



Plant Community Composition and Structure Monitoring for Wind Cave National Park

2011-2015 Summary Report

Natural Resource Report NPS/NGPN/NRR—2016/1236



ON THE COVER

Long-term monitoring plot PCM-0028 at Wind Cave National Park, 2015
Photograph courtesy of the National Park Service.

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2011-2015 Summary Report

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Executive Summary

The Northern Great Plains Inventory & Monitoring Program and Fire Effects Program have been monitoring vegetation in Wind Cave National Park for over 18 years. While methods have changed slightly, this report summarizes data from 97 locations from 1998-2015. Below, we list the questions we asked and provide a summarized answer, for more details see the Results and Discussion section. We conclude with a Natural Resource Condition Table (Table ES-1) that summarizes the current status and trends in a few key vegetation metrics.

1. What is the current status of plant community composition and structure of WICA vegetation (species richness, cover, and diversity) and how has this changed from 1998-2015?

The ponderosa pine woodlands and mixed-grass prairie within the boundaries of WICA are characterized by moderate to high native species richness. The closed canopy forest generally maintains lower species richness than the open grassland areas. We found no significant trends in native diversity or evenness from 1998 to 2015. Invasive annual brome grasses are an emerging threat in WICA, and keeping them in low abundance will help maintain native plant diversity. Other exotics, such as Kentucky bluegrass are more prevalent, but there is no evidence of an increasing trend in their cover.

2. What are the differences and similarities in forested and grassland condition and trends?

We examined the status and trends in native species richness, exotic species cover, and litter cover between forest and grasslands plots in WICA. We found that grassland plots had higher native richness and higher cover of annual brome grasses but there was not a difference in the relative cover of exotic plant species. Despite some differences in species composition, trends over time appear consistent in grasslands and forested plots. This suggests that both ecotypes are responding similarly to climate and other external drivers.

3. How do trends in vegetation correlate with climate and fire history?

The large variability in the climate of WICA has made it difficult to discern strong patterns linking temperature, precipitation, and plant community structure (e.g. exotic cover, species richness). A longer time series of vegetation data will make it easier to elucidate trends in the future.

WICA has been using prescribed fire as a management tool since the 1970s. There was no difference in native diversity among plots that had burned recently and those that had not burned for over 25 years. However, the sites which burned recently have a lower cover of annual brome grasses than sites that have not burned in over 20 years. Ongoing adaptive management programs and research will provide better guidance to the park on whether prescribed burns are an effective tool to reduce the cover of annual bromes.

4. What, if any, rare plants were found in WICA long-term monitoring plots?

We identified 2 rare plant species in WICA between 1998 and 2015- nylon hedgehog cactus (*Echinocereus viridiflorus*) and a moonwort species (*Botrychium* sp.). These plants are found in such low abundance and in such few plots, it will take many years to determine any trends in rare plant cover. We recommend a more targeted survey of rare plants be completed when funds are available.

Table ES-1. Natural resource condition summary table for plant communities in Wind Cave National Park. Current values are based on data from 2011-2015 and trends are based on data from 1998-2015.

Indicator of Condition	Specific Measures	Current Value (mean $\pm$ SE)	Reference Condition and Data Source	Condition Status/Trend	Rationale for Resource Condition
Upland Plant Community Structure and Composition	Native species richness (1m ² quadrats)	11.1 $\pm$ 0.4 species	8-18 species		The ponderosa pine woodland and mixed-grass prairie plant communities within the boundaries of WICA are characterized by moderate to high native species richness that is within the natural range of variability (Symstad and Jonas 2014). Native diversity and plant cover is higher in grassland plots than forested plots. Native evenness is high indicating one species is not dominating the community and it not changed significantly since monitoring began in 1998.
	Evenness (point-intercept transects)	0.77 $\pm$ 0.006	To be determined		
Exotic Plant Early Detection and Management	Relative cover of exotic species	20.9 $\pm$ 1.4%	< 10 % cover		Many areas of WICA have a high cover of exotic species. Kentucky bluegrass is the most widespread and abundant invasive plant species. There is no evidence of an increasing or decreasing trend in total exotic cover or Kentucky bluegrass cover. While still in low abundance, annual brome cover has shown an increasing trend since 1998.
	Annual brome cover	3.3 $\pm$ 0.4%	< 10 % cover		

Acknowledgments

We thank the authors of the NGPN Plant Community Monitoring Protocol, particularly A. Symstad, for outstanding guidance on data collection and reporting. Thank you to the current and past staff at WICA, particularly G. Schroeder and B. Burkhart, for providing logistical support and performing safety checks. The NGPN and NGPFire vegetation field crews collected all the data included in this report. We thank D. Swanson for providing data on fire history and A. Weaver for helping with the maps for this report. Comments from C. Wienk and T. Richardson improved this report.

Introduction

The Black Hills is a 1.5 million ha refuge of ponderosa pine (*Pinus ponderosa*) forest surrounded by the mixed-grass prairies of western South Dakota and eastern Wyoming. The Black Hills is a unique ecosystem composed of species from the western Rocky Mountains, eastern deciduous forests, northern boreal forests, and the surrounding Great Plains (Larson and Johnson 2007). Wind Cave National Park (WICA) is located in the southern Black Hills with a purpose to protect the unique Wind Cave resources and preserve and enhance the mixed-grass prairie and native wildlife, while providing for the enjoyment of the public. The 33,851 acres (13,700 ha) of WICA is a mosaic of ponderosa pine forest and mixed-grass prairie, with approximately 30% covered by ponderosa pine forests. While some areas have high exotic species cover, the native plant communities within the upland areas of WICA are considered to be in good condition (Komp et al. 2011). The Northern Great Plains Inventory & Monitoring Program (NGPN) began vegetation monitoring efforts in WICA in 2011 (Ashton et al. 2012). Vegetation monitoring protocols and plot locations were chosen to represent the entire park (based on the 2010 boundary) and to coordinate efforts with the Northern Great Plains Fire Ecology Program (NGPFire). NGPFire had been monitoring upland vegetation in WICA since 1997. There is a separate effort to monitor streambank condition because riparian communities are an important resource for the park (Burkhart and Kovacs 2013). Additional upland plots were added to represent the 2011 Addition to the park property. In this report, we use the data from 2011-2015 to assess the current condition of park vegetation and the data from 1998-2015 are used to look at longer-term trends.

Using 18 years of plant community monitoring data in WICA, we explore the following questions:

1. What is the current status of plant community composition and structure of WICA vegetation (species richness, cover, and diversity) and how has this changed from 1998-2015?
2. What are the differences and similarities in forested and grassland condition and trends?
3. How do trends in condition correlate with climate, fire history, and grazing?
4. What, if any, rare plants were found in WICA long-term monitoring plots?

Methods

Two different methods and protocols have been used to monitor long-term vegetation plots at WICA since 1997: the NGPN monitoring protocol (Symstad et al. 2012b, a) and the Fire Monitoring Handbook (NPS 2003). Below, we briefly describe both methods, but focus on the NGPN monitoring protocol which is the current standard and was used to collect most of the data in this report. For more detail on either method, please see the protocol publications (cited above).

NGPN and NGPFire Monitoring Plots 2011-2015

NGPN and NGPFire implemented a survey to monitor plant community structure and composition in WICA using a spatially balanced probability design (Generalized Random Tessellation Stratified [GRTS]; Stevens and Olsen 2003, 2004). Using a GRTS design, NGPN selected 35 randomly located sites within the park to become Plant Community Monitoring plots (PCM plots; Figure 1). In 2011, the park acquired new property and we selected 10 randomly located sites within the addition using the above procedure. The NGPN visits 14 PCM plots within the original boundary every year using a rotating sampling scheme where 7 sites were visited in the previous year and 7 sites are new visits. After 5 years (2011-2015), most of the 35 PCM plots were visited at least twice between mid-June and mid-July. We had time to visit only 2 PCM plots within the new addition since 2012. When a PCM plot fell within an active burn unit, NGPFire added additional visits based on a 1, 2, 5, and 10 year sampling schedule. NGPFire also established and monitored a number of new sites using the same GRTS sampling schema focused in active burn units (Fire FPCM plots). From 2011-2015, 25 FPCM plots were established.

At each of the grassland 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 ≤ 2 m, and plant cover were collected on two 50 m transects (the long sides of the plot) using a point-intercept method (Figure 3). Species richness data from the point-intercept method were supplemented in the 20 NGPN plots with species presence data collected in five sets of nested square quadrats (0.01 m², 0.1 m², 1 m², and 10 m²) located systematically along each transect (Figure 2).

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, were mapped and tagged. For each tree, the species, DBH, status, and condition (e.g., leaf-discoloration, insect-damaged, etc.) were recorded. Dead and downed woody fuel load data were collected on two perpendicular, 100 ft (30.49 m) transects with midpoints at the center of the plot (Figure 2), following Brown's Line methods (Brown 1974, Brown et al. 1982). For this report, we do not provide results on the fuels and forest structure data that were collected on an annual basis because we have a limited sample and because we completed a more large forest survey using 90 plots in 2012 (Ashton et al. 2013) and plan to repeat the survey in 2017.

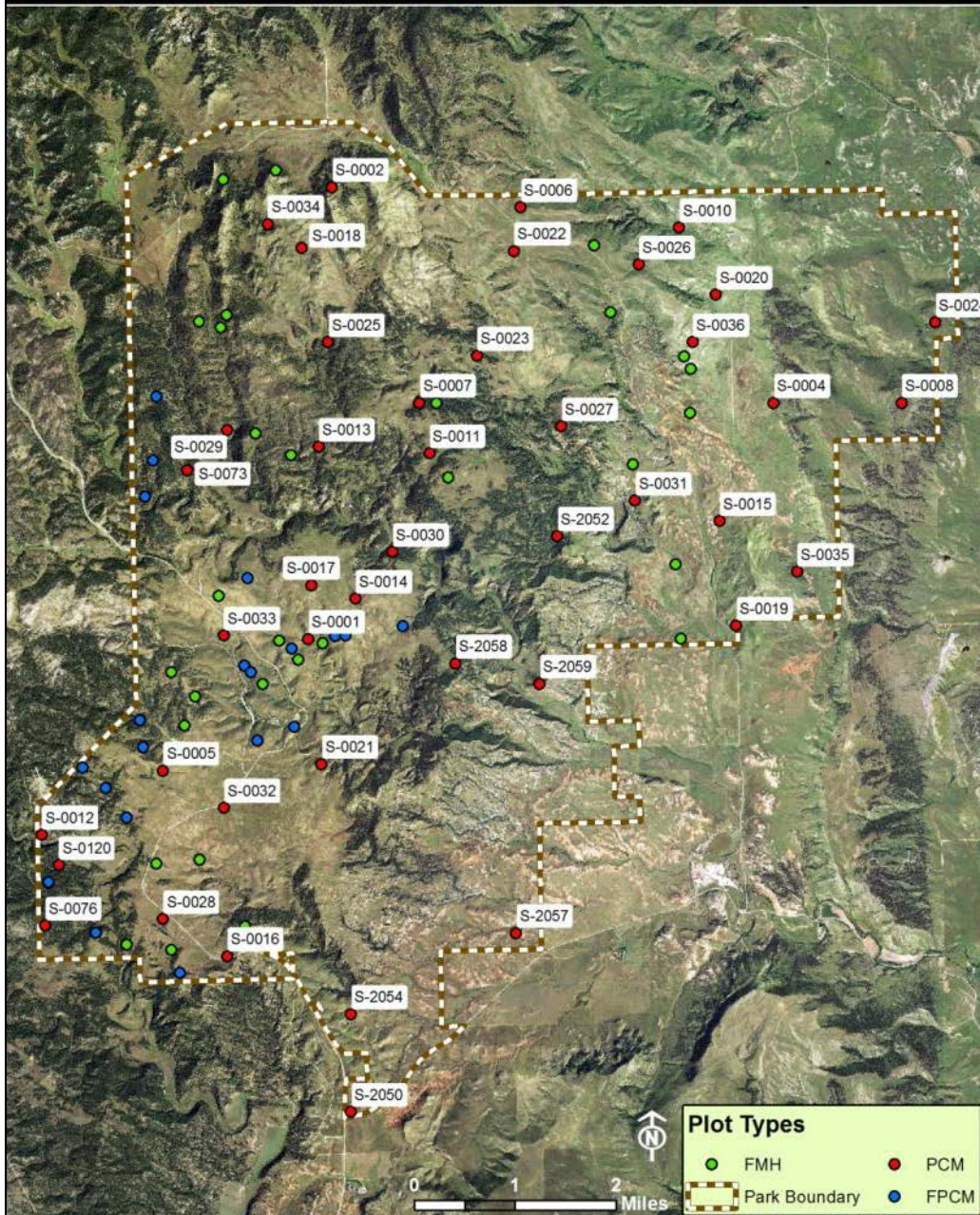


Figure 1. Map of Wind Cave National Park (WICA) plant community monitoring plots, 1998-2015. Thirty-seven PCM plots (red) were established by the Northern Great Plains Inventory & Monitoring Program (NGPN) and 25 (blue) FPCM plots were established by the Fire Effects Program (NGPFire) between 2011 and 2015. An additional 35 FMH plots (green) were monitored from 1997-2011 by NGPFire.

