



Plant Community Composition and Structure Monitoring at Wind Cave National Park

2018 Data Report

Natural Resource Data Series NPS/NGPN/NRDS—2019/1197



**ON THIS PAGE**

Plant community composition and structure monitoring plot WICA_PCM_0019 at Wind Cave National Park, June 2018.
Photograph courtesy of the National Park Service.

ON THE COVER

Plant community composition and structure monitoring plot WICA_PCM_2054 at Wind Cave National Park, June 2018.
Photograph courtesy of the National Park Service.

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January 2019

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

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All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner.

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Please cite this publication as:

Manuel, R. M., and D. J. Swanson. 2019. Plant community composition and structure monitoring at Wind Cave National Park: 2018 data report. Natural Resource Data Series NPS/NGPN/NRDS—2019/1197. National Park Service, Fort Collins, Colorado.

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Abstract

This report presents the results of vegetation monitoring efforts in 2018 at Wind Cave National Park (WICA) by the Northern Great Plains Inventory and Monitoring Network (NGPN) and the Northern Great Plains Fire Ecology (NGPFire) program.

During the eighth full year of field work, the NGPN field crew visited eighteen long-term plant community monitoring (PCM) plots to collect data on the plant communities at WICA. The NGPFire crew visited twenty-five PCM plots. In early spring of 2018 NGPFire conducted post-burn severity assessments at an additional eight PCM plots. This is part of a long-term monitoring effort to better understand the condition of the mixed-grass prairie and ponderosa pine woodlands within the boundaries of WICA. NGPN staff captured data relating to species richness, herb-layer height, abundances of native and non-native species, ground cover, and site disturbance from each PCM plot. In plots where woody species were present, NGPN measured tree regeneration, tall shrub and tree density, and woody fuel load. The NGPFire crew collected data relating to burn severity, herb-layer height, abundance of native and non-native species, ground cover, and target species.

Monitoring crews identified 230 species in the 36 monitoring plots visited in 2018 at WICA, 38 of which were exotic species. One plant species identified in the PCM plots visited in 2018 is listed as rare, though not critically imperiled, in South Dakota: nylon hedgehog cactus (*Echinocereus viridiflorus*). The average absolute cover at plots was 40% for exotics species and 140% for native. Tree density, health, and seedling regeneration, as well as woody fuel loads, were observed at twenty plots. The most common disturbances observed were related to wildfire and animal use (e.g., grazing, game trails, and prairie dogs).



Lillium philadelphicum observed in Wind Cave National Park (NPS /RYAN MANUEL)

Acknowledgments

We thank all the authors of the Northern Great Plains Plant Community Monitoring Protocol, particularly A. Symstad, for outstanding guidance on data collection and reporting. Thank you to the staff at WICA, A. Cammen, D. Stephan, and T. Richardson, for providing logistical support. Thank you to U.S. Fish and Wildlife Service employee C. Dixon, contractor M. Bynum, and volunteers B. Shipe, E. Myers, E. Duda, and E. Green for assistance in the field. The 2018 NGPN vegetation field crew of I. Ashton, C. Davis, M. Davis, R. Manuel, R. Oltjenbruns, S. Rockwood, and T. Schaffner, with the assistance of the Northern Great Plains Fire Ecology crew of D. Swanson, I. Muirhead, K. Ronsani and J. Roy, collected all the data included in this report.

Introduction

Wind Cave National Park (WICA), located in the southern Black Hills of South Dakota, was established in 1903 with a purpose to protect the unique Wind Cave resources. Over the years the park has grown in size to preserve and enhance the mixed-grass prairie and native wildlife, while also providing for the enjoyment of the public. The 33,851 acres 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](#)). Vegetation monitoring began at WICA in 1997 by the Northern Great Plains Fire Ecology Program (NGPFire) ([Wienk et al. 2011](#)). In 2011, the Northern Great Plains Inventory & Monitoring Program (NGPN) combined efforts with NGPFire ([Ashton et al. 2012](#)) to establish a coordinated vegetation monitoring protocol, and plot locations were shifted to better represent the entire park ([Symstad et al. 2012b](#)), based on the 2010 boundary. Additional upland plots were later added to represent a 2011 addition to the park property. There is a separate effort to monitor streambank condition because riparian communities are an important resource for the park ([Burkhart and Kovacs 2013](#)). In this report, we provide summaries of the data collected at 36 plots visited in 2018 (Figure 1). Please refer to the “Northern Great Plains Fire Ecology Annual Report: Calendar Year 2017” for park burn unit analysis and interpretation of the 2017 monitoring results accessible on the Data Store <https://irma.nps.gov/DataStore>.

Methods

The NGPN Plant Community Composition and Structure Monitoring Protocol (Symstad et al. 2012b, a) describes in detail the methods used for sampling long-term plots. Below, we briefly describe the general approach. For those interested in more detail, please see the protocol publications cited above, and available at <http://science.nature.nps.gov/im/units/ngpn/monitor/plants.cfm>.

Sample Design

The NGPN and NGPFire implemented a survey to monitor plant community structure and composition in WICA using a spatially balanced probability design (Generalized Random Tessellation Stratified [GRTS]; [Stevens and Olsen 2003, 2004](#)). Using the GRTS design, NGPN selected 35 randomly located sites within WICA to install Plant Community Monitoring (PCM) plots. These 35 sites are split into five panels containing seven sites each. NGPN crews visit two panels (14 sites total) every year using a rotating sampling scheme, and after five years all 35 sites will have been visited twice. Data from these randomly selected sites can be used to estimate condition of vegetation communities for the whole park and, over time, can be used to discern trends in condition. Ten additional monitoring sites (2 per panel) were selected within the 2011 park addition, and are scheduled to be visited on the same schedule as above, as time allows. In 2018, NGPN crews visited sites in panel 2 and panel 3 (Figure 1) during late June and early July (Table 1). The crew commuted from Rapid to WICA daily. Sampling was completed by a seven person NGPN crew, two WICA NPS employees, one contractor, one USFWS employee, and four graduate students in approximately 362 working hours. This total does not include the weather delays or drive time between Rapid City and WICA.

