National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Plant Community Composition and Structure Monitoring at Knife River Indian Villages National Historic Site

2017 Data Summary Report

Natural Resource Data Series NPS/NGPN/NRDS—2018/1154

ON THE COVER

Image from long-term plant community monitoring plot PCM_001 at Knife River Indian Villages National Historic Site, visited in July 2017.

Photograph courtesy of the National Park Service.

Plant Community Composition and Structure Monitoring at Knife River Indian Villages National Historic Site

2017 Data Summary Report

Natural Resource Data Series NPS/NGPN/NRDS—2018/1154

Stephanie L. Rockwood

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

March 2018

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

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

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.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available in digital format from the Northern Great Plains Inventory & Monitoring website and the Natural Resource Publications Management website.

Please cite this publication as:

Rockwood, S. L. 2018. Plant community composition and structure monitoring at Knife River Indian Villages National Historic Site: 2017 data summary report. Natural Resource Data Series NPS/NGPN/NRDS—2018/1154. National Park Service, Fort Collins, Colorado.

NPS 468/143325, March 2018

Contents

Page

Figures....iv

Tables....v

Abstract....vi

Acknowledgments....vii

Introduction....1

Methods....3

Sample Design....3

Plot Layout and Sampling....4

Data Management and Analysis....7

Results....8

Further Analysis....18

Literature Cited....19

Figures

Page

Figure 1. Map of Knife River Indian Villages National Historic Site (KNRI) long-term monitoring plots visited in 2017. 2

Figure 2. Long-term monitoring plot layout used for sampling vegetation used by the Northern Great Plains Inventory and Monitoring vegetation crew..... 5

Figure 3. The Northern Great Plains Inventory & Monitoring vegetation crew used point-intercept and quadrats to document plant diversity and abundance..... 5

Figure 4. Overview of plot PCM_006 at Knife River Indian Villages National Historic Site, July 2017..... 15

Figure 5. Orange stakes used to replace some of the metal rebar and nails in plot at Knife River Indian Villages National Historic Site.. 17

Tables

Page

Table 1. Field journal for Northern Great Plains Network (NGPN) plant community monitoring (PCM) at Knife River Indian Villages National Historic Site (KNRI) in 2017. 3

Table 2. Field journal for Northern Great Plains Fire Effects Program (NGPFire) visits to plant community monitoring (PCM) plots at Knife River Indian Villages National Historic Site (KNRI) in 2017. 4

Table 3. Exotic species included in the Northern Great Plains Network's early detection and rapid response program. 6

Table 4. List of all plant species identified in Knife River Indian Villages National Historic Site long-term plant community monitoring plots in 2017. 8

Table 5. Total number of plant species identified in each of the 21 plots monitored at KNRI in 2017. 12

Table 6. Absolute percent cover of native and exotic plant species in plots monitored at KNRI in 2017. 13

Table 7. Woody species data from three long-term monitoring plots visited at Knife River Indian Villages National Historic Site in 2017. 14

Table 8. Surface fuels summary for four plots visited in 2017 at Knife River Indian Villages National Historic Site by NGPN. 15

Table 9. Disturbance type and area observed in eight plots visited at Knife River Indian Villages National Historic Site by NGPN in 2017. 16

Abstract

This report presents the results of vegetation monitoring in 2017 at Knife River Indian Villages National Historic Site (KNRI) by the Northern Great Plains Inventory and Monitoring Network (NGPN) and the Northern Great Plains Fire Effects Program (NGPFire). This was the seventh year of field work conducted by NGPN at KNRI.

In 2017, 21 long-term plant community monitoring (PCM) plots were visited to collect data on the plant communities at KNRI. Crew members from NGPN visited eight PCM plots and the NGPFire crew visited thirteen PCM plots. This work is part of a long-term monitoring effort designed to provide a better understanding of the condition of the vegetation community and how it changes over time. Crews measured species richness, herb-layer height, native and non-native species abundance, ground cover, and site disturbance at each of the six plots. In plots where woody species were present, tree regeneration, tall shrub density, tree density, and woody fuel loads were also measured.

In 2017, monitoring crews identified 100 unique plant species, 21 of which were exotic species. No rare plants or early detection exotic plants were observed. Overall, the plots visited in 2017 were on average more exotic than native in absolute cover. The NGPN crew collected tree regeneration and fuel load data in four of the 21 plots. A total of seven different tree and shrub species were present. The most commonly observed ground disturbances were severe drought, prescribed fire, and animal use.

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 KNRI, particularly J. Schiferl, for providing logistical support and performing safety checks. The NGPN crew of M. Davis, I. Ashton, and S. Rockwood, and the NGPFire crew of D. Swanson, T. Schaffner, M. Whitman, and I. Muirhead collected all the data included in this report.

Introduction

Knife River Indian Villages National Historic Site (KNRI) was established in 1974 with a mission to commemorate the culture and history of the Northern Great Plains Indian peoples and to preserve, study, and interpret the historic and archeological resources of the site. KNRI sits on 1,758 acres of upland mixed-grass prairie and riparian forests, much of which has a long history of human use. As a result of its agricultural legacy and a loss of natural disturbance regimes, exotic species play a major role in the makeup of the park's current vegetation (DeKeyser and Krabbenhoft 2006). In 1997 the Northern Great Plains Fire Ecology Program began monitoring vegetation in KNRI (NGPFire; Wienk et al. 2010), and in 2010 KNRI monitoring was incorporated into the Northern Great Plains Inventory & Monitoring Network (NGPN). At that time, vegetation monitoring protocols and plot locations were modified to better represent the entire park and to better coordinate efforts with NGPFire (Symstad et al. 2012b). A total of 37 plots were established in KNRI by NGPFire and NGPN, and combined sampling efforts began in 2011 (Ashton et al. 2012).