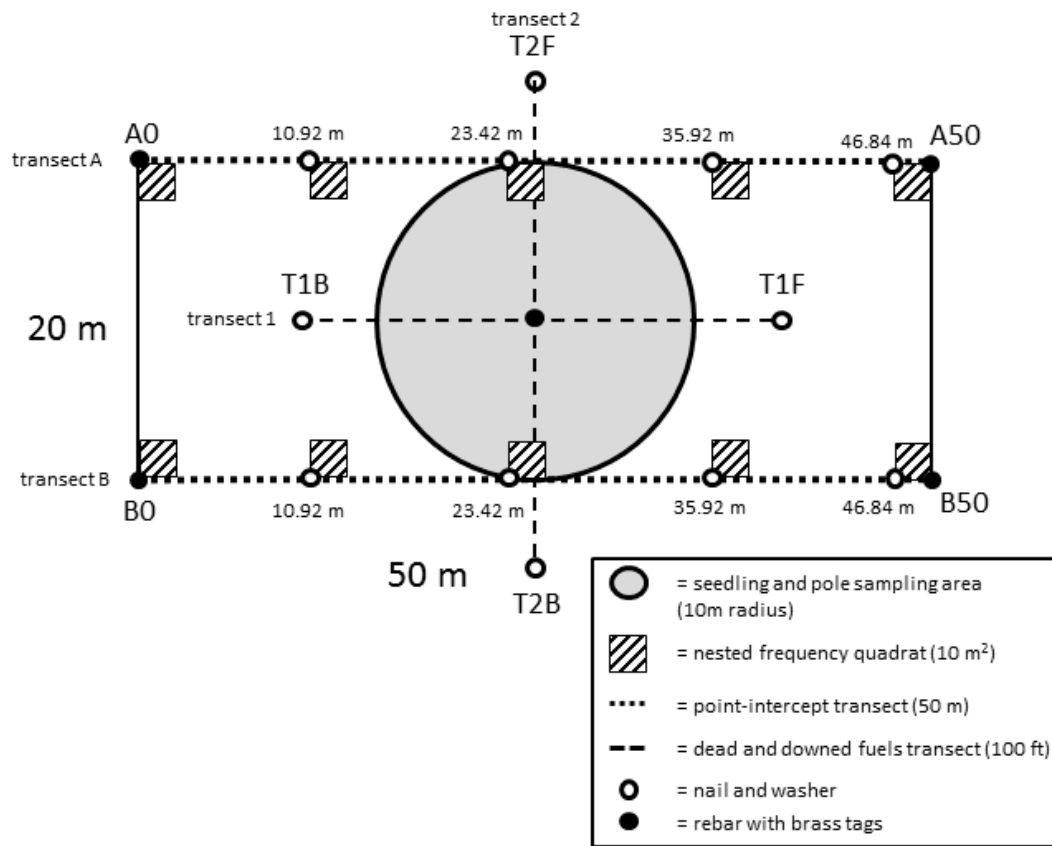


Figure 2. Long-term monitoring plot layout used for sampling vegetation in Wind Cave National Park.

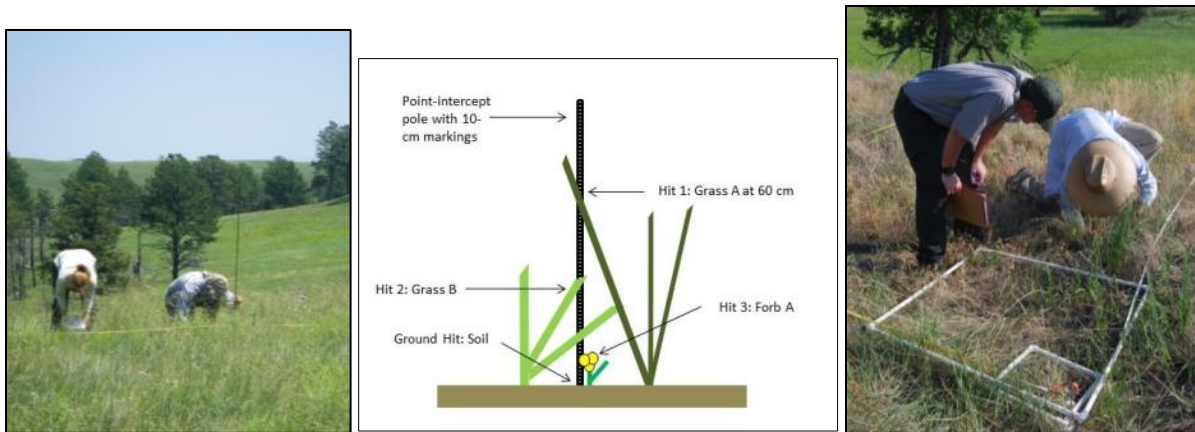


Figure 3. The Northern Great Plains Inventory & Monitoring vegetation crew used point-intercept (left panel and center) and quadrats (right panel) to document plant diversity and abundance.

At all PCM plots, but not the FPCM plots, we also surveyed the area for common disturbances and target species of interest to the park. Common disturbances included such things as prairie dog towns, 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). These species were chosen in collaboration with the Midwest Invasive Plant Network, the Exotic Plant Management Team, park managers, and local weed experts. 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.

Table 1. Exotic species surveyed for at Wind Cave National Park as part of the early detection and rapid response program within the Northern Great Plains Network.

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

Other Monitoring Plots (1997-2015)

In 1997, NGPFire began monitoring plots within WICA to evaluate the effectiveness of prescribed burns. Starting in 1998, data collection followed the NPS National Fire Ecology Program protocols (NPS 2003): in grassland plots vegetation cover and height data were collected using a point-intercept method, with 100 points evenly distributed along a single 30 m transect. In forested sites, plots are 0.1 ha (20 x 50 m) in size and point-intercept data was collected along the two 50 m sides. For each live tree with a DBH > 15 cm located within the 0.1 ha plot, the species and DBH were recorded. The densities of smaller trees (2.54 cm ≤ DBH ≤ 15 cm) were measured within a subset of the plot area. NGPFire plot locations were located randomly within major vegetation types within areas planned for prescribed burning (burn units) in the near future. The data were not collected using these protocols in 1997, so this year is excluded from analyses. Hereafter, we refer to these 35 plots

as Fire Monitoring Handbook (FMH) plots. These FMH plots are being retired after 10 years of monitoring is completed (e.g. the rebar will be removed).

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 2015). 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. This report uses common names after the first occurrence in the text, but scientific names can be found in the Appendix A. Plant life forms (e.g., shrub, forb) were based on definitions from the USDA Plants Database (USDA-NRCS 2015). The conservation status ranks of plant species in South Dakota is determined by the South Dakota Natural Heritage Program (SDNHP). For the purpose of this report, a species was considered rare if its conservation status rank was S1, S2, or S3. See Table 2 for a detailed definition of each conservation status rank.

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 used 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/or the FFI database as needed. Summaries were produced using the FFI reporting and query tools and statistical summaries, and graphics were generated using R software (version 3.2.2). In most cases, linear mixed models were used to analyses for differences across time or treatments, where plot was considered a random factor.

Table 2 Definitions of state and global species conservation status ranks*.

Status Rank	Category	Definition
S1/G1	Critically imperiled	Due to extreme rarity (5 or fewer occurrences) or other factor(s) making it especially vulnerable to extirpation.
S2/G2	Imperiled	Due to rarity resulting from a very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation.
S3/G3	Vulnerable	Due to a restricted range, relatively few populations (often 80 or fewer), recent widespread declines, or other factors making it vulnerable to extirpation.
S4/G4	Apparently secure	Uncommon but not rare; some cause for concern due to declines or other factors.
S5/G5	Secure	Common, widespread and abundant.
S#S#/ G#G#	Range rank (e.g. S2S3)	Used to indicate uncertainty about the status of the species or community. Ranges cannot skip more than one rank.

*Adapted from NatureServe status assessment table (<http://www.natureserve.org/conservation-tools/conservation-status-assessment>)

We measured diversity at the plots in 2 ways: species richness and Pielou's Index of Evenness. Species richness is simply a count of the species recorded in an area. 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. Plant richness was calculated for each plot using the total number of species intersected along the transects. Average height was calculated as the average height per plot using all species intersected on the transects.

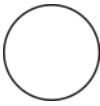
Climate data from the Wind Cave National Park, SD weather station were downloaded from NOAA's online database (NOAA 2015). A fire history map was compiled for WICA and cross-referenced with plot locations. For each plot visit, we determined the number of years since it burned and the number of recorded fires. Plots where no burns were recorded, were excluded from the analysis.

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://www1.nrintra.nps.gov/im/stateoftheparks/index.cfm>). 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: 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 concern, 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 cases, 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

Status & Trends in Vegetation Community Composition and Structure of WICA

The plant species list for WICA includes 871 species and we found 424 plant species from 1998-2015 at WICA (Appendix A). Graminoids, which includes grasses, sedges, and rushes, accounted for most of the vegetative cover at WICA, but forbs, shrubs, trees, and vines were also present (Figure 4). We found 73 exotic plant species at WICA and none were the targeted early detection exotics (Table 1). Exotic graminoids were particularly abundant (Figure 4). The trees and subshrubs were all native species.

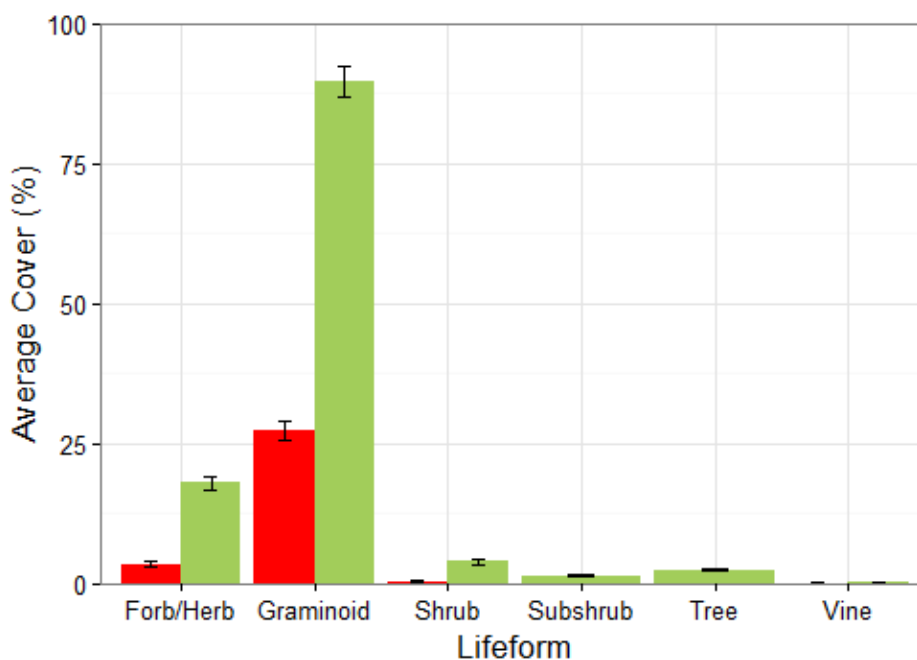


Figure 4. Average cover by lifeform of native (green) and exotic (red) plants recorded in monitoring plots in Wind Cave National Park (1998-2015). Absolute cover can be greater than 100% because the point-intercept methods records layers of overlapping vegetation.

Western wheatgrass (*Pascopyrum smithii*) was the most abundant native grass and averaged close to 20% absolute cover (Figure 5). Other common native grasses include little bluestem (*Schizachyrium scoparium*), threadleaf sedge (*Carex filifolia*), needle and thread (*Hesperostipa comata*), and big bluestem (*Andropogon gerardii*). Kentucky bluegrass (*Poa pratensis*) was the most pervasive exotic at WICA. The average percent cover of exotic plant species in WICA fluctuates from year to year (Figure 6), and there was very little exotic cover in 2008. Currently (2011-2015), the relative cover of exotic species at long-term plots in WICA averages 20.9 ± 1.4 % (mean $\pm$ one standard error). However, there is a great deal of variation across the park and some sites have few exotic species while others are heavily invaded (Figure 7). Much of this cover is Kentucky bluegrass, which averaged 11.9 ± 1.0 % from 2011-2015 and there is no evidence that it has decreased or increased since 1998. Kentucky bluegrass is a cool-season perennial grass that has recently been increasing in abundance in and around the Northern Great Plains (DeKeyser et al. 2013) and its presence is often

correlated with declines in native species richness (Miles and Knops 2009). The Fish and Wildlife Service has begun an adaptive management program to control Kentucky bluegrass in South Dakota and North Dakota refuges (Grant et al. 2009). Their work suggests that Kentucky bluegrass can often spread and become a dominant component in mixed-grass prairie that is rested for long periods (e.g. neither burned nor grazed) (Grant et al. 2009).