Table 1. Field journal for Northern Great Plains Network (NGPN) plant community monitoring (PCM) at Wind Cave National Park (WICA) in 2018. Seven NGPN crew members completed 18 plots with the assistance of two WICA National Park Service employees, one contracted employee - Mike Bynum, one U.S. Fish and Wildlife Service employee Cami Dixon, and four volunteer graduate students.

Date Visited	Plot Name	Field Notes
6/18/2018	PCM_0014	–
6/18/2018	PCM_0016	–
6/18/2018	PCM_0017	Prairie dog plot
6/19/2018	PCM_0009	–
6/19/2018	PCM_0020	–
6/19/2018	PCM_0021	–
6/20/2018	PCM_0011	–
6/20/2018	PCM_0013	–
6/21/2018	PCM_0008	–
6/21/2018	PCM_0018	Prairie dog plot
6/25/2018	PCM_0015	High bison use area; diverse
6/25/2018	PCM_0019	–

Table 1 (continued). Field journal for Northern Great Plains Network (NGPN) plant community monitoring (PCM) at Wind Cave National Park (WICA) in 2018. Seven NGPN crew members completed 18 plots with the assistance of two WICA National Park Service employees, one contracted employee - Mike Bynum, one U.S. Fish and Wildlife Service employee Cami Dixon, and four volunteer graduate students.

Date Visited	Plot Name	Field Notes
6/25/2018	PCM_2053	–
6/25/2018	PCM_2054	–
6/26/2018	PCM_0010	–
6/26/2018	PCM_0012	–
6/27/2018	PCM_2052	–
6/27/2018	PCM_2055	On wet years, water in creek is very high, which runs through B line of plot, still not enough water for rejecting. Photos adjusted due to water.

NGPFire established new sites focused in active burn units [Fire Plant Community Monitoring (FPCM) plots] using the same GRTS sampling schema. When a PCM or FPCM plot fell within an active burn unit, NGPFire visited additional plots based on an immediate post-burn, 1, 2, 5, and 10 year post-fire sampling schedule. Eight plots were visited in March and April by the fire ecologist and WICA botanist in which post-burn severity and fuels lines were monitored after the Legion Lake wildfire. During the summer of 2018, the NGPFire crew visited eighteen sites in four active burn units (Figure 1). One of the eight post-burn severity assessments was PCM_0020, also visited by NGPN. A second of the eight-post burn severity assessments was later revisited by NGPFire and included in their 18 plots visited in the 2018 summer season. Nine plots visited were burned in the 2,132 acre Rankin wildfire (September 11-14, 2017) and nine plots visited were burned in the 54,023 acre Legion Lake wildfire (December 11-14, 2017) (Figure 2). Approximately 7,000 acres of the Legion Lake wildfire burned within the park. Burn unit sampling was completed by a four-person crew in approximately 216 working hours (Table 2). This total does not include weather delays and drive time between the WICA Fire office and plots.

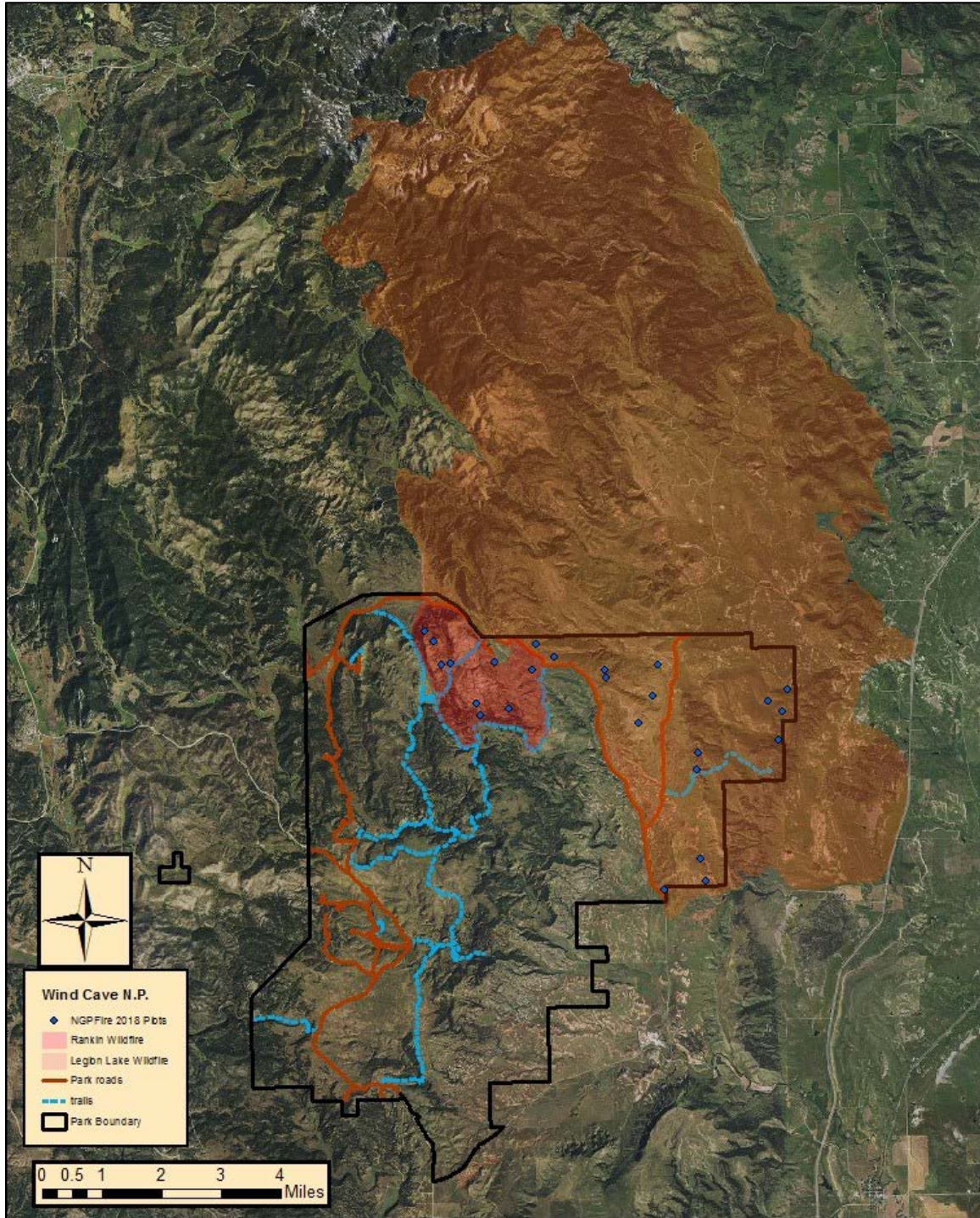


Figure 2. Map of the Rankin and Legion Lake wildfire perimeters and the Wind Cave National Park long-term monitoring plots visited by the Northern Great Plains Fire Ecology Program (NGPFire) during 2018. Nine plots were monitored in the Rankin wildfire and sixteen were monitored in the Legion Lake wildfire.

