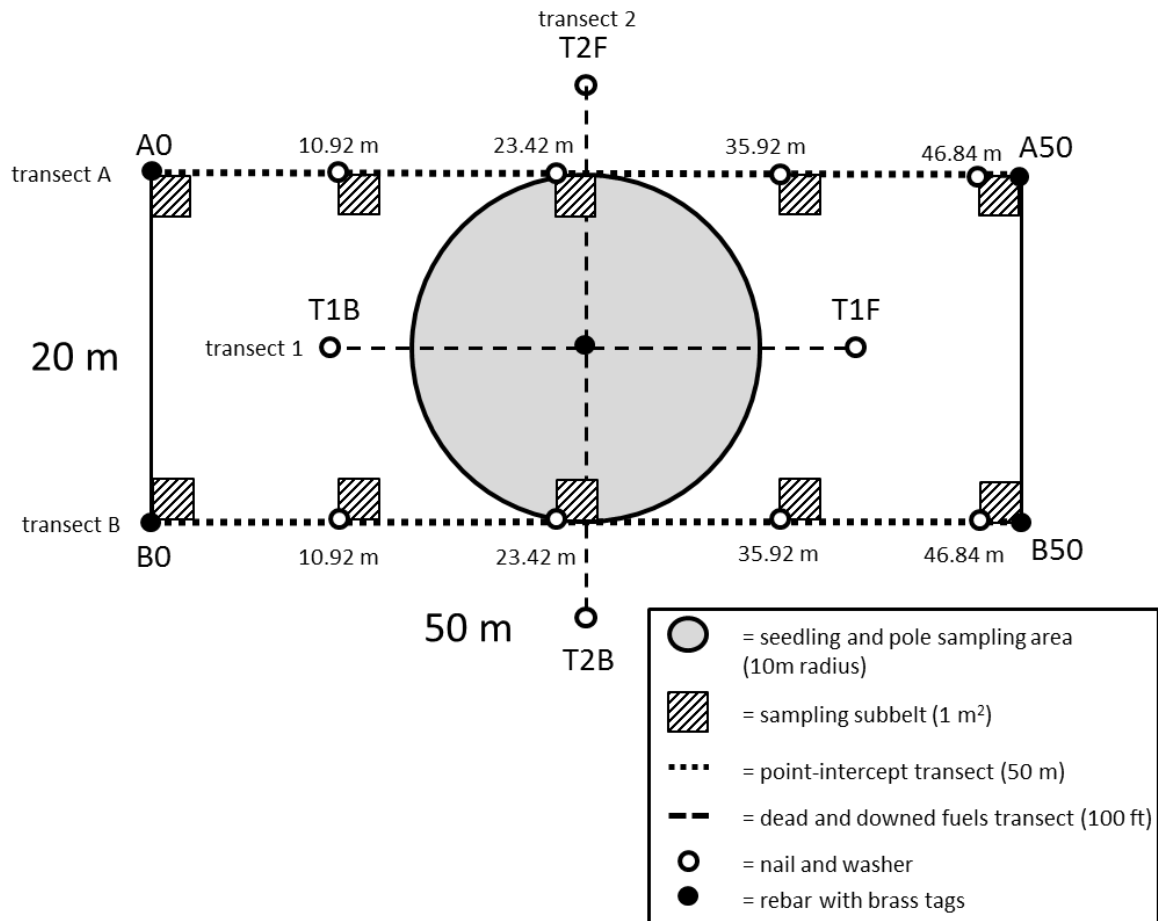


Figure 2. Long-term monitoring plot layout used for sampling vegetation at Fort Laramie National Historic Site.