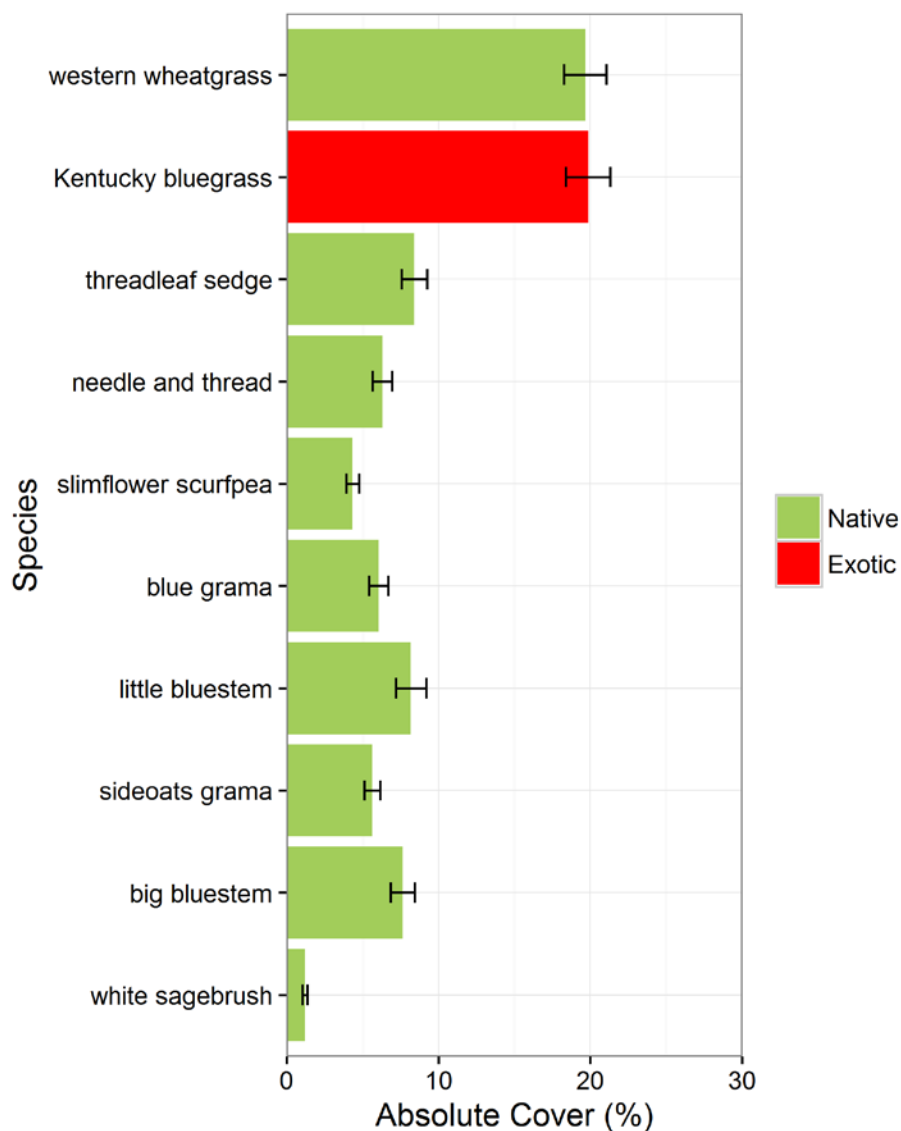


Figure 5. The average absolute cover of the 10 most common native (green) and exotic (red) plants recorded at Wind Cave National Park in 1998-2015. Bars represent means $\pm$ standard errors.

Another concern in WICA is the spread of invasive cheatgrass (*Bromus tectorum*) and Japanese brome (*Bromus japonicus*). Together, the two species accounted for an average of $5.2 \pm 0.7\%$ cover from 2011 to 2015. Cheatgrass and Japanese brome are Eurasian annual grasses that have been a part of the NGP landscape for more than a century, but their invasion in the region has accelerated since 1950 (Schachner et al. 2008). Our data suggest that the cover of annual bromes has been increasing

over time at WICA (Figure 6). This is a concern because the presence of bromes is associated with a decrease in native species richness in the Northern Great Plains ($F_{1,551}=36.5$, $P<0.0001$; Figure 8). An adaptive management program for annual bromes in the NGPN, starting in 2017, should help guide management actions in the future so that abundances of annual bromes remain low in WICA.

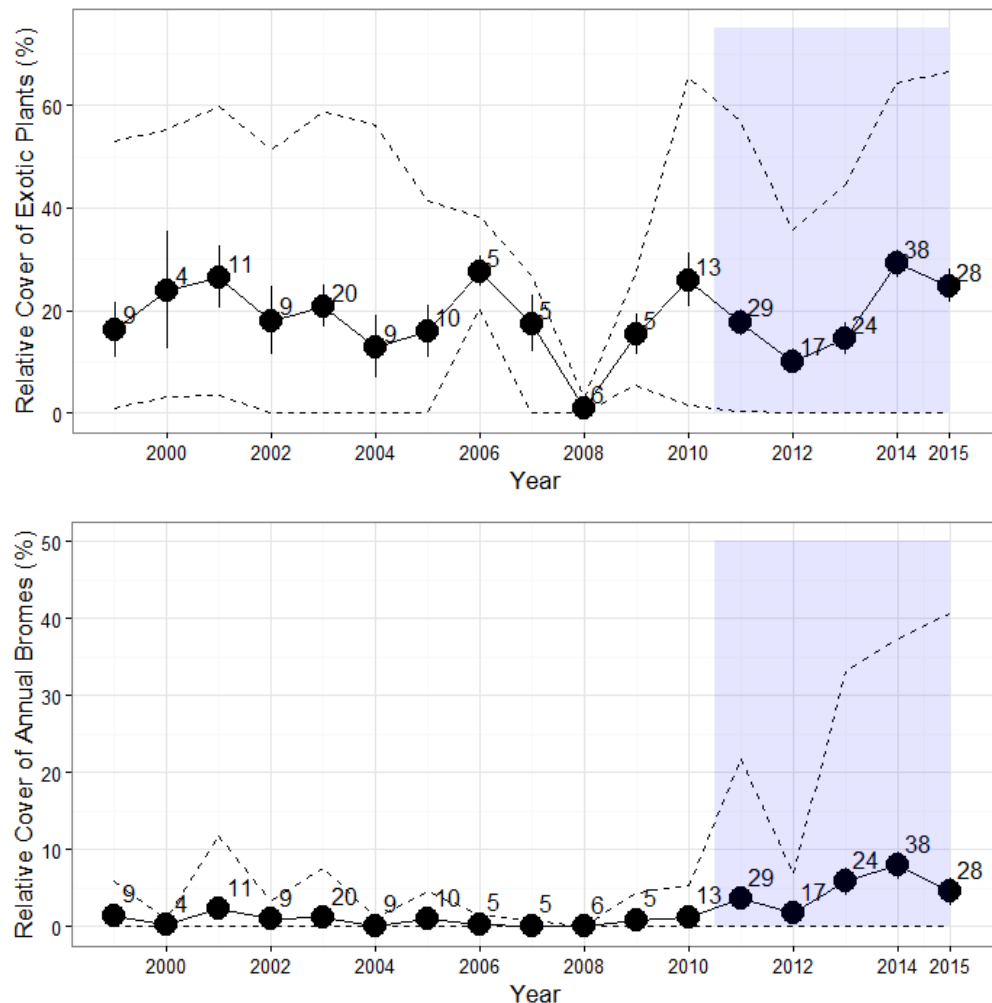


Figure 6. Trends in the relative cover of exotic plants and annual bromes in Wind Cave National Park from 1998-2015. Points represent mean $\pm$ one standard error and sample size is to the right of the point. Years with fewer than three monitoring plots were excluded from the graph. The shaded area highlights the period from 2011-2015 when sampling methods were consistent and distribution of plots was more even and consistent across years. The dashed line represents the maximum and minimum cover values for each year.

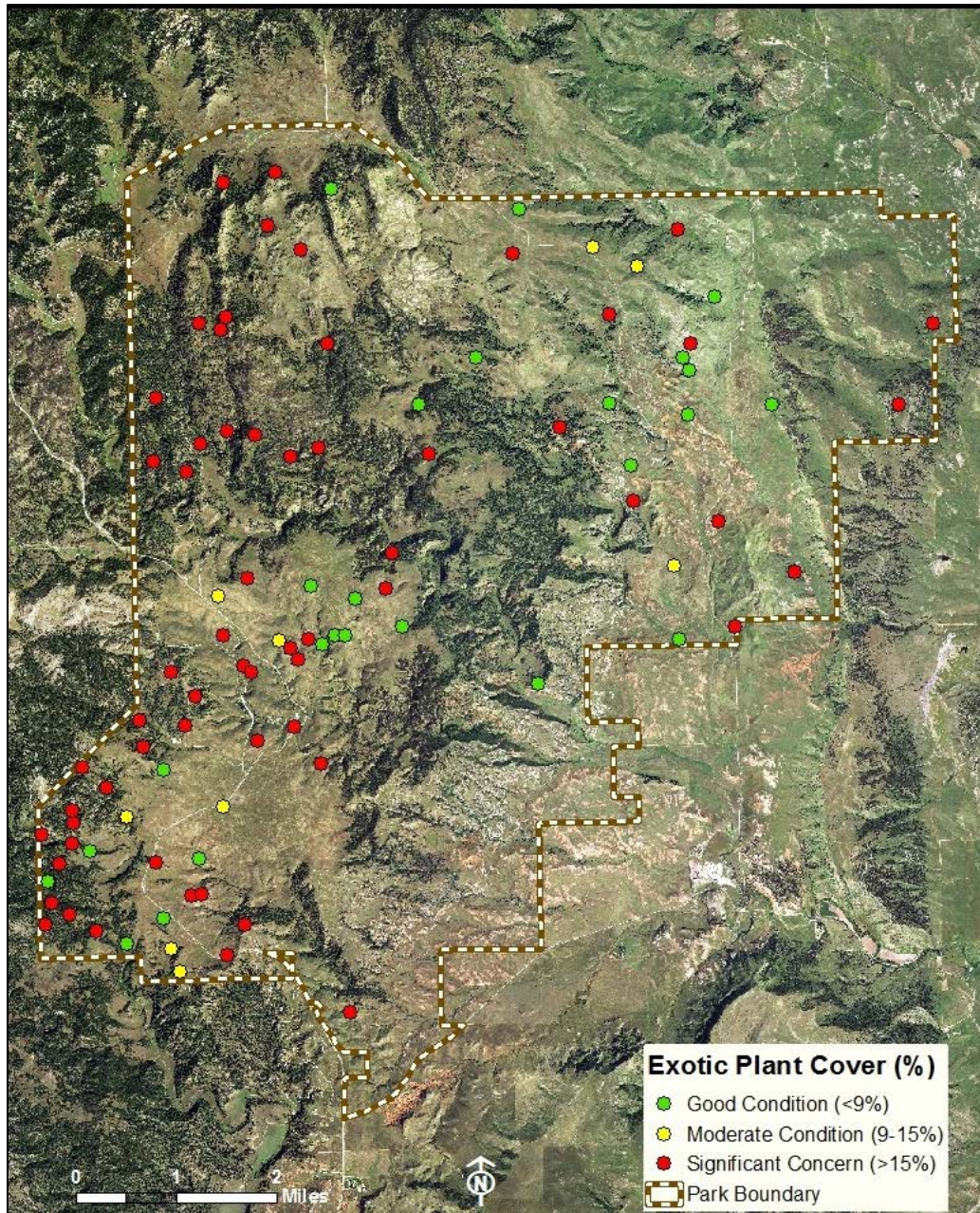


Figure 7. A map of long-term monitoring plots and the relative cover of exotic plants. Red dots indicate plots with a high cover of exotic plants (>15%), yellow has a moderate cover, and green dots indicate plots with low exotic species cover (<9%).

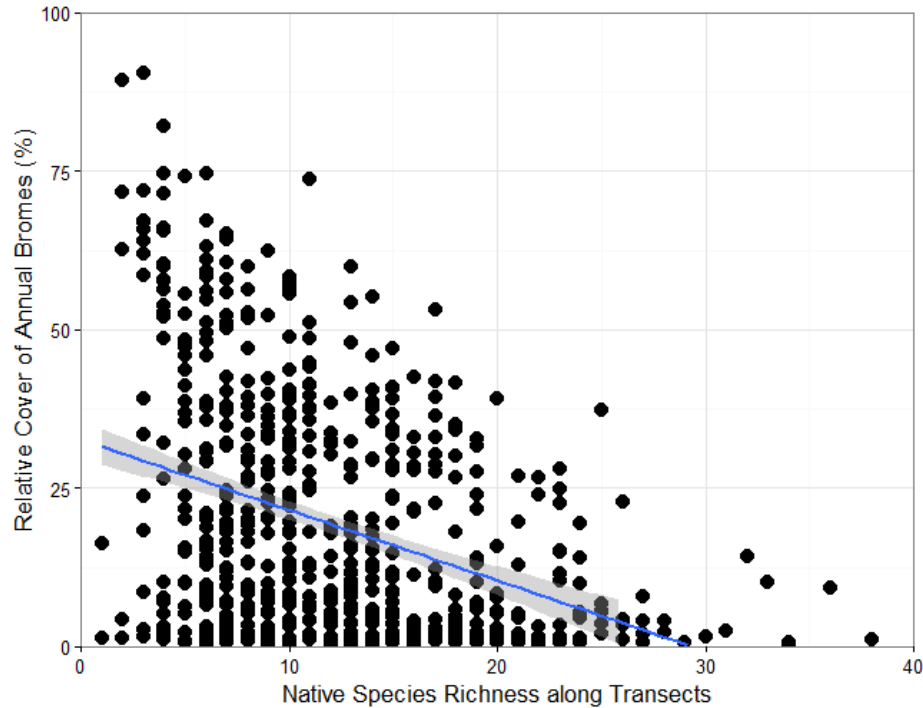


Figure 8. The relationship between native species richness and the relative cover of annual bromes (in long-term monitoring plots in National Park units of the Northern Great Plains, 1998-2015).

Species Richness, Diversity, and Evenness

One of the ways for the NPS to measure effectiveness at the mission to ‘preserve ecological integrity’ is to examine trends in native plant diversity and evenness within their boundaries. Average species richness has been measured by point-intercept since 1998 and in 1 m² and 10 m² quadrats since 2011 (Table 4).

Table 4. Average plant species richness in monitoring plots at Wind Cave National Park from 1998 to 2015. Values represent means $\pm$ one standard error.

Category	Point-intercept (1998-2011; n=98)	1 m² quadrats (2011-2015, n=69)	10 m² quadrats (2011-2015, n=69)
Species richness	21.6 $\pm$ 0.6	12.7 $\pm$ 0.4	23.6 $\pm$ 0.6
Native species richness	18.5 $\pm$ 0.5	11.1 $\pm$ 0.4	20.4 $\pm$ 0.6
Exotic species richness	3.3 $\pm$ 0.2	1.7 $\pm$ 0.1	3.2 $\pm$ 0.2
Graminoid species richness	11.3 $\pm$ 0.3	5.4 $\pm$ 0.2	8.0 $\pm$ 0.2
Forb species richness	8.3 $\pm$ 0.4	6.5 $\pm$ 0.3	13.7 $\pm$ 0.5

While there was some variation across the park, the plots we visited in WICA tended to have a moderate to high number 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, which naturally varies considerably across both space and

time, the natural range of variation over long-time periods may be a good starting point (Symstad and Jonas 2014). 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 2014). Since there are no long-term records of mixed-grass prairie diversity within the Black Hills, we are relying on these data as a reference condition. Future work is needed to develop a robust reference condition for plant communities in the Black Hills. Compared to the nearby mixed-grass prairie, WICA is within the natural range (Table 4). The lowest diversity of native plants was found in closed canopy ponderosa pine forests, such as plot WICA_PCM_007 where there were only an average of 5 native species per square meter (Figure 9). Grassland sites tended to be more diverse and WICA_PCM_0018 and WICA_PCM_0026 had an average of 16.9 and 16.8 species per m², respectively (Figure 9).



