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Vegetation Community Monitoring at Pipestone National Monument, Minnesota

1997-2009

Natural Resource Data Series NPS/HTLN/NRDS—2011/145

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Introduction

The natural resources of Pipestone National Monument (PIPE) include 240 acres of tallgrass prairie. Management of the prairie has been ongoing since the parks inception in 1937. Natural and cultural resource management continues today through various activities with the goal of promoting native species diversity, composition and prairie function in addition to protecting the integrity of rare prairie community types and listed plant species. The Heartland Inventory and Monitoring Network (HTLN) began monitoring plant communities at PIPE in 1996. Today, thirteen sites distributed across three plant communities are monitored on a four year cycle (James et al, 2009). Maintaining and restoring the native communities not only protect rare natural communities and species but also allow for a more complete interpretation of the cultural resources in the park (NPS 2006).

Tallgrass prairie

The tallgrass prairie community is culturally significant as the historic background to the Pipestone quarries. Today, one hundred and sixty acres of virgin tallgrass prairie remain in the monument. Previous botanical investigations have identified 250 vascular plants species occurring in the prairie, including the federally endangered western prairie fringed orchid (*Platanthera praeclara*). Prescribed fire is employed as a management tool in this community. Four monitoring sites (sites 11-14) are located in the native tallgrass prairie community.

Restored tallgrass prairie

A goal at PIPE is maintenance and restoration of the historic tallgrass vista that surrounds the Pipestone quarries. A component of this goal is the restoration of tallgrass prairie communities. Restoration efforts in the 1990's focused on introducing native grasses and forb species into smooth brome dominated fields. The persistence of exotic species in these areas is a concern to resource managers. Restored areas are managed with fire, mowing and manual exotic removal. Three monitoring sites (sites 7-9) were established in 1996, and three additional sites (sites 15-17) were established and monitored in 2009, for a total of six current monitoring sites.

Sioux quartzite prairie

The Sioux quartzite prairie at PIPE represents one of the least disturbed examples of this globally significant and endangered plant community. The combination of water retaining depressions and thin, arid soils support many unique species including several Minnesota state listed rare plants. Prescribed fire is employed as a management tool in this community. Three sample sites (sites 5, 6 and 10) are located in the Sioux quartzite prairie type.

Methods

Data collection

The Heartland Inventory and Monitoring Network (HTLN) implemented monitoring at PIPE in 1996 to provide analysis of baseline conditions and to assess future change in floral communities (see James et al, 2009 for detailed information on the monitoring protocol). Monitoring of the original ten sites occurred in 1998, 1999, 2001, 2005, and 2006. In 2009, three new sites were established bringing the total number of sites monitored to thirteen (Fig. 1).

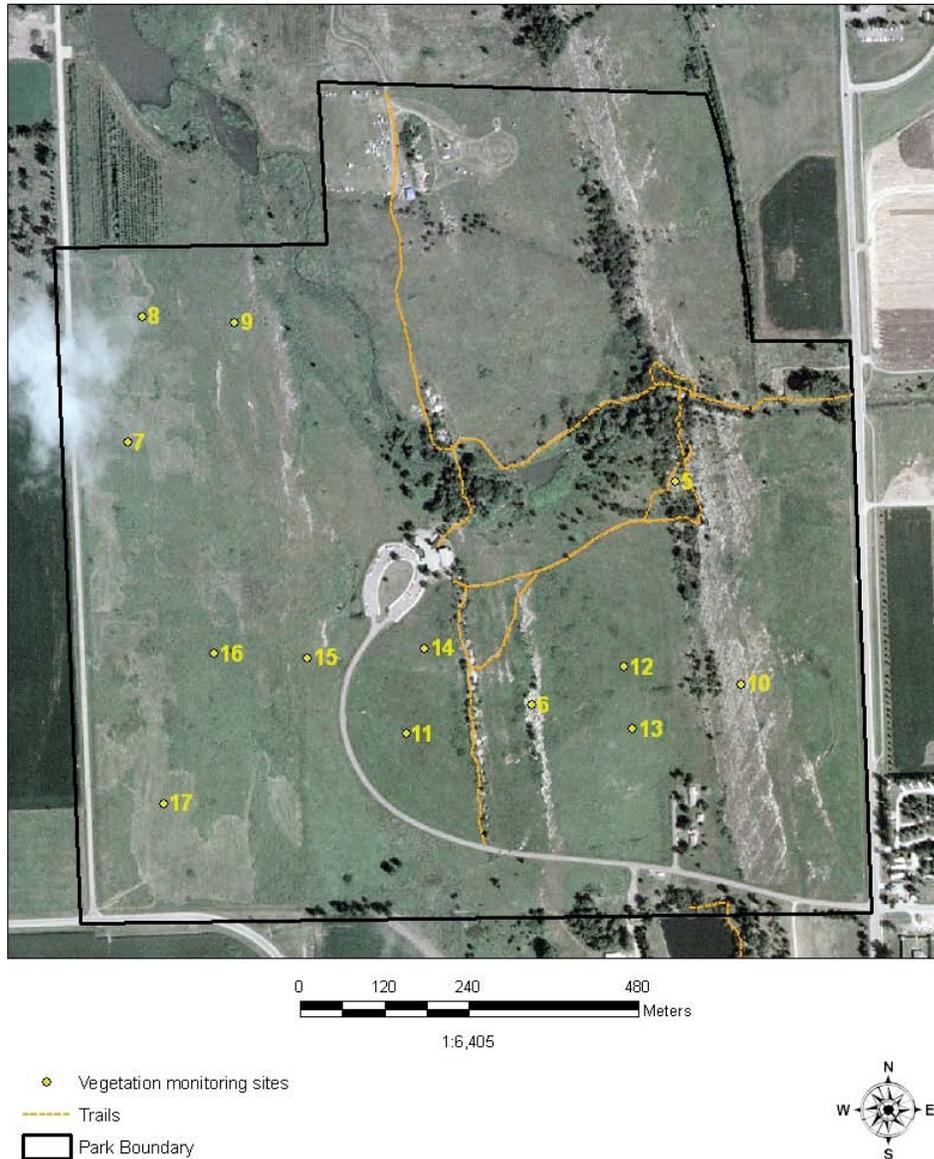


Figure 1. Location of Heartland Inventory and Monitoring Network vegetation monitoring sites (n=13) at Pipestone National Monument, Minnesota.

