National Park Service
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Natural Resource Stewardship and Science

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

2013 Annual Report

Natural Resource Data Series NPS/NGPN/NRDS—2014/614

ON THE COVER
Knife River Indian Villages National Historic Site, 2013
Photograph by: E. Moore, NPS

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

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January 2014

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:

Ashton, I.W and M. Prowatzke. 2014. Plant community composition and structure monitoring for Knife River Indian Villages National Historic Site: 2013 annual report. Natural Resource Data Series NPS/NGPN/NRDS—2014/614. National Park Service, Fort Collins, Colorado.

NPS 468/123548, January 2014

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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 W. Ross for providing logistical support and safety checks. The 2013 NGPN vegetation field crew of I. Ashton, E. Moore, C. Traft, and S. Rockwood collected all the data included in this report. We thank S. Wilson for invaluable support and instruction on managing data in the FFI database and for assistance with the GIS data.

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. Within North Dakota, greater than 71% of the area of native mixed-grass prairie has been lost since European settlement (Samson and Knopf 1994). 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.

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. KNRI sits on 1758 acres of upland mixed-grass prairie and riparian forests, much of which has a long history of human use. As a result, exotic species play a major role in the makeup of the park's current vegetation (DeKeyser and Krabbenhoft 2006). The Northern Great Plains Inventory & Monitoring Program (NGPN) began vegetation monitoring at KNRI in 2011 (Ashton et al. 2012). Vegetation monitoring protocols and plot locations were chosen to represent the park and to coordinate efforts with the Northern Great Plains Fire Ecology Program (FireEP). The long-term objectives of the NGPN plant community monitoring effort (Symstad et al. 2012b) in KNRI 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-year intervals) and long-term trends of tree density by species, height class, and diameter class in the riparian forest.

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 KNRI in 2013, our third year of sampling. We visited 8 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.