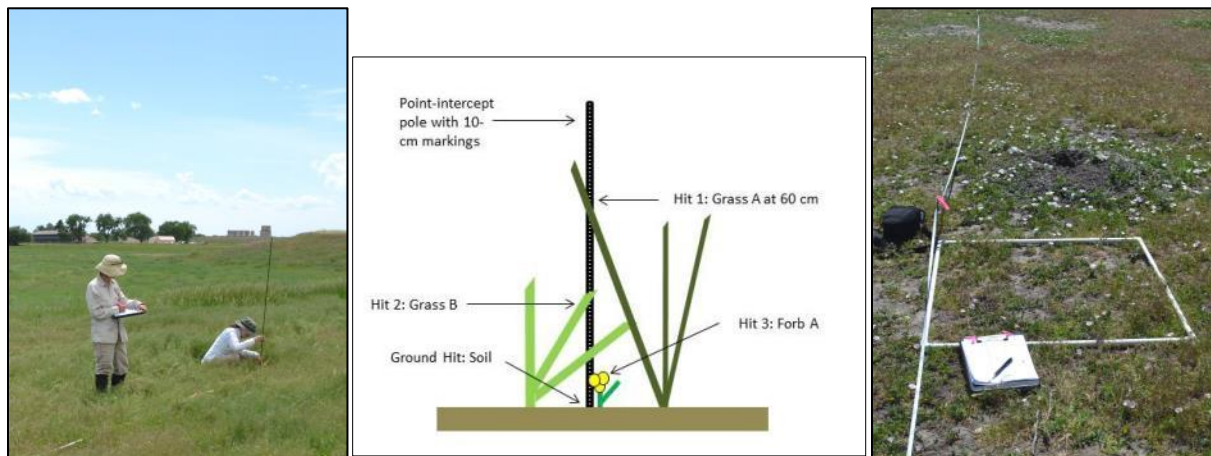


Figure 3. The Northern Great Plains Inventory & Monitoring vegetation crew used point-intercept (left and center panel) and 1m² quadrats (right panel) to document plant diversity and abundance.

At each of the plots visited, common disturbances and target early detection exotic species were also assessed and documented. Common disturbances include such things as prairie dog towns, animal

trails, and fire occurrence. For all plots, the type, severity, and approximate area (m²) of the disturbances were recorded. Early detection exotic species have the potential to spread into the park and cause significant ecological impacts were chosen in collaboration with the Midwest Invasive Plant Network, the Exotic Plant Management Team, park managers, and local weed experts (Table 2). For each early detection exotic species present, 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.

Table 2. 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>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

Table 2 (continued). 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>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 aethiopsis</i>	Mediterranean sage	Upland
<i>Ventenata dubia</i>	African wiregrass	Upland

The conservation status ranks of plant species in Wyoming is determined by the Wyoming Natural Diversity Database (WYNDD). For the purpose of this report, a species was considered rare if its

conservation status rank was S1, S2, or S3. See 3 for a detailed definition of each conservation status rank (Table 3).

Table 3. Definitions of state and global species conservation status ranks*.

Status Rank	Category	Definition
S1/G1	Critically imperiled	Due to extreme rarity (5 or fewer occurrences) or other factor(s) making it especially vulnerable to extirpation.
S2/G2	Imperiled	Due to rarity resulting from a very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation.
S3/G3	Vulnerable	Due to a restricted range, relatively few populations (often 80 or fewer), recent widespread declines, or other factors making it vulnerable to extirpation.
S4/G4	Apparently secure	Uncommon but not rare; some cause for concern due to declines or other factors.
S5/G5	Secure	Common, widespread and abundant.
S#S#/G#G#	Range rank (e.g. S2S3)	Used to indicate uncertainty about the status of the species or community. Ranges cannot skip more than one rank.

*Adapted from NatureServe status assessment table (<http://www.natureserve.org/conservation-tools/conservation-status-assessment>)

Data Management and Analysis

The FFI database (FEAT/FIREMON Integrated; <http://frames.gov/ffi/>) was used as the primary software environment for managing the sampling data. This database 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 2016). Nomenclature follows the Integrated Taxonomic Information System (ITIS) standards (<http://www.itis.gov>). In the rare case where ITIS recognized 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 into the FFI database, 100% of database records were verified with the original data sheets to minimize transcription errors, followed by a final 10% check. After all data were entered and verified, automated queries were used to check for errors in the data. When errors were identified by the crew or the automated queries, changes were made to the original datasheets and the FFI database as needed.