Table 2. Field journal for Northern Great Plains Fire Effects Program (NGPFire) visits to plant community monitoring (PCM) plots at Wind Cave National Park in 2018. An NGPFire crew of four people visited 18 PCM plots. A crew of two, a fire ecologist and park botanist, visited and conducted post-burn severity assessments at eight plots indicated with an asterisk.

Date Visited	Burn Unit	Plot Name	Field Notes
6/27/2018	Boland Ridge	PCM_0024	Burned in Legion Lake wildfire Dec. 11-14, 2017
9/18/2018	Boland Ridge	PCM_0056	Burned in Legion Lake wildfire Dec. 11-14, 2017
4/25/2018*	Boland Ridge	PCM_0059	Burned in Legion Lake wildfire Dec. 11-14, 2017
3/13/2018*	Boland Ridge	PCM_0068	Burned in Legion Lake wildfire Dec. 11-14, 2017
9/18/2018	Boland Ridge	PCM_0072	Burned in Legion Lake wildfire Dec. 11-14, 2017
9/18/2018	Boland Ridge	PCM_0088	Burned in Legion Lake wildfire Dec. 11-14, 2017
6/28/2018	Hidden Valley	PCM_0002	Burned in Rankin wildfire Sept. 11-14, 2017
6/26/2018	Hidden Valley	PCM_0022	Burned in Rankin wildfire Sept. 11-14, 2017
6/25/2018	Hidden Valley	PCM_0038	Burned in Rankin wildfire Sept. 11-14, 2017
9/17/2018	Hidden Valley	PCM_0051	Burned in Rankin wildfire Sept. 11-14, 2017
6/25/2018	Hidden Valley	PCM_0054	Burned in Rankin wildfire Sept. 11-14, 2017
6/25/2018	Hidden Valley	PCM_0102	Burned in Rankin wildfire Sept. 11-14, 2017
9/17/2018	Hidden Valley	PCM_0103	Burned in Rankin wildfire Sept. 11-14, 2017
9/17/2018	Hidden Valley	PCM_0115	Burned in Rankin wildfire Sept. 11-14, 2017
9/20/2018	Hidden Valley	PCM_0118	Burned in Rankin wildfire Sept. 11-14, 2017
6/19/2018	Red Valley	PCM_0006	Burned in Legion Lake wildfire Dec. 11-14, 2017
3/13/2018*	Red Valley	PCM_0020	Burned in Legion Lake wildfire Dec. 11-14, 2017; Burn Severity Read Only
3/13/2018*	Red Valley	PCM_0026	Burned in Legion Lake wildfire Dec. 11-14, 2017
3/13/2018*	Red Valley	PCM_0036	Burned in Legion Lake wildfire Dec. 11-14, 2017
6/26/2018	Red Valley	PCM_0036	Burned in Legion Lake wildfire Dec. 11-14, 2017
9/20/2018	Red Valley	PCM_0058	Burned in Legion Lake wildfire Dec. 11-14, 2017
9/21/2018	Red Valley	PCM_0070	Burned in Legion Lake wildfire Dec. 11-14, 2017
8/22/2018	Red Valley	PCM_0090	Burned in Legion Lake wildfire Dec. 11-14, 2017
3/14/2018*	South Boland Ridge	PCM_0019	Burned in Legion Lake wildfire Dec. 11-14, 2017
4/25/2018*	South Boland Ridge	PCM_0035	Burned in Legion Lake wildfire Dec. 11-14, 2017
4/25/2018*	South Boland Ridge	PCM_0099	Burned in Legion Lake wildfire Dec. 11-14, 2017

*Post-burn severity assessments conducted

Plot Layout and Sampling

At each site visited, the NGPN crew recorded plant species cover and frequency in a rectangular, 50 m x 20 m (0.1 ha), permanent plot (Figure 2). Data on ground cover, herb-layer height (≤ 2 m), and plant cover were collected on two 50 m transects (the long sides of the plot) using a point-intercept

method (Figure 3). Species richness data from the point-intercept method were supplemented with species presence data collected in five 1 m² quadrats located systematically along each transect (Figure 4). The NGPN crew measured species presence at ten quadrats per plot. If a plant species was identified in the plot but was not included on the verified park species list, a voucher plant specimen was collected when possible and submitted to a botanist for independent verification.