In this report, we provide summaries of the vegetation data collected in 2017 from a total of 21 plots (Figure 1). For a more in-depth data report on long-term trends at KNRI, refer to the 1998-2016 summary report (Davis and Ashton, 2017).

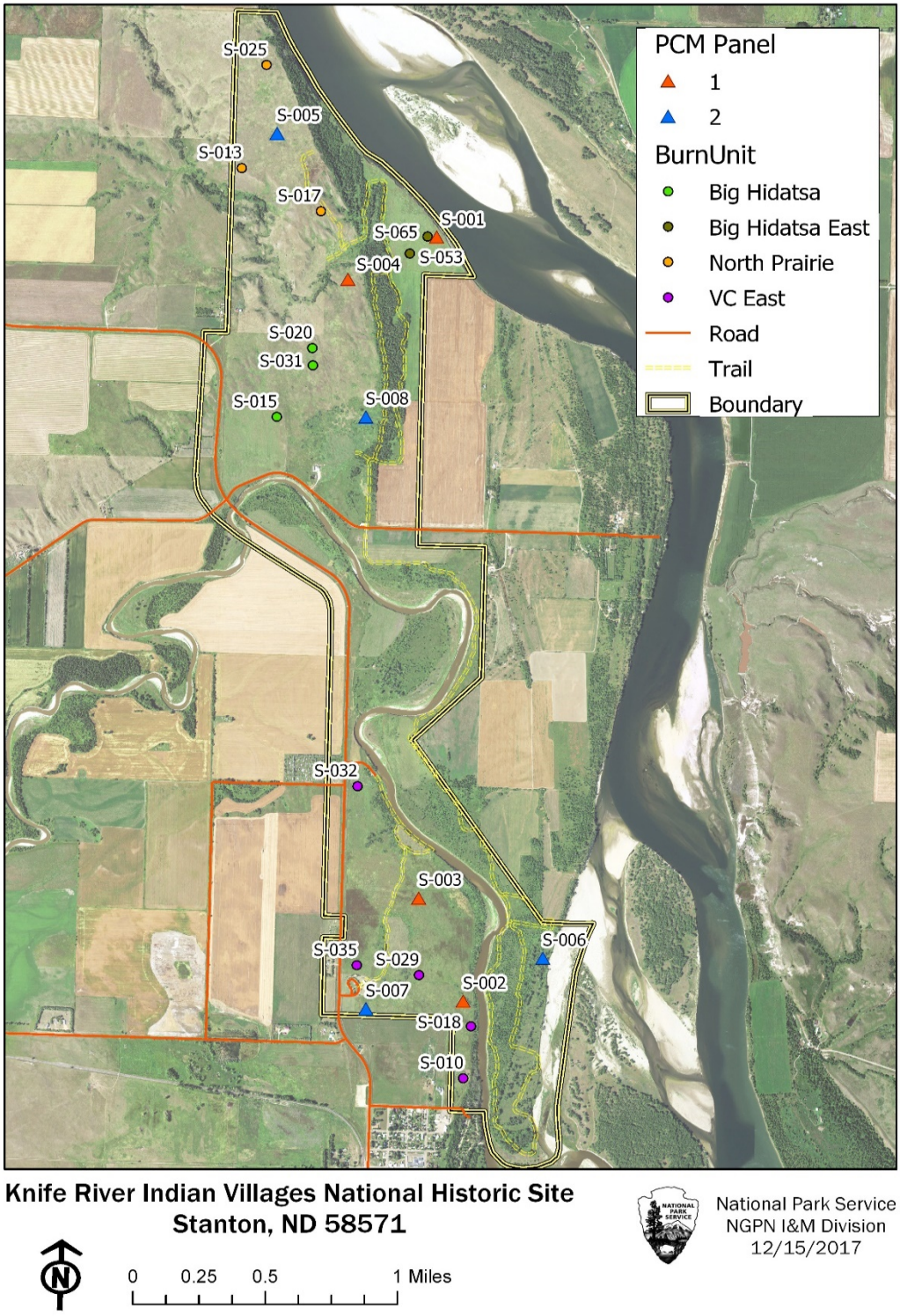

Figure 1. Map of Knife River Indian Villages National Historic Site (KNRI) long-term monitoring plots visited in 2017. Four Panel 1 and four Panel 2 Plant Community Monitoring (PCM) plots were visited by the Northern Great Plains Inventory & Monitoring (NGPN), and thirteen plots were visited by the Northern Great Plains Fire Effects Program (NGPFire). Burn unit designations are based on the KNRI fire management plan for prescribed fire use in the park.

Methods

The NGPN Plant Community Composition and Structure Monitoring Protocol (Symstad et al. 2012b, a) describes in detail the methods used for sampling long-term plots. The general approach is briefly described below. For more detail, please see Symstad et al. 2012a, available at http://science.nature.nps.gov/im/units/ngpn/monitor/plants.cfm.