Sites are monitored according to the revised 2009 protocol and are comprised of two parallel transects containing five nested sample plots (Fig. 2). Species composition and foliar cover estimates are collected from each plot and values are summarized to the individual site.

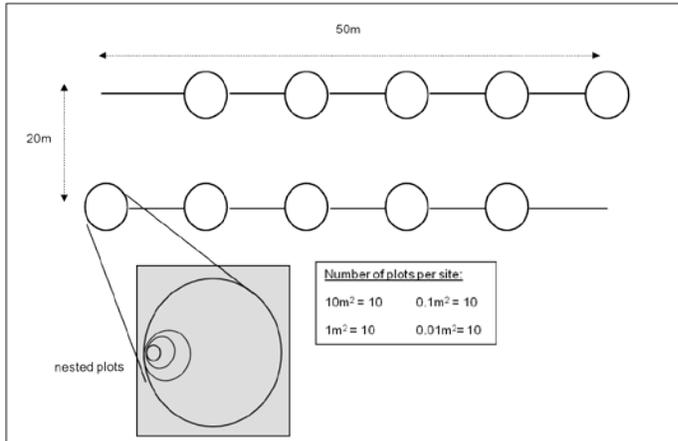


Figure 2. Heartland Inventory and Monitoring Network vegetation community sample design showing transects and plots including nested plots.

Individual species percent foliar cover was calculated for each site. Foliar cover served as an estimate of abundance for herbaceous species. Cover class intervals were converted to median values to estimate percent cover for each herbaceous and shrub species. Mean percent cover was then calculated as the species percent cover for a site, averaged for all ten plots within the site.

Data Summary and Analysis

Data collected from all plots within a site are summarized by species to the site level. Mean site values along with a measure of among site variability (± 1 standard error of the mean) are presented for each community type. Foliar cover estimates collected for each species within a plot are the basis of field data used in all subsequent analysis.

Prairie community diversity

Three measures of diversity were calculated among all sites within the native and restored prairies. Alpha diversity (i.e., site level diversity) was calculated as the average species richness per site; gamma diversity (i.e., community level diversity) was estimated as the total number of species across all sites (McCune and Grace 2002). Each measure of diversity was summarized for comparison between the native and restored prairie communities. Beta diversity, as a measure of the heterogeneity in the data, was calculated as (Whittaker 1972):

$$\beta_w = (S_c / S) - 1$$

where:

β_w = beta diversity,

S_c = the number of species in the prairie,

S = the average species richness in the sample sites.

As a rule of thumb, values of $\beta_w < 1$ are rather low and $\beta_w > 5$ are considered high beta diversity (McCune and Grace 2002). If $\beta_w = 0$, then all species are found within each site. The one is subtracted to make zero beta diversity correspond to zero variation in species presence. While this measure does not have any formal units, the result could be thought of in approximate units as the “number of distinct communities” (McCune and Grace 2002).

Prairie species diversity

For each site within a community, species richness (S) along with the effective number of species derived from both Shannon diversity index (Shannon number or H_e) and Simpson’s diversity index (Simpson’s number or D_e) was calculated. Foliar cover estimates for each species in a site are used to determine each measure of species diversity in PC-ORD (McCune and Medford 1999).

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

$$H' = - \sum_{i=1}^n p_i \ln p_i$$

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

$$\text{Simpson's index} = 1 - \sum_{i=1}^n p_i^2$$

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 2006). Shannon index was converted into effective number of species (H_e) using the following formula:

$$H_e = \exp^{(H)}$$

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

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

where D was the Simpson’s index value.

As S, H_e and D_e approach the same number, species begin to be equally abundant in the prairie while large differences in the number of species between each measure reflect an increasing number of less abundant species and decreasing number of more abundant species. See Jost (2006) and James and Rowell (2009) for a complete explanation and implementation of species diversity measures, respectively.

Prairie guild abundance

Species are grouped into functional guilds and foliar cover estimates are presented at the guild level for each community. For every guild, foliar cover is totaled for each plot and then a mean site value is calculated from all ten plots. Guilds are first divided among native and nonnative groups and then among grasses, forbs, sedges/rushes, ferns and woody species within each group. A complete species list along with guild assignment is provided in Appendix A.

Results

Community diversity: native and restored prairie communities

Site level diversity (alpha) between the two prairie types remained similar through all sample years (Table 1). Community wide diversity (gamma), although similar, was slightly higher in the native prairie for all but the most recent sample year, 2009.

Table 1. Alpha, beta and gamma diversity for both native tallgrass prairie and the prairie restoration by sample year.

Year	Alpha		Beta		Gamma	
	Native	Restored	Native	Restored	Native	Restored
1998	50	50	0.76	0.66	88	83
1999	54.7	51	0.72	0.59	94	81
2001	58	58.3	0.67	0.6	97	93
2005	55	55.7	0.71	0.62	94	90
2006	57.2	51.3	0.82	0.62	104	83
2009	44.5	39.8	0.51	0.98	67	79

Beta diversity remained low for both communities among all sample years. Values <1 were low and indicate a high degree of similarity of species among sites within each type.

Species diversity

Species richness was measurably greater than species counts for Shannon number and Simpson's number in each community (Figures 3-5). Each community type was composed of a larger number of less abundant species and fewer highly abundant species, typically prairie grasses and forbs.