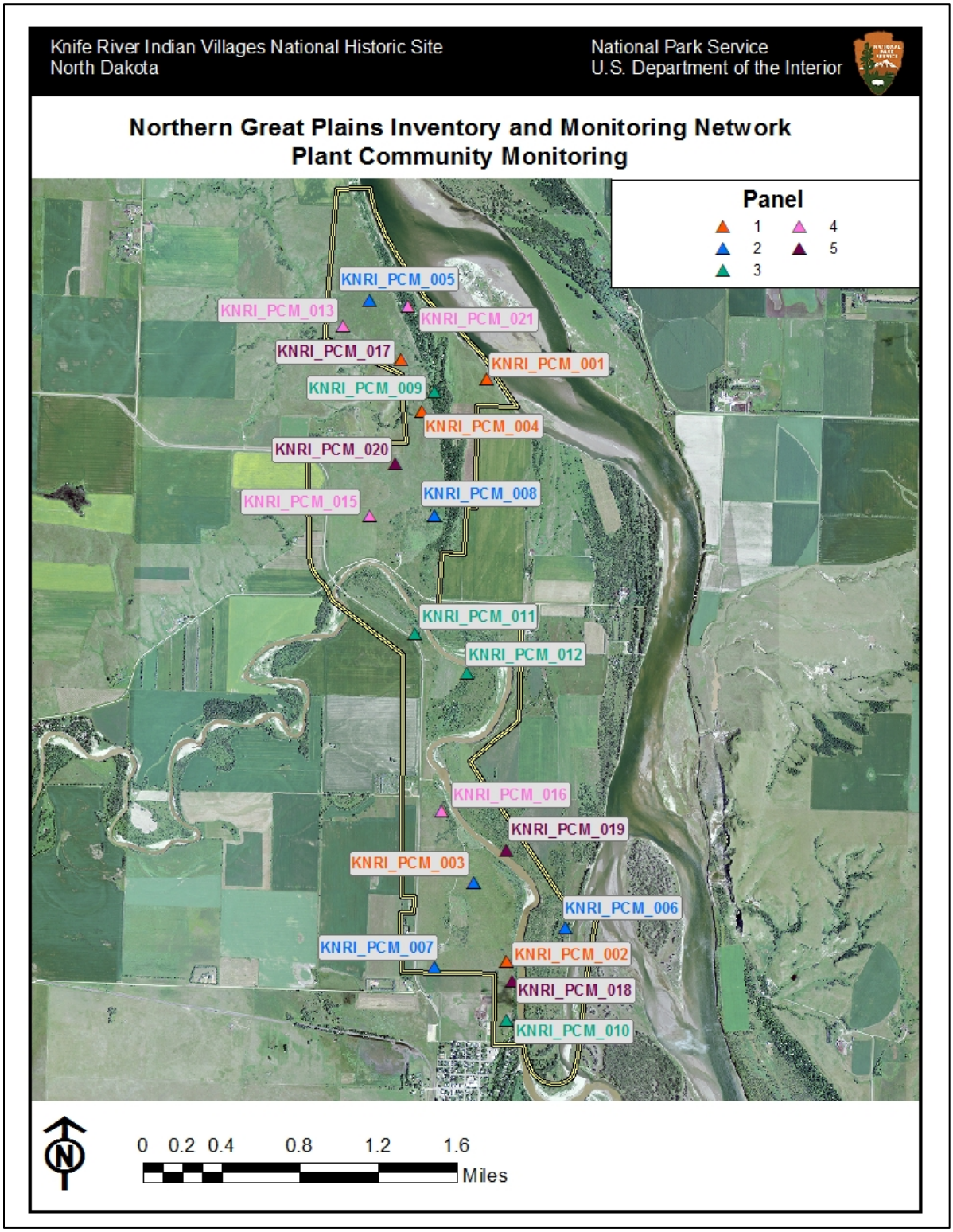


Figure 1. Map of Knife River Indian Villages National Historic Site (KNRI) and plant community monitoring (PCM) plots. Plots in panel 2 (blue) and panel 3 (green) were visited in 2013.

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 KNRI using a spatially balanced probability design (Generalized Random Tessellation Stratified [GRTS]; Stevens and Olsen 2003, 2004). Using a GRTS design, we selected 20 randomly located sites within KNRI (Figure 1). We split these 20 sites into 5 panels with 4 sites each. We visit 2 panels (8 sites) every year, and after 5 years (2015) we will have visited all 20 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 last week of July. 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 $\leq$ 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 m^2, 0.1 m^2, 1 m^2, and 10 m^2) located systematically along each transect (Figure 2). In 2013, sampling at KNRI took a 4-person crew 4 days with travel time (see Appendix A for a detail of activities each day).