Figure 9. A photograph of long-term monitoring plot WICA_PCM_0007 and WICA_PCM_0018 which has a low and high diversity of native plant species, respectively.

We did not find any trends in species richness or evenness (Figure 10). Native diversity in 1m² quadrats was fairly similar from 2011-2015; it ranged from a low in 2012 of 9.4 ± 0.8 (a drought year) to a high of 12.5 ± 1.1 in 2014 (a wet year). We have a longer record of native richness from point-intercept data (Figure 10; top). From 1998-2015, we recorded an average between 12.6 and 21.6 native species. Annual average evenness of native species ranged from 0.65 to 0.81 during this time period, indicating the plots were not strongly dominated by a single species (Figure 10: bottom). There is a great deal of variation in species richness and evenness among sites within WICA (dashed lines in Figure 10 represent the maximum and minimum values) which makes long-term trends in these metrics difficult to detect.

Disturbance from grazing, fire, and humans affects plant community structure and composition in mixed-grass prairie. We estimated the approximate area affected by natural and human disturbances at each site we visited in 2011-2015 by surveying the area for ~ 5 minutes at the end of the plot visit. The most common disturbance was from fires and evidence of recent fire was found at 56 plot visits. There was also evidence of animal use including trails, wallows, and grazing. We found no correlation with total disturbance, small or large animal disturbance and native richness or exotic cover. As more monitoring data are collected in future years, we may be able to better explore the statistical relationship between these metrics and disturbance.

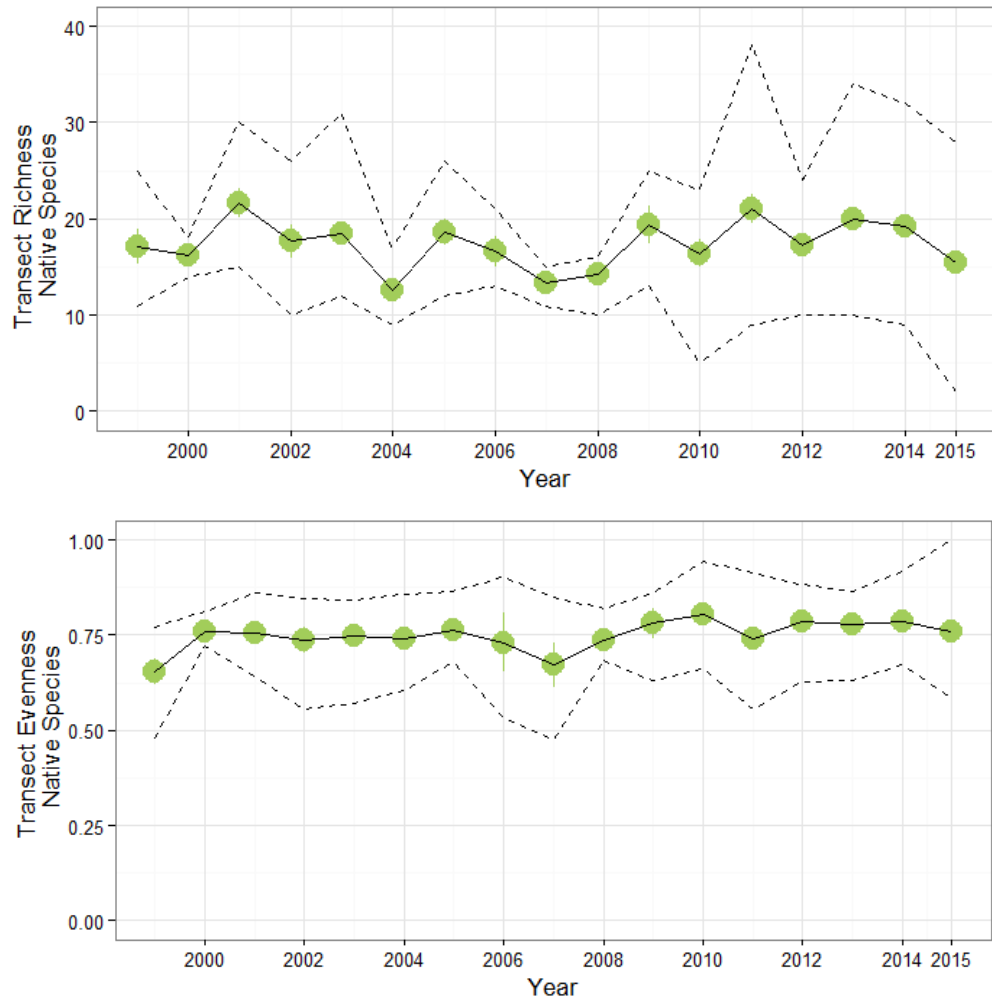


Figure 10. Trends in native species richness and evenness in Wind Cave National Park,1998-2015. Data are means $\pm$ one standard error. The dashed line indicates the maximum and minimum values for each year.

Comparing Forest and Grassland Plots

Wind Cave NP is located at the transition zone between the mixed-grass prairie of the Northern Great Plains and ponderosa pine forests of the Black Hills. Approximately 30% of the land area of WICA is dominated by ponderosa pine forest (Cogan et al. 1999). Fire is an important component of ponderosa pine and mixed-grass prairie ecosystems, and promotes healthy function of both systems while limiting encroachment of ponderosa pine into prairie habitat (Brown and Sieg 1999). Recent work has shown that changing climate may alter the complex interactions between ponderosa pine forests, climate, and fire, causing shifts in the extent of ponderosa pine forests in the Black Hills (King et al. 2013; King et al. 2015).

Randomly located NPGN vegetation monitoring plots in WICA are comprised of 71% grassland plots and 29% forested plots, which agrees with previous estimates of plant community composition in the park. Plots were considered forested if the mean diameter at breast height (DBH) is greater than 15 m²/ha at an individual plot. We compared forested plots to grassland plots to determine whether exotic species abundance and other plot attributes differed between these ecotypes (Figure 11).

Originally, we suspected that forested plots harbored a greater abundance of exotic species when compared with adjacent grasslands (Figures 12 & 13), but exotic species relative cover was not significantly different between forest and grassland plots (Figure 11A; $F_{1,54}=2.8$, $P=0.10$). Exotic species cover did change over time in both plot types ($F_{1,54}=15.8$, $P<0.01$).

Native species richness was greater in grassland plots (Figure 11B; $F_{1,54}=7.9$, $P<0.01$), and changed over time in both plot types ($F_{1,54}=6.0$, $P=0.02$). Relative cover of annual brome grasses (*B. tectorum* and *B. japonicus*) was greater in grassland plots (Figure 11C; $F_{1,54}=7.9$, $P<0.01$) and varied over time in both plot types ($F_{1,54}=5.0$, $P=0.02$); and litter cover was greater in forest plots in 2011, but by 2015 litter cover was the same in both plot types after a 16% increase in grassland plots (Figure 11D; $F_{1,54}=9.2$, $P<0.01$).

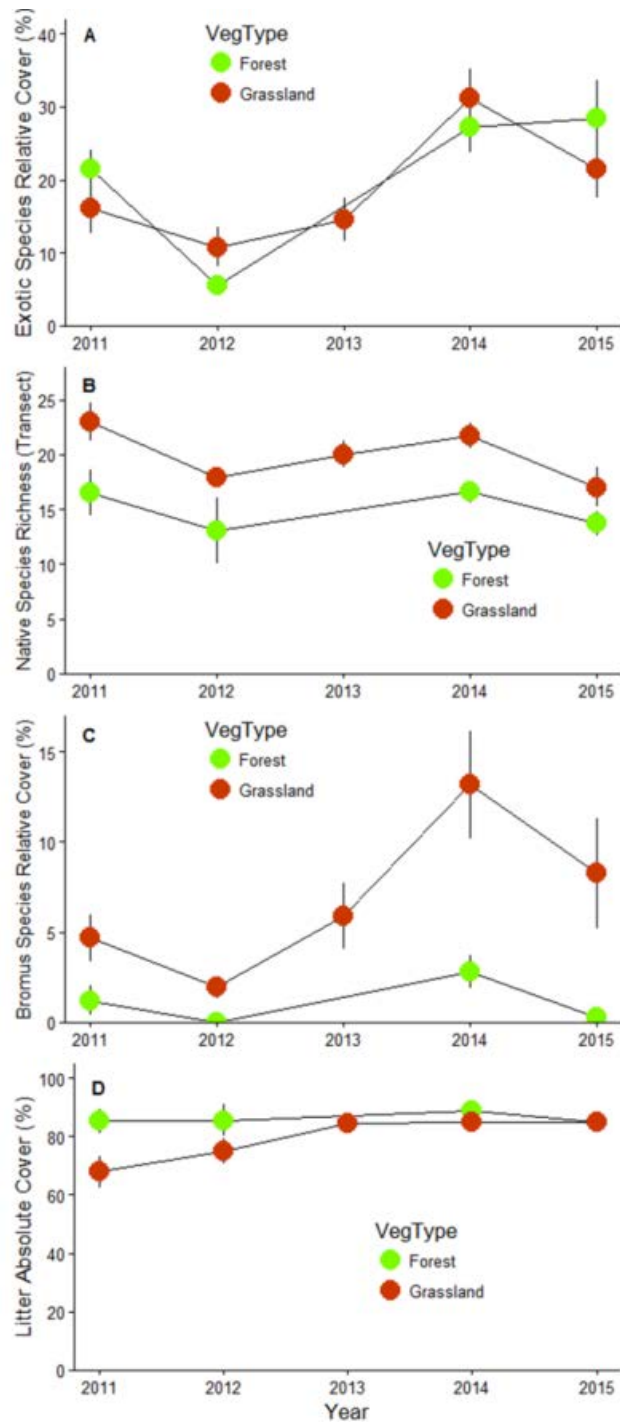


Figure 11. Comparison of forest and grassland plots in Wind Cave National Park. Values are means $\pm$ one standard error.



Figure 12. Examples of dense forest plots (left), moderately dense forest plots (center) and grassland plots (right).

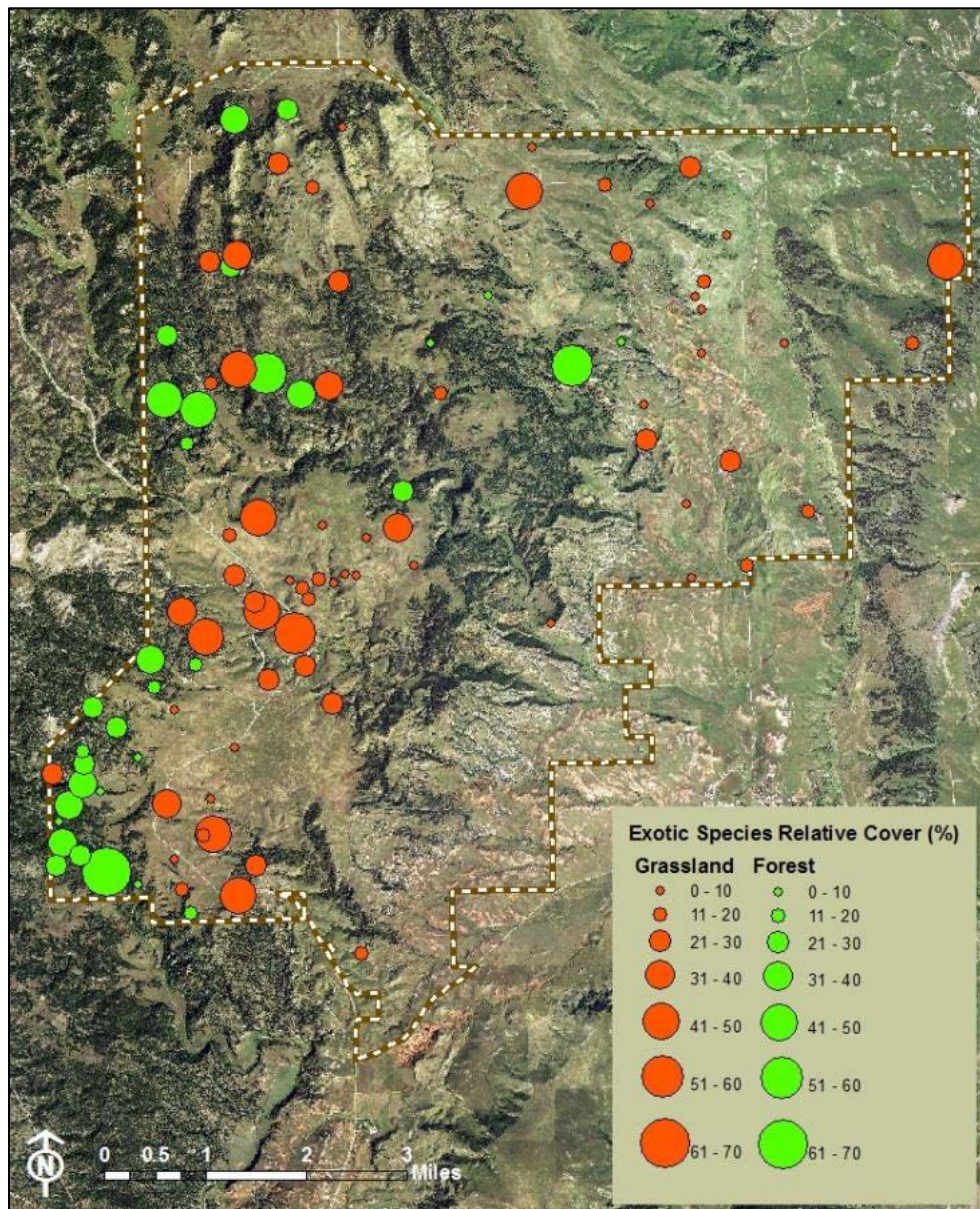


Figure 13. Map comparing exotic species relative cover in forest and grassland plots in Wind Cave National Park. Plot marker size is proportional to the cover of exotic species observed in each plot, as described in the legend.

