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Natural Resource Stewardship and Science

Prairie Plant Community Monitoring at Herbert Hoover National Historic Site, Iowa

2004–2017

Natural Resource Report NPS/HTLN/NRR—2018/1807

ON THIS PAGE
Prarie at Herbert Hoover National Historic Site, 2005.
Photography by Heartland Inventory and Monitoring Network

ON THE COVER
Prairie flora at Herbert Hoover National Historic Site, 2017.
Photography by Jacob Johnson/Heartland Inventory and Monitoring Network

Prairie Plant Community Monitoring at Herbert Hoover National Historic Site, Iowa

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Natural Resource Report NPS/HTLN/NRR—2018/1807

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Abstract

The purpose of the restored prairie at Herbert Hoover National Historic Site (NHS) is to provide a sense of the landscape that was present at the time of Herbert Hoover's life as a contemplative backdrop for visitors to learn about his life. The 47-year old reconstruction has been monitored throughout its restoration. The Heartland Inventory and Monitoring Network completed five plant community monitoring events at the park to date. Species richness of native prairie species continues to increase. Species diversity measures were consistently low, however. Plant guilds are dominated by forbs and grasses, respectively. Woody and exotic plant abundance in the prairie increased during the last monitoring period. This increase may be associated with the recent decrease in fire frequency and the shift away from chemical control of select woody plants. Grass litter and deciduous leaf litter have also increased. While the increase in species richness is positive, increasing trends in exotic and woody species will likely continue without adjustments in management practices.

Acknowledgments

We are grateful for the contributions of previous staff who helped to monitor vegetation at Herbert Hoover NHS. Some of the language of this report is taken from James (2011), particularly the introduction and methods. This program is supported by J. Haack-Gaynor and G. Rowell. J. Bell provided invasive species data. J. Salesman has also supported vegetation management efforts at the park. We appreciate the dialog with Herbert Hoover NHS staff to help put the monitoring data into the park's management context.

Introduction

Herbert Hoover National Historic Site (NHS) is home to a 47-year old restored prairie and was established to preserve properties associated with President Hoover (NPS 2004). The prairie provides a sense of the landscape that once covered 80% of Iowa, and would have been part of the experience of Herbert Hoover and his family (NPS 2003; Smith 1998). The prairie also serves as a peaceful backdrop for visitors to commemorate the former president's life. Prairie reconstruction commenced in 1971 with a mix of only five native prairie grasses. Vegetation inventory and monitoring has been ongoing in the park's 81-acre tallgrass prairie since 1984. Dr. Paul Christiansen began annual monitoring surveys taking note of changes to the prairie as seeds and plants were added over time (Williams et al. 2007). The Heartland Inventory and Monitoring Network then began monitoring in 2004 and monitoring sites were placed to continue the efforts that Dr. Christiansen had begun.

The prairie is actively managed to achieve the goals and objectives presented in the Prairie Management Plan (NPS 2003) and draft Resource Stewardship Strategy (NPS 2006). The Resource Stewardship Strategy places an emphasis on plant diversity (Shannon Index) and native plant dominance. See Williams et al. (2007) for a detailed management history and summary of monitoring results from 1984 to 2005.

In this study, we distinguish between exotic and invasive plant species given the long history of overlap in the usage of these terms. For our purposes, exotic species are introduced, non-native (to the U.S.) species. While exotic plants include invasive plants, "invasive," as used in this study, characterizes native as well as non-native species that are able to spread quickly once established. Invasive plants, in particular, may play a large role in pushing woody species beyond a 10% threshold in native prairie (Drake 2015; Nelson 2005). We maintain this exotic-invasive distinction throughout the report.

This report summarizes findings from five vegetation community monitoring events by the Heartland Inventory and Monitoring Network. Maintenance of the prairie has included prescribed fire, chemical treatments, mechanical treatments, seed augmentation, and mowing. Herein we provide a brief analysis of plant monitoring, fire history, and invasive plant treatment investments.

Vegetation monitoring in the prairie at Herbert Hoover NHS.

Methods

The Heartland Inventory and Monitoring Program established six vegetation monitoring sites at Herbert Hoover NHS in 2004 and 2005 (Figure 1). Monitoring methods followed the standard operating procedures outlined in the Heartland Network vegetation community monitoring protocol (James et al. 2009). Monitoring sites were 50 m x 20 m (0.1 ha) in size with two focal transects bounding the site on the 50-m sides (Figure 2). For this protocol, metrics were collected within 10 plots located along the site boundaries. Each plot consisted of a series of nested plots (0.01 m^2, 0.1 m^2, 1 m^2, and 10 m^2), but observations were summarized at the site scale to understand park level patterns. All site means were calculated based on 10 plots (n = 10) per site. Species abundance was assessed using a cover class system (Table 1).

Table 1. Modified Daubenmire cover value scale used to determine abundance for plant species and ground cover.

Cover Class	Cover Range (%)	Class Midpoint (%)
7	95-100	97.5
6	75-95	85.0
5	50-75	62.5
4	25-50	37.5
3	5-25	15.0
2	1-5	2.5
1	0-0.99	0.5