Results

There are 362 plant species on the FOLA plant species list. The NGPN monitoring crew identified 98 or these species in six monitoring plots visited in 2016 at FOLA (Table 4). Of these plant species, 27 are exotic species at FOLA. Exotics plants included tree, forb, and graminoid (grasses, sedges, and rushes) species. Crack willow (*Salix fragilis*) was the only exotic tree observed and is located at FOLA_PCM_065. No rare species were observed in any of the six plots visited in 2016. All shrubs and subshrubs observed were native. Based on all species data collected, FOLA_PCM_069, a plot located in riparian habitat, had the highest native species diversity and FOLA_PCM_001 was the least diverse plot (Table 5). FOLA_PCM_001 and FOLA_PCM_002, both in the upland prairie, had the highest exotic species cover. Generally, the three upland plots were less diverse and more exotic rich, whereas the three plots located in or near the riparian zone were higher in species diversity and nativity. No target early detection exotic species were observed (Table 2).

Table 4. List of all plant species identified in FOLA long-term plant community monitoring plots in 2016. The species are grouped by plant family. An "X" in the exotic column means that species is not native to the park or, in the case where only the genus was identified, there are some species within that genus that are exotic. Species considered to be rare in Wyoming are typically marked in the final column and the state conservation ranks provided.

Family	Symbol	Scientific	Common_Name	Exotic
Anacardiaceae	TORY	<i>Toxicodendron rydbergii</i>	western poison ivy	
Apocynaceae	APCA	<i>Apocynum cannabinum</i>	Indianhemp	
Asclepiadaceae	ASSP	<i>Asclepias speciosa</i>	showy milkweed	
Asteraceae	AMPS	<i>Ambrosia psilostachya</i>	Cuman ragweed	
	AMTO3	<i>Ambrosia tomentosa</i>	skeletonleaf burr ragweed	
	ARBI2	<i>Artemisia biennis</i>	biennial wormwood	X
	ARCA12	<i>Artemisia campestris</i>	field sagewort	
	ARDR4	<i>Artemisia dracunculus</i>	tarragon	
	ARFI2	<i>Artemisia filifolia</i>	sand sagebrush	
	ARFR4	<i>Artemisia frigida</i>	prairie sagewort	
	ARLU	<i>Artemisia ludoviciana</i>	white sagebrush	
	BIFR	<i>Bidens frondosa</i>	devil's beggartick	
	BITR	<i>Bidens tripartita</i>	threelobe beggarticks	
	CIAR4	<i>Cirsium arvense</i>	Canada thistle	X
	CIFL	<i>Cirsium flodmanii</i>	Flodman's thistle	
	COCA5	<i>Conyza canadensis</i>	Canadian horseweed	
	GRSQ	<i>Grindelia squarrosa</i>	curlycup gumweed	
	HELIA3	<i>Helianthus</i>	sunflower	
	LASE	<i>Lactuca serriola</i>	prickly lettuce	X
	LYJU	<i>Lygodesmia juncea</i>	rush skeletonplant	
	ONAC	<i>Onopordum acanthium</i>	Scotch cottonthistle	X
	SERI2	<i>Senecio riddellii</i>	Riddell's ragwort	

Table 4 (continued). List of all plant species identified in FOLA long-term plant community monitoring plots in 2016. The species are grouped by plant family. An “X” in the exotic column means that species is not native to the park or, in the case where only the genus was identified, there are some species within that genus that are exotic. Species considered to be rare in Wyoming are typically marked in the final column and the state conservation ranks provided.