Sample Design

The NGPN and NGPFire implemented a survey to monitor plant community structure and composition at KNRI using a spatially balanced probability design (Generalized Random Tessellation Stratified [GRTS]; Stevens and Olsen 2003, 2004). Using a GRTS design, 20 randomly located sites were selected within KNRI to become Plant Community Monitoring (PCM) plots. These sites were split into five panels of four sites each. An NGPN crew visits two panels (eight PCM plots) during late July every year, using a rotating sampling scheme that consists of four sites visited the previous year and four sites that have not been visited for four years. Data from these randomly selected sites can be used to estimate condition of vegetation communities for the whole park, and over time to discern trends in condition. In 2017, the NGPN crew visited sites in panel 1 and panel 2 (Figure 1). Sampling was completed by a three-person crew in approximately 62 crew hours (Table 1). This total does not include the weather delays or drive time between Rapid City and KNRI. The crew lodged for four nights at the AmericInn in Beulah, ND.

Table 1. Field journal for Northern Great Plains Network (NGPN) plant community monitoring (PCM) at Knife River Indian Villages National Historic Site (KNRI) in 2017. An NGPN crew of three people completed 8 PCM plots.

Travel Time	Date Visited	Field Time	Plot Name	Field Notes
30 min	7/24/2017	1 hour	PCM_007	Severe drought
30 min each way	7/25/2017	4 hours	PCM_002	Voucher plant specimen collected; lots of shrubs!
	7/25/2017	2 hours	PCM_003	No trees in plot
	7/25/2017	3 hours	PCM_006	Adjusted tree nails to correct heights
30 min each way	7/26/2017	3 hours	PCM_005	Seedlings nearby, but not in plot; extra travel time to plot ~1.5 hours along trail; rain delays
	7/26/2017	2 hours	PCM_004	Plastic stakes melted along transects; replaced B50 with rebar, and B4 with nail/washer
30 min each way	7/27/2017	2 hours	PCM_001	Severe drought; plot in restoration area; lots of rain delays
	7/27/2017	1 hour	PCM_008	Replaced a missing corner plastic marker with rebar at A50

NGPFire established new sites focused in active burn units [Fire Plant Community Monitoring (FPCM) plots] using the same GRTS sampling schema. When a PCM or FPCM plot fell within an active burn unit, NGPFire visited additional plots based on a 1, 2, 5, and 10 year sampling schedule. In 2017, the NGPFire crew visited a total of 13 sites in four active burn units (Figure 1). Burn unit sampling was completed by a four-person crew in approximately 118 crew hours (Table 2). This total does not include weather delays and drive time between Wind Cave National Park and KNRI. The crew also lodged for four nights at the AmericInn in Beulah, ND.

Table 2. Field journal for Northern Great Plains Fire Effects Program (NGPFire) visits to plant community monitoring (PCM) plots at Knife River Indian Villages National Historic Site (KNRI) in 2017. An NGPFire crew of four people completed 13 PCM plots.

Travel Time	Date Visited	Burn Unit	Field Time	Plot Name	Field Notes
30 min each way	7/18/2017	Big Hidatsa	2 hours	PCM_015	Severe drought
	7/18/2017	Big Hidatsa	2 hours	PCM_020	Severe drought
	7/18/2017	Big Hidatsa	2 hours	FPCM_031	Severe drought
	7/18/2017	Big Hidatsa East	2 hours	FPCM_053	Drought
30 min each way	7/19/2017	Big Hidatsa East	2 hours	FPCM_065	Drought
	7/19/2017	V.C. East	2 hours	FPCM_029	Severe drought
	7/19/2017	V.C. East	2 hours	FPCM_032	Drought
	7/19/2017	V.C. East	2 hours	FPCM_035	Drought
30 min each way	7/20/2017	V.C. East	2 hours	PCM_010	Drought
	7/20/2017	V.C. East	2 hours	PCM_018	Severe drought
	7/20/2017	North Prairie	2 hours	PCM_013	Severe drought
30 min	7/21/2017	North Prairie	2 hours	FPCM_025	Severe drought
	7/21/2017	North Prairie	2 hours	PCM_017	Severe drought

Plot Layout and Sampling

At each site 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 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 m^2 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.