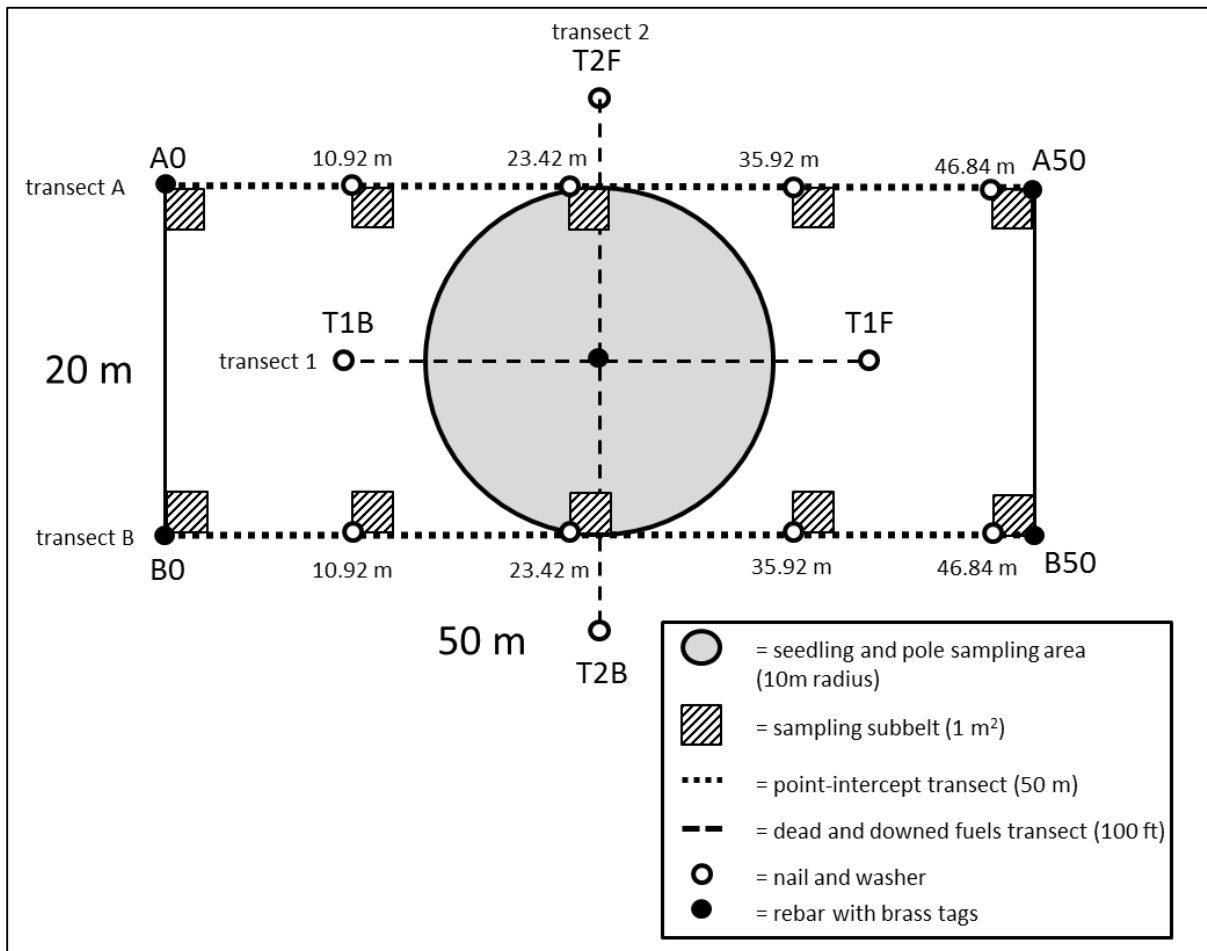


Figure 3. Long-term monitoring plot layout used for sampling vegetation used by the Northern Great Plains Inventory and Monitoring and Fire Ecology programs.

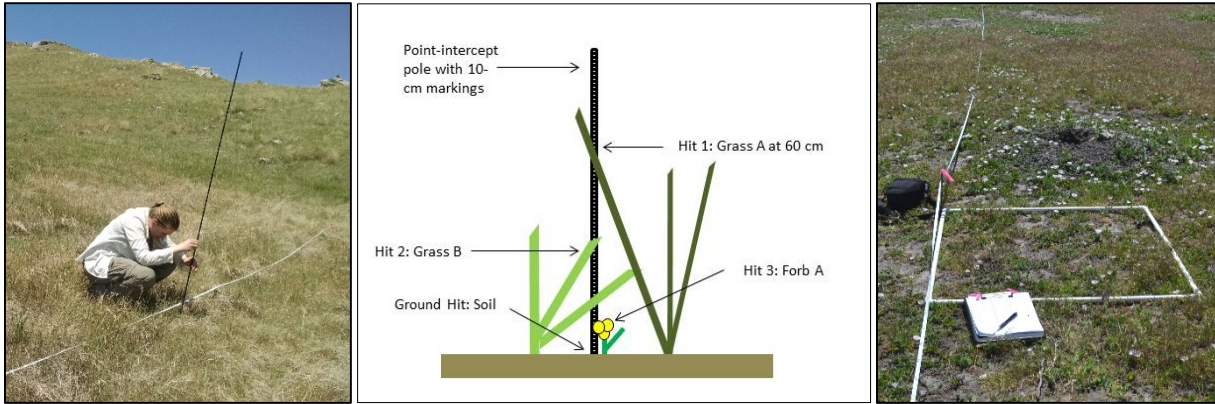


Figure 4. The Northern Great Plains Inventory & Monitoring vegetation crew used point-intercept (left and center panel) and quadrats (right panel) to document plant diversity and abundance.

When woody species were present within 38 m of plot center, monitoring crews collected tree regeneration and tall shrub density data within a 10 m radius subplot centered in the larger 50 m x 20 m (0.1 ha) plot. Trees with diameter at breast height (DBH) > 15 cm, present within the 0.1 ha plot were mapped and tagged. For each tree, the species, DBH, status (live or dead), and condition (e.g., leaf-discoloration, insect-damaged, etc.) were recorded. For all poles ($2.54 \leq \text{DBH} \leq 15$ cm) located within the 10 m radius subplot, only DBH and status were recorded. Tree and tall shrub species with DBH < 2.54 cm (seedlings) were tallied by species within the 10 m radius subplot. Dead and downed woody fuel load data were collected along two perpendicular, 100 ft (30.49 m) transects (fuel lines) with midpoints at the center of the plot (Figure 3), following Brown's Line methods (Brown 1974, Brown et al. 1982). Fuel load data were only collected if at least one piece of woody litter or fuel intersected a fuel line.

The NGPN crew assessed and documented common disturbances at each plot. The type, which included rodent mounds, animal trails, and fire, and the approximate area (m^2) of each disturbance was recorded. Plots were also assessed for the presence and abundance of target exotic species (Table 3), which is critical for early detection and rapid response to exotic species threats. These species were chosen in collaboration with the Midwest Invasive Plant Network, Northern Great Plains Exotic Plant Management Team, park managers, and local weed experts. Each target species was assigned an abundance class from 1-5, based on an ocular estimate of cover, where 1 = one individual, 2 = few individuals, 3 = cover of 1-5%, 4 = cover of 5-25%, and 5 = cover > 25% of the plot.

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

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

In 2018, several changes were made to the protocol to avoid inconsistent density calculations: first, seedlings (i.e. trees and tall shrubs with DBH < 2.54 cm) were always counted or estimated in all four quarters of the 10 m radius subplot. Previously, once the count for a species had reached 100, seedlings were not counted in the following quarters. In addition, a new category of disturbance, Soil Disturbance, was added in 2018. Soil Disturbance is defined as loose, exposed soil from all sources.