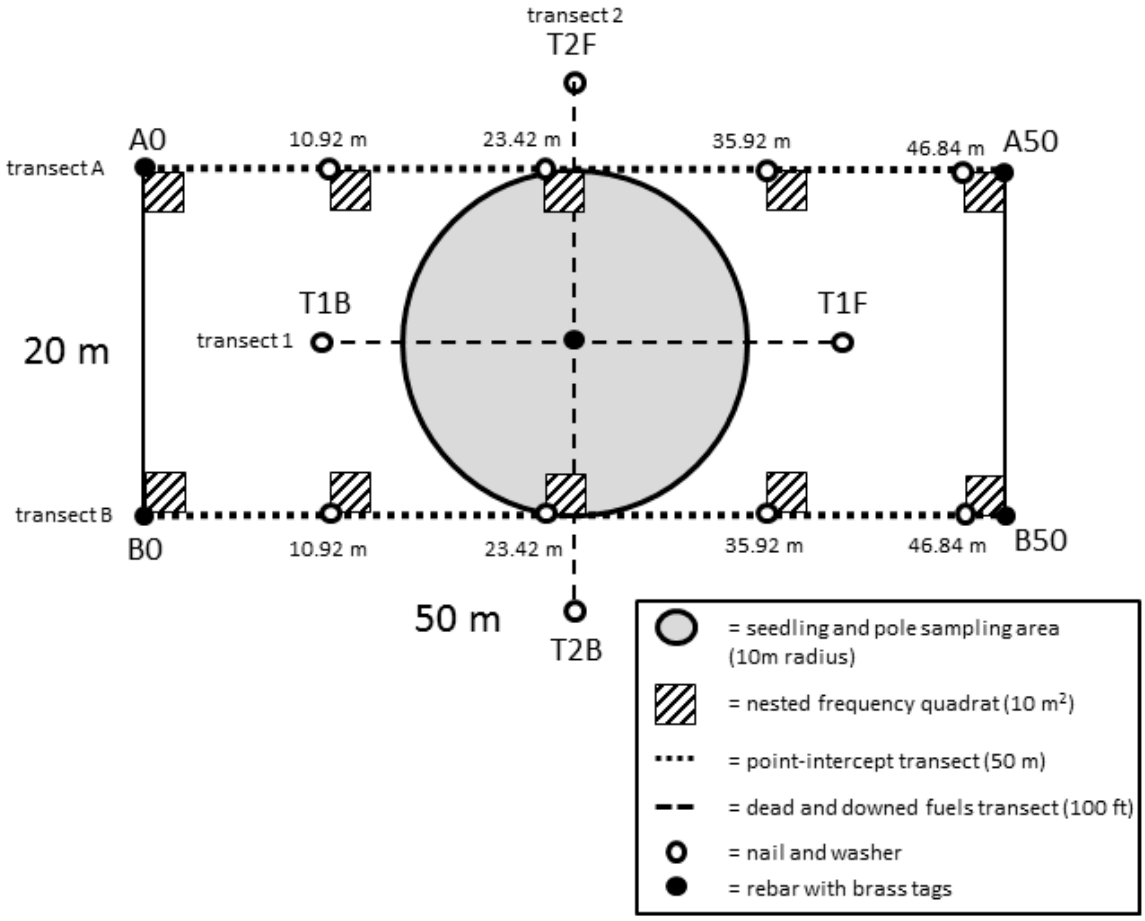


Figure 2. Long-term monitoring plot used for sampling vegetation in Knife River Indian Villages National Historic Site.

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 KNRI.

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 North Dakota, and may occur in KNRI (Table 2).

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

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

Table 2. Rare species that was surveyed for during the 2013 field season at Knife River Indian Villages National Historic Site.

Scientific Name	Common Name
Carex gravida	heavy sedge

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.

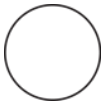
Disturbances were recorded in square meters and ranged from 0 (not present) to 2290 (the whole plot area) for each type of disturbance. We report the sum of all individual disturbances, so the value can be greater than 2290 m^2.

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

While much of the the southern part of the region suffered from drought in 2013, Knife River Indian Villages NHS experienced normal conditions and drought conditions were not present when we visited in July (Figure 3). Average canopy cover was 175% (Table 4) in 2013, which was similar to the previous year (Ashton et al. 2013). There was a large amount of standing litter on the ground with ground cover at the sites averaging 96% plant litter.

We found 105 plant species in 2013 at KNRI (Appendix B). Graminoids, which includes grasses, sedges, and rushes, accounted for most of the vegetative cover at KNRI, but forbs, shrubs, trees, and vines were also abundant (Figure 4). We found 23 exotic species at the park, all of which were either forbs or graminoids. The shrubs, vines, and trees were all native species. Exotic graminoids accounted for most of the cover. Smooth brome (*Bromus inermis*) and Kentucky bluegrass (*Poa pratensis*) were particularly abundant (Figure 5). We found one target exotic species (Table 1). Baby's breath (*Gypsophila paniculata)* was found in PCM_007 near the visitor center.

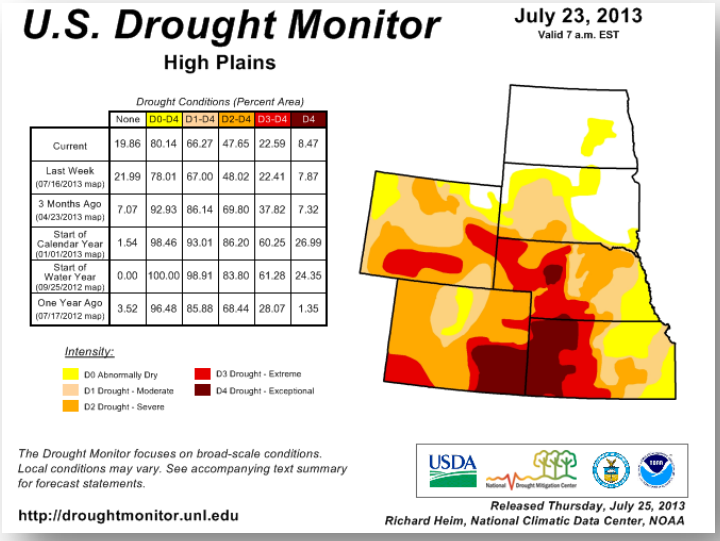


Figure 3. Drought conditions in late July 2013 in the Northern Great Plains. Knife River Indian Villages NHS experienced normal conditions.