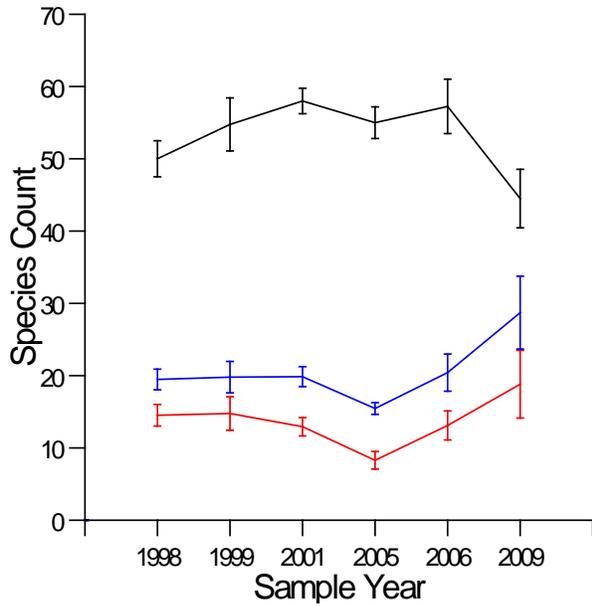


Figure 3. Mean number of species within a site as measured by species richness (black) and effective number of species for two diversity measures (Shannon number, blue; and Simpson's number, red) for native tallgrass prairie sites. Error bars are ± 1 standard error of the mean.

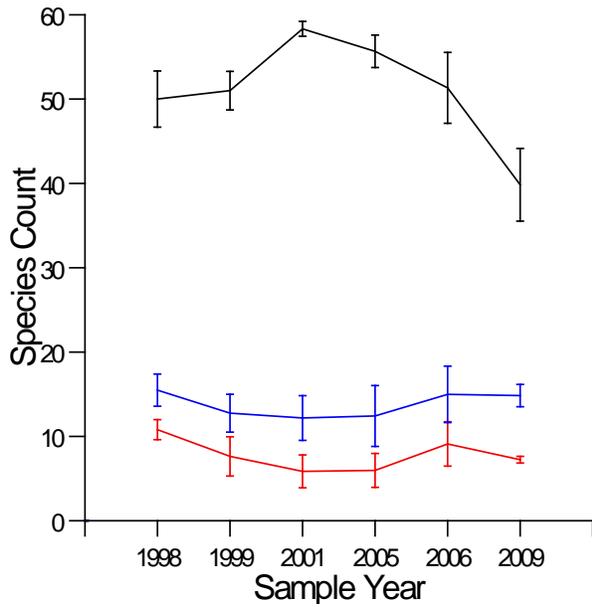


Figure 4. Mean number of species within a site as measured by species richness (black) and effective number of species for two diversity measures (Shannon number, blue; and Simpson's number, red) in the prairie restoration sites. Error bars are ± 1 standard error of the mean.

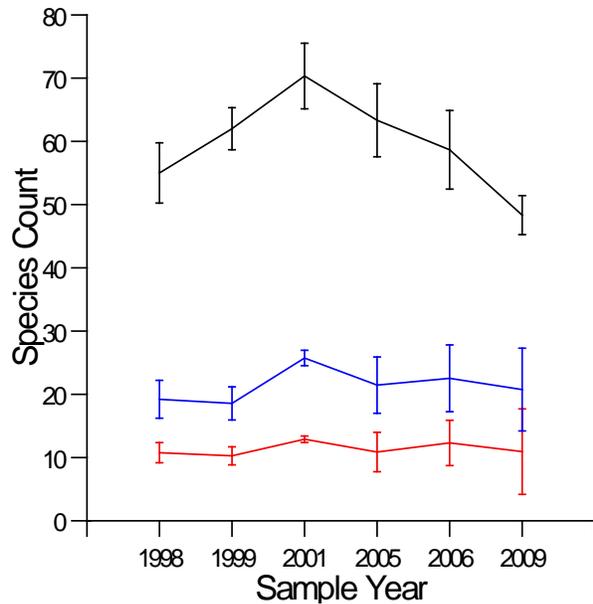


Figure 5. Mean number of species within a site as measured by species richness (black) and effective number of species for two diversity measures (Shannon number, blue; and Simpson's number, red) in the Sioux quartzite prairie sites. Error bars are ± 1 standard error of the mean.

Overall there was a declining pattern in species richness for the two native prairie types beginning in 2001 and continuing until 2009. A similar pattern was not observed in the other two species diversity measures. Therefore, over time species represented by one or few individuals were not consistently observed locally, while the number of highly abundant species remained relatively unchanged over time. A decline in species richness was evident at the restored prairie sites from 2001-2009. In contrast to the restored prairie, in the native prairie the other two species diversity measures increased as total species richness decreased. Therefore the community composition shifted toward fewer total species that were observed in near equal abundance.

Guild abundance

Even though native guilds composed most of the foliar cover within sites of each community, nonnative guilds, primarily nonnative grasses, were detected as well (Figures 6-8).