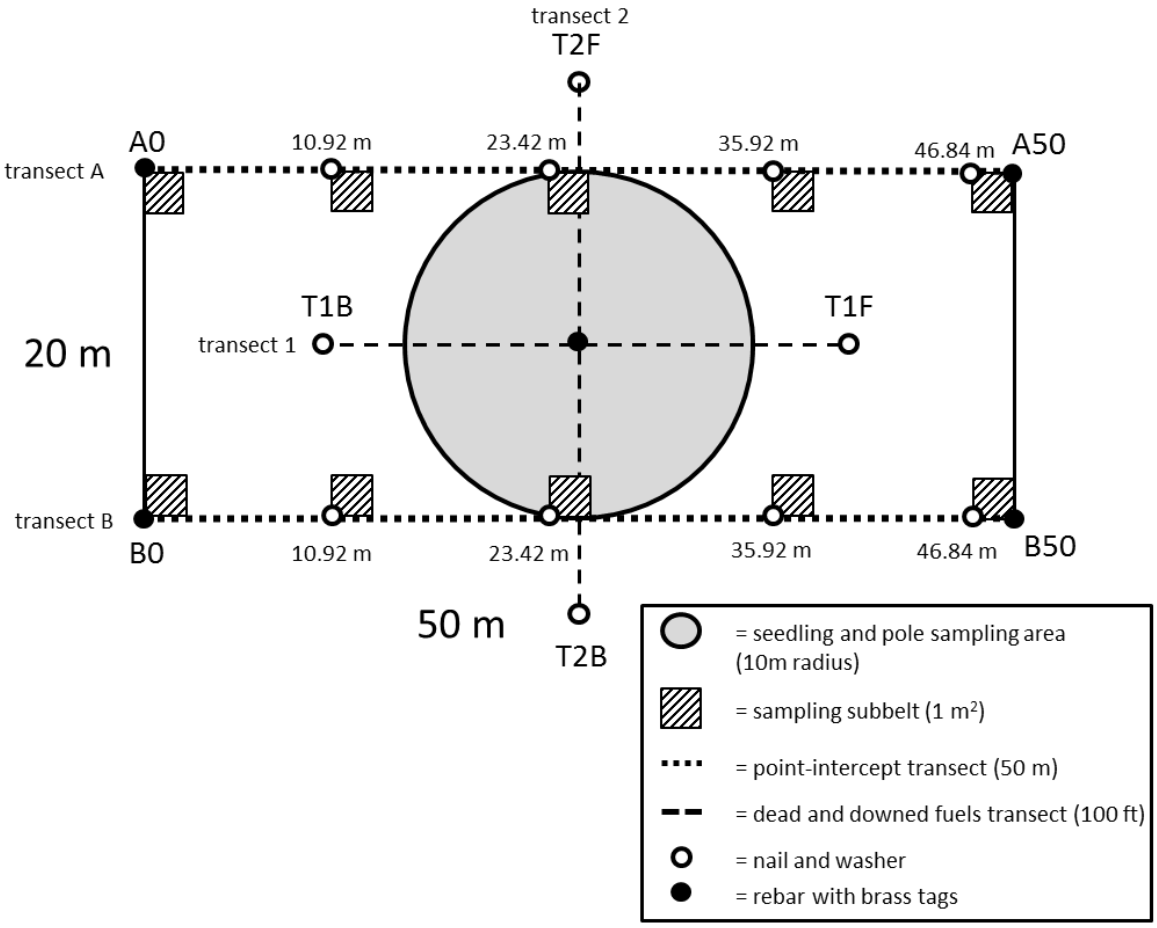

Figure 2. Long-term monitoring plot layout used for sampling vegetation used by the Northern Great Plains Inventory and Monitoring vegetation crew.

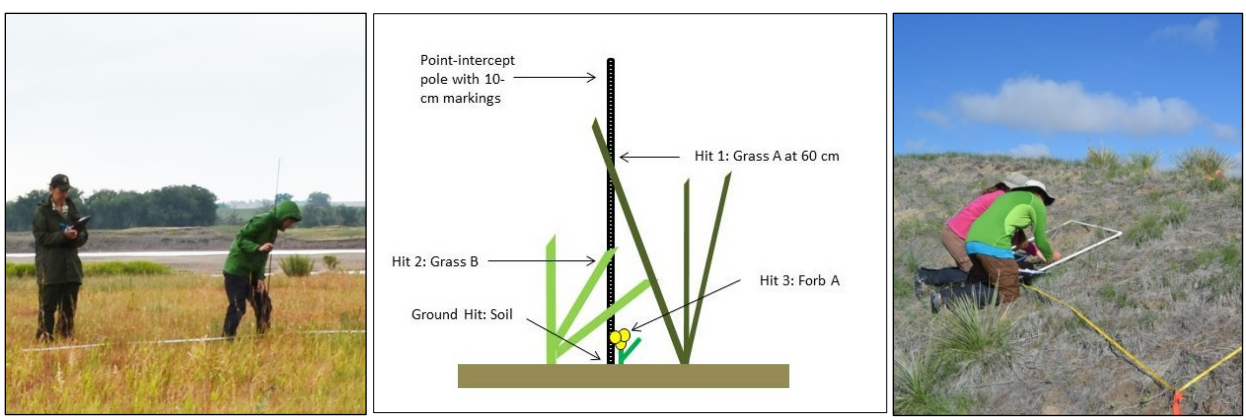

Figure 3. The Northern Great Plains Inventory & Monitoring vegetation crew used point-intercept (left and center panel) and quadrats (right panel) to document plant diversity and abundance.

When woody species were present within 38 m of plot center, monitoring crews collected tree regeneration and tall shrub density data within a 10 m radius subplot centered in the larger 50 m x 20 m (0.1 ha) plot. Trees with diameter at breast height (DBH) > 15 cm, present within the 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. For all poles (2.54 ≤ DBH ≤ 15 cm) located within the 10 m radius subplot, only DBH and status were recorded. Tree and tall shrub species with 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.

The NGPN crew assessed and documented common disturbances at each plot. The type, which included rodent mounds, animal trails, and fire, and the approximate area (m^2) of each disturbance was recorded. Plots were also assessed for the presence and abundance of target exotic species (Table 3), 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 3. Exotic species included in the Northern Great Plains Network's early detection and rapid response program. ND Status indicates if the species is on North Dakota's list of noxious weeds.

Habitat	Scientific Name	Common Name	ND Status
Riparian	*Alliaria petiolata*	garlic mustard	–
	Polygonum cuspidatum; P. sachalinense; P. x bohemicum	knotweeds	–
	Pueraria montana var. lobata	kudzu	–
	Iris pseudacorus	yellow iris	–
	Ailanthus altissima	tree of heaven	–
	Lepidium latifolium	perennial pepperweed	–
	Arundo donax	giant reed	–
	Rhamnus cathartica	common buckthorn	–
	Heracleum mantegazzianum	giant hogweed	–
Upland	*Centaurea solstitialis*	yellow star thistle	–
	Hieracium aurantiacum; H. caespitosum	orange and meadow hawkweed	–
	Isatis tinctoria	Dyer's woad	–
	Taeniatherum caput-medusae	medusahead	–
	Chondrilla juncea	rush skeletonweed	–
	Gypsophila paniculata	baby's breath	–

Table 3 (continued). Exotic species included in the Northern Great Plains Network's early detection and rapid response program. ND Status indicates if the species is on North Dakota's list of noxious weeds.