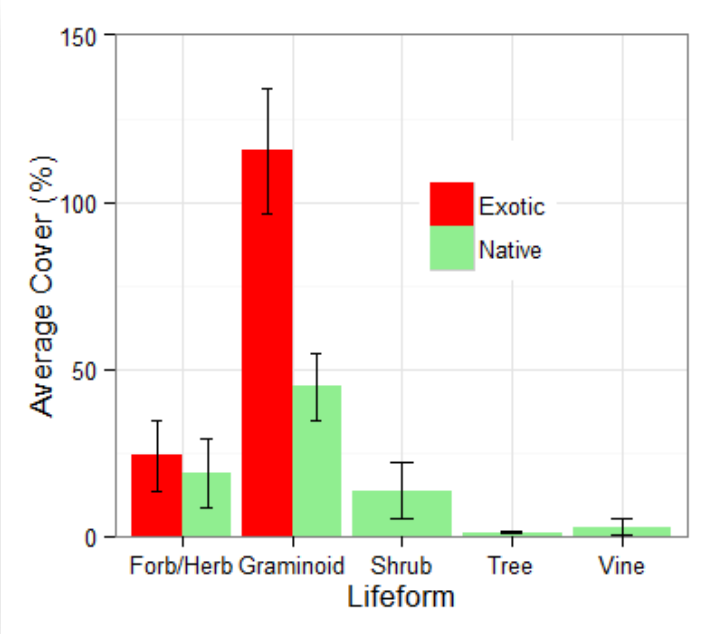


Figure 4. Average cover by lifeform and nativity in 8 plant community monitoring plots in Knife River Indian Villages National Historic Site in 2013. Native (green) and exotic (red) graminoids were the most abundant lifeform across the plots. Bars represent means ± standard errors.

Table 4. Natural resource condition summary table for upland plant communities in Knife River Indian Villages National Historic Site (KNRI).

Indicator of Condition	Specific Measures	2013 Value (mean ± SE)	Reference Condition and Data Source	Condition Status/Trend	Rationale for Resource Condition
Upland Plant Community Structure and Composition	Absolute herb-layer canopy cover	175 ± 24.2 %	TBD (1)		KNRI protects and manages small remnants of northern mixed-grass prairie and supports an active prairie restoration program. A history of extensive human-use has led to low native species richness when compared to more intact mixed-grass prairies in the region. We do not have a reference condition or baseline for evenness or canopy cover, so we have low confidence in our estimate that current values indicate good condition. Future monitoring will help the park determine if the goal to maintain or increase native diversity is being met.
	Native species richness (based on average of 10 1m^2 quadrats per plot)	3 ± 1.0 species	8-18 species (2)		
	Evenness (based on point-intercept of 2-50m transects per plot)	0.59 ± 0.05	TBD (1)		
Exotic Plant Early Detection and Management	Relative cover of exotic species	78 ± 10 %	A decreasing trend in exotic cover (3)		KNRI manages a landscape with a very high cover of exotic species. Smooth brome and Kentucky bluegrass are particularly abundant and there cover should be reduced to retain native plant diversity. As NGPN collects more data, we will be able to determine whether the park is able to reduce the abundance of exotics.
	Relative percent cover of smooth brome	46 ± 12.1 %	A decreasing trend in smooth brome cover (3)		

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. 3. Based on professional opinion.

