



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

2020 Data Report

Natural Resource Data Series NPS/FOLA/NRDS—2022/1350





ON THIS PAGE

The rolling hills of Fort Laramie National Historic Site
Photo by Amy Symstad, United States Geological Survey

ON THE COVER

The grassland prairie of Fort Laramie National Historic Site
Photo by Amy Symstad, United States Geological Survey

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April 2022

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science
Fort Collins, Colorado

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Please cite this publication as:

Bortz, T.M., M. B. Davis, and R. M. Manuel. 2022. Plant community composition and structure monitoring at Fort Laramie National Historic Site: 2020 data report. Natural Resource Data Series NPS/FOLA/NRDS—2022/1350. National Park Service, Fort Collins, Colorado.
<https://doi.org/10.36967/nrds-2293003>.

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Abstract

This report presents the results of vegetation monitoring efforts in 2020 at Fort Laramie National Historic Site (FOLA) by the Northern Great Plains Inventory and Monitoring Network (NGPN) and the United States Geological Survey (USGS). This was the tenth year of combined monitoring efforts.

Crew members from USGS visited 9 long-term monitoring plots to collect data on the plant communities at FOLA. This work is part of a long-term monitoring effort designed to provide a better understanding of the condition of the vegetation community at FOLA and how it changes over time. USGS staff measured species richness, herb-layer height, native and non-native species abundance, ground cover, and site disturbance at each of the nine plots. In plots where woody species were present, tree regeneration, tall shrub density, tree density, and woody fuel loads were also measured. Data collection at seven plots was incomplete, where only point-intercept, site disturbance, and invasive species presence data were collected, while in two plots the previously listed protocols as well as the quadrat protocol were performed.

In 2020, the monitoring crews identified 44 unique plant species in 9 monitoring plots. Of those species, 19 were exotic species. In a majority of plots (5 of 9), there was a greater percent of native species cover compared to exotic species cover. However, exotic plants were found at every plot in FOLA. No rare species were observed during our surveys.

Acknowledgments

We thank all the authors of the NGPN Plant Community Monitoring Protocol, particularly A. Symstad, for outstanding guidance on data collection and reporting. Thank you to the staff at FOLA for providing logistical support. The 2020 USGS vegetation field crew, A. Symstad and A. Sechrist, collected the data included in this report. The 2020 NGPN vegetation field crew—I. Ashton, R. Manuel, M. Davis, and T. Bortz—entered and summarized data.

Introduction

Fort Laramie National Historic Site (FOLA) was established in 1938 to protect and preserve the well-known military post that occupies 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 (Heidel 2004). The Northern Great Plains Inventory & Monitoring Program (NGPN) began vegetation monitoring at FOLA in 2011 (Ashton et al. 2012) and has revisited the park every year between 2011 and 2020. A total of 30 permanent vegetation monitoring plots, which are separated into five panels, were established at FOLA between 2011 and 2014. Of these 30 plots, 10 plots 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 riparian forest condition and herbaceous plant communities (Ashton and Davis 2016).

Usually, plots are visited and observed by the Northern Great Plains Inventory and Monitoring team, however, in 2020 plots were visited by USGS staff. NGPN staff were unable to travel out-of-state or further than a 100-mile radius from Rapid City, SD due to travel restrictions from the COVID-19 pandemic. Thankfully, A. Symstad, a colleague from USGS, volunteered to collect data on Plant Community Monitoring (PCM) plots. Symstad and the USGS vegetation team's efforts allowed for the continued long-term observation of plant communities in Fort Laramie National Historic Site.

According to NGPN's monitoring schedule, a total of six plots—three in Panel 4 (PCM_007, PCM_012, and PCM_068) and three in Panel 5 (PCM_009, PCM_010, and PCM_069)—were originally scheduled to be visited by NGPN in 2020. When USGS volunteered to collect data for the NGPN team, they visited four of these plots—two in each panel—plus an additional 5 plots (PCM_001 and PCM_002 in Panel 1, PCM_003 in Panel 2, and PCM_006 and PCM_011 in Panel 3). These additional plots were located within, or overlap, a 2019 Annual Brome Adaptive Monitoring (ABAM) Indazaflam treatment area and were scheduled to be visited by the USGS team. In this report we provide summaries of the data collected from the nine upland plots visited in 2020 (Figure 1).