Habitat	Scientific Name	Common Name	ND Status
Upland, cont.	*Centaurea virgata; C.diffusa*	knapweeds	Noxious
	Linaria dalmatica; L. vulgaris	toadflax	Noxious
	Euphorbia myrsinites & E. cyparissias	myrtle spurge	–
	Dipsacus fullonum & D. laciniatus	common teasel	–
	Salvia aethiopis	Mediterranean sage	–
	Ventenata dubia	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 recognizes a new name that was not in the USDA PLANTS database, the new name was used, and a unique plant code was assigned. In the case where there is not enough evidence for genus and species identification, a special code for the unknown species was created. These are then designated as an exotic species in the total count, but omitted from the species list.

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. After all data were entered and verified, 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. 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 KNRI in 2017 was determined by cross-referencing with the NatureServe conservation status list, as well as the North Dakota rare plant species list. For the purpose of this report, a species was considered rare or of conservation concern if its state or global conservation status rank was critically imperiled (S1/G1), imperiled (S1/G2), or vulnerable (S3/G3. More information on conservation ranks can be found at the NatureServe website. The 2017 species list was also cross-referenced with the list of noxious weeds maintained by the North Dakota Department of Agriculture.

Results

There are 285 plant species on the KNRI species list, and the NGPN and NGPFire monitoring crews identified a total of 100 species from 21 monitoring plots visited in 2017 (Table 4). Of these species, 21 are exotic species for the park. The 2017 species list was cross-referenced with state-wide rare and noxious exotic species lists for North Dakota. Three noxious exotic species matched the North Dakota list: absinth wormwood (*Artemisia absinthium*), Canada thistle (*Cirsium arvense*), and leafy spurge (*Euphorbia esula*). These exotic species are abundant and widespread in North Dakota. No rare plant species were identified by either crew. Plant species identified by monitoring crews were also cross-referenced with the NPSpecies list for KNRI, which resulted in two potential new species for the park: wavyleaf thistle (*Cirsium undulatum*) and strict blue-eyed grass (*Sisyrinchium montanum*). Samples of these species will be collected during a future field season for verification.

Table 4. List of all plant species identified in Knife River Indian Villages National Historic Site long-term plant community monitoring plots in 2017. 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-wide noxious weed species designated as “Noxious” for North Dakota in the Notes column. Species that are not on the NPS species list for KNRI are indicated with “New” in the notes column.

Family	Symbol	Scientific Name	Common Name	Notes
Asclepiadaceae	ASPU	*Asclepias pumila*	plains milkweed	–
	ASSY	*Asclepias syriaca*	common milkweed	–
Asteraceae	ACMI2	*Achillea millefolium*	common yarrow	–
	ANPA4	*Antennaria parvifolia*	small-leaf pussytoes	–
	ARAB3	*Artemisia absinthium*	absinthium	Exotic, Noxious
	ARDR4	*Artemisia dracunculus*	tarragon	–
	ARFR4	*Artemisia frigida*	prairie sagewort	–
	ARLU	*Artemisia ludoviciana*	white sagebrush	–
	CIAR4	*Cirsium arvense*	Canada thistle	Exotic, Noxious
	CIFL	*Cirsium flodmanii*	Flodman's thistle	–
	CIUN	*Cirsium undulatum*	wavyleaf thistle	New
	COCA5	*Conyza canadensis*	Canadian horseweed	–
	ECAN2	*Echinacea angustifolia*	blacksamson echinacea	–
	HEVI4	*Heterotheca villosa*	hairy false goldenaster	–
	LIPU	*Liatris punctata*	dotted blazing star	–
	LYJU	*Lygodesmia juncea*	rush skeletonplant	–
	MUOB99	*Mulgedium oblongifolium*	blue lettuce	–
	RACO3	*Ratibida columnifera*	upright prairie coneflower	–

Table 4 (continued). List of all plant species identified in Knife River Indian Villages National Historic Site long-term plant community monitoring plots in 2017. 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-wide noxious weed species designated as “Noxious” for North Dakota in the Notes column. Species that are not on the NPS species list for KNRI are indicated with “New” in the notes column.