Data Management and Analysis

FFI (FEAT/FIREMON Integrated; <http://frames.gov/ffi/>) was the primary software environment used for managing our sampling data. FFI is used by a variety of agencies (e.g., NPS, USDA Forest Service, U.S. Fish and Wildlife Service), has a national-level support system, and generally conforms to the [Natural Resource Database Template](#) standards established by the Inventory and Monitoring Program. Species scientific names, codes, common names, and native status are from the USDA

Plants Database (USDA-NRCS 2017). However, nomenclature follows the [Integrated Taxonomic Information System](#) (ITIS). In the few cases where ITIS recognizes a new name that was not in the USDA PLANTS database, the new name was used, and a unique plant code was assigned. In the case where there is not enough evidence for genus and species identification, a special code for the unknown species was created. These are then designated as an exotic species in the total count, but omitted from the species list.

After data were entered in the database, 100% of records were verified with the original data sheets to minimize transcription errors, followed by a 10% review of records to confirm accuracy. After all data were entered and verified, automated queries were used to check for any remaining errors in the data. When errors were identified by the crew or the automated queries, corrections were made to the original datasheets and the FFI database.

Data summaries were produced using the FFI reporting and query tools. The number of species encountered in each plot was calculated using data from point-intercept, quadrat, woody species, and target species protocols. Absolute cover was calculated using point-intercept data and is the total number of vegetation intercepts. This is often greater than 100% because more than one species can be intercepted per point due to overlapping vegetation.

The conservation status rank of plant species observed at WICA in 2018 was determined by cross-referencing with the NatureServe conservation status list, as well as the South Dakota rare plant species list. For the purpose of this report, a species was considered rare or of conservation concern if its state or global conservation status rank was critically imperiled (S1/G1), imperiled (S1/G2), or vulnerable (S3/G3). More information on conservation ranks can be found at the [NatureServe](#) website. The 2018 species list was also cross-referenced with the list of noxious weeds maintained by the [South Dakota Department of Agriculture](#).

Results

There are 868 vascular plant species on the WICA species list, and monitoring crews found 230 of these species in 2018 (Table 4). Of these plant species, 38 are exotic species at WICA. A majority of exotic plants identified were either forbs or graminoids (grasses, sedges, and rushes). One plant species identified in the PCM and FPCM plots visited in 2018 is listed as rare, though not critically imperiled, in South Dakota: nylon hedgehog cactus (*Echinocereus viridiflorus*) (Figure 5).



Figure 5. A rare cactus, *Echinocereus viridiflorus*, observed in Wind Cave National Park (NPS /RYAN MANUEL)

Table 4. A list of all plant species identified in Wind Cave National Park’s long-term plant community monitoring plots in 2018. ‘Exotic’ in the notes column indicates that the species is invasive, or non-native. Species considered to be rare are marked with the appropriate state conservation ranks. If a species is considered noxious in the state of South Dakota, it is indicated in the notes column as Noxious - SD. If a species is considered noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name.

Family	Symbol	Scientific Name	Common Name	Notes
Agavaceae	YUGL	<i>Yucca glauca</i>	soapweed yucca	–
Amaranthaceae	AMBL	<i>Amaranthus blitoides</i>	mat amaranth	Exotic
Amaranthaceae	AMRE	<i>Amaranthus retroflexus</i>	redroot amaranth	–
Anacardiaceae	RHTR	<i>Rhus trilobata</i>	skunkbush sumac	–
Anacardiaceae	TORY	<i>Toxicodendron rydbergii</i>	western poison ivy	–
Apiaceae	LOFO	<i>Lomatium foeniculaceum</i>	desert biscuitroot	–
Asclepiadaceae	ASPU	<i>Asclepias pumila</i>	plains milkweed	–
Asclepiadaceae	ASST	<i>Asclepias stenophylla</i>	slimleaf milkweed	–
Asclepiadaceae	ASVI	<i>Asclepias viridiflora</i>	green comet milkweed	–
Asteraceae	AMPS	<i>Ambrosia psilostachya</i>	Cuman ragweed	–
Asteraceae	ANPA4	<i>Antennaria parvifolia</i>	small-leaf pussytoes	–
Asteraceae	ARDR4	<i>Artemisia dracunculus</i>	tarragon	–
Asteraceae	ARFR4	<i>Artemisia frigida</i>	prairie sagewort	–
Asteraceae	ARLU	<i>Artemisia ludoviciana</i>	white sagebrush	–
Asteraceae	BREU	<i>Brickellia eupatorioides</i>	false boneset	–
Asteraceae	CIAR4	<i>Cirsium arvense</i>	Canada thistle	Exotic, Noxious – Custer Co.
Asteraceae	CIUN	<i>Cirsium undulatum</i>	wavyleaf thistle	–
Asteraceae	CIVU	<i>Cirsium vulgare</i>	bull thistle	Exotic
Asteraceae	COCA5	<i>Conyza canadensis</i>	Canadian horseweed	–
Asteraceae	CYXA	<i>Cyclachaena xanthifolia</i>	giant sumpweed	–
Asteraceae	DYPA	<i>Dyssodia papposa</i>	fetid marigold	–
Asteraceae	ECAN2	<i>Echinacea angustifolia</i>	blacksamson echinacea	–
Asteraceae	ERCA4	<i>Erigeron canus</i>	hoary fleabane	–
Asteraceae	ERFL	<i>Erigeron flagellaris</i>	trailing fleabane	–
Asteraceae	GRSQ	<i>Grindelia squarrosa</i>	curlycup gumweed	–
Asteraceae	GUSA2	<i>Gutierrezia sarothrae</i>	broom snakeweed	–
Asteraceae	HEAN3	<i>Helianthus annuus</i>	common sunflower	–
Asteraceae	HELIA3	<i>Helianthus</i>	sunflower	–
Asteraceae	HEMA2	<i>Helianthus maximiliani</i>	Maximilian sunflower	–
Asteraceae	HEVI4	<i>Heterotheca villosa</i>	hairy false goldenaster	–
Asteraceae	LASE	<i>Lactuca serriola</i>	prickly lettuce	Exotic
Asteraceae	LIPU	<i>Liatris punctata</i>	dotted blazing star	–
Asteraceae	LOAR5	<i>Logfia arvensis</i>	field cottonrose	Exotic
Asteraceae	LYJU	<i>Lygodesmia juncea</i>	rush skeletonplant	–
Asteraceae	MUOB99	<i>Mulgedium oblongifolium</i>	blue lettuce	–
Asteraceae	PAPL12	<i>Packera plattensis</i>	prairie groundsel	–
Asteraceae	RACO3	<i>Ratibida columnifera</i>	upright prairie coneflower	–

Table 4 (continued). A list of all plant species identified in Wind Cave National Park's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. Species considered to be rare are marked with the appropriate state conservation ranks. If a species is considered noxious in the state of South Dakota, it is indicated in the notes column as Noxious - SD. If a species is considered noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name.