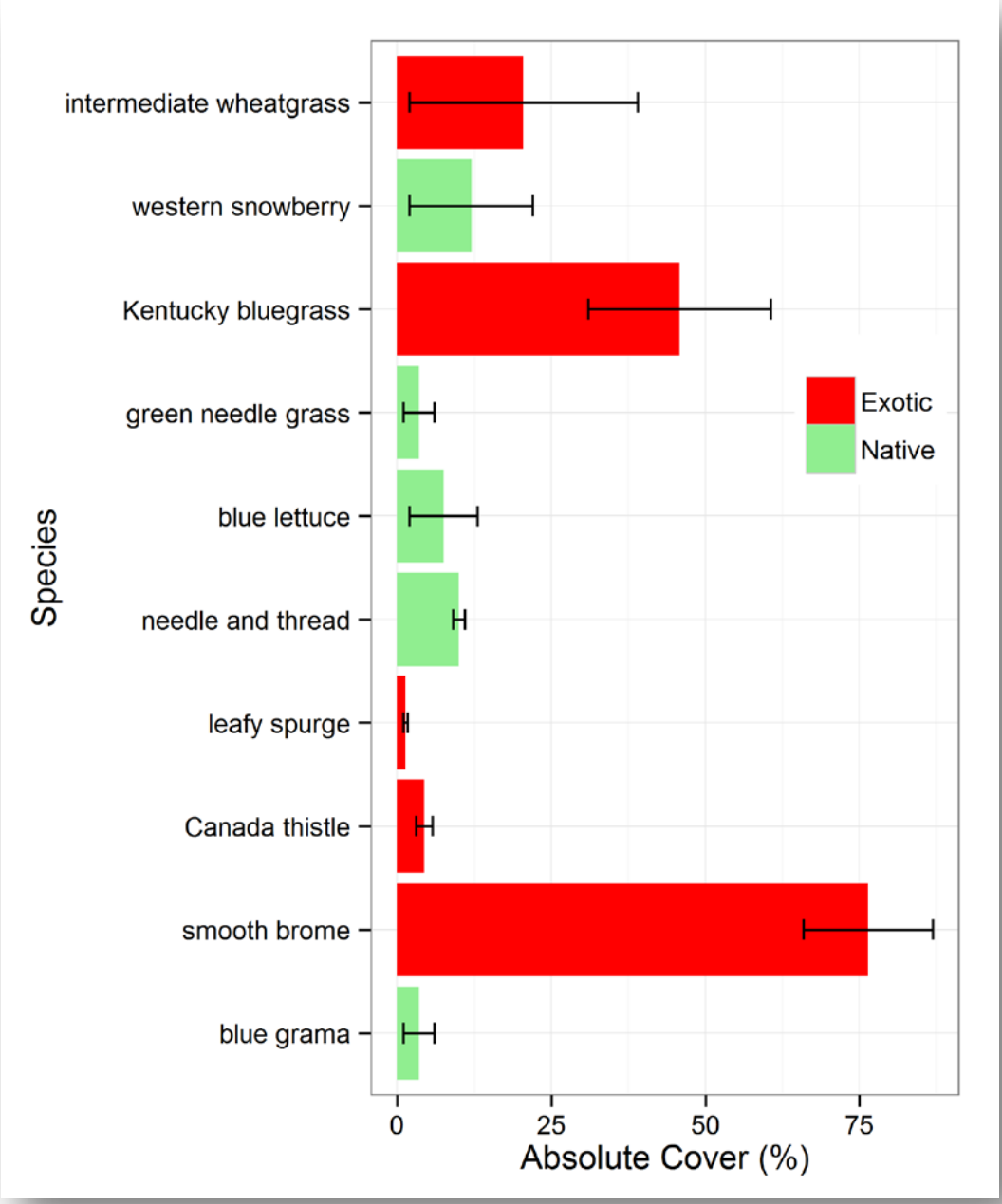


Figure 5. The average absolute cover of the 10 most common native (green) and exotic (red) plants recorded at Knife River Indian Villages National Historic Site in 2013. Bars represent means ± standard errors.

Average species richness at each of the 8 plots was measured by point-intercept and in 1 m^2 and 10 m^2 quadrats (Table 5). On average, there were about 3 exotic species within the 1 m^2 quadrat (Table 5). From the point-intersect data, we found average plot diversity, H', to be 1.3 ± 0.25. Evenness, J', averaged 0.59 ± 0.05 across the plots (Table 4). When including only native species, average

diversity and evenness were 0.9 ± 0.3 and 0.48 ± 0.13, respectively. These low numbers are driven by two plots where we found no native species on the point-intercept transects.

Table 5. Average plant species richness in 8 plots at Knife River Indian Villages National Historic Site in 2013. Values represent means ± standard errors, n=8.