Family	Symbol	Scientific Name	Common Name	Notes
Asteraceae, cont.	SOMI2	*Solidago missouriensis*	Missouri goldenrod	–
	SOMO	*Solidago mollis*	velvety goldenrod	–
	SONE	*Solidago nemoralis*	gray goldenrod	–
	SORI2	*Solidago rigida*	stiff goldenrod	–
	SOAR2	*Sonchus arvensis*	field sowthistle	Exotic
	SYER	*Symphyotrichum ericoides*	white heath aster	–
	SYOB	*Symphyotrichum oblongifolium*	aromatic aster	–
	TAOF	*Taraxacum officinale*	common dandelion	Exotic
	TRDU	*Tragopogon dubius*	yellow salsify	Exotic
Boraginaceae	LIIN2	*Lithospermum incisum*	narrowleaf stoneseed	–
Brassicaceae	BOHO99	*Boechera holboellii*	Holboell's rockcress	–
Caprifoliaceae	SYOC	*Symphoricarpos occidentalis*	western snowberry	–
Chenopodiaceae	CHENO	*Chenopodium spp.*	goosefoot	Exotic
Convolvulaceae	COAR4	*Convolvulus arvensis*	field bindweed	Exotic
Cyperaceae	CAREX	*Carex*	sedge	–
	CABR10	*Carex brevior*	shortbeak sedge	–
	CADU6	*Carex duriuscula*	needleleaf sedge	–
	CAFI	*Carex filifolia*	threadleaf sedge	–
	CAIN9	*Carex inops*	long-stolon sedge	–
Elaeagnaceae	SHAR	*Shepherdia argentea*	silver buffaloberry	–
Euphorbiaceae	EUES	*Euphorbia esula*	leafy spurge	Exotic, Noxious
Fabaceae	ACAM99	*Acmispon americanus*	American bird's-foot trefoil	–
	AMCA6	*Amorpha canescens*	leadplant	–
	ASBI2	*Astragalus bisulcatus*	twogrooved milkvetch	–
	DACA7	*Dalea candida*	white prairie clover	–
	DAPU5	*Dalea purpurea*	purple prairie clover	–
	GLLE3	*Glycyrrhiza lepidota*	American licorice	–
	MELU	*Medicago lupulina*	black medick	Exotic

Table 4 (continued). List of all plant species identified in Knife River Indian Villages National Historic Site long-term plant community monitoring plots in 2017. 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-wide noxious weed species designated as “Noxious” for North Dakota in the Notes column. Species that are not on the NPS species list for KNRI are indicated with “New” in the notes column.

Family	Symbol	Scientific Name	Common Name	Notes
Fabaceae, cont.	MESA	*Medicago sativa*	alfalfa	Exotic
	MEOF	*Melilotus officinalis*	yellow sweetclover	Exotic
	PEAR6	*Pediomelum argophyllum*	silverleaf Indian breadroot	–
	VIAM	*Vicia americana*	American vetch	–
Iridaceae	SIMO2	*Sisyrinchium montanum*	strict blue-eyed grass	–
Lamiaceae	HEHI	*Hedeoma hispida*	rough false pennyroyal	–
	STPI6	*Stachys pilosa*	hairy hedgenettle	–
Liliaceae	ASOF	*Asparagus officinalis*	garden asparagus	Exotic
Linaceae	LILE3	*Linum lewisii*	Lewis flax	–
Malvaceae	SPCO	*Sphaeralcea coccinea*	scarlet globemallow	–
Oleaceae	FRPE	*Fraxinus pennsylvanica*	green ash	–
Onagraceae	OESU99	*Oenothera suffrutescens*	scarlet beeblossom	–
Poaceae	ANGE	*Andropogon gerardii*	big bluestem	–
	ARPU9	*Aristida purpurea*	purple threeawn	–
	BOCU	*Bouteloua curtipendula*	sideoats grama	–
	BOGR2	*Bouteloua gracilis*	blue grama	–
	BRIN2	*Bromus inermis*	smooth brome	Exotic
	CALO	*Calamovilfa longifolia*	prairie sandreed	–
	DIWI5	*Dichanthelium wilcoxianum*	fall rosette grass	–
	ELCA4	*Elymus canadensis*	Canada wildrye	–
	ELRE4	*Elymus repens*	quackgrass	Exotic
	ELTR7	*Elymus trachycaulus*	slender wheatgrass	–
	ELVI	*Elymus villosus*	hairy wildrye	–
	HECO26	*Hesperostipa comata*	needle and thread	–
	KOMA	*Koeleria macrantha*	prairie Junegrass	–
	MUCU3	*Muhlenbergia cuspidata*	plains muhly	–
	MURA	*Muhlenbergia racemosa*	marsh muhly	–
	NAVI4	*Nassella viridula*	green needlegrass	–
	PAVI2	*Panicum virgatum*	switchgrass	–

Table 4 (continued). List of all plant species identified in Knife River Indian Villages National Historic Site long-term plant community monitoring plots in 2017. 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-wide noxious weed species designated as “Noxious” for North Dakota in the Notes column. Species that are not on the NPS species list for KNRI are indicated with “New” in the notes column.

Family	Symbol	Scientific Name	Common Name	Notes
Poaceae, cont.	PASM	*Pascopyrum smithii*	western wheatgrass	–
	POPR	*Poa pratensis*	Kentucky bluegrass	Exotic
	SCSC	*Schizachyrium scoparium*	little bluestem	–
	SONU2	*Sorghastrum nutans*	Indiangrass	–
	SPCR	*Sporobolus cryptandrus*	sand dropseed	–
	THIN6	*Thinopyrum intermedium*	intermediate wheatgrass	Exotic
Polemoniaceae	PHHO	*Phlox hoodii*	spiny phlox	–
Polygalaceae	POAL4	*Polygala alba*	white milkwort	–
Ranunculaceae	THDA	*Thalictrum dasycarpum*	purple meadow-rue	–
Rhamnaceae	RHCA3	*Rhamnus cathartica*	common buckthorn	Exotic
Rosaceae	AMAL2	*Amelanchier alnifolia*	Saskatoon serviceberry	–
	PRAM	*Prunus americana*	American plum	–
	PRVI	*Prunus virginiana*	chokecherry	–
	ROAR3	*Rosa arkansana*	prairie rose	–
	ROWO	*Rosa woodsii*	Woods' rose	–
Salicaceae	PODE3	*Populus deltoides*	eastern cottonwood	–
	SAAM2	*Salix amygdaloides*	peachleaf willow	–
Solanaceae	PHVI5	*Physalis virginiana*	Virginia groundcherry	–
Ulmaceae	ULAM	*Ulmus americana*	American elm	–
Verbenaceae	VEBR	*Verbena bracteata*	bigbract verbena	–
Vitaceae	PAVI5	*Parthenocissus vitacea*	woodbine	–

Based on the total count of unique species observed in all plots in 2017, PCM_004 had the highest number with 35 total species, followed by PCM_017 with 30 species (Table 5). These two plots also had the most native species, with 32 and 27 respectively. Absolute cover calculations (Table 6) showed that the plant communities in plots visited in 2017 had greater exotic species cover than native species cover. PCM_008 had no native species recorded using the point-intercept method, and very few species in the plot overall. PCM_003 had the highest absolute cover of exotic species, and PCM_015 had the highest absolute cover of native species.