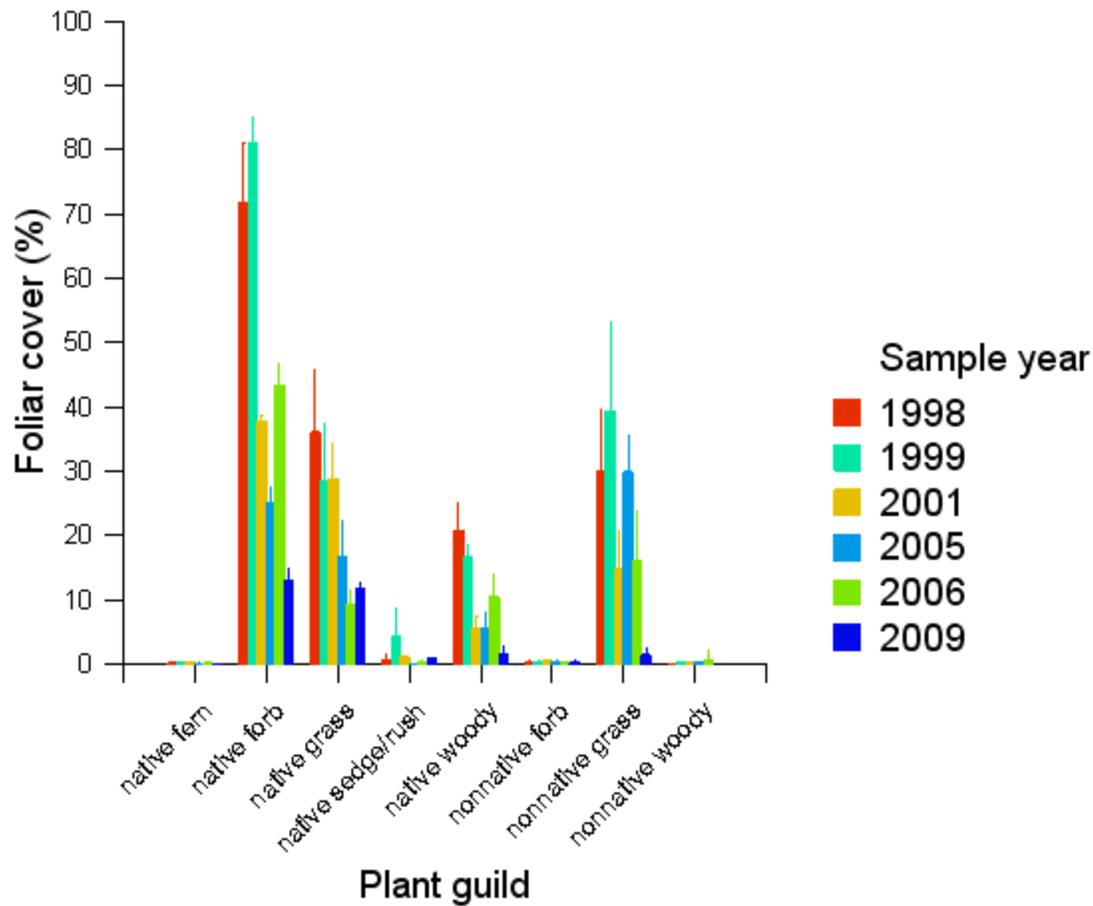


Figure 6. Mean foliar cover (± 1 standard error of the mean) for plant guilds in native tallgrass prairie.

Aside from the grass and forb guilds, the other guild types occurred in low abundance for all sample years. The nonnative woody guild showed remained low in the native tallgrass prairie during the monitoring period. This level reflected concerted efforts by the park to remove buckthorn (*Rhamnus cathartica*).

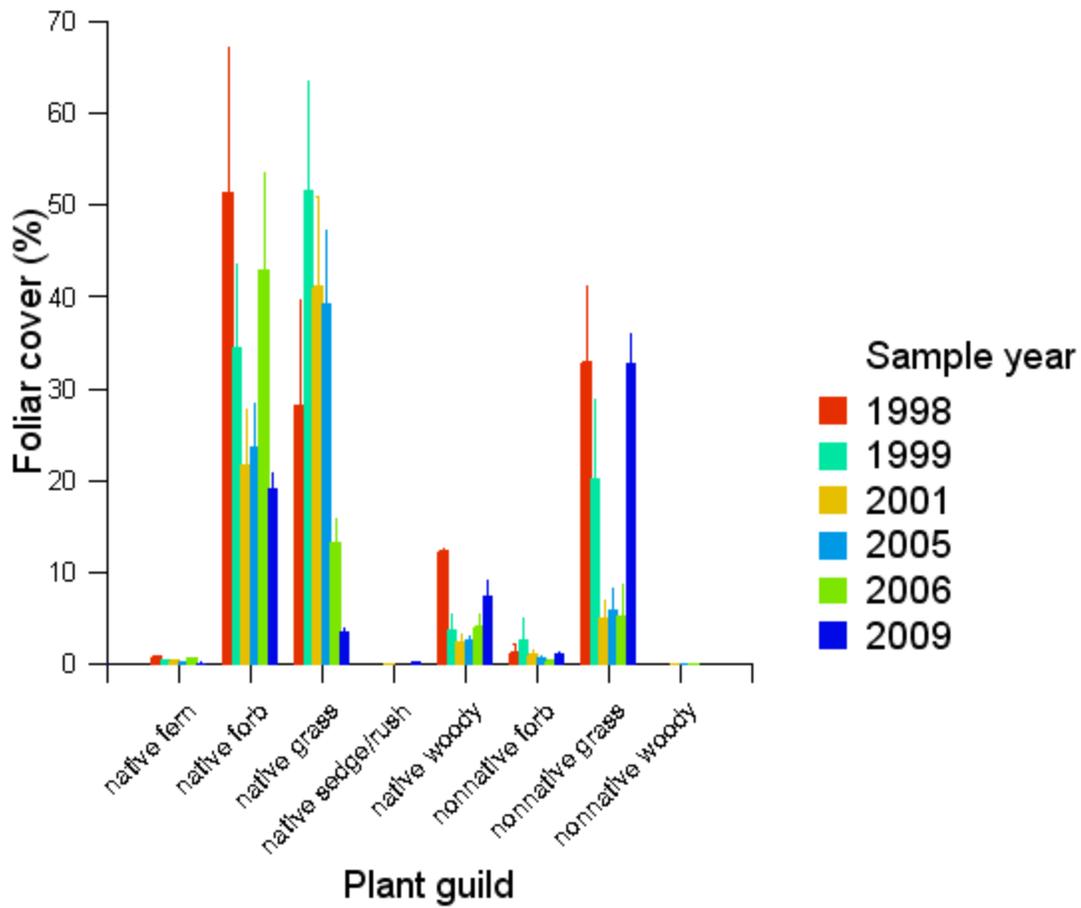


Figure 7. Mean foliar cover (± 1 standard error of the mean) for plant guilds in the prairie restoration.