	Point-intercept	**1 m^2 quadrats**	**10 m^2 quadrats**
Species richness	12 ± 2.8	5 ± 1.1	9 ± 2.0
Native species richness	7 ± 2.8	3 ± 1.0	6 ± 2.0
Exotic species richness	5 ± 0.9	3 ± 0.4	3 ± 0.5
Graminoid species richness	5 ± 1.1	2 ± 0.5	3 ± 0.7
Forb species richness	6 ± 1.5	3 ± 0.7	5 ± 1.2

While there was some variation across sites, the plots we visited in KNRI 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 in a moderately grazed site in Montana ranged between 8 and 18 species per square meter (10-90th percentile range) between 1933-1945 (Symstad and Jonas *in press*). The average native species richness falls below this natural range of variation for the park (Table 4, native richness in the 1 m2 quadrat and Table 5) and it is below the range in all but one site (Table 6). The highest diversity was seen in site PCM_005, in the northern prairie portion of the park.

The average relative cover of exotic species at sites in KNRI was high (78 ± 10%; Table 4). However, like species richness, cover of exotic species varied considerably among sites (Table 6). Site PCM_009 was a forested site and had a fairly low cover of exotic species, while site PCM_008 and PCM_011 were 100% exotic cover and were dominated by smooth brome.

Table 6. Characteristics of the plant community at 8 plots in Knife River Indian Villages National Historic Site in 2013 including species richness, average cover of smooth brome, 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)**
KNRI_PCM_005	9	51	12	2340
KNRI_PCM_006	3	86	54	100
KNRI_PCM_007	2	85	17	2290
KNRI_PCM_008	1	100	88	0
KNRI_PCM_009	6	19	0	2300
KNRI_PCM_010	2	88	38	2490
KNRI_PCM_011	1	100	79	0
KNRI_PCM_012	1	96	80	2300
Park Average	*3 ± 1.0*	*78 ± 10*	*46 ± 12.2*	-

Disturbance from grazing, 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 fire which was evident in 4 of the 8 sites. Other common disturbances included downed limbs from storm activity, animal trails, and small mammal disturbance.

Table 7. Seedling and sapling density at 4 long-term monitoring plots in Knife River Indian Villages National Historic Site.

Plot	Seedling Density (stems hectare^{-1})	Sapling Density (stems hectare^{-1})
KNRI_PCM_006	477	-
KNRI_PCM_009	95	-
KNRI_PCM_010	1305	732
KNRI_PCM_012	1210	414

Trees and seedlings were present in 4of the 8 sites we visited in 2013 (Table 7). We found a few scattered adult trees in these sites including boxelder (*Acer negundo*), green ash (*Fraxinus pennsylvanica*), Siberian elm (*Ulmus pumila)*, cottonwood (*Populus deltoides*), and peachleaf willow (*Salix amygdaloides*). We found seedlings and saplings at all four of these sites, but the species differed slightly. All the seedlings we found were green ash, box elder, Siberian elm, chokecherry (*Prunus virginiana*) or western serviceberry (*Amelanchier alnifolia*). We did not find any cottonwood seedlings or saplings. In 2014, NGPN is scheduled to complete a more thorough assessment of riparian forest structure and health in KNRI where we plan to have data from 20 locations. At that time, we will provide better estimates of forest health and condition.

Summary

In conclusion, KNRI protects and manages a small remnant of northern mixed-grass prairie. A history of extensive human use has led to low native species richness when compared to more intact mixed-grass prairies in the region. Exotic cover is high, and smooth brome and Kentucky bluegrass are particularly abundant. Reducing the cover of smooth brome will be critical to maintaining native diversity. Though challenging, it is important to continue efforts to reduce the cover of invasive plants to restore and retain ecological integrity. Allowing for natural disturbances such as fire may be critical to maintaining plant diversity in KNRI, but it should be balanced with the need to protect intact native communities and prevent further invasions of exotic species. Continued monitoring efforts will be critical to track changes in the condition of the vegetation communities in KNRI.

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

Plant community composition monitoring in Knife River Indian Villages National Historic Site was completed using a crew of 4 people working 4, 10-hour days.