The Influence of Climate and Fire on Plant Community Structure and Diversity

Climate

The Northern Great Plains has a continental climate, with hot summers and very cold winters. The 30-year normal temperatures at a nearby weather station, Wind Cave NP ranged from average minimum monthly temperatures in December of 13.9° F to maximum monthly July temperatures of 85.1° F (based on 1980-2010). The 30-year normal annual precipitation totals 19.65 inches. Annual precipitation at WICA in 1998-2015 was variable and ranged between 9.6 and 28.8 inches, in 2008 and 1998, respectively. There were dry years in the early to mid-2000s and in 2012 (Figure 10). The last few years have been much wetter than average. The native vegetation is adapted to this variation, and productivity responds strongly to decreases in spring and summer precipitation (Yang et al. 1998, Smart et al. 2007). Species richness and diversity in regional grasslands are also sensitive to temperature and precipitation fluctuation, but the response is complex and less predictable (Jonas et al. 2015). We found no statistically significant relationships between climate and vegetation, although there was a tendency for plant height to increase with precipitation and native species richness to decline with hotter maximum temperatures. Continued monitoring and a longer time series of vegetation data and climate will allow us to better understand how WICA vegetation responds to climate.

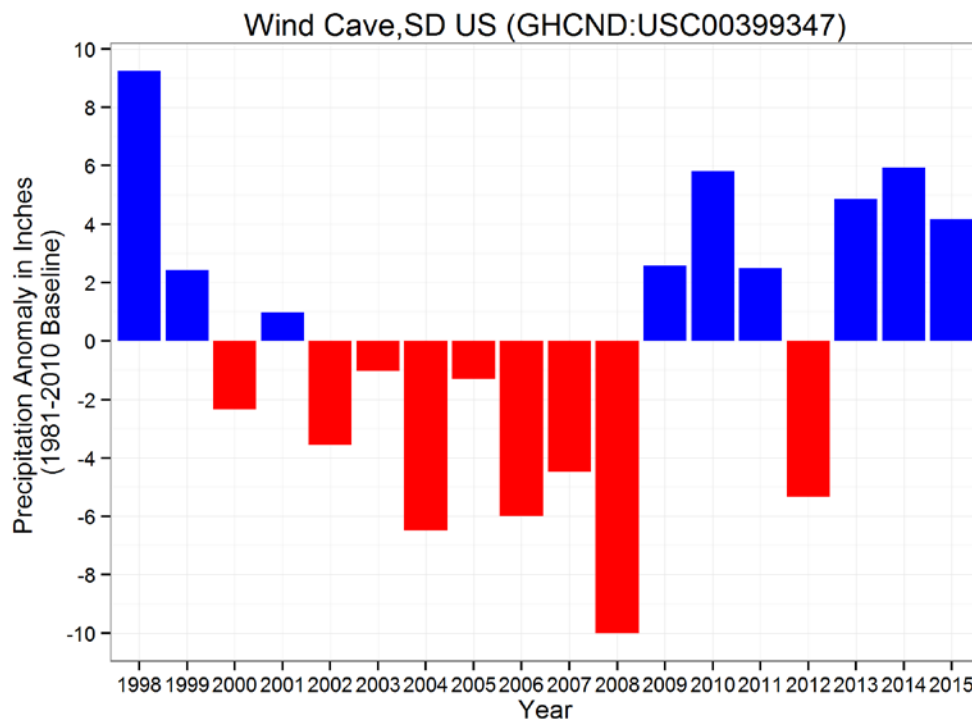


Figure 14. The total annual precipitation anomaly from 1998-2015 for Wind Cave National Park. Positive values (blue) represent years wetter than and negative values (red) are drier than the 1981-2010 normal. The anomaly is measured in inches and based on data from a nearby weather station.

Fire History

Historically, smaller fires maintained a relatively stable composition of grassland and forest in the Black Hills (Shepperd and Battaglia 2002, Brown and Cook 2006). During the period of 1500 to early 1900, the average number of years between wide-spread fires in the area was estimated at 10-12 years (Brown and Sieg 1999). Natural fires were suppressed for most of the last century, but the use of prescribed burning in Northern Great Plains parks to mitigate the effects of the absence of natural fires has increased over time since its start at Wind Cave NP in 1973 (Wienk et al. 2010). As of 2015, there is a mosaic of recently burned and unburned areas WICA (Figure 15).

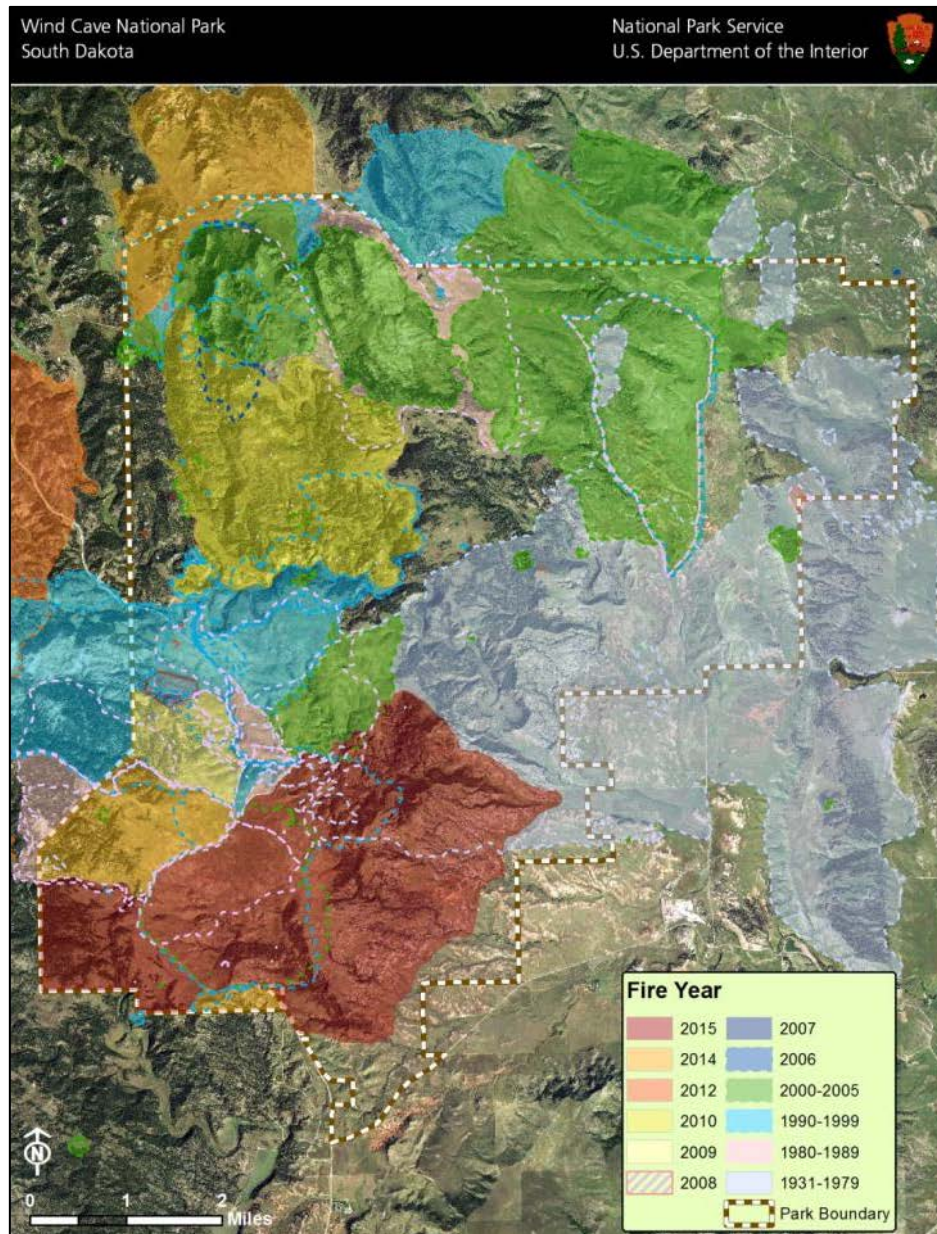


Figure 15. Map of recent fire history at Wind Cave National Park.

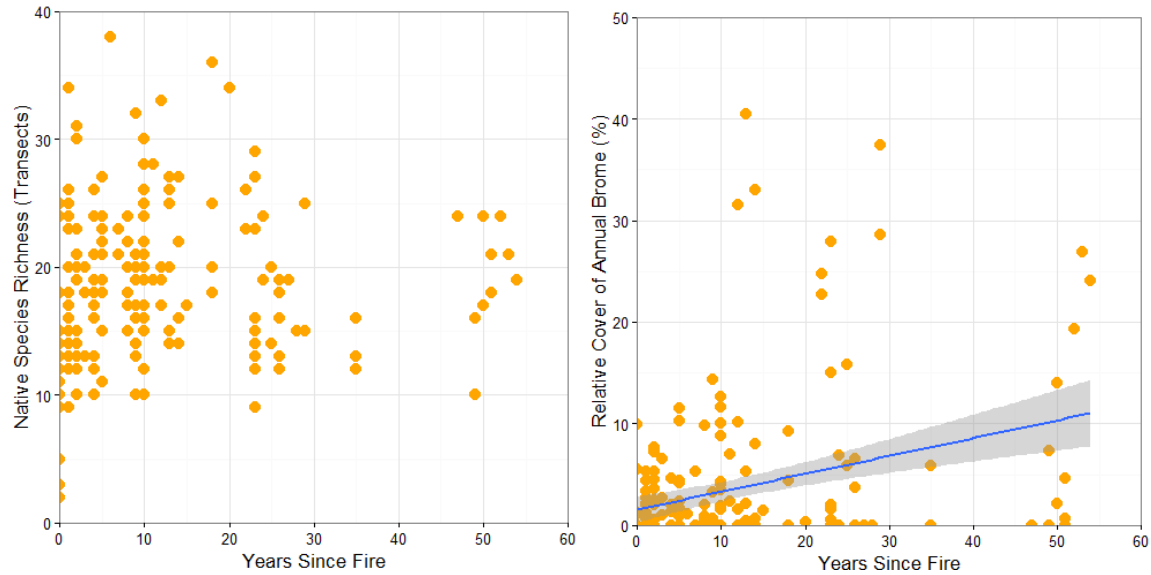


Figure 16. Native species richness and percent cover of annual bromes in plots with different fire histories.

The effects of specific prescribed burns on vegetation and more details about fires at WICA can be found in past NGPFire annual reports (see <http://www.nps.gov/ngpfire/docs.htm>). Here, we were interested in determining the relationship between fire history and vegetation. We compared two vegetation metrics: the native species richness and the relative cover of annual bromes with the length of time between the site visit and the last time a site had been burned (years since fire). For example, a site that burned in the spring and then was visited in the summer would be 0 years since fire.

We found no relationship between native richness and time since a plot had burned (Figure 16; $F_{1,177}=0.3$, $P=0.57$). We also found no relationship between the time since a plot had burned and the relative cover of exotic plants ($F_{1,177}=2.1$, $P=0.15$). There is a significant relationship between annual brome and fire (Figure 16; $F_{1,177}=19.0$, $P<0.0001$). While there was variation in the data, the sites which have not burned in over 20 years have a higher cover of annual bromes than sites that had burned more recently. This suggests that burning may assist in reducing annual brome cover. However, the increasing trend in annual brome abundance across the park (Figure 6) despite fairly frequent prescribed burns suggests that burning alone may not be sufficient. The best approach will likely include burning and targeted herbicides. Ongoing research on this topic and an upcoming adaptive management initiative for annual brome control in NGPN parks should provide more data and guidance to help with these management decisions.

Rare Plants

While locating rare species was not the focus of this study, two plant species of conservation concern were observed within vegetation monitoring plots at WICA. Nylon hedgehog cactus (*Echinocereus viridiflorus* S3) was observed in 10 plots, in very low abundances (Table 5). A moonwort species (*Botrychium* sp.) was observed in a single location. This moonwort individual could not be identified to the species level, but all moonwort species that occur in South Dakota are rare (an example of a moonwort is shown in Figure 12).

Table 5. Rare species occurrence in Wind Cave National Park from 1998-2015. Status ranks are based on South Dakota Natural Heritage Program designations. Plot count is the number of unique plots a species was recorded in across all years. Mean cover is the average cover of that species across all years.

Species	Common Name	State Rank	Global Rank	Plot Count	Mean Cover (%)
<i>Echinocereus viridiflorus</i>	nylon hedgehog cactus	S3	G5	10	<0.01
<i>Botrychium</i> sp.	moonwort species	S1-S3	G1-G5	1	0.00



Figure 17. Examples of two rare species found in plant community monitoring plots at Wind Cave National Park. *Left:* Nylon hedgehog cactus (*Echinocereus viridiflorus* S3). *Right:* an example of a moonwort species (*Botrychium lineare* S1).

There have been some vegetation mapping and survey projects completed at Wind Cave and the surrounding Black Hills (Cogan et al. 1999, Marriott 2000), but we recommend a survey focused on locating rare plant populations at WICA be completed when funds are available. A full rare plant survey will be more likely to accurately quantify the status of rare plants at WICA and identify rare plant populations in areas of the park with no NGPN monitoring plots.