The nonnative grass guild was composed of brome and bluegrass species (*Bromus* and *Poa*, respectively). Clover species made up the majority of the nonnative forb guild.

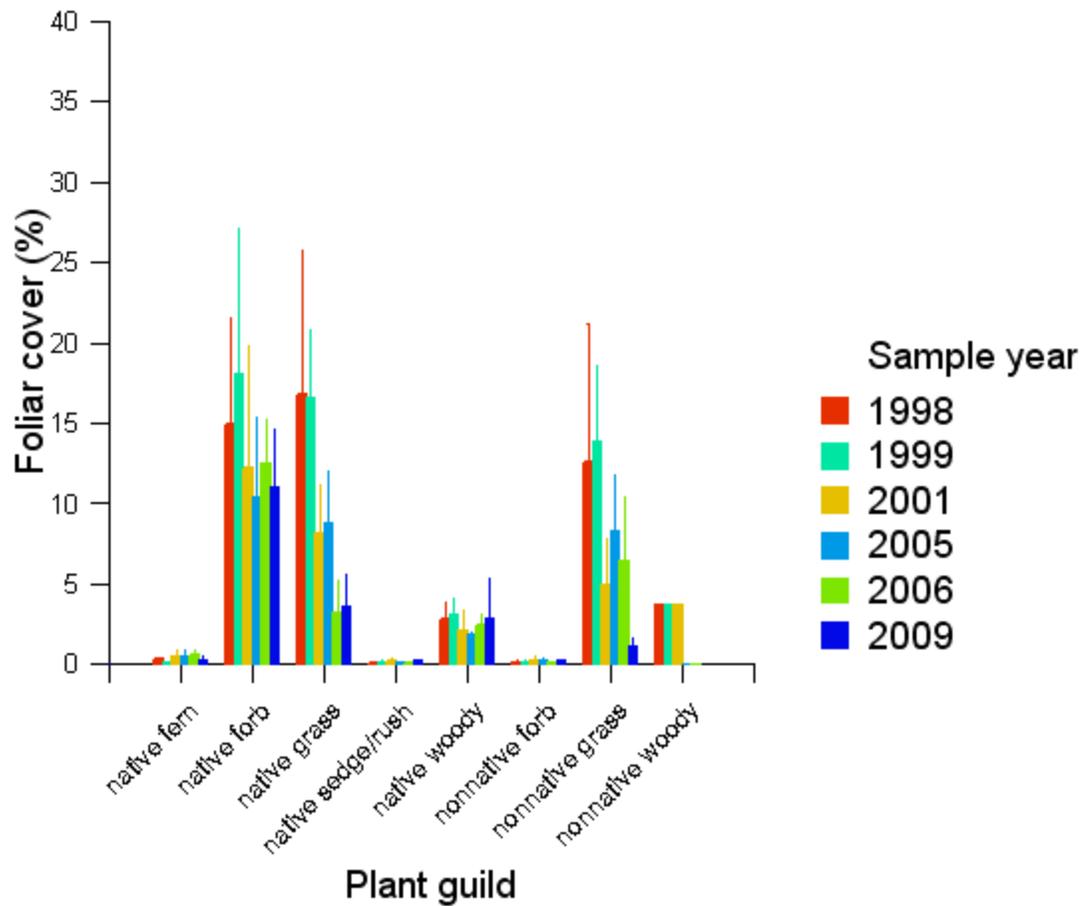


Figure 8. Mean foliar cover (± 1 standard error of the mean) for plant guilds in Sioux quartzite prairie.

Across all communities, mean foliar cover at the guild level rarely exceeded 50%. Mean native forb cover in the prairie restoration peaked at 80% in 1998 and then readily declined for the remaining sample years (Fig. 7).

Discussion

Prior to the 2009 data collection, fire management units that included the HTLN native prairie sites were burned. This may account for the lowest alpha and gamma diversity values recorded for the entire monitoring period in this community. However, a similar pattern of decline in species richness (S) was observed for both the prairie restoration and Sioux quartzite prairie sites, which were not burned in 2009. Corresponding patterns in guild foliar cover were not observed for the similar time period within the communities. As fluctuation in species richness is observed (presence/absence detection), diversity measures (species presence weighted by abundance) remained consistent across the monitoring period. Based on HTLN vegetation monitoring data collected between 1997 and 2009, the restored prairie is beginning to approximate the native prairie in terms of species richness. However, in 2009, a noticeable increase in abundant (H_e) and dominant (D_e) species was observed in the native prairie that was not matched in the restored prairie. The Sioux quartzite prairie continues to persist and benefit from active management addressing invasive species.

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Appendix

Appendix A. Species list compiled from all HTLN vegetation monitoring sites sampled between 1997 and 2009. Community type abbreviation corresponds to native tallgrass prairie (N), restored prairie (R) and Sioux quartzite prairie (S).