Date	Day of week	Approximate Travel Time (hrs)	Housing	Sites Completed/Notes
July 22, 2013	Monday	5.5	Rough Rider Inn	PCM-007
July 23, 2013	Tuesday	1	Rough Rider Inn	PCM-005 PCM-009 PCM-008 PCM-010
July 24, 2013	Wednesday	1	Rough Rider Inn	PCM-009 PCM-011
July 25, 2013	Thursday	1	Rough Rider Inn	PCM-006 PCM-012
July 26, 2013	Friday	2		Travel to THRO

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

Family	Code	Scientific Name	Common Name	Exotic
Aceraceae	ACNE2	*Acer negundo*	boxelder	
Anacardiaceae	TORY	*Toxicodendron rydbergii*	western poison ivy	
Asclepiadaceae	ASSP	*Asclepias speciosa*	showy milkweed	
Asteraceae	ACMI2	*Achillea millefolium*	common yarrow	
	ARMI2	*Arctium minus*	lesser burdock	*
	ARAB3	*Artemisia absinthium*	absinthium	*
	ARDR4	*Artemisia dracunculus*	tarragon	
	ARFR4	*Artemisia frigida*	prairie sagewort	
	ARLU	*Artemisia ludoviciana*	white sagebrush	
	CIAR4	*Cirsium arvense*	Canada thistle	*
	CIFL	*Cirsium flodmanii*	Flodman's thistle	
	HEAN3	*Helianthus annuus*	common sunflower	
	HEVI4	*Heterotheca villosa*	hairy false goldenaster	
	LASE	*Lactuca serriola*	prickly lettuce	*
	LYJU	*Lygodesmia juncea*	rush skeletonplant	
	MUOB99	*Mulgedium oblongifolium*	blue lettuce	
	RACO3	*Ratibida columnifera*	upright prairie coneflower	
	SOGI	*Solidago gigantea*	giant goldenrod	
	SOMI2	*Solidago missouriensis*	Missouri goldenrod	
	SYER	*Symphyotrichum ericoides*	white heath aster	
	SYLA3	*Symphyotrichum laeve*	smooth blue aster	
	SYLA6	*Symphyotrichum lanceolatum*	white panicle aster	
	TAOF	*Taraxacum officinale*	common dandelion	*
	TRDU	*Tragopogon dubius*	yellow salsify	*
Boraginaceae	HADE	*Hackelia deflexa*	nodding stickseed	
	LAOC3	*Lappula occidentalis*	flatspine stickseed	
	LIIN2	*Lithospermum incisum*	narrowleaf stoneseed	
Brassicaceae	PHAR99	*Physaria arenosa*	Great Plains bladderpod	
	BOHO99	*Boechera holboellii*	Holboell rockcres	
	HEMA3	*Hesperis matronalis*	dames rocket	*
	LEDE	*Lepidium densiflorum*	common pepperweed	
Cactaceae	OPPO	*Opuntia polyacantha*	plains pricklypear	
Caprifoliaceae	SYOC	*Symphoricarpos occidentalis*	western snowberry	
Caryophyllaceae	GYPA	*Gypsophila paniculata*	baby's breath	*
Celastraceae	CESC	*Celastrus scandens*	American bittersweet	
Chenopodiaceae	CHAL7	*Chenopodium album*	lambsquarters	*
	CHPR5	*Chenopodium pratericola*	desert goosefoot	
Commelinaceae	TROC	*Tradescantia occidentalis*	prairie spiderwort	
Convolvulaceae	COAR4	*Convolvulus arvensis*	field bindweed	*
Cyperaceae	CAREX	*Carex* spp.	sedge	
	CABR10	*Carex brevior*	shortbeak sedge	
	CAFI	*Carex filifolia*	threadleaf sedge	
	CAIN9	*Carex inops*	long-stolon sedge	
Euphorbiaceae	EUES	*Euphorbia esula*	leafy spurge	*