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. The general approach is briefly described below. For more detail, please see the monitoring protocol and standard operating procedures, available at <https://www.nps.gov/im/ngpn/plant-communities.htm>.

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 where we established vegetation monitoring plots (Figure 1). Ten sites are in upland areas of the park and five sites are located along the riparian corridor. Each plot was assigned to one of five panels and two panels were visited per year. In total, six plots are visited each year (four in upland areas and two riparian areas), and after five years all 15 plots are visited twice. In 2020, field crews visited nine plots during the first week of June (Table 1).

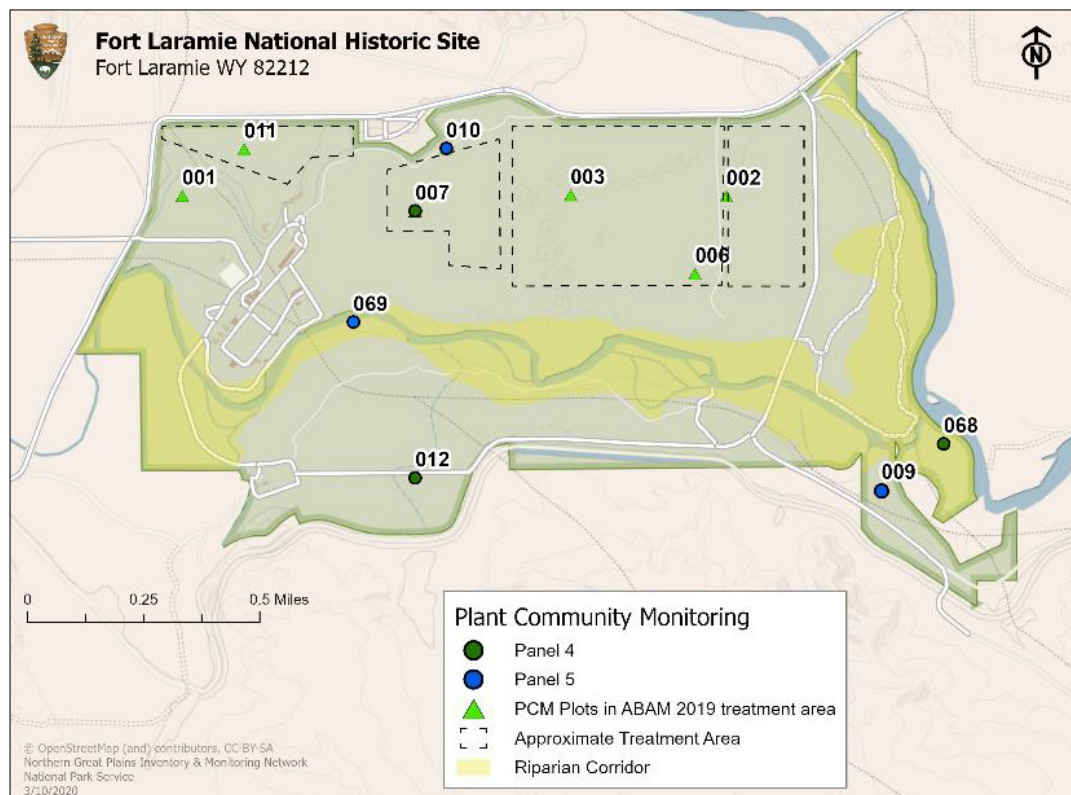


Figure 1. Fort Laramie National Historic Site plant community monitoring plots visited in 2020 by the United States Geological Survey team. Regularly scheduled plots are represented by circles (blue and green) while PCM plots in ABAM treatment areas are represented by triangles. Two plant community monitoring plots that were scheduled to be visited by the Northern Great Plains Network Inventory & Monitoring Program in 2020 were not visited due to time constraints (Plot_069 and Plot_068).

Table 1. Field journal for monitoring plot visits at Fort Laramie National Historic Site in 2020. A total of 9 plots were visited by United States Geological Survey for Northern Great Plains Inventory & Monitoring.