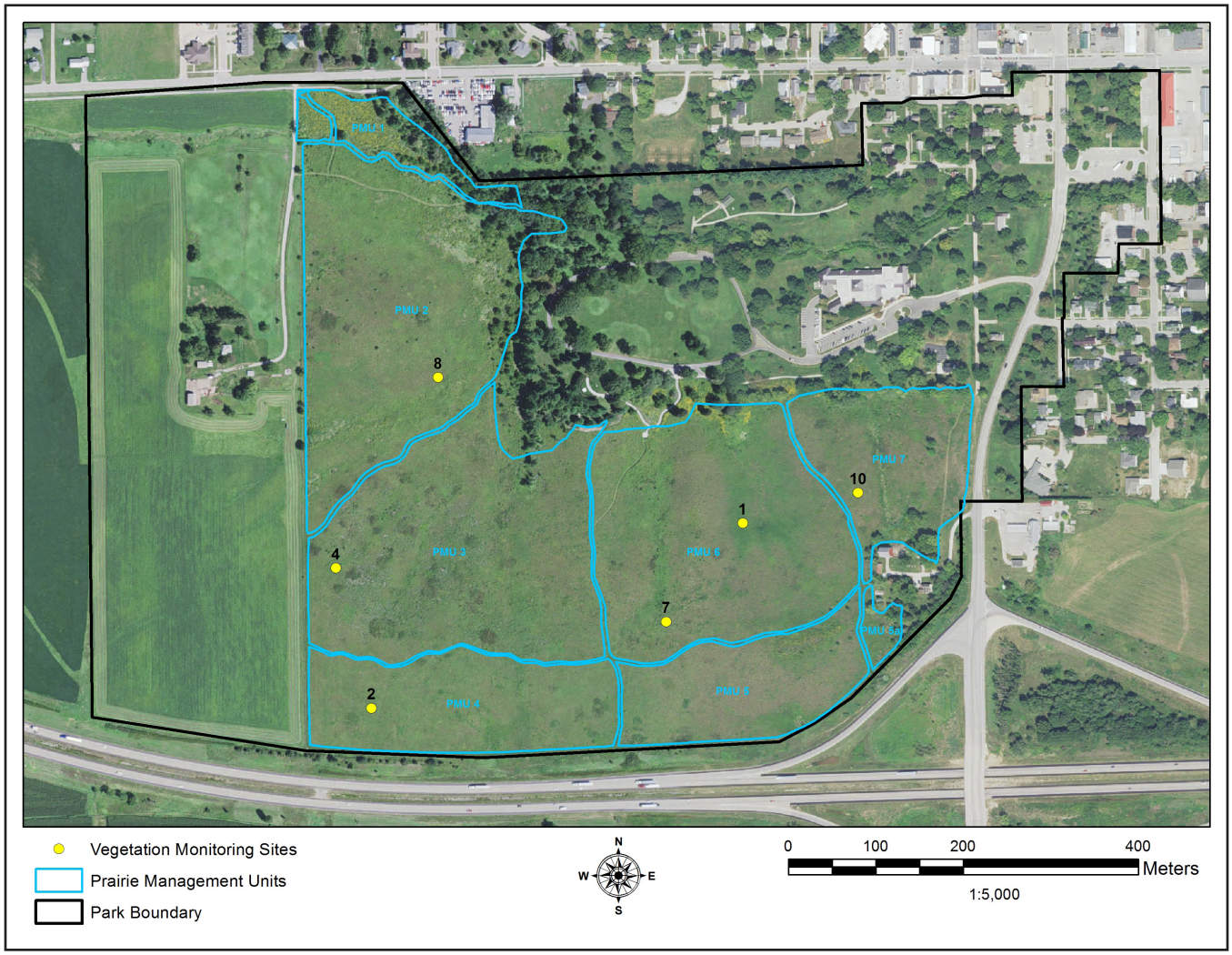

Figure 1. Herbert Hoover NHS, Iowa with management units and monitoring sites. West Branch, Iowa and Interstate 80 bound the park on three sides.

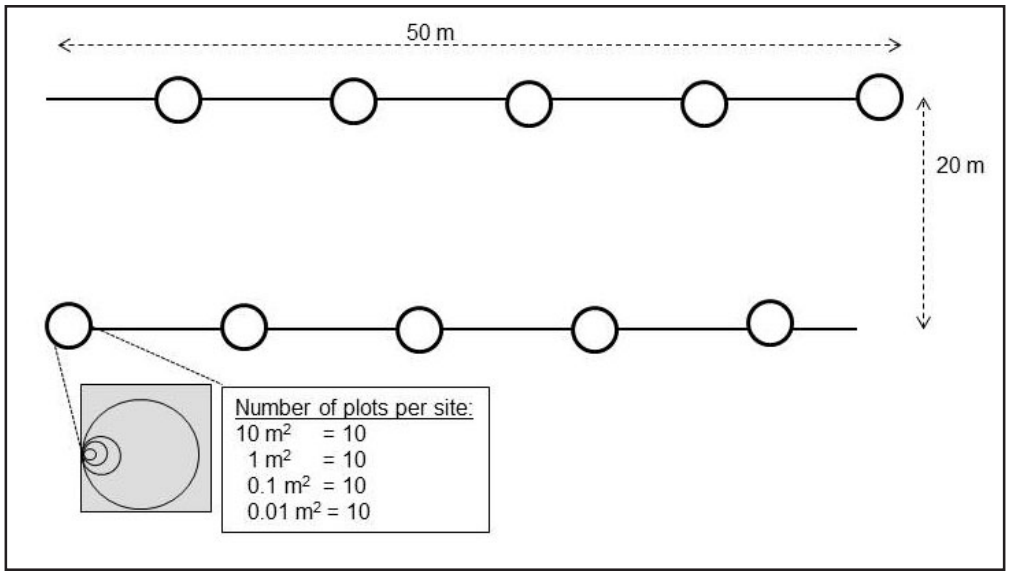

Figure 2. Plant community site monitoring design for Heartland Inventory and Monitoring Network parks.

Data Summary

SPSS (version 24) was used to generate descriptive statistics (IBM Corp. 2016).

Species Diversity Indices

Diversity indices describe the number of species and their abundances (based on foliar cover measurements), and can be compared across monitoring sites in the park. Mean site cover for all non-tree species was calculated using all plots within each site. For each site within the community, species richness (S) along with the effective number of species derived from Shannon diversity index (Shannon number, H_e) and Simpson's diversity index (Simpson's number, D_e) were calculated. S represents the number of species observed. H_e represents a measure of diversity, while D_e describes dominance within the community. PC-ORD (version 7.02) was used to calculate these diversity indices (McCune and Mefford 2016). Diversity indices were then converted to effective number of species and a grand mean was then calculated for all sites (N = 4 in 2004; N = 6 in all other years [2005–2017]).

Initial plant diversity for each site was calculated using the Shannon diversity index:

$$\text{Shannon Index:} \quad H' = -\sum_{i=1}^{n} p_i \ln p_i$$

where p_i is the relative cover of species i (Shannon 1948).

Simpson's index of diversity for an infinite population (D) was calculated by site (McCune and Grace 2002). D is the likelihood that two randomly chosen individuals from a site will be different species and emphasizes common species (McCune and Grace 2002). It was calculated by site using the complement of Simpson's original index of dominance:

$$\text{Simpson's Index of Diversity:} \quad D = 1 - \sum_{i}^{n} p_i^2$$

where p_i is the relative cover of species i (modified from Simpson 1949).

Shannon and Simpson's index values were converted into effective number of species for each community (H_e and D_e, respectively). This allowed for both diversity measures to be compared directly to species richness of the sites (S) within and among sample years based on counts of distinct species in the community (Jost 2006a). Shannon index was converted into effective number of species (H_e) using the following formula:

$$H_e = exp^{H'}$$

where H is the Shannon index value. The effective number of species based on Simpson's index (D_e) is the inverse of the index value or

$$D_e = 1/(1-D)$$

where D is the Simpson's index value.

These metrics express the degree of evenness or dominance in a community. All species are equally abundant when $S = H_e = D_e$. The degree to which effective number of species is less than S represents the variability among species abundances within the community. See Jost (2006a) and McCune and Grace (2002) for a further explanation and implementation of species diversity measures, respectively. Generally, we expect species richness values to be greater than effective number of species for diversity and dominance as many plant communities have a matrix of common (dominant) species and a suite of rare species. We provided the Shannon index values (H') as well as the H_e values to facilitate understanding about diversity as well as evaluation of park goals.