Family	Code	Scientific Name	Common Name	Exotic
Euphorbiaceae	EUSE5	*Euphorbia serpyllifolia*	thymeleaf sandmat	
Fabaceae	ASBI2	*Astragalus bisulcatus*	twogrooved milkvetch	
	DAPU5	*Dalea purpurea*	purple prairie clover	
	MELU	*Medicago lupulina*	black medick	*
	MESA	*Medicago sativa*	alfalfa	*
	MEOF	*Melilotus officinalis*	yellow sweetclover	*
	PEAR6	*Pediomelum argophyllum*	silverleaf Indian breadroot	
	VIAM	*Vicia americana*	American vetch	
Grossulariaceae	RIAM2	*Ribes americanum*	American black currant	
Lamiaceae	LYAS	*Lycopus asper*	rough bugleweed	
	SCLA2	*Scutellaria lateriflora*	blue skullcap	
	STPI6	*Stachys pilosa*	hairy hedgenettle	
Liliaceae	MAST4	*Maianthemum stellatum*	starry false lily of the valley	
Malvaceae	SPCO	*Sphaeralcea coccinea*	scarlet globemallow	
Oleaceae	FRPE	*Fraxinus pennsylvanica*	green ash	
Onagraceae	OESU99	*Oenothera suffrutescens*	scarlet beeblossom	
Oxalidaceae	OXST	*Oxalis stricta*	common yellow oxalis	
Plantaginaceae	PLMA2	*Plantago major*	common plantain	*
Poaceae	AGCR	*Agropyron cristatum*	crested wheatgrass	*
	BOCU	*Bouteloua curtipendula*	sideoats grama	
	BOGR2	*Bouteloua gracilis*	blue grama	
	BRIN2	*Bromus inermis*	smooth brome	*
	CALO	*Calamovilfa longifolia*	prairie sandreed	
	DIWI5	*Dichanthelium wilcoxianum*	fall rosette grass	
	ELRE4	*Elymus repens*	quackgrass	*
	ELTR7	*Elymus trachycaulus*	slender wheatgrass	
	ELVI	*Elymus villosus*	hairy wildrye	
	ELVI3	*Elymus virginicus*	Virginia wildrye	
	HECO26	*Hesperostipa comata*	needle and thread	
	KOMA	*Koeleria macrantha*	prairie Junegrass	
	MUCU3	*Muhlenbergia cuspidata*	plains muhly	
	NAVI4	*Nassella viridula*	green needlegrass	
	PASM	*Pascopyrum smithii*	western wheatgrass	
	PHAR3	*Phalaris arundinacea*	reed canarygrass	
	POPR	*Poa pratensis*	Kentucky bluegrass	*
	SPCR	*Sporobolus cryptandrus*	sand dropseed	
	THIN6	*Thinopyrum intermedium*	intermediate wheatgrass	*
Polygalaceae	POVE	*Polygala verticillata*	whorled milkwort	
Ranunculaceae	ANCY	*Anemone cylindrica*	candle anemone	
	CLLI2	*Clematis ligusticifolia*	western white clematis	
	THDA	*Thalictrum dasycarpum*	purple meadow-rue	
Rosaceae	AMAL2	*Amelanchier alnifolia*	Saskatoon serviceberry	
	PRVI	*Prunus virginiana*	chokecherry	
	ROAR3	*Rosa arkansana*	prairie rose	
Rubiaceae	GABO2	*Galium boreale*	northern bedstraw	
Salicaceae	PODE3	*Populus deltoides*	eastern cottonwood	

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Salicaceae	SALIX	*Salix* spp.	willow	
	SAAM2	*Salix amygdaloides*	peachleaf willow	
	SAEX	*Salix exigua*	narrowleaf willow	
Saxifragaceae	HERI	*Heuchera richardsonii*	Richardson's alumroot	
Scrophulariaceae	PEGR5	*Penstemon gracilis*	lilac penstemon	
Smilacaceae	SMLA3	*Smilax lasioneura*	Blue Ridge carrionflower	
Ulmaceae	ULPU	*Ulmus pumila*	Siberian elm	*
Unknown family	UNKFORB	*Unknown forb*	unknown forb	*
Urticaceae	PAPE5	*Parietaria pensylvanica*	Pennsylvania pellitory	
	URDI	*Urtica dioica*	stinging nettle	
Violaceae	VIOLA	*Viola* spp.	violet	*
	VICA4	*Viola canadensis*	Canadian white violet	
Vitaceae	PAVI5	*Parthenocissus vitacea*	woodbine	
	VIRI	*Vitis riparia*	riverbank grape	