Family	Symbol	Scientific Name	Common Name	Notes
Asteraceae	SOMI2	<i>Solidago missouriensis</i>	Missouri goldenrod	–
Asteraceae	SOMO	<i>Solidago mollis</i>	velvety goldenrod	–
Asteraceae	SONE	<i>Solidago nemoralis</i>	gray goldenrod	–
Asteraceae	SORI2	<i>Solidago rigida</i>	stiff goldenrod	–
Asteraceae	SYLA6	<i>Symphyotrichum lanceolatum</i>	white panicle aster	–
Asteraceae	SYMPH4	<i>Symphyotrichum</i>	aster	–
Asteraceae	SYOB	<i>Symphyotrichum oblongifolium</i>	aromatic aster	–
Asteraceae	TAOF	<i>Taraxacum officinale</i>	common dandelion	Exotic
Asteraceae	TEAC	<i>Tetraneuris acaulis</i>	stemless four-nerve daisy	–
Asteraceae	TRDU	<i>Tragopogon dubius</i>	yellow salsify	Exotic
Boraginaceae	CYOF	<i>Cynoglossum officinale</i>	gypsyflower	Exotic
Boraginaceae	LAOC3	<i>Lappula occidentalis</i>	flatspine stickseed	–
Boraginaceae	LIIN2	<i>Lithospermum incisum</i>	narrowleaf stoneseed	–
Boraginaceae	MELA3	<i>Mertensia lanceolata</i>	prairie bluebells	–
Boraginaceae	ONBE	<i>Onosmodium bejariense</i>	soft-hair marbleseed	–
Brassicaceae	ARPY4	<i>Arabis pycnocarpa</i>	creamflower rockcress	–
Brassicaceae	CAMI2	<i>Camelina microcarpa</i>	littlepod false flax	Exotic
Brassicaceae	DRRE2	<i>Draba reptans</i>	Carolina draba	–
Brassicaceae	ERAS2	<i>Erysimum asperum</i>	western wallflower	–
Brassicaceae	ERCA14	<i>Erysimum capitatum</i>	sanddune wallflower	–
Brassicaceae	LEDE	<i>Lepidium densiflorum</i>	common pepperweed	–
Brassicaceae	PHLU99	<i>Physaria ludoviciana</i>	foothill bladderpod	–
Brassicaceae	SIAL2	<i>Sisymbrium altissimum</i>	tall tumbled mustard	Exotic
Brassicaceae	THAR5	<i>Thlaspi arvense</i>	field pennycress	Exotic
Cactaceae	ECVI2	<i>Echinocereus viridiflorus</i>	nylon hedgehog cactus	SD S3/G5
Cactaceae	ESMI3	<i>Escobaria missouriensis</i>	Missouri foxtail cactus	–
Cactaceae	OPFR	<i>Opuntia fragilis</i>	brittle pricklypear	–
Cactaceae	OPMA2	<i>Opuntia macrorhiza</i>	twistspine pricklypear	–
Cactaceae	OPPO	<i>Opuntia polyacantha</i>	plains pricklypear	–
Cactaceae	OPUNT	<i>Opuntia</i>	pricklypear	–
Campanulaceae	CARO2	<i>Campanula rotundifolia</i>	bluebell bellflower	–
Campanulaceae	TRPE4	<i>Triodanis perfoliata</i>	clasping Venus' looking-glass	–
Caprifoliaceae	SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry	–
Caryophyllaceae	CEAR4	<i>Cerastium arvense</i>	field chickweed	–

Table 4 (continued). A list of all plant species identified in Wind Cave National Park's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. Species considered to be rare are marked with the appropriate state conservation ranks. If a species is considered noxious in the state of South Dakota, it is indicated in the notes column as Noxious - SD. If a species is considered noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name.