Community Diversity Metrics

Community richness metrics evaluate how species richness differs across study sites and the park. We limited these calculations to understory herbaceous species. *Alpha* diversity is synonymous with species richness at the site-scale (i.e., mean number of species per monitoring site). This is equivalent to species richness used to calculate the diversity measures described previously. *Gamma* diversity is the park richness (i.e., total number of species in the park) observed across all our monitoring sites. *Beta* diversity is a measure of variation in species richness across monitoring sites such that small values (near zero) indicate a high degree of similarity in richness across monitoring sites and greater values (>5) indicate a higher degree of variation in species between sites (i.e., more differentiated communities; McCune and Grace 2002).

$$\textit{Beta Diversity} = (\textit{gamma}/\textit{alpha})-1$$

Guild Abundance

Understory species were also summarized by guilds, also known as functional groups (designations per the USDA Plants database [USDA 2018]; James et al. 2009). Guild assignments were grasses, forbs, sedges/rushes, ferns, and woody species. A complete species list along with guild assignment is provided in Appendix A. Mean cover values were calculated for each guild-site-year combination. A grand mean was then calculated across all sites (N = 4 in 2004; N = 6 in all other years [2005–2017]).

Ground Cover

Ground cover was assessed using cover classes (Table 1). A site mean was calculated by averaging the cover class midpoints for plots (n = 10) in each site. We observed aerial cover of grass litter, leaf litter (woody plant leaves), rock (exposed rock), bare ground (soil), and the cover of woody debris (e.g. branches and sticks). Total unvegetated area reflects space unoccupied by stem basal areas in the plots (James et al. 2009).

Fire History

Fire plays an important role in prairie reconstructions, both in restoration and maintenance phases. We calculated fire frequency as time since fire (TSF), rounded to years for three time intervals of interest: 1987–2017 (all years of record, 30 years), 1987–2010 (23 years), and 2011–2017 (7 years). Time since fire was calculated for all prairie management units (PMUs) that contained monitoring sites (PMUs 2, 3, 4, 6, and 7). Thus, we did not include data from PMUs 1, 5, and 5a. We used the Heartland Network fire occurrence geodatabase in conjunction with fire ecology observations to determine whether a unit was burned in a given year. Zero was assigned for the year of a burn and subsequent years were tallied until the next burn. The average time since fire was then calculated averaging across TSF assignments for years in each of three intervals. Grand mean, range, and maximum values (of the PMU means) were then calculated.

Invasive Plant Treatment Data

The Exotic Plant Management Team (EPMT) assesses invasive plant treatment needs on a prairie-wide basis at Herbert Hoover NHS, and they are not limited to the monitoring sites delineated by the plant community monitoring project. As a result, they may encounter species that are not observed during plant community monitoring. Staff involved in invasive plant treatment estimated the total amount of each invasive plant species treated with herbicide during treatment work. To make this estimate, workers recorded plant identity and an estimate of foliar cover as a point feature with a GPS unit. Foliar cover was estimated using a cover scale with six options: 0.1, 1, 5, 10, 20, 50, or 100 m^2. The area associated with each point was summed by year to provide an estimate of total plant cover treatedfrom 2011 to 2016. These data complement the plant community monitoring data.

Results

Species diversity

Analysis of species diversity metrics indicated that native species richness (the number of species occupying monitoring sites) increased in 2013 and 2017. The Shannon H_e(diversity) and Simpson's D_e (dominance) indices indicated that the prairie was dominated by only a few species (3-4) and most species were rare across the park. This pattern was consistent through time (Figure 3).

The park's diversity goal is based on a raw value of the Shannon Index (H'), rather than the true diversity in the form of effective number of species, H_e (Figure 3). We provide the trend for the Shannon Index in order to provide a measure of progress toward the park's goal (Figure 4). A Shannon Index (H') of 2.63 is the goal of the park (NPS 2006). Park mean values for the Shannon Index have not reached that level, but did increase in 2017 (Figure 4). Site 7 had the greatest H' value in 2017 (2.50). Although the raw H' values indicate an increase in 2017, we consider the true value of diversity to be H_e as reported in Figure 3, which did not similarly increase. More discussion on this topic can be found at Jost's Diversity and Similarity Measures webpage (Jost 2006b).

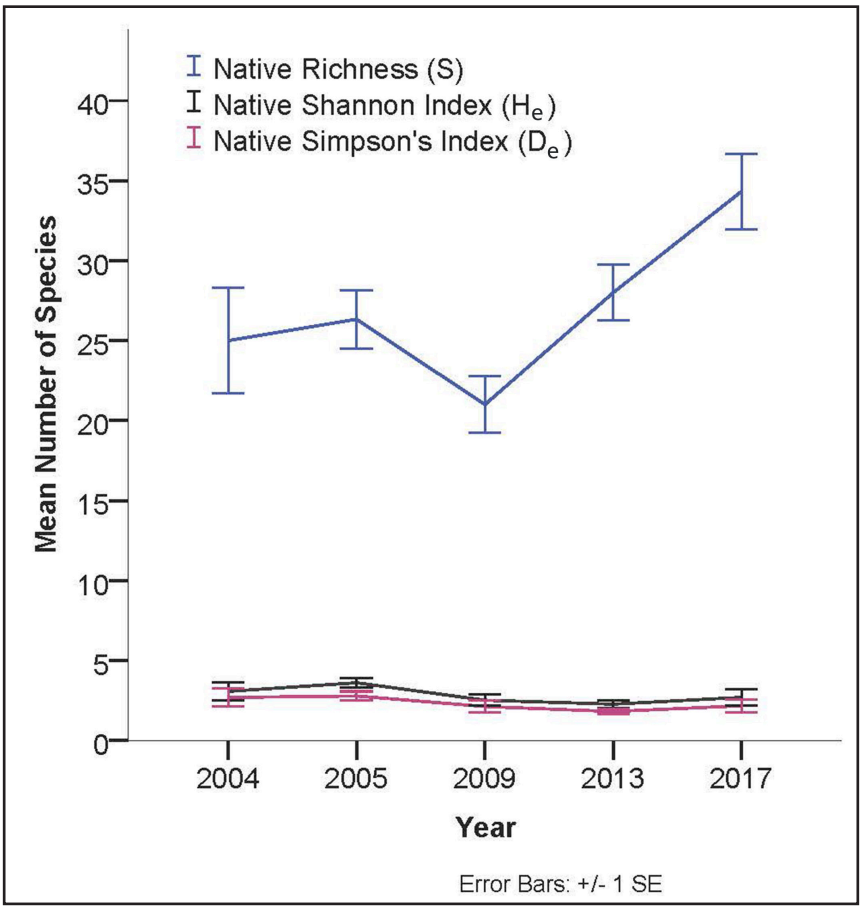

Figure 3. Native species diversity as monitored by the Heartland Network at Herbert Hoover NHS, Iowa. Shannon index (H_e) and Simpson's index (D_e) are measured as effective number of species. Note N = 4 in 2004 and N = 6 for all other years.