Table 5. Total number of plant species identified in each of the 21 plots monitored at KNRI in 2017. 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.

Plot	Burn Unit	Native Species	Exotic Species	Total Species
KNRI_PCM_001	–	17	3	20
KNRI_PCM_002	–	18	6	24
KNRI_PCM_003	–	4	6	10
KNRI_PCM_004	–	32	3	35
KNRI_PCM_005	–	24	2	26
KNRI_PCM_006	–	11	8	19
KNRI_PCM_007	–	5	4	9
KNRI_PCM_008	–	1	3	4
KNRI_FPCM_031*	Big Hidatsa	21	4	25
KNRI_PCM_015*	Big Hidatsa	12	4	16
KNRI_PCM_020*	Big Hidatsa	16	3	19
KNRI_FPCM_053*	Big Hidatsa East	14	4	18
KNRI_FPCM_065*	Big Hidatsa East	14	1	15
KNRI_FPCM_025*	North Prairie	19	3	22
KNRI_PCM_013*	North Prairie	21	1	22
KNRI_PCM_017*	North Prairie	27	3	30
KNRI_FPCM_029*	VC East	5	4	9
KNRI_FPCM_032*	VC East	6	9	15
KNRI_FPCM_035*	VC East	11	6	17
KNRI_PCM_010*	VC East	13	5	18
KNRI_PCM_018*	VC East	12	6	18

*Plot is visited by Northern Great Plains Fire Effects Program (NGPFire); associated burn unit is listed.

Table 6. Absolute percent cover of native and exotic plant species in plots monitored at KNRI in 2017. Absolute percent cover is calculated using the point-intercept data. This includes overlapping species canopies, which can result in values greater than 100%.

Plot	Burn Unit	Absolute Cover %	
		Exotic	Native
KNRI_PCM_001	-	24	115
KNRI_PCM_002	-	148	31
KNRI_PCM_003	-	216	11
KNRI_PCM_004	-	90	68
KNRI_PCM_005	-	112	29
KNRI_PCM_006	-	144	17
KNRI_PCM_007	-	175	7
KNRI_PCM_008	-	117	0
KNRI_FPCM_031*	Big Hidatsa	103	35
KNRI_PCM_015*	Big Hidatsa	13	134
KNRI_PCM_020*	Big Hidatsa	120	38
KNRI_FPCM_053*	Big Hidatsa East	25	94
KNRI_FPCM_065*	Big Hidatsa East	8	91
KNRI_FPCM_025*	North Prairie	85	65
KNRI_PCM_013*	North Prairie	50	76
KNRI_PCM_017*	North Prairie	46	96
KNRI_FPCM_029*	VC East	169	13
KNRI_FPCM_032*	VC East	106	74
KNRI_FPCM_035*	VC East	76	105
KNRI_PCM_010*	VC East	98	18
KNRI_PCM_018*	VC East	135	17

*Plot is visited by Northern Great Plains Fire Effects Program (NGPFire); associated burn unit is listed.

The NGPN monitoring crew collected woody species data in four plots in 2017: PCM_002, PCM_003, PCM_004, and PCM_006. Of those plots, only three had woody species within the surveyed area (Table 7). Seven unique species of trees and shrubs were observed in these plots, and forests were dominated by green ash (*Fraxinus pennsylvanica*) American elm (*Ulmus americana*) and plains cottonwood (*Populus deltoides*). No plains cottonwood seedlings were observed, however green ash seedlings were common in the understory of the cottonwoods in PCM_006 (Figure 4).

Table 7. Woody species data from three long-term monitoring plots visited at Knife River Indian Villages National Historic Site in 2017. 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	Density/ha.
KNRI_PCM_002	common buckthorn	Seedling	Live	700.19
KNRI_PCM_002	silver buffaloberry	Seedling	Live	572.88
KNRI_PCM_002	silver buffaloberry	Pole	Dead	159.24
KNRI_PCM_002	silver buffaloberry	Pole	Live	63.69
KNRI_PCM_002	green ash	Pole	Dead	31.85
KNRI_PCM_002	green ash	Pole	Live	31.85
KNRI_PCM_002	American elm	Pole	Dead	31.85
KNRI_PCM_002	silver buffaloberry	Tree	Dead	31.85
KNRI_PCM_002	silver buffaloberry	Tree	Live	31.85
KNRI_PCM_002	green ash	Tree	Dead	10
KNRI_PCM_002	green ash	Tree	Live	40
KNRI_PCM_002	American elm	Tree	Live	10
KNRI_PCM_004	chokecherry	Seedling	Live	31.83
KNRI_PCM_006	green ash	Seedling	Live	19350.73
KNRI_PCM_006	American elm	Seedling	Live	63.65
KNRI_PCM_006	eastern cottonwood	Tree	Dead	20
KNRI_PCM_006	eastern cottonwood	Tree	Live	180
KNRI_PCM_006	peachleaf willow	Tree	Live	10

Figure 4. Overview of plot PCM_006 at Knife River Indian Villages National Historic Site, July 2017. Photograph courtesy of the National Park Service.