<u>Scientific name</u>	<u>Common name</u>	<u>Guild</u>	<u>Community</u>
<i>Acalypha virginica</i>	Virginia copperleaf	native forb	S
<i>Achillea millefolium</i>	Common yarrow	native forb	N, R
<i>Agrostis scabra</i>	Ticklegrass	native grass	S
<i>Allium</i>	Onion	native forb	N
<i>Allium canadense</i>	Onion	native forb	N, S
<i>Allium stellatum</i>	Onion	native forb	N,R, S
<i>Alopecurus carolinianus</i>	Carolina foxtail	native grass	S
<i>Ambrosia artemisiifolia</i>	Common ragweed	native forb	N, R, S
<i>Ambrosia psilostachya</i>	Western ragweed	native forb	N, R, S
<i>Amorpha canescens</i>	Lead-plant	native forb	N, R, S
<i>Amorpha fruticosa</i>	False indigo	native forb	R, S
<i>Andropogon gerardii</i>	Big bluestem	native grass	N, R, S
<i>Androsace occidentalis</i>	Western androsace	native forb	S
<i>Anemone canadensis</i>	Canadian anemone	native forb	N, R
<i>Anemone caroliniana</i>	Prairie anemone	native forb	R
<i>Anemone cylindrica</i>	Long-headed anemone	native forb	N, R
<i>Bromus</i>	B. Tectorum, B. Japonicus	nonnative grass	S
<i>Antennaria neglecta</i>	Field pussytoes	native forb	R
<i>Apocynum cannabinum</i>	Hemp dogbane	native forb	N, R
<i>Arabis hirsuta</i>	Rock-cress	native forb	S
<i>Aristida dichotoma</i>	Churchmouse three-awn	native forb	S
<i>Artemisia campestris</i>	Wormwood	native forb	S
<i>Artemisia frigida</i>	Prairie-sagewort	native forb	S
<i>Artemisia ludoviciana</i>	White sage	native forb	N, R, S
<i>Asclepias ovalifolia</i>	Dwarf milkweed	native forb	N, R, S
<i>Asclepias syriaca</i>	Common milkweed	native forb	N, R, S
<i>Asclepias verticillata</i>	Whorled milkweed	native forb	N, R, S
<i>Asparagus officinalis</i>	Asparagus	nonnative forb	N, R, S
<i>Aster ericoides</i>	Squarrose white wild aster	native forb	N, R, S
<i>Aster laevis</i>	Smooth wild aster	native forb	N, R, S
<i>Aster lanceolatus</i>	White panicle aster	native forb	N
<i>Aster novae-angliae</i>	New england wild aster	native forb	R
<i>Aster oblongifolius</i>	Aromatic wild aster	native forb	N, S
<i>Aster sericeus</i>	Western silvery wild aster	native forb	N, S
<i>Astragalus canadensis</i>	Canada milk-vetch	native forb	N, R
<i>Bouteloua curtipendula</i>	Side-oats grama-grass	native grass	N, R, S
<i>Bouteloua gracilis</i>	Blue grama	native grass	S
<i>Brickellia eupatorioides</i>	Aster	native forb	R
<i>Bromus inermis</i>	Smooth brome	nonnative grass	N, R, S
<i>Bromus japonicus</i>	Japanese chess	nonnative grass	S
<i>Buchloe dactyloides</i>	Buffalograss	native grass	S
<i>Calystegia sepium</i>	Hedge-bindweed	native forb	N, R, S
<i>Carduus nutans</i>	Musk-thistle	nonnative forb	N, R

<i>Carex</i>	Sedge	native sedge/rush	N, R, S
<i>Cerastium arvense</i>	Field chickweed	native forb	N, S
<i>Cerastium glomeratum</i>	Clammy chickweed	nonnative forb	S
<i>Chamaesyce maculata</i>	Spotted sandmat	native forb	S
<i>Chamaesyce prostrata</i>	Spurge	native forb	R, S
<i>Chenopodium album</i>	Lamb's quarters, pigweed	native forb	N, S
<i>Cicuta maculata</i>	Common water-hemlock	native forb	R
<i>Cirsium</i>	Thistle	native sedge/rush	R
<i>Cirsium altissimum</i>	Tall thistle	native forb	N, R
<i>Cirsium arvense</i>	Canada thistle	nonnative forb	N, R, S
<i>Cirsium flodmanii</i>	Prairie thistle	native forb	N, R
<i>Cirsium vulgare</i>	Bull thistle	nonnative forb	N, R
<i>Collomia linearis</i>	Phlox	native forb	S
<i>Comandra umbellata</i>	Bastard toad-flax	native forb	N, R
<i>Convolvulus arvensis</i>	Field-bindweed	nonnative forb	N, R, S
<i>Conyza canadensis</i>	Horseweed	native forb	N, R, S
<i>Coreopsis palmata</i>	Finger-tickseed	native forb	R
<i>Cuscuta</i>	Dodder	native forb	S
<i>Cyperus</i>	Flatsedge	native sedge/rush	S
<i>Cyperus squarrosus</i>	Flatsedge	native sedge/rush	S
<i>Cystopteris fragilis</i>	Lowland bladder-fern	native fern	S
<i>Dalea candida</i>	White prairie clover	native forb	N, R
<i>Dalea purpurea</i>	Purple prairie clover	native forb	N, R
<i>Delphinium carolinianum</i>	Carolina larkspur	native forb	N, R, S
<i>Dichanthelium</i>	Panic grass	native grass	N, R, S
<i>Dichanthelium praecocius</i>	Early-branching panic	native grass	S
<i>Draba nemorosa</i>	Mustard	nonnative forb	S
<i>Draba reptans</i>	Mustard	native forb	S
<i>Echinacea angustifolia</i>	Prairie coneflower	native forb	N, R
<i>Eleocharis</i>	Spike-rush	native sedge/rush	R
<i>Eleocharis obtusa</i>	Blunt spike-rush	native sedge/rush	N, R, S
<i>Ellisia nyctelea</i>	Water-pod	native forb	S
<i>Elymus</i>	Rye grass	native grass	N, S
<i>Elymus canadensis</i>	Canada wild rye	native grass	N
<i>Elymus hystrix</i>	Bottlebrush-grass	native grass	N, S
<i>Elymus repens</i>	Quackgrass	nonnative grass	N, R, S
<i>Equisetum arvense</i>	Field horsetail	native fern	R
<i>Equisetum laevigatum</i>	Smooth scouring rushes	native fern	N, R
<i>Erigeron philadelphicus</i>	Philadelphia daisy	native forb	R
<i>Erigeron strigosus</i>	Rough fleabane	native forb	N, R, S
<i>Eriochloa villosa</i>	Hairy cupgrass	nonnative forb	S
<i>Erysimum cheiranthoides</i>	Wormseed-mustard	nonnative forb	S
<i>Euphorbia corollata</i>	Flowering spurge	native forb	N
<i>Euphorbia spathulata</i>	Prairie spurge	native forb	S
<i>Euthamia gymnospermoides</i>	Flat-topped goldenrod	native forb	N
<i>Fragaria virginiana</i>	Wild strawberry	native forb	N, R
<i>Fraxinus pennsylvanica</i>	Ash	native woody	S
<i>Galium aparine</i>	Cleavers	native forb	S
<i>Galium boreale</i>	Northern bedstraw	native forb	R
<i>Galium obtusum</i>	Bluntleaf bedstraw	native forb	N