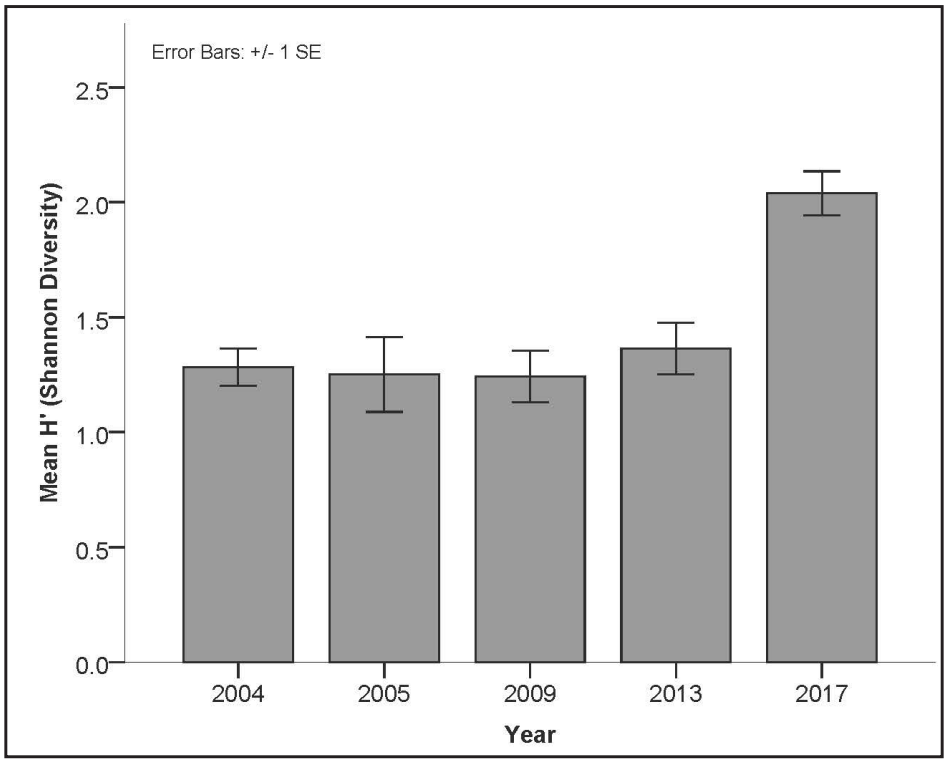

Figure 4. Mean Shannon Index (H') values for native species at Herbert Hoover NHS, Iowa, 2004–2017. This provides an indication of progress towards a park goal.

Community Diversity

Community diversity metrics were consistent with the species diversity metrics; the number of species, both within sites (*alpha*) and park-wide (*gamma*), increased (Table 2). There is a great deal of uniformity across the park, indicated by low *beta* diversity values. Essentially, the prairie is one homogenous community.

Table 2. Community diversity metrics for Native Species at Herbert Hoover NHS, Iowa, 2004–2017. STE = standard error.

Year	Alpha (STE)	Gamma	Beta
2004	29.50 (3.7)	51	0.73
2005	32.50 (2.3)	59	0.82
2009	26.33 (2.0)	51	0.94
2013	32.83 (1.8)	66	1.01
2017	40.80 (2.3)	82	1.00

Guilds

Native species abundance by guild revealed that forbs have become the most abundant group of plants within the prairie in Herbert Hoover NHS (Figure 5; Appendix A). In 2017, Canada goldenrod (*Solidago canadensis*) was the most abundant species in the prairie. Grasses were the next most abundant guild led by big bluestem (*Andropogon gerardii*). In other years, forbs and grasses had similar abundances and this is unusual because grasses are typically more abundant than forbs in native remnant prairies (Weaver 1968).

We examined woody cover (Figure 6) and found there was a clear increase in woody abundance between 2013 and 2017. Many of these species are normally limited by fire in a healthy prairie where fire is applied at appropriate intervals and intensity. The four-fold increase in woody species observed in 2017 was not a result of an influx of new species, but rather an increase in abundance of existing species such as smooth sumac, dogwoods, and grape vines (Table 3).

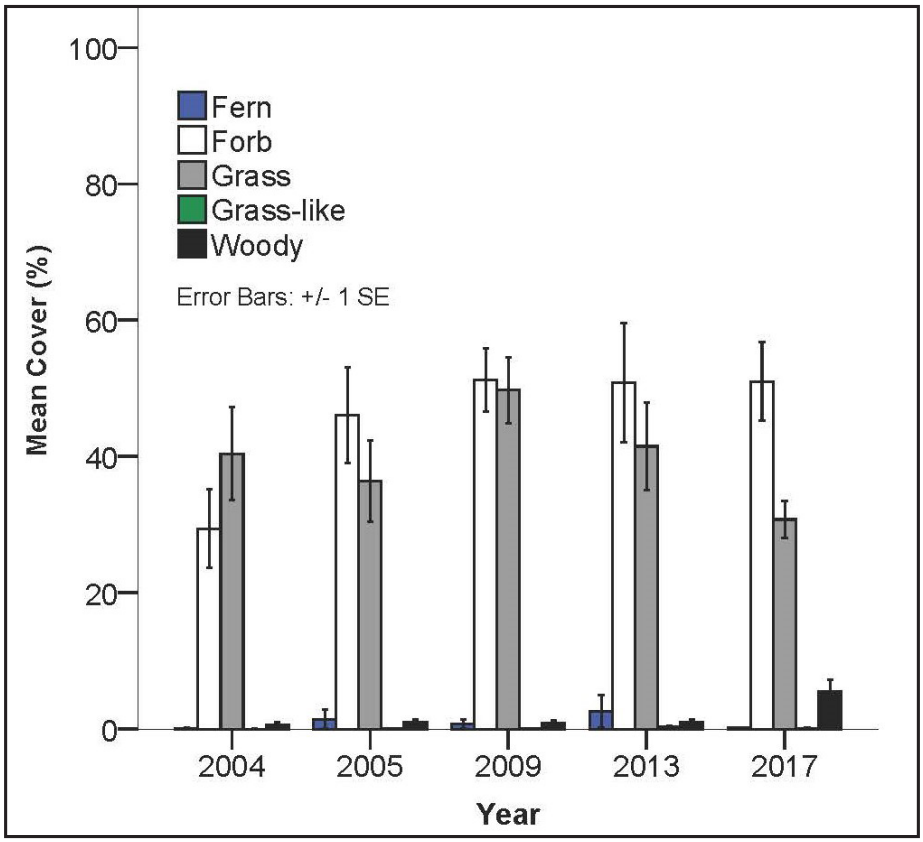

Figure 5. Abundance of native plant species at Herbert Hoover NHS, Iowa, 2004–2017.