Conclusion

The Northern Great Plains Inventory & Monitoring Program and Fire Effects Program have been monitoring vegetation in Wind Cave National Park for over 18 years. While methods have changed slightly, this report summarizes data from 97 locations from 1998-2015. Below, we list the questions we asked and provide a summarized answer, for more details see the Results and Discussion section. We conclude with a Natural Resource Condition Table (Table 6) that summarizes the current status and trends in a few key vegetation metrics.

1. What is the current status of plant community composition and structure of WICA vegetation (species richness, cover, and diversity) and how has this changed from 1998-2015?

The ponderosa pine woodlands and mixed-grass prairie within the boundaries of WICA are characterized by moderate to high native species richness. The closed canopy forest generally maintains lower species richness than the open grassland areas. We found no significant trends in native diversity or evenness from 1998 to 2015. Annual bromes are an emerging threat in WICA, and keeping them in low abundance will help maintain native plant diversity. Other exotics, such as Kentucky bluegrass are more prevalent, but there is no evidence of an increasing trend in their cover.

2. What are the differences and similarities in forested and grassland condition and trends?

We examined the status and trends in native species richness, exotic species cover, and litter cover between forest and grasslands plots in WICA. We found that grassland plots had higher native richness and higher cover of annual brome grasses but there was not a difference in the relative cover of exotic plant species. Despite some differences in species composition, trends over time appear consistent in grasslands and forested plots. This suggests that both ecotypes are responding similarly to climate and other external drivers.

3. How do trends in vegetation correlate with climate and fire history?

The large variability in the climate of WICA has made it difficult to discern strong patterns linking temperature, precipitation, and plant community structure (e.g. exotic cover, species richness). A longer time series of vegetation data will make it easier to elucidate trends in the future. WICA has been using prescribed burning as a management tool since the 1970s. There was no difference in native diversity among plots that had burned recently and those that had not burned for over 25 years. However, the sites which burned recently have a lower cover of annual brome grasses than sites that have not burned in over 20 years. Ongoing adaptive management programs and research will provide better guidance to the park on whether prescribed burns should be used to reduce the cover of annual bromes.

4. What, if any, rare plants were found in WICA long-term monitoring plots?

We identified 2 rare plant species in WICA between 1998 and 2015- nylon hedgehog cactus and a moonwort species (*Botrychium* sp.). These plants are found in such low abundance and in such few

plots, it will take many years to determine any trends in rare plant cover. We recommend a more targeted survey of rare plants be completed when funds are available.

Table 6. Natural resource condition summary table for plant communities in Wind Cave National Park. Current values are based on data from 2011-2015 and trends are based on data from 1998-2015.

Indicator of Condition	Specific Measures	Current Value (mean $\pm$ SE)	Reference Condition and Data Source	Condition Status/Trend	Rationale for Resource Condition
Upland Plant Community Structure and Composition	Native species richness (1m ² quadrats)	11.1 $\pm$ 0.4 species	8-18 species		The ponderosa pine woodland and mixed-grass prairie plant communities within the boundaries of WICA are characterized by moderate to high native species richness that is within the natural range of variability (Symstad and Jonas 2014). Native diversity and plant cover is higher in grassland plots than forested plots. Native evenness is high indicating one species is not dominating the community and it not changed significantly since monitoring began in 1998.
	Evenness (point-intercept transects)	0.77 $\pm$ 0.006	To be determined		
Exotic Plant Early Detection and Management	Relative cover of exotic species	20.9 $\pm$ 1.4%	< 10 % cover		Many areas of WICA have a high cover of exotic species. Kentucky bluegrass is the most widespread and abundant invasive plant species. There is no evidence of an increasing or decreasing trend in total exotic cover or Kentucky bluegrass cover. While still in low abundance, annual brome cover has shown an increasing trend since 1998.
	Annual brome cover	3.3 $\pm$ 0.4%	< 10 % cover		

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Appendix A: List of plant species found at WICA 1998-2015

Below is a list of all the plant species found in WICA long-term plant community monitoring plots. The species are grouped by plant family. An “X” in the exotic column means that species is not native to the park or in the case where only the genera was identified, there are some species within that genera that are exotic. Species considered to be rare in South Dakota are marked in the final column and the state ranks are provided. The definitions can be found in Table 4 of the report.

Family	Symbol	Scientific Name	Common Name	Exotic	Rare
Aceraceae	ACNE2	<i>Acer negundo</i>	boxelder		
Agavaceae	YUGL	<i>Yucca glauca</i>	soapweed yucca		
Amaranthaceae	AMBL	<i>Amaranthus blitoides</i>	mat amaranth	X	
	AMRE	<i>Amaranthus retroflexus</i>	redroot amaranth		
	DYAM99	<i>Dysphania ambrosioides</i>	Mexican tea	X	
Anacardiaceae	RHAR4	<i>Rhus aromatica</i>	fragrant sumac		
	RHTR	<i>Rhus trilobata</i>	skunkbush sumac		
	TORY	<i>Toxicodendron rydbergii</i>	western poison ivy		
Apiaceae	LOFO	<i>Lomatium foeniculaceum</i>	desert biscuitroot		
	MUSIN	<i>Musineon</i>	wildparsley		
	MUTE3	<i>Musineon tenuifolium</i>	slender wildparsley		
Apocynaceae	APAN2	<i>Apocynum androsaemifolium</i>	spreading dogbane		
	APCA	<i>Apocynum cannabinum</i>	common dogbane		
Asclepiadaceae	ASCLE	<i>Asclepias</i>	milkweed		
	ASOV	<i>Asclepias ovalifolia</i>	oval-leaf milkweed		
	ASPU	<i>Asclepias pumila</i>	plains milkweed		
	ASSP	<i>Asclepias speciosa</i>	showy milkweed		
	ASST	<i>Asclepias stenophylla</i>	slimleaf milkweed		
	ASVE	<i>Asclepias verticillata</i>	whorled milkweed		
	ASVI	<i>Asclepias viridiflora</i>	green comet milkweed		
Asteraceae	ACMI2	<i>Achillea millefolium</i>	common yarrow		
	AGGL	<i>Agoseris glauca</i>	pale agoseris		
	AMAR2	<i>Ambrosia artemisiifolia</i>	annual ragweed		
	AMPS	<i>Ambrosia psilostachya</i>	Cuman ragweed		
	ANMI3	<i>Antennaria microphylla</i>	littleleaf pussytoes		
	ANNE	<i>Antennaria neglecta</i>	field pussytoes		
	ANPA4	<i>Antennaria parvifolia</i>	small-leaf pussytoes		
	ANRO2	<i>Antennaria rosea</i>	rosy pussytoes		
	ANTEN	<i>Antennaria</i>	pussytoes	X	
	ARCA12	<i>Artemisia campestris</i>	field sagewort		
	ARCA13	<i>Artemisia cana</i>	silver sagebrush		
	ARDR4	<i>Artemisia dracunculus</i>	tarragon		
	ARFI2	<i>Artemisia filifolia</i>	sand sagebrush		
	ARFR4	<i>Artemisia frigida</i>	fringed sagewort		
	ARLU	<i>Artemisia ludoviciana</i>	white sagebrush		
	ARTEM	<i>Artemisia</i>	sagebrush	X	
	ASTER	<i>Aster</i>	aster	X	
	BREU	<i>Brickellia eupatorioides</i>	false boneset		
	CEST8	<i>Centaurea stoebe</i>	spotted knapweed	X	

Family	Symbol	Scientific Name	Common Name	Exotic	Rare
	CIAR4	<i>Cirsium arvense</i>	Canada thistle	X	
	CIDR2	<i>Cirsium drummondii</i>	dwarf thistle		
	CIFL	<i>Cirsium flodmanii</i>	Flodman's thistle		
	CIRSI	<i>Cirsium</i>	thistle	X	
	CIUN	<i>Cirsium undulatum</i>	wavyleaf thistle		
	CIVU	<i>Cirsium vulgare</i>	bull thistle	X	
	COCA5	<i>Conyza canadensis</i>	horseweed		
	CORA4	<i>Conyza ramosissima</i>	dwarf horseweed		
	CYXA	<i>Cyclachaena xanthifolia</i>	giant sumpweed		
	DYPA	<i>Dyssodia papposa</i>	fetid marigold		
	ECAN2	<i>Echinacea angustifolia</i>	blacksamson echinacea		
	ERCA4	<i>Erigeron canus</i>	hoary fleabane		
	ERFL	<i>Erigeron flagellaris</i>	trailing fleabane		
	ERFO3	<i>Erigeron formosissimus</i>	beautiful fleabane		
	ERGL2	<i>Erigeron glabellus</i>	streamside fleabane		
	ERIGE2	<i>Erigeron</i>	fleabane		
	EROC	<i>Erigeron ochroleucus</i>	buff fleabane		
	ERPU2	<i>Erigeron pumilus</i>	shaggy fleabane		
	ERST3	<i>Erigeron strigosus</i>	prairie fleabane		
	ERSU2	<i>Erigeron subtrinervis</i>	threenerve fleabane		
	EUSI13	<i>Eurybia sibirica</i>	arctic aster		
	GNPA	<i>Gnaphalium palustre</i>	western marsh cudweed		
	GRSQ	<i>Grindelia squarrosa</i>	curlycup gumweed		
	GUSA2	<i>Gutierrezia sarothrae</i>	broom snakeweed		
	HEAN3	<i>Helianthus annuus</i>	common sunflower		
	HELIA3	<i>Helianthus</i>	sunflower		
	HEMA2	<i>Helianthus maximiliani</i>	Maximilian sunflower		
	HEPA19	<i>Helianthus pauciflorus</i>	stiff sunflower		
	HEVI4	<i>Heterotheca villosa</i>	hairy false goldenaster		
	HIAL2	<i>Hieracium albiflorum</i>	white hawkweed		
	HIERA	<i>Hieracium</i>	hawkweed	X	
	HYFI	<i>Hymenopappus filifolius</i>	fineleaf hymenopappus		
	LACTU	<i>Lactuca</i>	lettuce	X	
	LASE	<i>Lactuca serriola</i>	prickly lettuce	X	
	LIPU	<i>Liatris punctata</i>	dotted blazing star		
	LOAR5	<i>Logfia arvensis</i>	field cottonrose	X	
	LYJU	<i>Lygodesmia juncea</i>	rush skeletonplant		
	MUOB99	<i>Mulgedium oblongifolium</i>	blue lettuce		
	OLRI	<i>Oligoneuron rigidum</i>	stiff goldenrod		
	PACA15	<i>Packera cana</i>	woolly groundsel		
	PAPL12	<i>Packera plattensis</i>	prairie groundsel		
	PSMA11	<i>Pseudognaphalium macounii</i>	Macoun's cudweed		
	RACO3	<i>Ratibida columnifera</i>	upright prairie coneflower		
	SECR	<i>Senecio crassulus</i>	thickleaf ragwort		
	SENEC	<i>Senecio</i>	ragwort	X	
	SOCA6	<i>Solidago canadensis</i>	Canada goldenrod		
	SOLID	<i>Solidago</i>	goldenrod		

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	SOMI2	<i>Solidago missouriensis</i>	Missouri goldenrod		
	SOMO	<i>Solidago mollis</i>	velvety goldenrod		
	SONE	<i>Solidago nemoralis</i>	gray goldenrod		
	SOPT4	<i>Solidago ptarmicoides</i>	prairie goldenrod		
	SORI2	<i>Solidago rigida</i>	stiff goldenrod		
	SOSP2	<i>Solidago speciosa</i>	showy goldenrod		
	SYER	<i>Symphyotrichum ericoides</i>	white heath aster		
	SYFA	<i>Symphyotrichum falcatum</i>	white prairie aster		
	SYLA3	<i>Symphyotrichum laeve</i>	smooth blue aster		
	SYLA6	<i>Symphyotrichum lanceolatum</i>	white panicle aster		
	SYMPH4	<i>Symphyotrichum</i>	aster		
	SYNO2	<i>Symphyotrichum novae-angliae</i>	New England aster		
	SYOB	<i>Symphyotrichum oblongifolium</i>	aromatic aster		
	TAOF	<i>Taraxacum officinale</i>	common dandelion	X	
	TEAC	<i>Tetaneuris acaulis</i>	stemless four-nerve daisy		
	TOEX2	<i>Townsendia exscapa</i>	stemless Townsend daisy		
	TRDU	<i>Tragopogon dubius</i>	yellow salsify	X	
	XASP99	<i>Xanthisma spinulosum</i>	lacy tansyaster		
Betulaceae	BEPA	<i>Betula papyrifera</i>	paper birch		
Boraginaceae	CRMI5	<i>Cryptantha minima</i>	little cryptantha		
	CRTH	<i>Cryptantha thysiflora</i>	calcareous cryptantha		
	CYOF	<i>Cynoglossum officinale</i>	houndstongue	X	
	HADE	<i>Hackelia deflexa</i>	nodding stickseed		
	LACE	<i>Lappula cenchrusoides</i>	Great Plains stickseed		
	LAOC3	<i>Lappula occidentalis</i>	flatspine stickseed		
	LASQ	<i>Lappula squarrosa</i>	European stickseed	X	
	LIIN2	<i>Lithospermum incisum</i>	narrowleaf stoneseed		
	MELA3	<i>Mertensia lanceolata</i>	prairie bluebells		
	MEOB	<i>Mertensia oblongifolia</i>	oblongleaf bluebells		
	ONBE	<i>Onosmodium bejariense</i>	soft-hair marbleseed		
Brassicaceae	ALDE	<i>Alyssum desertorum</i>	desert madwort	X	
	ARABI2	<i>Arabis</i>	rockcress		
	ARHI	<i>Arabis hirsuta</i>	hairy rockcress		
	ARPY4	<i>Arabis pycnocarpa</i>	creamflower rockcress		
	BOFE	<i>Boechera fendleri</i>	Fendler's rockcress		
	BOHO99	<i>Boechera holboellii</i>	Holboell's rockcress		
	BOP199	<i>Boechera pinetorum</i>	Holboell's rockcress		
	BRASS2	<i>Brassica</i>	mustard	X	
	CABU2	<i>Capsella bursa-pastoris</i>	shepherd's purse	X	
	CAMI2	<i>Camelina microcarpa</i>	littlepod false flax	X	
	DEPI	<i>Descurainia pinnata</i>	western tansymustard		
	DESO2	<i>Descurainia sophia</i>	herb sophia	X	
	DRABA	<i>Draba</i>	draba		
	DRAU	<i>Draba aurea</i>	golden draba		
	DRRE2	<i>Draba reptans</i>	Carolina draba		
	ERAS2	<i>Erysimum asperum</i>	western wallflower		