<i>Gaura coccinea</i>	Scarlet gaura	native forb	N
<i>Gentiana andrewsii</i>	Bottle-gentian	native forb	N
<i>Gentiana puberulenta</i>	Prairie gentian	native forb	N, R
<i>Geranium carolinianum</i>	Carolina crane's-bill	native forb	S
<i>Geum triflorum</i>	Prairie smoke	native forb	N, R, S
<i>Glycyrrhiza lepidota</i>	Wild licorice	native forb	N, R
<i>Hedeoma hispidum</i>	Mint	native forb	S
<i>Helianthus grosseserratus</i>	Sawtooth sunflower	native forb	N, R
<i>Helianthus maximiliani</i>	Maximilian sunflower	native forb	N, R, S
<i>Helianthus nuttallii</i>	Nuttall's sunflower	native forb	N
<i>Helianthus pauciflorus</i>	Stiff sunflower	native forb	N, R, S
<i>Helianthus petiolaris</i>	Plains sunflower	native forb	N
<i>Heliopsis helianthoides</i>	Sunflower-everlasting	native forb	N, R, S
<i>Heuchera richardsonii</i>	Prairie alum-root	native forb	S
<i>Hordeum jubatum</i>	Foxtail-barley	native grass	N
<i>Hordeum pusillum</i>	Little barley	native grass	S
<i>Hypoxis hirsuta</i>	Common star-grass	native forb	N
<i>Juncus</i>	Rush	native sedge/rush	N, S
<i>Juncus balticus</i>	Wire-rush	native sedge/rush	N, S
<i>Juncus interior</i>	Rush	native sedge/rush	N, S
<i>Koeleria macrantha</i>	Junegrass	native grass	N, R, S
<i>Lactuca serriola</i>	Prickly lettuce	nonnative forb	N, R
<i>Lactuca tatarica</i>	Blue lettuce	native forb	N, R
<i>Lappula occidentalis</i>	Western stickseed	native forb	S
<i>Lathyrus palustris</i>	Marsh pea	native forb	N
<i>Lathyrus venosus</i>	Forest pea	native forb	N, R
<i>Leersia virginica</i>	Whitegrass	native grass	N
<i>Lepidium densiflorum</i>	Prairie-pepperweed	native forb	S
<i>Lespedeza capitata</i>	Bush-clover	native forb	R
<i>Liatris aspera</i>	Lacerate blazing star	native forb	N, R
<i>Liatris punctata</i>	Blazing star, gay feather	native forb	N, R
<i>Liatris pycnostachya</i>	Thick-spike blazing star	native forb	N, R
<i>Linaria vulgaris</i>	Butter-and-eggs	nonnative forb	N, R
<i>Linum sulcatum</i>	Grooved yellow flax	native forb	N, S
<i>Lithospermum canescens</i>	Hoary puccoon	native forb	N, R
<i>Lithospermum incisum</i>	Narrow-leaved puccoon	native forb	R
<i>Lobelia spicata</i>	Spiked lobelia	native forb	R
<i>Lotus unifoliolatus</i>	Bird's foot trefoil	native forb	R, S
<i>Medicago lupulina</i>	Black medick	nonnative forb	N, R, S
<i>Melilotus officinalis</i>	Yellow sweet clover	nonnative forb	R
<i>Mirabilis hirsuta</i>	Hairy umbrella-wort	native forb	S
<i>Mirabilis nyctaginea</i>	Heart-leaved umbrella-wort	native forb	S
<i>Monarda fistulosa</i>	Wild bergamot	native forb	N, R
<i>Muhlenbergia cuspidata</i>	Muhly	native grass	N, S
<i>Muhlenbergia frondosa</i>	Muhly	native grass	S
<i>Muhlenbergia racemosa</i>	Muhly	native grass	N, R
<i>Myosotis verna</i>	Early scorpion grass	native forb	S
<i>Nepeta cataria</i>	Catnip	nonnative forb	S
<i>Oenothera biennis</i>	Common evening-primrose	native forb	N
<i>Oenothera villosa</i>	Evening-primrose	native forb	N, S