Family	Symbol	Scientific	Common_Name	Exotic
Asteraceae (continued)	TAOF	<i>Taraxacum officinale</i>	common dandelion	X
	TRDU	<i>Tragopogon dubius</i>	yellow salsify	X
	XAST	<i>Xanthium strumarium</i>	rough cocklebur	
Boraginaceae	LAOC3	<i>Lappula occidentalis</i>	flatspine stickseed	
	LIIN2	<i>Lithospermum incisum</i>	narrowleaf stoneseed	
Brassicaceae	ALDE	<i>Alyssum desertorum</i>	desert madwort	X
	CAMI2	<i>Camelina microcarpa</i>	littlepod false flax	X
	DEPI	<i>Descurainia pinnata</i>	western tansymustard	
	DESO2	<i>Descurainia sophia</i>	herb sophia	X
	LEDE	<i>Lepidium densiflorum</i>	common pepperweed	
	SIAL2	<i>Sisymbrium altissimum</i>	tall tumbledmustard	X
Cactaceae	OPMA2	<i>Opuntia macrorhiza</i>	twistspine pricklypear	
	OPPO	<i>Opuntia polyacantha</i>	plains pricklypear	
Capparaceae	PODO3	<i>Polanisia dodecandra</i>	redwhisker clammyweed	
Caprifoliaceae	SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry	
Chenopodiaceae	CHENO	<i>Chenopodium</i>	goosefoot	X
	KOSC	<i>Kochia scoparia</i>	burningbush, kochia	X
	SATR12	<i>Salsola tragus</i>	prickly Russian thistle	X
Commelinaceae	TROC	<i>Tradescantia occidentalis</i>	prairie spiderwort	
Convolvulaceae	COAR4	<i>Convolvulus arvensis</i>	field bindweed	X
Cyperaceae	CADU6	<i>Carex duriuscula</i>	needleleaf sedge	
	CAHY4	<i>Carex hystericina</i>	bottlebrush sedge	
	CYPER	<i>Cyperus</i>	flatsedge	X
	CYSQ	<i>Cyperus squarrosus</i>	bearded flatsedge	
Elaeagnaceae	SHAR	<i>Shepherdia argentea</i>	silver buffaloberry	
Equisetaceae	EQAR	<i>Equisetum arvense</i>	field horsetail	
	EQLA	<i>Equisetum laevigatum</i>	smooth horsetail	
Euphorbiaceae	EUGL3	<i>Euphorbia glyptosperma</i>		
	CRTE4	<i>Croton texensis</i>	Texas croton	
Fabaceae	AMFR	<i>Amorpha fruticosa</i>	desert false indigo	
	GLLE3	<i>Glycyrrhiza lepidota</i>	American licorice	
	MELU	<i>Medicago lupulina</i>	black medick	X
	MEOF	<i>Melilotus officinalis</i>	yellow sweetclover	X
Grossulariaceae	RIAU	<i>Ribes aureum</i>	golden currant	
Juncaceae	JUNCU	<i>Juncus</i>	rush	X
Lamiaceae	LYAM	<i>Lycopus americanus</i>	American water horehound	

Table 4 (continued). List of all plant species identified in FOLA long-term plant community monitoring plots in 2016. The species are grouped by plant family. An “X” in the exotic column means that species is not native to the park or, in the case where only the genus was identified, there are some species within that genus that are exotic. Species considered to be rare in Wyoming are typically marked in the final column and the state conservation ranks provided.