Family	Symbol	Scientific Name	Common Name	Notes
Caryophyllaceae	PADE4	<i>Paronychia depressa</i>	spreading nailwort	–
Caryophyllaceae	SIAN2	<i>Silene antirrhina</i>	sleepy silene	–
Caryophyllaceae	SILEN	<i>Silene</i>	catchfly	Exotic
Caryophyllaceae	SINO	<i>Silene noctiflora</i>	nightflowering silene	Exotic
Chenopodiaceae	CHENO	<i>Chenopodium</i>	goosefoot	Exotic
Chenopodiaceae	CHPR5	<i>Chenopodium pratericola</i>	desert goosefoot	–
Commelinaceae	TRBR	<i>Tradescantia bracteata</i>	longbract spiderwort	–
Commelinaceae	TROC	<i>Tradescantia occidentalis</i>	prairie spiderwort	–
Convolvulaceae	COAR4	<i>Convolvulus arvensis</i>	field bindweed	Exotic
Convolvulaceae	EVNU	<i>Evolvulus nuttallianus</i>	shaggy dwarf morning-glory	–
Convolvulaceae	IPLE	<i>Ipomoea leptophylla</i>	bush morning-glory	–
Cupressaceae	JUSC2	<i>Juniperus scopulorum</i>	Rocky Mountain juniper	–
Cyperaceae	CABR10	<i>Carex brevior</i>	shortbeak sedge	–
Cyperaceae	CADU6	<i>Carex duriuscula</i>	needleleaf sedge	–
Cyperaceae	CAFI	<i>Carex filifolia</i>	threadleaf sedge	–
Cyperaceae	CAIN9	<i>Carex inops</i>	long-stolon sedge	–
Cyperaceae	CAREX	<i>Carex</i>	sedge	–
Dryopteridaceae	WOSC	<i>Woodsia scopulina</i>	Rocky Mountain woodsia	–
Euphorbiaceae	EUGL3	<i>Euphorbia glyptosperma</i>	ribseed sandmat	–
Euphorbiaceae	EUPHO	<i>Euphorbia</i>	spurge	Exotic
Euphorbiaceae	EUSE5	<i>Euphorbia serpyllifolia</i>	thymeleaf sandmat	–
Euphorbiaceae	EUSP	<i>Euphorbia spathulata</i>	warty spurge	–
Fabaceae	AMCA6	<i>Amorpha canescens</i>	leadplant	–
Fabaceae	ASAG2	<i>Astragalus agrestis</i>	purple milkvetch	–
Fabaceae	ASCR2	<i>Astragalus crassicaupus</i>	groundplum milkvetch	–
Fabaceae	ASGI5	<i>Astragalus gilviflorus</i>	plains milkvetch	–
Fabaceae	ASGR3	<i>Astragalus gracilis</i>	slender milkvetch	–
Fabaceae	ASLA27	<i>Astragalus laxmannii</i>	Laxmann's milkvetch	–
Fabaceae	ASLO4	<i>Astragalus lotiflorus</i>	lotus milkvetch	–
Fabaceae	ASMI10	<i>Astragalus missouriensis</i>	Missouri milkvetch	–
Fabaceae	ASPL2	<i>Astragalus plattensis</i>	Platte River milkvetch	–
Fabaceae	ASTRA	<i>Astragalus</i>	milkvetch	–
Fabaceae	DAPU5	<i>Dalea purpurea</i>	purple prairie clover	–
Fabaceae	GLLE3	<i>Glycyrrhiza lepidota</i>	American licorice	–
Fabaceae	LAOC2	<i>Lathyrus ochroleucus</i>	cream pea	–
Fabaceae	LAPO2	<i>Lathyrus polymorphus</i>	manystem pea	–
Fabaceae	MELU	<i>Medicago lupulina</i>	black medick	Exotic
Fabaceae	MEOF	<i>Melilotus officinalis</i>	yellow sweetclover	Exotic

Table 4 (continued). A list of all plant species identified in Wind Cave National Park's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. Species considered to be rare are marked with the appropriate state conservation ranks. If a species is considered noxious in the state of South Dakota, it is indicated in the notes column as Noxious - SD. If a species is considered noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name.

Family	Symbol	Scientific Name	Common Name	Notes
Fabaceae	PEAR6	<i>Pedimelum argophyllum</i>	silverleaf Indian breadroot	–
Fabaceae	PEES	<i>Pedimelum esculentum</i>	large Indian breadroot	–
Fabaceae	PSTE5	<i>Psoraleidum tenuiflorum</i>	slimflower scurfpea	–
Fabaceae	VIAM	<i>Vicia americana</i>	American vetch	–
Grossulariaceae	RIAU	<i>Ribes aureum</i>	golden currant	–
Grossulariaceae	RICE	<i>Ribes cereum</i>	wax currant	–
Grossulariaceae	RIOX	<i>Ribes oxyacanthoides</i>	Canadian gooseberry	–
Iridaceae	SIMO2	<i>Sisyrinchium montanum</i>	strict blue-eyed grass	–
Juncaceae	JUIN2	<i>Juncus interior</i>	inland rush	–
Lamiaceae	HEHI	<i>Hedeoma hispida</i>	rough false pennyroyal	–
Lamiaceae	MAVU	<i>Marrubium vulgare</i>	horehound	Exotic, Noxious – Custer Co.
Lamiaceae	MOFI	<i>Monarda fistulosa</i>	wild bergamot	–
Lamiaceae	NECA2	<i>Nepeta cataria</i>	catnip	Exotic
Lamiaceae	SARE3	<i>Salvia reflexa</i>	lanceleaf sage	–
Liliaceae	ALTE	<i>Allium textile</i>	textile onion	–
Liliaceae	CAGU	<i>Calochortus gunnisonii</i>	Gunnison's mariposa lily	–
Liliaceae	LEMO4	<i>Leucocrinum montanum</i>	common starlily	–
Liliaceae	MAST4	<i>Maianthemum stellatum</i>	starry false lily of the valley	–
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	scarlet globemallow	–
Melanthiaceae	TOVE2	<i>Toxicoscordion venenosum</i>	meadow deathcamas	–
Montiaceae	PHPA29	<i>Phemeranthus parviflorus</i>	sunbright	–
Nyctaginaceae	MILI3	<i>Mirabilis linearis</i>	narrowleaf four o'clock	–
Oleaceae	FRPE	<i>Fraxinus pennsylvanica</i>	green ash	–
Onagraceae	OECO2	<i>Oenothera coronopifolia</i>	crownleaf evening-primrose	–
Onagraceae	OECU2	<i>Oenothera curtiflora</i>	velvetweed	–
Onagraceae	OESE3	<i>Oenothera serrulata</i>	yellow sundrops	–
Onagraceae	OESU99	<i>Oenothera suffrutescens</i>	scarlet beeblossom	–
Orobanchaceae	ORFA	<i>Orobanche fasciculata</i>	clustered broomrape	–
Oxalidaceae	OXST	<i>Oxalis stricta</i>	common yellow oxalis	–
Pinaceae	PIPO	<i>Pinus ponderosa</i>	ponderosa pine	–
Plantaginaceae	PLPA2	<i>Plantago patagonica</i>	woolly plantain	–
Plantaginaceae	SYWY99	<i>Synthyris wyomingensis</i>	Wyoming kittentails	–
Poaceae	ACHY	<i>Achnatherum hymenoides</i>	Indian ricegrass	–
Poaceae	AGCR	<i>Agropyron cristatum</i>	crested wheatgrass	Exotic
Poaceae	AGSC5	<i>Agrostis scabra</i>	rough bentgrass	–
Poaceae	AGST2	<i>Agrostis stolonifera</i>	creeping bentgrass	Exotic
Poaceae	ANGE	<i>Andropogon gerardii</i>	big bluestem	–

Table 4 (continued). A list of all plant species identified in Wind Cave National Park's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. Species considered to be rare are marked with the appropriate state conservation ranks. If a species is considered noxious in the state of South Dakota, it is indicated in the notes column as Noxious - SD. If a species is considered noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name.