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	ERCA14	<i>Erysimum capitatum</i>	sanddune wallflower		
	ERCH9	<i>Erysimum cheiranthoides</i>	wormseed wallflower	X	
	ERIN7	<i>Erysimum inconspicuum</i>	shy wallflower		
	ERYSI	<i>Erysimum</i>	wallflower	X	
	HEMA3	<i>Hesperis matronalis</i>	dames rocket	X	
	LEDE	<i>Lepidium densiflorum</i>	common pepperweed		
	LEMO3	<i>Lesquerella montana</i>	mountain bladderpod		
	PHLU99	<i>Physaria ludoviciana</i>	foothill bladderpod		
	PHMO99	<i>Physaria montana</i>	mountain bladderpod		
	SIAL2	<i>Sisymbrium altissimum</i>	tall tumbledmustard	X	
	THAR5	<i>Thlaspi arvense</i>	field pennycress	X	
	TUGL	<i>Turritis glabra</i>	tower rockcress		
Cactaceae	ECVI2	<i>Echinocereus viridiflorus</i>	nylon hedgehog cactus		S3
	ESCOB	<i>Escobaria</i>	foxtail cactus, beehive cactus		
	ESMI3	<i>Escobaria missouriensis</i>	Missouri foxtail cactus		
	ESVI2	<i>Escobaria vivipara</i>	spiny star		
	OPFR	<i>Opuntia fragilis</i>	brittle pricklypear		
	OPMA2	<i>Opuntia macrorhiza</i>	twistspine pricklypear		
	OPPO	<i>Opuntia polyacantha</i>	plains pricklypear		
	OPUNT	<i>Opuntia</i>	pricklypear		
Campanulaceae	CARO2	<i>Campanula rotundifolia</i>	bluebell bellflower		
	TRIOD	<i>Triodanis</i>	Venus' looking-glass		
	TRLE3	<i>Triodanis leptocarpa</i>	slimpod Venus' looking-glass		
	TRPE4	<i>Triodanis perfoliata</i>	clasping Venus' looking-glass		
Caprifoliaceae	SYAL	<i>Symphoricarpos albus</i>	common snowberry		
	SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry		
Caryophyllaceae	ARENA	<i>Arenaria</i>	sandwort	X	
	CEAR4	<i>Cerastium arvense</i>	field chickweed		
	CEFO2	<i>Cerastium fontanum</i>	common mouse-ear chickweed	X	
	PADE4	<i>Paronychia depressa</i>	spreading nailwort		
	PASE	<i>Paronychia sessiliflora</i>	creeping nailwort		
	SIAN2	<i>Silene antirrhina</i>	sleepy silene		
	SIDR	<i>Silene drummondii</i>	Drummond's campion		
	SILA21	<i>Silene latifolia</i>	bladder campion	X	
	SILEN	<i>Silene</i>	catchfly		
	SINO	<i>Silene noctiflora</i>	nightflowering silene	X	
	SIVU	<i>Silene vulgaris</i>	maidenstears	X	
Celastraceae	CESC	<i>Celastrus scandens</i>	American bittersweet		
Chenopodiaceae	CHAL7	<i>Chenopodium album</i>	lamb'squarters	X	
	CHBE4	<i>Chenopodium berlandieri</i>	pitseed goosefoot		
	CHDE	<i>Chenopodium desiccatum</i>	aridland goosefoot		
	CHENO	<i>Chenopodium</i>	goosefoot	X	
	CHLE4	<i>Chenopodium leptophyllum</i>	narrowleaf goosefoot		
	CHPR5	<i>Chenopodium pratericola</i>	desert goosefoot		
	CHSI2	<i>Chenopodium simplex</i>	mapleleaf goosefoot		
	MONU	<i>Monolepis nuttalliana</i>	Nuttall's povertyweed		

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	SATR12	<i>Salsola tragus</i>	prickly Russian thistle	X	
Cistaceae	HEBI2	<i>Helianthemum bicknellii</i>	hoary frostweed		
Commelinaceae	TRBR	<i>Tradescantia bracteata</i>	longbract spiderwort		
	TROC	<i>Tradescantia occidentalis</i>	prairie spiderwort		
Convolvulaceae	COAR4	<i>Convolvulus arvensis</i>	field bindweed	X	
	EVNU	<i>Evolvulus nuttallianus</i>	shaggy dwarf morning-glory		
	IPLE	<i>Ipomoea leptophylla</i>	bush morning-glory		
Crassulaceae	SELA	<i>Sedum lanceolatum</i>	spearleaf stonecrop		
Cupressaceae	JUCO6	<i>Juniperus communis</i>	common juniper		
	JUSC2	<i>Juniperus scopulorum</i>	Rocky Mountain juniper		
Cyperaceae	CABA3	<i>Carex backii</i>	Back's sedge		
	CABR10	<i>Carex brevior</i>	shortbeak sedge		
	CADU6	<i>Carex duriuscula</i>	needleleaf sedge		
	CAFI	<i>Carex filifolia</i>	threadleaf sedge		
	CAIN11	<i>Carex interior</i>	inland sedge		
	CAIN9	<i>Carex inops</i>	sun sedge		
	CANE2	<i>Carex nebrascensis</i>	Nebraska sedge		
	CAPE42	<i>Carex pellita</i>	woolly sedge		
	CAREX	<i>Carex</i>	sedge		
	CARI	<i>Carex richardsonii</i>	Richardson's sedge		
	CARO5	<i>Carex rossii</i>	Ross' sedge		
	CAST5	<i>Carex stipata</i>	awlfruit sedge		
	ELPA3	<i>Eleocharis palustris</i>	common spikerush		
Dryopteridaceae	CYFR2	<i>Cystopteris fragilis</i>	brittle bladderfern		
	DRYOP	<i>Dryopteris</i>	woodfern		
	GYDR	<i>Gymnocarpium dryopteris</i>	western oakfern		
	WOOR	<i>Woodsia oregana</i>	Oregon cliff fern		
	WOSC	<i>Woodsia scopulina</i>	Rocky Mountain cliff fern		
Ericaceae	ARUV	<i>Arctostaphylos uva-ursi</i>	kinnikinnick		
Euphorbiaceae	EUBR	<i>Euphorbia brachycera</i>	horned spurge		
	EUDE4	<i>Euphorbia dentata</i>	toothed spurge		
	EUGL3	<i>Euphorbia glyptosperma</i>	ribseed sandmat		
	EUMA8	<i>Euphorbia marginata</i>	snow on the mountain		
	EUPHO	<i>Euphorbia</i>	spurge, sandmat	X	
	EUPR3	<i>Euphorbia prostrata</i>	prostrate sandmat		
	EUSE5	<i>Euphorbia serpyllifolia</i>	thymeleaf sandmat		
	EUMA7	<i>Euphorbia maculata</i>	spotted sandmat		
	EUSP	<i>Euphorbia spathulata</i>	warty spurge		
Fabaceae	AMCA6	<i>Amorpha canescens</i>	leadplant		
	ASAG2	<i>Astragalus agrestis</i>	purple milkvetch		
	ASAU4	<i>Astragalus australis</i>	Indian milkvetch		
	ASBI2	<i>Astragalus bisulcatus</i>	twogrooved milkvetch		
	ASCR2	<i>Astragalus crassicaarpus</i>	groundplum milkvetch		
	ASDR3	<i>Astragalus drummondii</i>	Drummond's milkvetch		
	ASFL2	<i>Astragalus flexuosus</i>	flexile milkvetch		
	ASGI5	<i>Astragalus gilviflorus</i>	plains milkvetch		
	ASGR3	<i>Astragalus gracilis</i>	slender milkvetch		

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	ASLA27	<i>Astragalus laxmannii</i>	Laxmann's milkvetch		
	ASLO4	<i>Astragalus lotiflorus</i>	lotus milkvetch		
	ASMI10	<i>Astragalus missouriensis</i>	Missouri milkvetch		
	ASMU99	<i>Astragalus multiflorus</i>	looseflower milkvetch		
	ASPL2	<i>Astragalus plattensis</i>	Platte River milkvetch		
	ASRA2	<i>Astragalus racemosus</i>	cream milkvetch		
	ASSP6	<i>Astragalus spatulatus</i>	tufted milkvetch		
	ASTRA	<i>Astragalus</i>	milkvetch		
	DACA7	<i>Dalea candida</i>	white prairie clover		
	DAEN	<i>Dalea enneandra</i>	nineanther prairie clover		
	DALEA	<i>Dalea</i>	prairie clover		
	DAPU5	<i>Dalea purpurea</i>	purple prairie clover		
	GLLE3	<i>Glycyrrhiza lepidota</i>	American licorice		
	LAOC2	<i>Lathyrus ochroleucus</i>	cream pea		
	LAPO2	<i>Lathyrus polymorphus</i>	manystem pea		
	MELIL	<i>Melilotus</i>	sweetclover	X	
	MELU	<i>Medicago lupulina</i>	black medick	X	
	MEOF	<i>Melilotus officinalis</i>	yellow sweetclover	X	
	MESA	<i>Medicago sativa</i>	alfalfa	X	
	OXCA4	<i>Oxytropis campestris</i>	field locoweed		
	OXLA3	<i>Oxytropis lambertii</i>	purple locoweed		
	OXSE	<i>Oxytropis sericea</i>	white locoweed		
	OXYTR	<i>Oxytropis</i>	locoweed		
	PEAR6	<i>Pedimelum argophyllum</i>	silverleaf Indian breadroot		
	PECU3	<i>Pedimelum cuspidatum</i>	largebract Indian breadroot		
	PEES	<i>Pedimelum esculentum</i>	large Indian breadroot		
	PSCU	<i>Psoralea cuspidata</i>	largebract Indian breadroot		
	PSLA3	<i>Psoralegium lanceolatum</i>	lemon scurfpea		
	PSTE5	<i>Psoralegium tenuiflorum</i>	slimflower scurfpea		
	THRH	<i>Thermopsis rhombifolia</i>	golden pea		
	VIAM	<i>Vicia americana</i>	American vetch		
	QUMA2	<i>Quercus macrocarpa</i>	bur oak		
Fumariaceae	COMI2	<i>Corydalis micrantha</i>	smallflower fumewort		
Geraniaceae	GERAN	<i>Geranium</i>	geranium	X	
Grossulariaceae	RIAU	<i>Ribes aureum</i>	golden currant		
	RICE	<i>Ribes cereum</i>	wax currant		
	RIHI	<i>Ribes hirtellum</i>	hairystem gooseberry		
	RIOX	<i>Ribes oxycanthoides</i>	Canadian gooseberry		
Hydrophyllaceae	ELNY	<i>Ellisia nyctelea</i>	Aunt Lucy		
Iridaceae	SIAN3	<i>Sisyrinchium angustifolium</i>	narrowleaf blue-eyed grass		
	SIMO2	<i>Sisyrinchium montanum</i>	strict blue-eyed grass		
Juncaceae	JUIN2	<i>Juncus interior</i>	inland rush		
	JUNCU	<i>Juncus</i>	rush	X	
Lamiaceae	HEDR	<i>Hedeoma drummondii</i>	Drummond's false pennyroyal		
	HEHI	<i>Hedeoma hispida</i>	rough false pennyroyal		
	MAVU	<i>Marrubium vulgare</i>	horehound	X	
	MOFI	<i>Monarda fistulosa</i>	wild bergamot		