Family	Symbol	Scientific	Common_Name	Exotic
Loasaceae	MENU	<i>Mentzelia nuda</i>	bractless blazingstar	
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	scarlet globemallow	
Oleaceae	FRPE	<i>Fraxinus pennsylvanica</i>	green ash	
Onagraceae	OECU2	<i>Oenothera curtiflora</i>	velvetweed	
	OESU99	<i>Oenothera suffrutescens</i>	scarlet beeblossom	
Plantaginaceae	PLMA2	<i>Plantago major</i>	common plantain	
Poaceae	ACHY	<i>Achnatherum hymenoides</i>	Indian ricegrass	
	AGST2	<i>Agrostis stolonifera</i>	creeping bentgrass	
	ARPU9	<i>Aristida purpurea</i>	purple threeawn	
	BOGR2	<i>Bouteloua gracilis</i>	blue grama	
	BRIN2	<i>Bromus inermis</i>	smooth brome	X
	BRJA	<i>Bromus japonicus</i>	Japanese brome	X
	BRTE	<i>Bromus tectorum</i>	cheatgrass	X
	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed	
	ECMU2	<i>Echinochloa muricata</i>	rough barnyardgrass	
	ELRE4	<i>Elymus repens</i>	quackgrass	X
	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	
	ERCI	<i>Eragrostis cilianensis</i>	stinkgrass	X
	HECO26	<i>Hesperostipa comata</i>	needle and thread	
	LEOR	<i>Leersia oryzoides</i>	rice cutgrass	
	NAVI4	<i>Nassella viridula</i>	green needlegrass	
	PACA6	<i>Panicum capillare</i>	witchgrass	
	PASM	<i>Pascopyrum smithii</i>	western wheatgrass	
	PAVI2	<i>Panicum virgatum</i>	switchgrass	
	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed	
	SPPE	<i>Spartina pectinata</i>	prairie cordgrass	
	VUOC	<i>Vulpia octoflora</i>	sixweeks fescue	
Polygonaceae	PEMA24	<i>Persicaria maculosa</i>	spotted ladythumb	X
Salicaceae	POAC5	<i>Populus acuminata</i>	lanceleaf cottonwood	
	PODE3	<i>Populus deltoides</i>	eastern cottonwood	
	SAAM2	<i>Salix amygdaloides</i>	peachleaf willow	
	SAEX	<i>Salix exigua</i>	narrowleaf willow	
	SAFR	<i>Salix fragilis</i>	crack willow	X
Solanaceae	PHLO4	<i>Physalis longifolia</i>	longleaf groundcherry	
	SORO	<i>Solanum rostratum</i>	buffalobur nightshade	

Table 4 (continued). List of all plant species identified in FOLA long-term plant community monitoring plots in 2016. The species are grouped by plant family. An “X” in the exotic column means that species is not native to the park or, in the case where only the genus was identified, there are some species within that genus that are exotic. Species considered to be rare in Wyoming are typically marked in the final column and the state conservation ranks provided.

Family	Symbol	Scientific	Common Name	Exotic
Unknown Family	UNKFORB	<i>Unknown forb</i>	unknown forb	X
	UNKGRAM	<i>Unknown graminoid</i>	unknown graminoid	X
Verbenaceae	PHCU3	<i>Phyla cuneifolia</i>	wedgeleaf	
	VEBR	<i>Verbena bracteata</i>	bigbract verbena	
	VEHA2	<i>Verbena hastata</i>	swamp verbena	

Table 5. Number of plant species per plot identified in six plots at Fort Laramie National Historic Site in 2016.

MacroPlot Name	Native species	Exotic species	Total species
FOLA_PCM_001	10	6	16
FOLA_PCM_002	14	11	25
FOLA_PCM_009	15	7	22
FOLA_PCM_010	20	11	31
FOLA_PCM_065	16	7	23
FOLA_PCM_069	34	13	47

Live trees and seedlings were present in two of the six plots visited in 2016 (Table 6). Data collected included species name, size class based on diameter at breast height (DBH), status (live or dead), total number of individuals, and density per hectare. DBH categories are tree (DBH>15 cm), pole (2.54 cm<DBH>15 cm), and seedling (DBH<2.54 cm). Tree regeneration was greatest in FOLA_PCM_069, a plot along the riparian corridor, with a total pole count of 18.

Table 6. Woody species data from two plots visited at Fort Laramie National Historic Site in 2016. DBH categories are tree (DBH>15 cm), pole (2.54 cm<DBH>15 cm), and seedling (DBH<2.54 cm).

Plot Name	Common Name	DBH	Status	Total Individuals	Density/ha.
FOLA_PCM_069	Green ash	Tree	Alive	1	10
FOLA_PCM_069	Peachleaf willow	Tree	Alive	1	10
FOLA_PCM_069	Eastern cottonwood	Pole	Alive	18	574
FOLA_PCM_069	Eastern cottonwood	Tree	Alive	2	20
FOLA_PCM_065	Crack willow	Tree	Alive	1	10
FOLA_PCM_065	Eastern cottonwood	Tree	Alive	1	10

Dead and downed wood and surface fuels provide foraging habitat and refugia for wildlife, substrate for mosses and fungi, and microhabitats that can encourage plant establishment. When surface fuels

are too abundant they can increase the risk of high intensity fires. The NGP Fire Effects Program has developed a management target for surface fuels of 2-10 tons per acre within Black Hills parks. We surveyed surface fuels in six plots and FOLA_PCM_065 and FOLA_PCM_069 were the only plots with measurable fuels (Table 7). While there were trees near FOLA_PCM_002, no measurable woody fuels were present.