Dead and downed wood and surface fuels provide foraging habitat and refugia for small wildlife species, as well as substrate for mosses and fungi. Downed wood sometimes also provides "nursery" logs for vascular plant establishment. However, when surface fuels are too abundant in a forest they can increase the risk of high intensity fires. NGPN measured surface fuels in 4 plots (Table 8). In two of these plots, all fuels values are zeros because the plots contained no measureable woody fuels.

Table 8. Surface fuels summary for four plots visited in 2017 at Knife River Indian Villages National Historic Site by NGPN.

	Average Tons per Acre										Avg. Depth (in.)		
Macroplot	**1-hr**	**10-hr**	**100-hr**	**1-100-hr**	**1000-hr sound**	**1000-hr rotten**	**1-1000-hr**	**Duff**	**Litt**	**Total**	**Duff**	**Litt**	**Total**
PCM_002	0.06	0.10	0.76	0.92	3.80	0.00	4.71	0.54	0.32	5.58	0.1	0.2	0.2
PCM_003	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
PCM_004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0
PCM_006	0.03	0.12	0.63	0.79	0.73	0.35	1.86	1.74	2.11	5.71	0.2	1.3	1.5

NGPN observed disturbances were observed in each of the eight plots visited in 2017 (Table 9). The most common disturbances were small mammal activity, prescribed fire, and severe drought. All eight plots were also assessed for the presence of early detection exotic species, but none were found in 2017.

Table 9. Disturbance type and area observed in eight plots visited at Knife River Indian Villages National Historic Site by NGPN in 2017. The disturbance area was approximated out of a total area of 1000 m^2.

Plot	Disturbance Type	Area (m^2)
KNRI_PCM_001	Small Mammal	10
KNRI_PCM_001	Other: restoration site	1000
KNRI_PCM_001	Rx Fire	1000
KNRI_PCM_002	Small Mammal	5
KNRI_PCM_002	Rx Fire	1000
KNRI_PCM_003	Animal Trail (deer)	5
KNRI_PCM_003	Small Mammal	2
KNRI_PCM_003	Severe Drought	1000
KNRI_PCM_004	Severe Drought	1000
KNRI_PCM_004	Small Mammal	35
KNRI_PCM_004	Rx Fire	1000
KNRI_PCM_005	Small Mammal	20
KNRI_PCM_005	Rx Fire	1000
KNRI_PCM_006	Animal Trail (deer)	10
KNRI_PCM_006	Rx Fire	1000
KNRI_PCM_007	Small Mammal	5
KNRI_PCM_007	Severe Drought	1000
KNRI_PCM_008	Small Mammal	1

In 2012, NGPN replaced metal rebar and nails used to mark plots PCM_008 and PCM_005 (Ashton et al. 2013) with orange plastic stakes. This was done due to concerns that the metal markers might interfere with archeological research. After five years, the orange stakes were faded, but usually still easy to spot in the grass. Unfortunately the stakes didn’t stand up to recent prescribed burns and some of them had melted or disappeared (Figure 5). The stakes that were missing were replaced with metal nails.

Figure 5. Orange stakes used to replace some of the metal rebar and nails in plot at Knife River Indian Villages National Historic Site. The first image is of a new stake in 2012, and the other two images were taken in 2017 of stakes that had suffered damage due to prescribed fire. Photograph courtesy of the National Park Service.

Further Analysis

This 2017 Data Summary Report is intended to provide a basic review of the data collected during the NGPN team's 2017 visit to Knife River Indian Villages National Historic Site. All data included in this report is available upon request from the Northern Great Plains Inventory and Monitoring Network, plus it is archived at https://irma.nps.gov/DataStore.

Literature Cited

Ashton, I., M. Prowatzke, M. Bynum, T. Shepherd, S. K. Wilson, and K. Paintner-Green. 2012. Knife River Indian Villages National Historic Site plant community composition and structure monitoring: 2011 annual report. Natural Resource Technical Report NPS/NGPN/NRTR—2012/529. National Park Service, Fort Collins, Colorado.

Ashton, I. W., M. Prowatzke, D. Swanson, P. Graeve, and S. K. Wilson. 2013. Plant community composition and structure monitoring for Knife River Indian Villages National Historic Site: 2012 annual report. Natural Resource Technical Report NPS/NGPN/NRTR—2013/682. 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.

Davis, C. J., and I. W. Ashton. 2017. Plant community composition and structure monitoring for Knife River Indian Villages National Historic Site: 2011-2016 summary report. Natural Resource Report NPS/NGPN/NRR—2017/1391. National Park Service, Fort Collins, Colorado.

DeKeyser, E. and K. Krabbenhoft. 2006. Prairie management plan for the Knife River Indian Villages National Historic Site. North Dakota State University, Fargo, ND.

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. 2017. The PLANTS Database (http://plants.usda.gov, 15 December 2017). National Plant Data Team, Greensboro, NC 27401-4901 USA.

Wienk, C., A. Thorstenson, J. Freeman, and D. Swanson. 2010. Northern Great Plains Fire Ecology Program review: 1997-2007. Natural Resource Report NPS/NRDS/NRDS—2010/112. National Park Service, Fort Collins, Colorado.

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.

NPS 468/143325, March 2018

National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525