Date Visited	Plot Name	Field Notes
June 8, 2020	PCM_001	Panel 1
June 8, 2020	PCM_011	Panel 3
June 9, 2020	PCM_002	Panel 1. ABAM treatment area.
June 9, 2020	PCM_003	Panel 2. ABAM treatment area.
June 9, 2020	PCM_007	Panel 4. ABAM treatment area. Has quadrat data
June 9, 2020	PCM_010	Panel 5. Overlaps ABAM treatment area. Has quadrat data
June 10, 2020	PCM_006	Panel 3. ABAM treatment area.
June 10, 2020	PCM_009	Panel 5
June 10, 2020	PCM_012	Panel 4
Not Visited	PCM_068	Panel 4. Skipped due to time constraints
Not Visited	PCM_069	Panel 5. Skipped due to time constraints

Plot Layout and Sampling

At each site visited, the USGS 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 on two 50 m transects (the long sides of the plot) using a point-intercept method (Figure 3). 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 2). If a plant species was identified in the plot but was not included on the verified park species list, a voucher plant specimen was collected when possible and submitted to a botanist for independent verification.

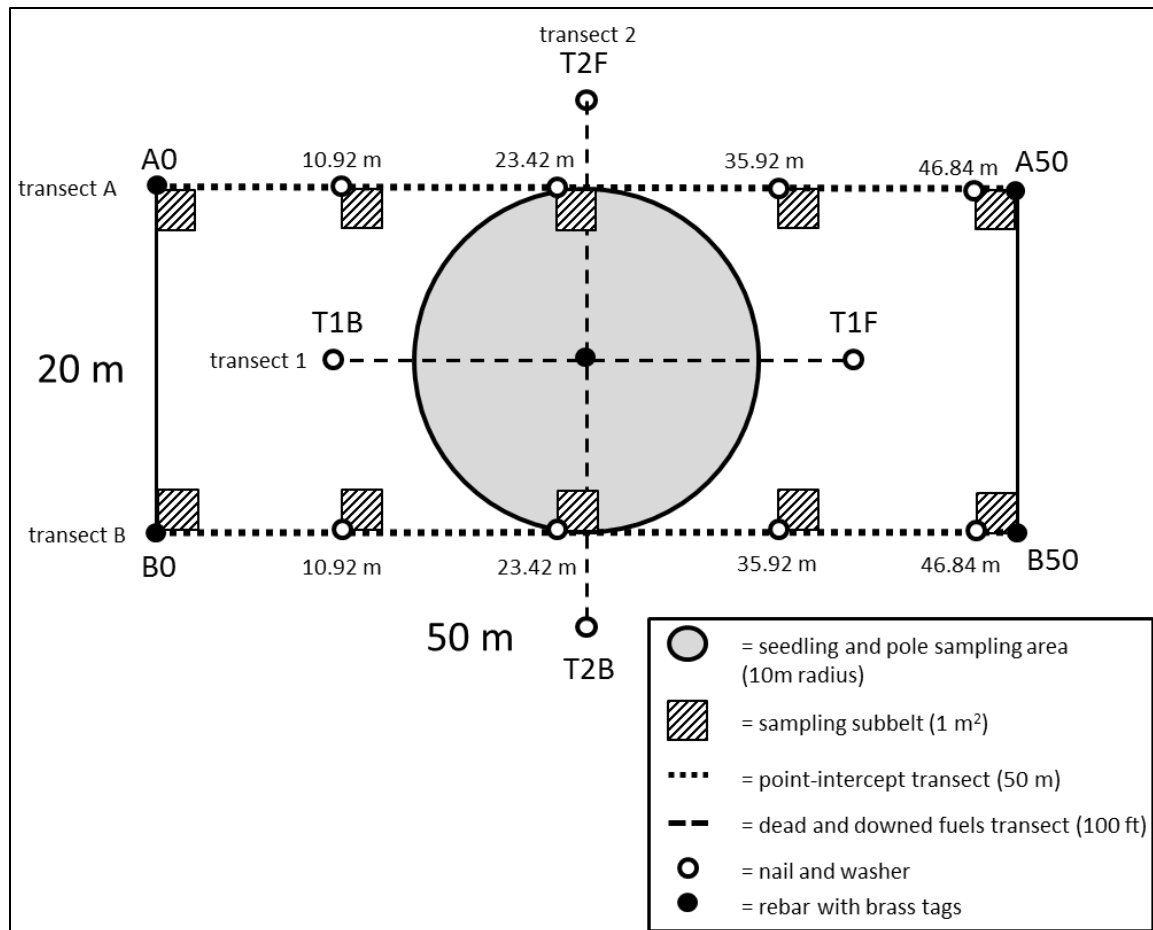


Figure 2. Long-term monitoring plot layout used for sampling vegetation used by the Northern Great Plains Inventory and Monitoring vegetation crew.

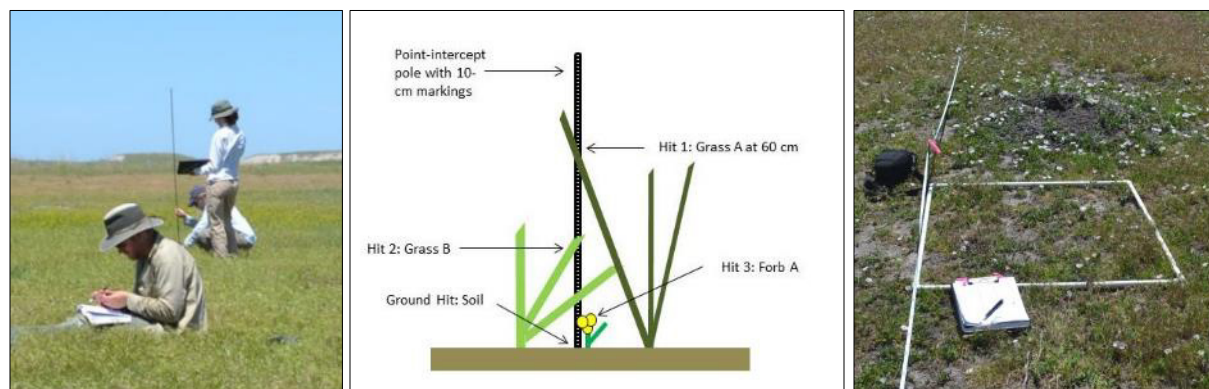


Figure 3. The Northern Great Plains Inventory & Monitoring vegetation crew used point-intercept (left and center panel) and quadrats (right panel) to document plant diversity and abundance.

When woody species were present within 38 m of plot center, tree regeneration and tall shrub density data were collected within a 10 m radius subplot centered in the larger 50 m x 20 m (0.1 ha) plot. Trees within the entire 0.1 ha plot with a diameter at breast height (DBH) of > 15 cm were mapped