Disturbances were observed in five of six plant community monitoring plots at FOLA in 2016 (Table 8). The most common disturbances were: animal use resulting in trails and trampled or missing vegetation, and prescribed fire evidence which was often most noticeable as char and scars on trees.

Table 7. Surface fuels summary for two plots visited in 2016 at Fort Laramie National Historic Site.

Macroplot	Average Tons per Acre										Avg. Depth (in.)		
	1-hr	10-hr	100-hr	1-100-hr	1000-hr sound	1000-hr rotten	1-1000-hr	Duff	Litter	Total	Duff	Litt	Total
FOLA_PCM_065	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.1	0.1
FOLA_PCM_069	0.0	0.0	0.0	0.0	0.2	1.7	1.9	0.0	0.1	2.0	0.0	0.1	0.1

Table 8. Disturbance type and approximate area observed in five plots visited at Fort Laramie National Historic Site in 2016. The size was approximated, and out of a total area of 1000 m².

MacroPlot Name	Disturbance Type	Size (m ²)
FOLA_PCM_001	Animal Trail	20
FOLA_PCM_002	None	--
FOLA_PCM_009	Small Mammal	50
FOLA_PCM_010	Road	250
	Animal Trail	750
	Small Mammal	5
FOLA_PCM_065	Flood	1000
FOLA_PCM_069	Flood	1000
	Beaver	20

Literature Cited

- Ashton, I., M. Prowatzke, M. Bynum, T. Shepherd, S. K. Wilson, and K. Paintner-Green. 2012. Fort Union Trading Post National Historic Site plant community composition and structure monitoring: 2011 annual report. Natural Resource Technical Report NPS/NGPN/NRTR—2012/528. National Park Service, Fort Collins, Colorado.
- Brown, J. K. 1974. Handbook for inventorying downed material. General Technical Report INT-16. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.
- Brown, J. K., R. D. Oberhue, and C. M. Johnston. 1982. Inventorying surface fuels and biomass in the Interior West. General Technical Report INT-129. USDA Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT.
- Stevens, D. L. and A. R. Olsen. 2003. Variance estimation for spatially balanced samples of environmental resources. *Environmetrics* 14:593-610.
- Stevens, D. L. and A. R. Olsen. 2004. Spatially balanced sampling of natural resources. *Journal Of The American Statistical Association* 99:262-278.
- Symstad, A. J., R.A. Gitzen, C. L. Wienk, M. R. Bynum, D. J. Swanson, A. D. Thorstenson, and K. J. Paintner. 2012a. Plant community composition and structure monitoring protocol for the Northern Great Plains I&M Network-Standard Operating Procedures: version 1.01. Natural Resource Report NPS/NGPN/ NRR-2012/489.1.
- Symstad, A. J., R.A. Gitzen, C. L. Wienk, M. R. Bynum, D. J. Swanson, A. D. Thorstenson, and K. J. Paintner. 2012b. Plant community composition and structure monitoring protocol for the Northern Great Plains I&M Network: version 1.01. Natural Resource Report NPS/NGPN/ NRR-2012/489.
- USDA-NRCS. 2016. The PLANTS Database (<http://plants.usda.gov>, 02 December 2016). National Plant Data Team, Greensboro, NC 27401-4901 USA.
- Wienk, C., A. Thorstenson, J. Freeman, and D. Swanson. 2011. Northern Great Plains Fire Ecology Program review: 1997-2007. Natural Resource Report NPS/NRDS/NRDS—2010/112. National Park Service, Fort Collins, Colorado.

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