<i>Onosmodium molle</i>	Western false gromwell	native forb	R
<i>Opuntia fragilis</i>	Little prickly pear	native forb	S
<i>Opuntia macrorhiza</i>	Plains prickly pear	native forb	S
<i>Oxalis</i>	Wood-sorrel	native forb	N, R, S
<i>Oxalis violacea</i>	Violet wood-sorrel	native forb	N, R, S
<i>Panicum capillare</i>	Witch-grass	native grass	N, S
<i>Panicum virgatum</i>	Switchgrass	native grass	N, R, S
<i>Parthenocissus vitacea</i>	Grape-woodbine	native woody	S
<i>Pascopyrum smithii</i>	Western wheatgrass	native grass	N, R, S
<i>Phalaris arundinacea</i>	Reed canary-grass	nonnative grass	N
<i>Phleum pratense</i>	Timothy	nonnative grass	N
<i>Phlox pilosa</i>	Prairie phlox	native forb	N, R, S
<i>Physalis heterophylla</i>	Clammy ground cherry	native forb	N, R
<i>Physalis longifolia</i>	Longflower ground cherry	native forb	R
<i>Physalis pumila</i>	Prairie ground cherry	native forb	N
<i>Physalis virginiana</i>	Virginia ground cherry	native forb	N, R, S
<i>Plantago patagonica</i>	Woolly plantain	native forb	R, S
<i>Platanthera praeclara</i>	White fringed orchid	native forb	N
<i>Poa compressa</i>	Canada bluegrass	nonnative grass	S
<i>Poa pratensis</i>	Kentucky bluegrass	nonnative grass	N, R, S
<i>Polygonum ramosissimum</i>	Smartweed	native forb	S
<i>Portulaca oleracea</i>	Common purslane	native forb	S
<i>Potentilla arguta</i>	Tall potentilla	native forb	N, S
<i>Potentilla pensylvanica</i>	Cinquefoil or five-fingers	native forb	S
<i>Prenanthes racemosa</i>	Purple rattlesnakeroot	native forb	N
<i>Prunus americana</i>	Wild plum	native woody	N, R, S
<i>Prunus pumila</i>	Sand-cherry	native woody	N, S
<i>Psoralea argophylla</i>	Silvery scurf-pea	native forb	N, R, S
<i>Quercus macrocarpa</i>	Bur oak	native woody	S
<i>Ratibida pinnata</i>	Globular coneflower	native forb	N, R
<i>Rhamnus cathartica</i>	Common buckthorn	nonnative woody	N, R, S
<i>Rhus glabra</i>	Smooth sumac	native woody	S
<i>Rosa arkansana</i>	Dwarf prairie rose	native woody	N, R, S
<i>Rudbeckia hirta</i>	Black-eyed susan	native forb	R
<i>Rumex crispus</i>	Curly dock	nonnative forb	N, S
<i>Schedonnardus paniculatus</i>	Tumblegrass	native grass	S
<i>Schizachyrium scoparium</i>	Little bluestem	native grass	N, R, S
<i>Scirpus</i>	Bulrush	native sedge/rush	N, S
<i>Selaginella rupestris</i>	Rock-selaginella	native fern	S
<i>Senecio plattensis</i>	Platte groundsel	native forb	N, S
<i>Setaria pumila</i>	Yellow foxtail	nonnative forb	S
<i>Setaria viridis</i>	Green foxtail-grass	nonnative grass	R, S
<i>Silene antirrhina</i>	Catchfly	native forb	S
<i>Silene latifolia ssp. Alba</i>	White campion	nonnative forb	N
<i>Silene stellata</i>	Widows frill	native forb	N
<i>Sisyrinchium</i>	Blue-eyed grass	native forb	N
<i>Sisyrinchium campestre</i>	Blue-eyed grass	native forb	N, R, S
<i>Solanum</i>	Nightshade	native forb	S
<i>Solidago canadensis</i>	Common goldenrod	native forb	N, R, S
<i>Solidago gigantea</i>	Smooth goldenrod	native forb	N

<i>Solidago missouriensis</i>	Missouri goldenrod	native forb	N, R, S
<i>Solidago nemoralis</i>	Gray goldenrod	native forb	S
<i>Solidago rigida</i>	Stiff goldenrod	native forb	N, R
<i>Sonchus arvensis</i>	Sowthistle	nonnative forb	R
<i>Sorghastrum nutans</i>	Indian grass	native grass	N, R, S
<i>Spartina pectinata</i>	Prairie cord-grass	native grass	N, S
<i>Sporobolus asper</i>	Tall dropseed	native grass	N, R, S
<i>Sporobolus heterolepis</i>	Prairie dropseed	native grass	N, R, S
<i>Sporobolus vaginiflorus</i>	Poverty-grass	native grass	S
<i>Stachys palustris</i>	Hedge-nettle	nonnative forb	N
<i>Stipa comata</i>	Needle-and-thread grass	native grass	R, S
<i>Stipa spartea</i>	Porcupine-grass	native grass	N, R, S
<i>Symphoricarpos occidentalis</i>	Wolfberry	native woody	R, S
<i>Talinum parviflorum</i>	Prairie fame-flower	native forb	S
<i>Taraxacum laevigatum</i>	Red-seeded dandelion	nonnative forb	N, R
<i>Taraxacum officinale</i>	Common dandelion	nonnative forb	N, R, S
<i>Thalictrum dasycarpum</i>	Purple meadow-rue	native forb	N, R
<i>Tradescantia bracteata</i>	Sticky spiderwort	native forb	N, R, S
<i>Tragopogon dubius</i>	Fistulous goat's beard	nonnative forb	N, R, S
<i>Trichostema brachiatum</i>	Blue curls	native forb	S
<i>Trifolium</i>	T. Hybridum and T. Pratense	nonnative forb	R
<i>Trifolium pratense</i>	Red clover	nonnative forb	N
<i>Trifolium repens</i>	White clover	nonnative forb	R
<i>Ulmus</i>	Elm	native woody	R
<i>Ulmus rubra</i>	Slippery or red elm	native woody	R
<i>Verbascum thapsus</i>	Common mullein	nonnative forb	N
<i>Verbena stricta</i>	Hoary vervain	native forb	R
<i>Vernonia fasciculata</i>	Smooth ironweed	native forb	R
<i>Veronica arvensis</i>	Corn speedwell	nonnative forb	S
<i>Veronica peregrina</i>	Purslane speedwell	native forb	S
<i>Veronicastrum virginicum</i>	Culver's root	native forb	N
<i>Vicia americana</i>	American vetch	native forb	N, R
<i>Viola pedatifida</i>	Wood violet	native forb	N, R, S
<i>Viola pratincola</i>	Violet	native forb	R
<i>Vulpia octoflora</i>	Six-weeks fescue	native grass	S
<i>Zanthoxylum americanum</i>	Common prickly ash	native woody	S
<i>Zizia aptera</i>	Heart-leaved golden alexanders	native forb	N, R
<i>Zizia aurea</i>	Common golden alexanders	native forb	N, R