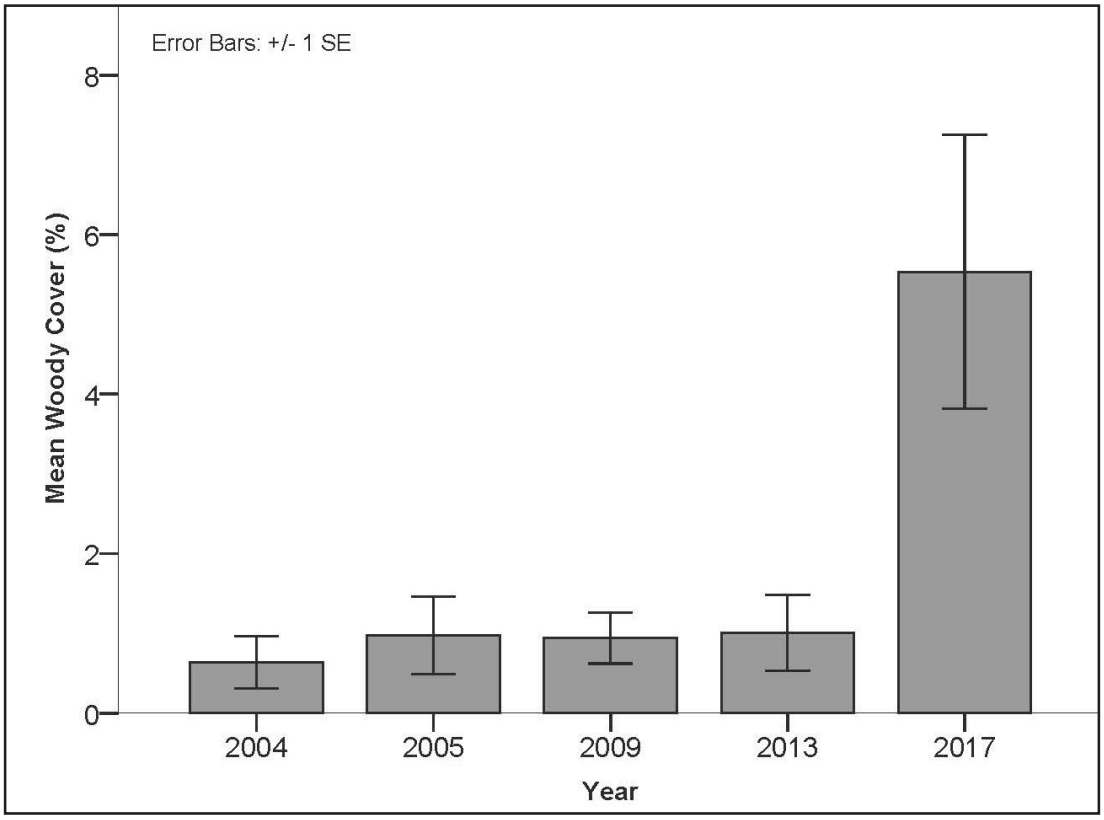

Figure 6. Abundance of native woody plants guild at Herbert Hoover NHS, 2004–2017.

Table 3. Woody species observed by the Heartland Network at Herbert Hoover NHS, 2013–2017. Values are the yearly site average cover (%) for each species. Total woody cover is the sum of all woody species. N = native, E = exotic.

Species	Common Name	Nativity	2013	2017
Cornus spp.	dogwood	N	0.4	0
Cornus drummondii	roughleaf dogwood	N	0	0.45
Cornus racemosa	gray dogwood	N	0.65	7.5
Juniperus virginiana	eastern redcedar	N	0.05	0
Malus spp.	apple	E	0	0.05
Morus rubra	red mulberry	N	0	0.05
Parthenocissus quinquefolia	Virginia creeper	N	0	0.05
Prunus spp.	plum	N	0.1	0
Prunus virginiana	chokecherry	N	0.05	0.65
Rhus glabra	smooth sumac	N	0.3	9.7
Rosa carolina	Carolina rose	N	0.3	0.05
Rubus spp.	blackberry	N	0.6	1.85
Ulmus spp.	elm	N	0.05	0
Ulmus rubra	red elm	N	0.05	0
Viburnum lentago	nannyberry	N	0.3	1.55
Vitis spp.	grape	N	0.35	3.95
Sum of mean site covers	**–**	**–**	**3.2**	**25.85**
Number of species	**–**	**–**	**13**	**12**

Ground Cover

Ground cover has shifted through time (Figure 7). Mean bare soil declined from abundant in 2004 to rare (1%) in 2017. Similarly, mean unvegetated cover steadily declined over the record. Mean grass litter was greater in the last two monitoring events than previously. Of note, mean leaf litter, although low in cover, increased from 0 to 7% between 2004 and 2017.

Fire History

Fire history was assessed using burn units that included plant community monitoring sites. Recommended fire return intervals for the area generally range from 3 to 5 years. Fire treatments have decreased over the most recent monitoring period (Table 4) with the most recent burn occurring in 2011. Mean fire return intervals, as measured by time since fire (TSF) in years, for the whole period of record (1987–2017) appear to be in line with recommended rates. But when we break the fire history into two distinct time periods, it is evident that TSF intervals have lengthened from 1.9 to 6.0 years. Mean fire return intervals are informative, but maximum fire return intervals are also important. These intervals represent the longest time since the last burn across the burn units. For the most recent period, two of the burn units have reached 12 years since their last burn. This increase in TSF corresponds with the time-period where we observed increases in woody species.