and tagged. For each tree, the species, DBH, status (live or dead), and condition (e.g., leaf-discoloration, insect-damaged) were recorded. For all poles ($2.54 \leq \text{DBH} \leq 15$ cm) located within the 10 m radius subplot, only DBH and status were recorded. Tree and tall shrub species with $\text{DBH} < 2.54$ cm (seedlings) were tallied by species within the 10 m radius subplot. Dead and downed woody fuel load data were collected along two perpendicular, 100 ft (30.49 m) transects (fuel lines) with midpoints at the center of the plot (Figure 2), following Brown's Line methods (Brown 1974, Brown et al. 1982). Fuel load data were only collected if at least one piece of woody litter or fuel intersected a fuel line.

Common disturbances were assessed and documented at each plot. The type of disturbance, such as animal trails, erosion or prairie dogs was recorded, and the area of the disturbance was estimated in m^2 . For some large-scale disturbances like fire, the disturbance was recorded as either present or absent. Plots were also assessed for the presence and abundance of target exotic species (Table 2), which is critical for early detection and rapid response to exotic species threats. These species were chosen in collaboration with the Midwest Invasive Plant Network, Northern Great Plains Exotic Plant Management Team, park managers, and local weed experts. Each target species was assigned an abundance class from 1–5, based on an ocular estimate of cover, where 1 = one individual, 2 = few individuals, 3 = cover of 1–5%, 4 = cover of 5–25%, and 5 = cover > 25% of the plot.