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	NECA2	<i>Nepeta cataria</i>	catnip	X	
	PRVU	<i>Prunella vulgaris</i>	common selfheal		
	SAAZ	<i>Salvia azurea</i>	azure blue sage		
	SARE3	<i>Salvia reflexa</i>	lanceleaf sage		
Liliaceae	ALCE2	<i>Allium cernuum</i>	nodding onion		
	ALLIU	<i>Allium</i>	onion	X	
	ALTE	<i>Allium textile</i>	textile onion		
	CAGU	<i>Calochortus gunnisonii</i>	Gunnison's mariposa lily		
	CANU3	<i>Calochortus nuttallii</i>	sego lily		
	LEMO4	<i>Leucocrinum montanum</i>	common starlily		
	MAST4	<i>Maianthemum stellatum</i>	starry false lily of the valley		
Linaceae	LILE3	<i>Linum lewisii</i>	Lewis flax		
Linaceae	LIRI	<i>Linum rigidum</i>	stiffstem flax		
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	scarlet globemallow		
	SPCOC	<i>Sphaeralcea coccinea</i> ssp. <i>coccinea</i>	scarlet globemallow		
Melanthiaceae	TOVE2	<i>Toxicoscordion venenosum</i>	meadow deathcamas		
Montiaceae	PHPA29	<i>Phemeranthus parviflorus</i>	sunbright		
Nyctaginaceae	ABFR2	<i>Abronia fragrans</i>	snowball sand verbena		
	MIHI	<i>Mirabilis hirsuta</i>	hairy four o'clock		
	MILI3	<i>Mirabilis linearis</i>	narrowleaf four o'clock		
Oleaceae	FRPE	<i>Fraxinus pennsylvanica</i>	green ash		
Onagraceae	EPBR3	<i>Epilobium brachycarpum</i>	tall annual willowherb		
	OEBI	<i>Oenothera biennis</i>	common evening primrose		
	OECE2	<i>Oenothera cespitosa</i>	tufted evening primrose		
	OECO2	<i>Oenothera coronopifolia</i>	crownleaf evening primrose		
	OECU99	<i>Oenothera curtiflora</i>	velvetweed		
	OEEN	<i>Oenothera engelmannii</i>	Engelmann's evening primrose		
	OELA	<i>Oenothera laciniata</i>	cutleaf evening-primrose		
	OENOT	<i>Oenothera</i>	evening primrose		
	OENU	<i>Oenothera nuttallii</i>	Nuttall's evening primrose		
	OESE3	<i>Oenothera serrulata</i>	yellow sundrops		
	OESU99	<i>Oenothera suffrutescens</i>	scarlet beeblossom		
	OEVI	<i>Oenothera villosa</i>	hairy evening primrose		
Ophioglossaceae	BOTRY	<i>Botrychium</i>	grapefern		S1-S3
Orobanchaceae	ORFA	<i>Orobanche fasciculata</i>	clustered broomrape		
Oxalidaceae	OXST	<i>Oxalis stricta</i>	common yellow woodsorrel		
Papaveraceae	ARPO2	<i>Argemone polyanthemus</i>	crested pricklypoppy		
Pinaceae	PIPO	<i>Pinus ponderosa</i>	ponderosa pine		
Plantaginaceae	PLPA2	<i>Plantago patagonica</i>	woolly plantain		
	SYWY99	<i>Synthyris wyomingensis</i>	Wyoming kittentails		
Poaceae	ACHY	<i>Achnatherum hymenoides</i>	Indian ricegrass		
	ACRO7	<i>Achnatherum robustum</i>	sleepygrass		
	AGROP2	<i>Agropyron</i>	wheatgrass	X	
	AGSC5	<i>Agrostis scabra</i>	rough bentgrass		
	AGST2	<i>Agrostis stolonifera</i>	creeping bentgrass	X	
	ANGE	<i>Andropogon gerardii</i>	big bluestem		

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	ARLO16	<i>Aristida longespica</i>	slimspike threeawn		
	AROL	<i>Aristida oligantha</i>	prairie threeawn		
	ARPU9	<i>Aristida purpurea</i>	purple threeawn		
	BOCU	<i>Bouteloua curtipendula</i>	sideoats grama		
	BODA2	<i>Bouteloua dactyloides</i>	buffalograss		
	BOGR2	<i>Bouteloua gracilis</i>	blue grama		
	BOHI2	<i>Bouteloua hirsuta</i>	hairy grama		
	BRAN	<i>Bromus anomalus</i>	nodding brome		
	BRIN2	<i>Bromus inermis</i>	smooth brome	X	
	BRJA	<i>Bromus japonicus</i>	Japanese brome	X	
	BROMU	<i>Bromus</i>	brome	X	
	BRPO2	<i>Bromus porteri</i>	Porter brome		
	BRTE	<i>Bromus tectorum</i>	cheatgrass	X	
	BUDA	<i>Buchloe dactyloides</i>	buffalograss		
	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed		
	DASP2	<i>Danthonia spicata</i>	poverty oatgrass		
	DICL	<i>Dichanthelium clandestinum</i>	deertongue		
	DILI2	<i>Dichanthelium linearifolium</i>	slimleaf panicgrass		
	DIOL	<i>Dichanthelium oligosanthes</i>	Heller's rosette grass		
	DIWI5	<i>Dichanthelium wilcoxianum</i>	fall rosette grass		
	ECMU2	<i>Echinochloa muricata</i>	rough barnyardgrass		
	ELCA4	<i>Elymus canadensis</i>	Canada wildrye		
	ELEL5	<i>Elymus elymoides</i>	squirreltail		
	ELRE4	<i>Elymus repens</i>	quackgrass	X	
	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass		
	ELVI3	<i>Elymus virginicus</i>	Virginia wildrye		
	ELYMU	<i>Elymus</i>	wildrye	X	
	FEID	<i>Festuca idahoensis</i>	Idaho fescue		
	FEOV	<i>Festuca ovina</i>	sheep fescue	X	
	FESA	<i>Festuca saximontana</i>	Rocky Mountain fescue		
	HECO26	<i>Hesperostipa comata</i>	needle and thread		
	HESP11	<i>Hesperostipa spartea</i>	porcupinegrass		
	HOJU	<i>Hordeum jubatum</i>	foxtail barley		
	HOPU	<i>Hordeum pusillum</i>	little barley		
	KOMA	<i>Koeleria macrantha</i>	prairie Junegrass		
	MUAS	<i>Muhlenbergia asperifolia</i>	scratchgrass, alkali muhly		
	MUCU3	<i>Muhlenbergia cuspidata</i>	plains muhly		
	MUPA99	<i>Muhlenbergia paniculata</i>	tumblegrass		
	MURA	<i>Muhlenbergia racemosa</i>	marsh muhly		
	MUSQ3	<i>Munroa squarrosa</i>	false buffalograss		
	NAVI4	<i>Nassella viridula</i>	green needlegrass		
	PACA6	<i>Panicum capillare</i>	witchgrass		
	PANIC	<i>Panicum</i>	panicgrass	X	
	PASM	<i>Pascopyrum smithii</i>	western wheatgrass		
	PAVI2	<i>Panicum virgatum</i>	switchgrass		
	PIMI7	<i>Piptatherum micranthum</i>	littleseed ricegrass		
	POA	<i>Poa</i>	bluegrass	X	

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	POAL2	<i>Poa alpina</i>	alpine bluegrass		
	POCO	<i>Poa compressa</i>	Canada bluegrass	X	
	PONE	<i>Poa nemoralis</i>	wood bluegrass		
	POPA2	<i>Poa palustris</i>	fowl bluegrass		
	POPR	<i>Poa pratensis</i>	Kentucky bluegrass	X	
	SCPR4	<i>Schedonorus pratensis</i>	meadow fescue	X	
	SCPU	<i>Schizachne purpurascens</i>	false melic		
	SCSC	<i>Schizachyrium scoparium</i>	little bluestem		
	SONU2	<i>Sorghastrum nutans</i>	Indiangrass		
	SPCO16	<i>Sporobolus compositus</i>	composite dropseed		
	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed		
	SPHE	<i>Sporobolus heterolepis</i>	prairie dropseed		
	THIN6	<i>Thinopyrum intermedium</i>	intermediate wheatgrass	X	
	VUOC	<i>Vulpia octoflora</i>	sixweeks fescue		
Polemoniaceae	COLI2	<i>Collomia linearis</i>	tiny trumpet		
	PHAL3	<i>Phlox alyssifolia</i>	alyssumleaf phlox		
	PHAN4	<i>Phlox andicola</i>	prairie phlox		
	PHHO	<i>Phlox hoodii</i>	spiny phlox		
Polygalaceae	POAL4	<i>Polygala alba</i>	white milkwort		
	POLYG	<i>Polygala</i>	milkwort		
	POVE	<i>Polygala verticillata</i>	whorled milkwort		
Polygonaceae	ERAN4	<i>Eriogonum annuum</i>	annual buckwheat		
	ERFL4	<i>Eriogonum flavum</i>	alpine golden buckwheat		
	ERPA9	<i>Eriogonum pauciflorum</i>	fewflower buckwheat		
	FACO	<i>Fallopia convolvulus</i>	black bindweed	X	
	POAV	<i>Polygonum aviculare</i>	prostrate knotweed	X	
	PODO4	<i>Polygonum douglasii</i>	Douglas' knotweed		
	PORA3	<i>Polygonum ramosissimum</i>	bushy knotweed		
Portulacaceae	POOL	<i>Portulaca oleracea</i>	little hogweed	X	
Primulaceae	ANAR	<i>Anagallis arvensis</i>	scarlet pimpernel	X	
	ANOC2	<i>Androsace occidentalis</i>	western rockjasmine		
	ANSE4	<i>Androsace septentrionalis</i>	pygmyflower rockjasmine		
	PRPA99	<i>Primula pauciflora</i>	darkthroat shootingstar		
Ranunculaceae	ANCY	<i>Anemone cylindrica</i>	candle anemone		
	ANEMO	<i>Anemone</i>	Anemone		
	ANMU	<i>Anemone multifida</i>	cutleaf anemone		
	ANPA19	<i>Anemone patens</i>	eastern pasqueflower		
	MYMI2	<i>Myosurus minimus</i>	tiny mousetail		
Rosaceae	AGST	<i>Agrimonia striata</i>	roadside agrimony		
	AMAL2	<i>Amelanchier alnifolia</i>	Saskatoon serviceberry		
	CEMO2	<i>Cercocarpus montanus</i>	mountain mahogany		
	DRAR8	<i>Drymocallis arguta</i>	tall cinquefoil		
	DRFI3	<i>Drymocallis fissa</i>	bigflower cinquefoil		
	FRVI	<i>Fragaria virginiana</i>	Virginia strawberry		
	GETR	<i>Geum triflorum</i>	prairie smoke		
	PHMO4	<i>Physocarpus monogynus</i>	mountain ninebark		
	POCO13	<i>Potentilla concinna</i>	elegant cinquefoil		

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	POHI6	<i>Potentilla hippiana</i>	woolly cinquefoil		
	POPE8	<i>Potentilla pensylvanica</i>	Pennsylvania cinquefoil		
	POTEN	<i>Potentilla</i>	cinquefoil	X	
	PRAM	<i>Prunus americana</i>	American plum		
	PRPU3	<i>Prunus pumila</i>	sandcherry		
	PRVI	<i>Prunus virginiana</i>	chokecherry		
	ROAC	<i>Rosa acicularis</i>	prickly rose		
	ROAR3	<i>Rosa arkansana</i>	prairie rose		
	ROSA5	<i>Rosa</i>	rose		
	ROWO	<i>Rosa woodsii</i>	Woods' rose		
	RUID	<i>Rubus idaeus</i>	American red raspberry	X	
	RUSA99	<i>Rubus sachalinensis</i>	common red raspberry		
Rubiaceae	GAAP2	<i>Galium aparine</i>	stickywilly		
	GABO2	<i>Galium boreale</i>	northern bedstraw		
Salicaceae	PODE3	<i>Populus deltoides</i>	eastern cottonwood		
	SALIX	<i>Salix</i>	willow		
Santalaceae	COUM	<i>Comandra umbellata</i>	bastard toadflax		
Saxifragaceae	HERI	<i>Heuchera richardsonii</i>	Richardson's alumroot		
Scrophulariaceae	CASE5	<i>Castilleja sessiliflora</i>	Great Plains Indian paintbrush		
	CASU12	<i>Castilleja sulphurea</i>	sulphur Indian paintbrush		
	COPA3	<i>Collinsia parviflora</i>	maiden blue eyed Mary		
	NUTE	<i>Nuttallanthus texanus</i>	Texas toadflax		
	ORLU2	<i>Orthocarpus luteus</i>	yellow owl's-clover		
	PEAL2	<i>Penstemon albidus</i>	white penstemon		
	PEAN4	<i>Penstemon angustifolius</i>	broadbeard beardtongue		
	PEGL3	<i>Penstemon glaber</i>	sawsepal penstemon		
	PEGR5	<i>Penstemon gracilis</i>	lilac penstemon		
	PEGR7	<i>Penstemon grandiflorus</i>	large beardtongue		
	PENST	<i>Penstemon</i>	beardtongue		
	VEAR	<i>Veronica arvensis</i>	corn speedwell	X	
Selaginellaceae	VETH	<i>Verbascum thapsus</i>	common mullein	X	
	SEDE2	<i>Selaginella densa</i>	lesser spikemoss		
Smilacaceae	SMLA3	<i>Smilax lasioneura</i>	Blue Ridge carrionflower		
Solanaceae	PHHE5	<i>Physalis heterophylla</i>	clammy groundcherry		
	PHLO4	<i>Physalis longifolia</i>	longleaf groundcherry		
	PHVI5	<i>Physalis virginiana</i>	Virginia groundcherry		
	PHYSA	<i>Physalis</i>	groundcherry		
	SOPT3	<i>Solanum ptychanthum</i>	West Indian nightshade		
	SORO	<i>Solanum rostratum</i>	buffalobur nightshade		
	SOTR	<i>Solanum triflorum</i>	cutleaf nightshade		
Ulmaceae	CEOC	<i>Celtis occidentalis</i>	common hackberry		
	ULAM	<i>Ulmus americana</i>	American elm		
	ULMUS	<i>Ulmus</i>	elm	X	
	ULPU	<i>Ulmus pumila</i>	Siberian elm	X	
Urticaceae	PAPE5	<i>Parietaria pensylvanica</i>	Pennsylvania pellitory		
Urticaceae	URDI	<i>Urtica dioica</i>	stinging nettle		
Verbenaceae	GLBI2	<i>Glandularia bipinnatifida</i>	Dakota mock vervain		

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Verbenaceae	VEBR	<i>Verbena bracteata</i>	bigbract verbena		
Verbenaceae	VEHA2	<i>Verbena hastata</i>	swamp verbena		
Verbenaceae	VEST	<i>Verbena stricta</i>	hoary verbena		
Violaceae	VIAD	<i>Viola adunca</i>	hookedspur violet		
Violaceae	VINU2	<i>Viola nuttallii</i>	Nuttall's violet, yellow prairie violet		
Violaceae	VIOLA	<i>Viola</i>	violet	X	
Violaceae	VIPE2	<i>Viola pedatifida</i>	prairie violet		
Vitaceae	PAVI5	<i>Parthenocissus vitacea</i>	woodbine		

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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