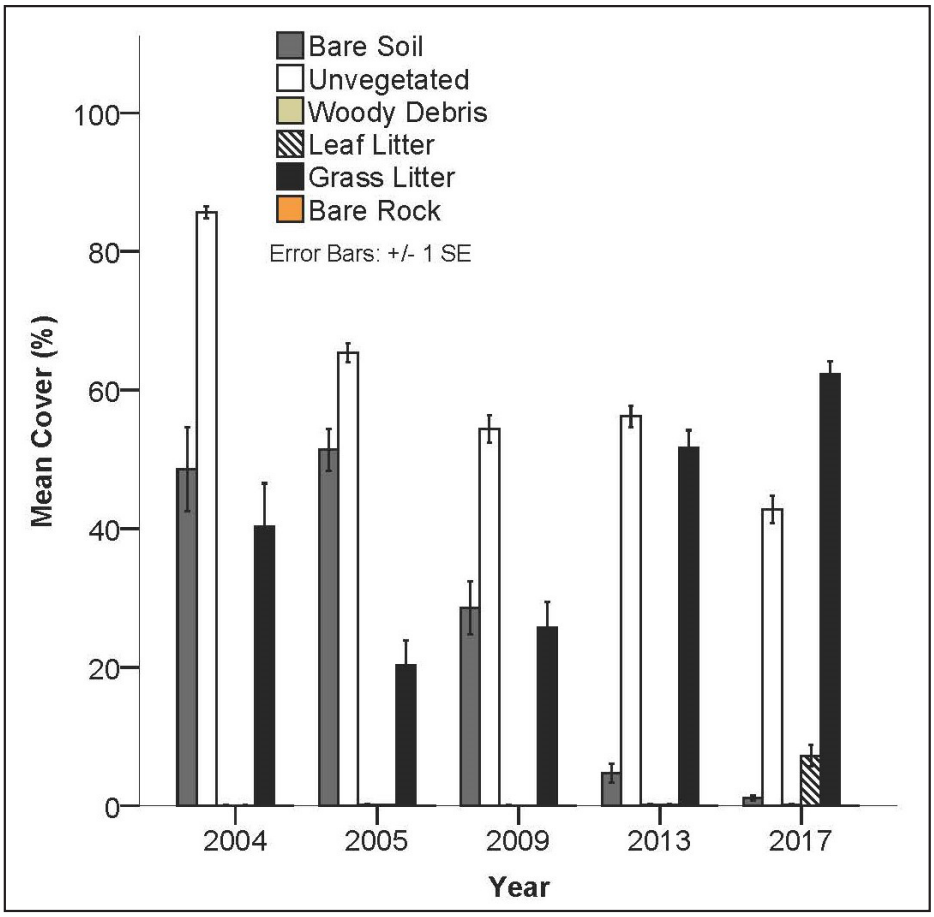

Figure 7. Ground cover elements observed in monitoring sites from 2004 to 2017 at Herbert Hoover NHS. Note that N = 4 in 2004 and N = 6 in all other years.

Table 4. Fire occurrence at Herbert Hoover NHS, Iowa from 1987 to 2017. Time since fire (TSF) in years for three intervals: 1985–2017 (all years of record), 1985–2010, and 2011–2017. TSF was calculated by monitoring site and the maximum and mean TSF are provided for each period.

Period	Mean TSF (yrs)	Mean TSF Range (yrs)	Maximum of Mean TSF (yrs)	Maximum TSF Range (yrs)
1987–2017	2.8	1.9–3.6	9.0	6.0–12.0
1987–2010	1.9	1.6–2.0	5.8	5.0–6.0
2011–2017	6.0	3.0–9.0	9.0	6.0–12.0

Exotic and Invasive Species

Exotic and invasive species may require focused monitoring or treatment. Despite chemical treatment efforts, exotic plant abundance increased over the monitoring period (Figure 8). This increase was due primarily to Kentucky bluegrass (*Poa pratensis*), which has not been treated, and honeysuckle species, which have been treated (*Lonicera* spp.; Appendix A). Fire, especially during the late spring, as it has been applied at Herbert Hoover NHS, is known to control Kentucky bluegrass (Stumpf et al. 1994; Rice 2004).

We found that as emphasis on treating invasive woody plants decreased (Figure 9) and prescribed fire use decreased (Figure 9), the abundance of all woody plants increased (see Guilds subsection Figure 6).

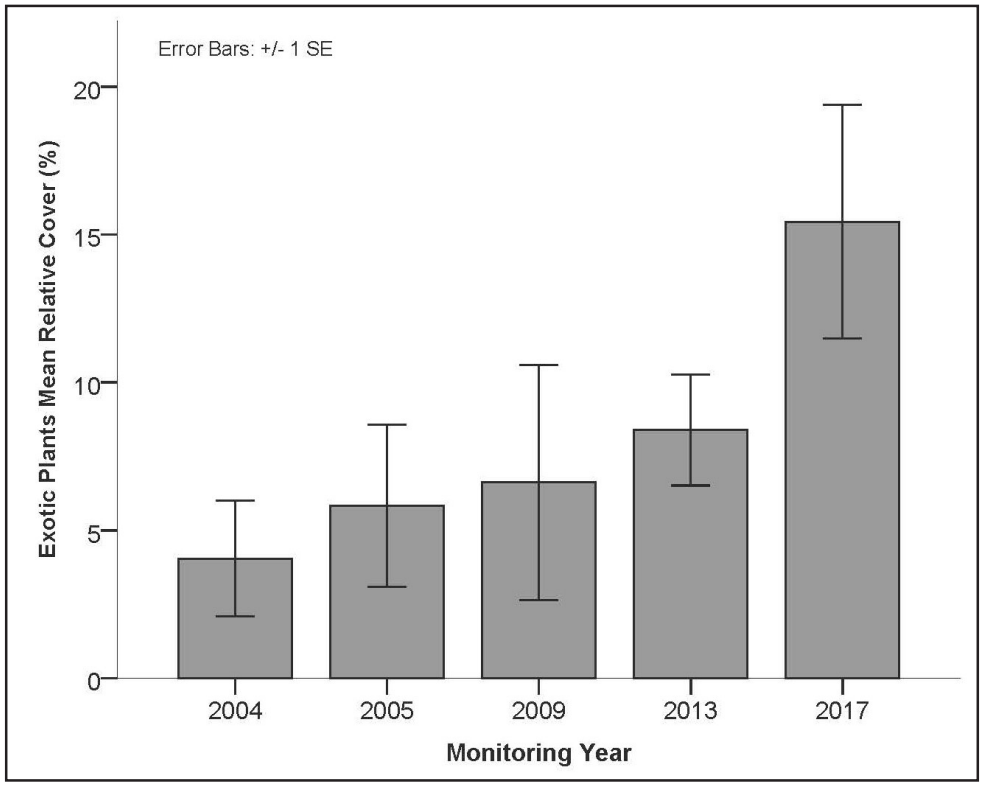

Figure 8. Mean relative cover of exotic species observed in monitoring sites from 2004 to 2017 at Herbert Hoover NHS. Note that N = 4 in 2004, and N = 6 in all other years.