Table 2. Exotic species included in the Northern Great Plains Network's early detection and rapid response program.

Habitat	Scientific Name	Common Name
Riparian	<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
Upland	<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

Table 2 (continued). Exotic species included in the Northern Great Plains Network’s early detection and rapid response program.

Habitat	Scientific Name	Common Name
Upland	<i>Euphorbia myrsinites</i> & <i>E. cyparissias</i>	myrtle spurge
Upland	<i>Dipsacus fullonum</i> & <i>D. laciniatus</i>	common teasel
Upland	<i>Salvia aethiopis</i>	Mediterranean sage
Upland	<i>Ventenata dubia</i>	African wiregrass

Data Management and Analysis

FFI (FEAT/FIREMON Integrated; <http://frames.gov/ffi/>) was the primary software environment used 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, common names, and native status are from the USDA Plants Database (USDA-NRCS 2017). However, nomenclature follows the Integrated Taxonomic Information System (ITIS). In the few cases 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 were entered in the database, 100% of records were verified with the original data sheets to minimize transcription errors, followed by a 10% review of records to confirm accuracy. Automated queries were used to check for any remaining errors in the data. When errors were identified by the crew or the automated queries, corrections were made to the original datasheets and the FFI database.

Data summaries were produced using the FFI reporting and query tools and R software (R version 3.6.1). The number of species encountered in each plot was calculated using data from point-intercept, quadrat, woody species, and target species protocols. Absolute cover was calculated using point-intercept data and is the total number of vegetation intercepts. This is often greater than 100% because more than one species can be intercepted per point due to overlapping vegetation.

The conservation status rank of plant species observed at FOLA in 2020 was determined by cross-referencing with the NatureServe conservation status list, as well as the Wyoming rare plant species lists. For this report, a species is considered rare or of conservation concern if its global (G) or state (S) conservation status rank is classified as critically imperiled (G1/S1), imperiled (G2/S2), or vulnerable (G3/S3). The 2020 species list was also cross-referenced with the list of county and state noxious weeds maintained by the Wyoming Department of Agriculture.

Results

There are 393 vascular plant species on the [FOLA species list](#), and the USGS field crew identified a total of 44 species from 9 monitoring plots in 2020 (Table 3). Of these species, 19 are exotic species for the park. The 2020 species list was cross-referenced with state-wide rare and noxious exotic species lists for Wyoming. No rare or noxious exotic species were observed.

Based on the total count of species observed in each plot in 2020, PCM_010 had the highest number with 27 total species (Table 4). Plot PCM_010 had the most native diversity, with 18 native species (Figure 4). Absolute cover calculations (Table 5) reflected a greater percent of native species cover compared to exotic species cover in the majority (5 out of 9) of plots. FOLA_PCM_011 had the highest absolute native species cover, and FOLA_PCM_012 had the highest absolute exotic species cover (Table 5; Figure 5). Exotic species were observed at every plot in FOLA. One exotic species, *Bromus tectorum* (Downy Brome or Cheatgrass), was present in all 9 plots.

Table 3. List of all plant species identified in Fort Laramie National Historic Site plant community monitoring plots in 2020. In the Notes column, “Exotic” indicates that a 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. State or county noxious weed species are designated in the Notes column. Rare species are designated in the Notes column as Rare, along with their conservation rank.