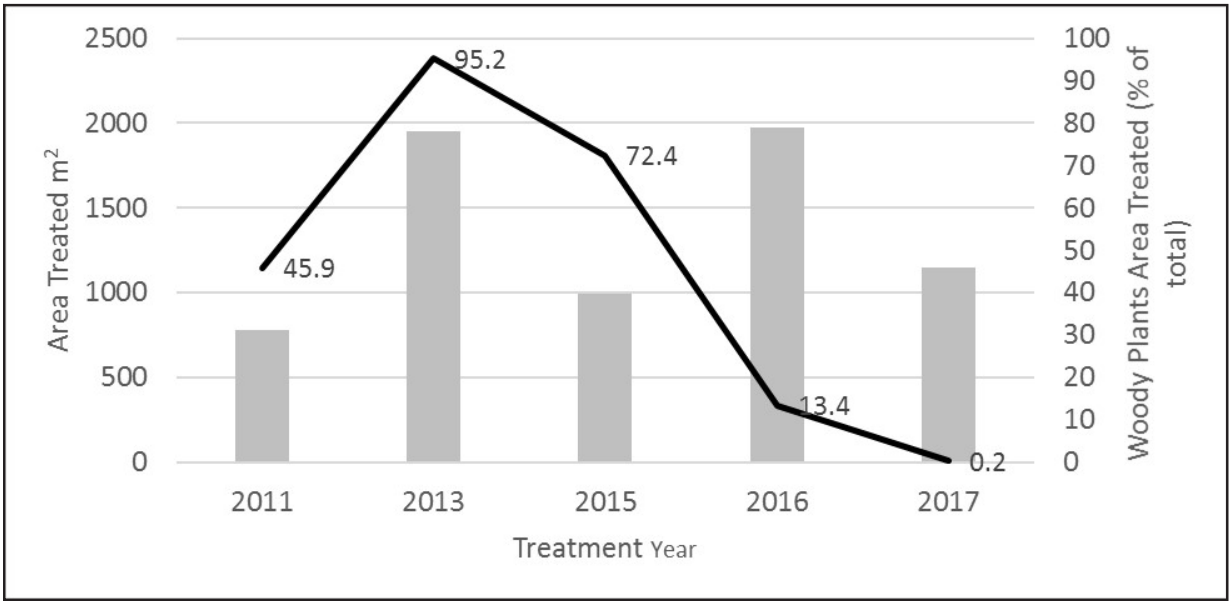

Figure 9. Invasive plant treatment effort of the Heartland Exotic Plant Management Team as represented by area treated (m^2)-gray bars. The black line represents the proportion of treatments (%) focused on woody plants (right axis and data point labels).

Discussion

The prairie at Herbert Hoover NHS has gone from a low diversity planting (Williams et.al. 2007) to a species rich mix of forbs, grasses, and other plants. Species richness continues to increase although true diversity and dominance measures (H_e and D_e) have been very stable. Dominance measures indicate that less than five plant species dominate the system and the remaining species are relatively rare. Species diversity (H') is below the park's stated goal. Our work does not allow us to know what the mechanisms for increase are, but seed additions are ongoing in the prairie (personal communication Adam Prato).

Fire and invasive plant management treatments have been used to maintain the Herbert Hoover NHS prairie. While mean fire return intervals increased (from 1.7 to 5.8 years), chemical treatments may have masked vegetation response to this change. For example, the EPMT's action may have mitigated the increase in woody plants that may have otherwise occurred in the absence of prescribed fire. The plant community monitoring sites indicated that the number of woody species (Table 3) was steady, but their abundances increased. Even with treatments, exotic plant abundance increased (Figure 8), including some species that were the target of chemical treatment.

There are other trends in the prairie that may also be related to the extended fire return intervals. Although grass litter cover can be related to plant productivity, litter also builds up with increased fire return intervals. The appearance of deciduous leaf litter in the ground cover measurements is also a reflection of the increased abundance of woody plants in the prairie.

Prairie plant community monitoring at Herbert Hoover NHS. Early seral woody species are clumped in the lower right corner of the picture.

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Appendix A. Native Species

Table A-1. Native species are listed in order of the greatest mean cover for 2017. Species with 0 values were not recorded in 2017, but were only observed in previous years. StdDev = Standard deviation, Origin: N = native, I = introduced.

Species	Common Name	Mean Cover (%)	StdDev	Origin
Solidago canadensis	Canada goldenrod	29.62	12.34	N
Andropogon gerardii	big bluestem	14.13	4.49	N
Poa pratensis	Kentucky bluegrass	8.58	5.76	I
Monarda fistulosa	wild bergamot	3.38	4.26	N
Sorghastrum nutans	Indiangrass	3.09	1.54	N
Packera plattensis	Platte groundsel	2.94	4.25	N
Schizachyrium scoparium	little bluestem	2.22	2.74	N
Elymus canadensis	Canada wildrye	2.11	2.81	N
Pastinaca sativa	wild parsnip	2.00	4.85	I
Rhus glabra	smooth sumac	1.62	3.01	N
Ratibida pinnata	pinnate prairie coneflower	1.27	1.71	N
Cornus racemosa	gray dogwood	1.25	1.48	N
Helianthus grosseserratus	sawtooth sunflower	1.00	1.23	N
Eryngium yuccifolium	button eryngo	0.90	1.92	N
Tradescantia ohiensis	bluejacket	0.87	1.30	N
Oligoneuron rigidum var. *rigidum*	Stiff goldenrod	0.83	1.95	N
Coreopsis tripteris	tall tickseed	0.72	1.29	N
Melilotus officinalis	yellow sweetclover	0.68	1.05	I
Desmodium canadense	showy ticktrefoil	0.67	1.44	N
Vitis sp.	grape	0.66	0.92	N
Zizia aurea	golden zizia	0.63	1.53	N
Lonicera morrowii	Morrow's honeysuckle	0.58	0.66	I
Silphium perfoliatum	cup plant	0.56	0.96	N
Panicum virgatum	switchgrass	0.54	0.55	N
Anemone canadensis	Canadian anemone	0.51	1.17	N
Baptisia alba var. *macrophylla*	largeleaf wild indigo	0.51	1.11	N
Cirsium discolor	field thistle	0.37	0.34	N
Bromus inermis	smooth brome	0.31	0.34	I
Rubus sp.	blackberry	0.31	0.60	N
Calystegia sepium	hedge false bindweed	0.28	0.30	N
Symphyotrichum pilosum var. *pilosum*	Awl wild aster	0.27	0.27	N
Geum canadense	white avens	0.26	0.61	N
Lactuca canadensis	Canada lettuce	0.26	0.09	N
Viburnum lentago	nannyberry	0.26	0.61	N
Antennaria neglecta	field pussytoes	0.25	0.61	N
Elaeagnus umbellata	autumn olive	0.25	0.61	I
Lonicera tatarica	Tatarian honeysuckle	0.25	0.61	I
Convolvulus arvensis	field bindweed	0.18	0.40	I
Equisetum arvense	field horsetail	0.17	0.27	N

Table A-1 (continued). Native species are listed in order of the greatest mean cover for 2017. Species with 0 values were not recorded in 2017, but were only observed in previous years. StdDev = Standard deviation, Origin: N = native, I = introduced.