Family	Species Code	Scientific Name	Common Name	Notes
Asteraceae	AMPS	<i>Ambrosia psilostachya</i>	Cuman ragweed	–
Asteraceae	AMTO3	<i>Ambrosia tomentosa</i>	skeletonleaf burr ragweed	–
Asteraceae	ARFI2	<i>Artemisia filifolia</i>	sand sagebrush	–
Asteraceae	ARFR4	<i>Artemisia frigida</i>	fringed sagewort	–
Asteraceae	ARLU	<i>Artemisia ludoviciana</i>	white sagebrush	–
Asteraceae	ONAC	<i>Onopordum acanthium</i>	Scotch cottonthistle	Exotic
Asteraceae	ARDR4	<i>Artemisia dracunculus</i>	tarragon	–
Asteraceae	GRSQ	<i>Grindelia squarrosa</i>	curlycup gumweed	–
Asteraceae	HELIA3	<i>Helianthus</i>	sunflower	–
Asteraceae	SYER	<i>Symphyotrichum ericoides</i>	white heath aster	–
Asteraceae	TRDU	<i>Tragopogon dubius</i>	yellow salsify	Exotic
Brassicaceae	ALDE	<i>Alyssum desertorum</i>	desert madwort	Exotic
Brassicaceae	THAR5	<i>Thlaspi arvense</i>	field pennycress	Exotic
Cactaceae	OPMA2	<i>Opuntia macrorhiza</i>	twistspine pricklypear	–
Cactaceae	OPPO	<i>Opuntia polyacantha</i>	plains pricklypear	–
Chenopodiaceae	CHENO	<i>Chenopodium</i>	goosefoot	Exotic
Chenopodiaceae	SATR12	<i>Salsola tragus</i>	prickly Russian thistle	Exotic
Chenopodiaceae	KOSC	<i>Kochia scoparia</i>	burningbush; kochia	Exotic
Chenopodiaceae	SALSO	<i>Salsola</i>	Russian thistle	Exotic
Convolvulaceae	COAR4	<i>Convolvulus arvensis</i>	field bindweed	Exotic
Cyperaceae	CADU6	<i>Carex duriuscula</i>	needleleaf sedge	–
Cyperaceae	CANE2	<i>Carex nebrascensis</i>	Nebraska sedge	–
Cyperaceae	CAPR5	<i>Carex praegracilis</i>	clustered field sedge	–
Cyperaceae	CAREX	<i>Carex</i>	sedge	–
Equisetaceae	EQLA	<i>Equisetum laevigatum</i>	smooth horsetail	–
Fabaceae	GLLE3	<i>Glycyrrhiza lepidota</i>	American licorice	–
Fabaceae	MEOF	<i>Melilotus officinalis</i>	yellow sweetclover	Exotic

Table 3 (continued). List of all plant species identified in Fort Laramie National Historic Site plant community monitoring plots in 2020. In the Notes column, “Exotic” indicates that a 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. State or county noxious weed species are designated in the Notes column. Rare species are designated in the Notes column as Rare, along with their conservation rank.

Family	Species Code	Scientific Name	Common Name	Notes
Fabaceae	MESA	<i>Medicago sativa</i>	alfalfa	Exotic
Grossulariaceae	RIAU	<i>Ribes aureum</i>	golden currant	–
Juncaceae	JUCO	<i>Juncus compressus</i>	roundfruit rush	Exotic
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	scarlet globemallow	–
Onagraceae	OESU99	<i>Oenothera suffrutescens</i>	scarlet beeblossom	–
Poaceae	ARPU9	<i>Aristida purpurea</i>	purple threeawn	–
Poaceae	BOGR2	<i>Bouteloua gracilis</i>	blue grama	–
Poaceae	BRIN2	<i>Bromus inermis</i>	smooth brome	Exotic
Poaceae	BRJA	<i>Bromus japonicus</i>	Japanese brome	Exotic
Poaceae	BRTE	<i>Bromus tectorum</i>	cheatgrass	Exotic
Poaceae	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed	–
Poaceae	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	–
Poaceae	HECO26	<i>Hesperostipa comata</i>	needle and thread	–
Poaceae	NAVI4	<i>Nassella viridula</i>	green needlegrass	–
Poaceae	PASM	<i>Pascopyrum smithii</i>	western wheatgrass	–
Poaceae	POPR	<i>Poa pratensis</i>	Kentucky bluegrass	Exotic
Poaceae	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed	–
Poaceae	AGCR	<i>Agropyron cristatum</i>	crested wheatgrass	Exotic
Unknown Family	UNKGRAMPER	Unknown perennial graminoid	unknown perennial graminoid	Exotic
Unknown Family	UNKFORB	Unknown forb	unknown forb	Exotic
Solanaceae	SORO	<i>Solanum rostratum</i>	buffalobur nightshade	–

Table 4. Total number of plant species identified in each of the 9 plots monitored at Fort Laramie National Historic Site (FOLA) in 2020. This is a count of all unique species identified in the plot using species data from point-intercept, quadrat, woody species, and target species protocols. Note that additional quadrat data was collected at two plots, FOLA_PCM_007 and FOLA_PCM_010, resulting in an increased species count at these two plots.

Plot Name	Exotic Species	Native Species	Total species
FOLA_PCM_001	2	7	9
FOLA_PCM_002	2	4	6
FOLA_PCM_003	2	2	4
FOLA_PCM_006	3	9	12
FOLA_PCM_007	9	10	19
FOLA_PCM_009	1	6	7
FOLA_PCM_010	9	18	27
FOLA_PCM_011	1	9	10
FOLA_PCM_012	9	11	20



Figure 4. Plot FOLA_PCM_010 was one of the plots with the most native species diversity in 2020. Photograph courtesy of the United States Geological Survey.

Table 5. Absolute percent cover of native and exotic plant species in plots monitored at Fort Laramie National Historic Site in 2020. Absolute percent cover is calculated using the point-intercept data. This includes overlapping species canopies, which can result in values greater than 100%.

Plot	Absolute % Exotic Cover	Absolute % Native Cover
FOLA_PCM_001	16	61
FOLA_PCM_002	21	46
FOLA_PCM_003	51	31
FOLA_PCM_006	57	43
FOLA_PCM_007	6	63
FOLA_PCM_009	52	45
FOLA_PCM_010	33	51
FOLA_PCM_011	5	77
FOLA_PCM_012	89	54



Figure 5. Fort Laramie National Historic Site plot PCM_011 was one of the plots with the highest absolute native species cover in 2020. Photograph courtesy of the United States Geological Survey.

The USGS monitoring crew did not collect any woody species data at the nine plots visited in 2020. The tree, seedling, and surface fuel protocols were skipped due to personnel shortages, COVID-19

travel restrictions, and overall time constraints. However, woody species protocols were completed in past years in plots PCM_002, PCM_006, and PCM_012. Previous years data show no trees, seedlings, or fuels present in any of the observed areas.

Disturbances occurred at many of the plots visited in 2020 (Table 6). There was a variety of disturbances observed, including small mammals, animal trails, roads, and soil disturbance. The most common disturbance observed was soil disturbance, which was observed at 8 plots; while road disturbance covered the largest area, 72m².

Table 6. Disturbance types and occurrence in plant community monitoring plots visited in 2020 at Fort Laramie National Historic Site.

Plot	Disturbance Type	Area (m ²)
FOLA_PCM_001	Small Mammal	1.00
FOLA_PCM_001	Soil Disturbance	1.00
FOLA_PCM_002	Small Mammal	0.25
FOLA_PCM_003	Small Mammal	2.00
FOLA_PCM_003	Soil Disturbance	2.00
FOLA_PCM_006	Animal Trail	1.00
FOLA_PCM_006	Small Mammal	1.00
FOLA_PCM_006	Soil Disturbance	1.00
FOLA_PCM_007	Animal Trail	1.20
FOLA_PCM_007	Soil Disturbance	0.25
FOLA_PCM_009	Small Mammal	2.00
FOLA_PCM_009	Soil Disturbance	2.00
FOLA_PCM_010	Road	72.00
FOLA_PCM_010	Soil Disturbance	0.25
FOLA_PCM_011	Small Mammal	15.00
FOLA_PCM_011	Soil Disturbance	15.00
FOLA_PCM_012	Small Mammal	10.00
FOLA_PCM_012	Soil Disturbance	10.00

Further Analysis

This Data Report is intended to provide a basic review of the data collected during the USGS monitoring team's 2020 visit to Fort Laramie National Historic Site for the Northern Great Plains Inventory and Monitoring Network. All data included in this report is available upon request from the Northern Great Plains Inventory and Monitoring Network, as well as in the archives found in the [IRMA Data Store](#).

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NPS 375/180053, April 2022

National Park Service
U.S. Department of the Interior



Natural Resource Stewardship and Science

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