Species	Common Name	Mean Cover (%)	StdDev	Origin
Apocynum cannabinum	Indian hemp	0.13	0.24	N
Carex sp.	sedge	0.13	0.21	N
Viola sp.	violet	0.13	0.24	N
Heliopsis helianthoides	smooth oxeye	0.12	0.10	N
Hypericum ascyron	great St. Johnswort	0.11	0.24	N
Prunus virginiana	chokecherry	0.11	0.24	N
Ambrosia trifida	great ragweed	0.10	0.25	N
Lonicera maackii	Amur honeysuckle	0.10	0.16	I
Echinacea pallida	pale purple coneflower	0.09	0.14	N
Asclepias syriaca	common milkweed	0.08	0.16	N
Cornus drummondii	roughleaf dogwood	0.08	0.16	N
Rudbeckia hirta	blackeyed Susan	0.08	0.16	N
Physalis heterophylla	clammy groundcherry	0.07	0.05	N
Cirsium altissimum	tall thistle	0.06	0.05	N
Erigeron strigosus	prairie fleabane	0.06	0.07	N
Lespedeza capitata	roundhead lespedeza	0.06	0.10	N
Taraxacum officinale	common dandelion	0.06	0.06	I
Thalictrum dasycarpum	purple meadow-rue	0.06	0.14	N
Dalea purpurea	purple prairie clover	0.05	0.12	N
Daucus carota	Queen Anne's lace	0.05	0.05	I
Elymus hystrix var. hystrix	eastern bottlebrush grass	0.05	0.12	N
Glechoma hederacea	ground ivy	0.05	0.12	I
Morus alba	white mulberry	0.05	0.12	I
Verbena urticifolia	white vervain	0.05	0.12	N
Chamaecrista fasciculata	partridge pea	0.04	0.10	N
Oxalis sp.	woodsorrel	0.04	0.04	N
Bouteloua curtipendula	sideoats grama	0.03	0.04	N
Helianthus sp.	sunflower	0.03	0.06	N
Silphium terebinthinaceum	prairie rosinweed	0.03	0.04	N
Ambrosia artemisiifolia	annual ragweed	0.02	0.04	N
Asclepias sp.	milkweed	0.02	0.04	N
Elymus virginicus	Virginia wildrye	0.02	0.04	N
Euphorbia corollata	flowering spurge	0.02	0.03	N
Phalaris arundinacea	reed canarygrass	0.02	0.04	I
Physalis virginiana	Virginia groundcherry	0.02	0.03	N
Veronicastrum virginicum	Culver's root	0.02	0.03	N
Dalea candida	white prairie clover	0.01	0.02	N
Draba sp.	draba	0.01	0.02	N
Euphorbia sp.	spurge	0.01	0.02	N
Hackelia virginiana	beggarslice	0.01	0.02	N
Helianthus strumosus	paleleaf woodland sunflower	0.01	0.02	N

Table A-1 (continued). Native species are listed in order of the greatest mean cover for 2017. Species with 0 values were not recorded in 2017, but were only observed in previous years. StdDev = Standard deviation, Origin: N = native, I = introduced.

Species	Common Name	Mean Cover (%)	StdDev	Origin
Heuchera richardsonii	Richardson's alumroot	0.01	0.02	N
Liatris pycnostachya	prairie blazing star	0.01	0.02	N
Malus sp.	apple	0.01	0.02	N
Morus rubra	red mulberry	0.01	0.02	N
Parthenium integrifolium	wild quinine	0.01	0.02	N
Parthenocissus quinquefolia	Virginia creeper	0.01	0.02	N
Physostegia virginiana	obedient plant	0.01	0.02	N
Potentilla arguta	tall cinquefoil	0.01	0.02	N
Rosa carolina	Carolina rose	0.01	0.02	N
Sanicula sp.	sanicle	0.01	0.02	N
Sanicula canadensis	Canadian blacksnakeroot	0.01	0.02	N
Silphium integrifolium	wholeleaf rosinweed	0.01	0.02	N
Solidago gigantea	giant goldenrod	0.01	0.02	N
Solidago missouriensis	Missouri goldenrod	0.01	0.02	N
Tradescantia occidentalis	prairie spiderwort	0.01	0.02	N
Acalypha virginica	Virginia threeseed mercury	0	0	N
Aster sp.	aster	0	0	N
Astragalus canadensis	Canadian milkvetch	0	0	N
Barbarea vulgaris	garden yellowrocket	0	0	I
Conyza canadensis	Canadian horseweed	0	0	N
Cornus sp.	dogwood	0	0	N
Galium aparine	stickywilly	0	0	N
Gaura biennis	biennial beeblossom	0	0	N
Juglans nigra	black walnut	0	0	N
Juniperus virginiana	eastern redcedar	0	0	N
Lactuca serriola	prickly lettuce	0	0	I
Lobelia spicata	palespike lobelia	0	0	N
Lonicera sp.	honeysuckle	0	0	I
Medicago sp.	alfalfa	0	0	I
Melilotus sp.	sweetclover	0	0	I
Muhlenbergia	muhly	0	0	N
Muhlenbergia racemosa	marsh muhly	0	0	N
Poa compressa	Canada bluegrass	0	0	I
Prunus sp.	plum	0	0	N
Rudbeckia laciniata	cutleaf coneflower	0	0	N
Rumex crispus	curly dock	0	0	I
Sambucus nigra ssp. *canadensis*	American black elderberry	0	0	N
Setaria viridis	green bristlegrass	0	0	I
Solanum carolinense	Carolina horsenettle	0	0	N
Symphoricarpos occidentalis	western snowberry	0	0	N
Symphoricarpos orbiculatus	coralberry	0	0	N

Table A-1 (continued). Native species are listed in order of the greatest mean cover for 2017. Species with 0 values were not recorded in 2017, but were only observed in previous years. StdDev = Standard deviation, Origin: N = native, I = introduced.

Species	Common Name	Mean Cover (%)	StdDev	Origin
Symphyotrichum lanceolatum ssp. lanceolatum var. *lanceolatum*	white panicle aster	0	0	N
Symphyotrichum novae-angliae	New England wild aster	0	0	N
Trifolium repens	white clover	0	0	I
Ulmus sp.	elm	0	0	N
Ulmus rubra	slippery elm	0	0	N
Viburnum sp.	viburnum	0	0	N

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.

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