Family	Symbol	Scientific Name	Common Name	Notes
Poaceae	ARPU9	<i>Aristida purpurea</i>	purple threeawn	–
Poaceae	BOCU	<i>Bouteloua curtipendula</i>	sideoats grama	–
Poaceae	BODA2	<i>Bouteloua dactyloides</i>	buffalograss	–
Poaceae	BOGR2	<i>Bouteloua gracilis</i>	blue grama	–
Poaceae	BOHI2	<i>Bouteloua hirsuta</i>	hairy grama	–
Poaceae	BRIN2	<i>Bromus inermis</i>	smooth brome	Exotic
Poaceae	BRJA	<i>Bromus japonicus</i>	Japanese brome	Exotic
Poaceae	BRTE	<i>Bromus tectorum</i>	cheatgrass	Exotic
Poaceae	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed	–
Poaceae	DASP2	<i>Danthonia spicata</i>	poverty oatgrass	–
Poaceae	DILI2	<i>Dichanthelium linearifolium</i>	slimleaf panicgrass	–
Poaceae	DIOL	<i>Dichanthelium oligosanthos</i>	Heller's rosette grass	–
Poaceae	DIWI5	<i>Dichanthelium wilcoxianum</i>	fall rosette grass	–
Poaceae	ELCA4	<i>Elymus canadensis</i>	Canada wildrye	–
Poaceae	ELEL5	<i>Elymus elymoides</i>	squirreltail	–
Poaceae	ELLA3	<i>Elymus lanceolatus</i>	thickspike wheatgrass	–
Poaceae	ELRE4	<i>Elymus repens</i>	quackgrass	Exotic
Poaceae	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	–
Poaceae	HECO26	<i>Hesperostipa comata</i>	needle and thread	–
Poaceae	HOPU	<i>Hordeum pusillum</i>	little barley	–
Poaceae	KOMA	<i>Koeleria macrantha</i>	prairie Junegrass	–
Poaceae	MUAS	<i>Muhlenbergia asperifolia</i>	scratchgrass	–
Poaceae	MUCU3	<i>Muhlenbergia cuspidata</i>	plains muhly	–
Poaceae	MUPA99	<i>Muhlenbergia paniculata</i>	tumblegrass	–
Poaceae	NAVI4	<i>Nassella viridula</i>	green needlegrass	–
Poaceae	PASM	<i>Pascopyrum smithii</i>	western wheatgrass	–
Poaceae	PAVI2	<i>Panicum virgatum</i>	switchgrass	–
Poaceae	PIMI7	<i>Piptatherum micranthum</i>	littleseed ricegrass	–
Poaceae	POCO	<i>Poa compressa</i>	Canada bluegrass	Exotic
Poaceae	POPA2	<i>Poa palustris</i>	fowl bluegrass	–
Poaceae	POPR	<i>Poa pratensis</i>	Kentucky bluegrass	Exotic
Poaceae	POSE	<i>Poa secunda</i>	Sandberg bluegrass	–
Poaceae	SCSC	<i>Schizachyrium scoparium</i>	little bluestem	–
Poaceae	SONU2	<i>Sorghastrum nutans</i>	Indiangrass	–
Poaceae	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed	–
Poaceae	SPHE	<i>Sporobolus heterolepis</i>	prairie dropseed	–
Poaceae	THIN6	<i>Thinopyrum intermedium</i>	intermediate wheatgrass	Exotic
Poaceae	VUOC	<i>Vulpia octoflora</i>	sixweeks fescue	–

Table 4 (continued). A list of all plant species identified in Wind Cave National Park's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. Species considered to be rare are marked with the appropriate state conservation ranks. If a species is considered noxious in the state of South Dakota, it is indicated in the notes column as Noxious - SD. If a species is considered noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name.

Family	Symbol	Scientific Name	Common Name	Notes
Polemoniaceae	COLI2	<i>Collomia linearis</i>	tiny trumpet	–
Polemoniaceae	PHAL3	<i>Phlox alyssifolia</i>	alyssumleaf phlox	–
Polemoniaceae	PHAN4	<i>Phlox andicola</i>	prairie phlox	–
Polemoniaceae	PHHO	<i>Phlox hoodii</i>	spiny phlox	–
Polygalaceae	POAL4	<i>Polygala alba</i>	white milkwort	–
Polygalaceae	POVE	<i>Polygala verticillata</i>	whorled milkwort	–
Polygonaceae	FACO	<i>Fallopia convolvulus</i>	black bindweed	Exotic
Polygonaceae	POAV	<i>Polygonum aviculare</i>	prostrate knotweed	Exotic
Polygonaceae	PORA3	<i>Polygonum ramosissimum</i>	bushy knotweed	–
Portulacaceae	POOL	<i>Portulaca oleracea</i>	little hogweed	Exotic
Primulaceae	ANAR	<i>Anagallis arvensis</i>	scarlet pimpernel	Exotic
Primulaceae	ANOC2	<i>Androsace occidentalis</i>	western rockjasmine	–
Ranunculaceae	ANCY	<i>Anemone cylindrica</i>	candle anemone	–
Ranunculaceae	ANPA19	<i>Anemone patens</i>	eastern pasqueflower	–
Ranunculaceae	RAAB	<i>Ranunculus abortivus</i>	littleleaf buttercup	–
Ranunculaceae	RARH	<i>Ranunculus rhomboideus</i>	Labrador buttercup	–
Rosaceae	CEMO2	<i>Cercocarpus montanus</i>	alderleaf mountain mahogany	–
Rosaceae	DRYMO	<i>Drymocallis spp</i>	cinquefoil	–
Rosaceae	POHI6	<i>Potentilla hippiana</i>	woolly cinquefoil	–
Rosaceae	POPE8	<i>Potentilla pensylvanica</i>	Pennsylvania cinquefoil	–
Rosaceae	PRAM	<i>Prunus americana</i>	American plum	–
Rosaceae	PRVI	<i>Prunus virginiana</i>	chokecherry	–
Rosaceae	ROAC	<i>Rosa acicularis</i>	prickly rose	–
Rosaceae	ROAR3	<i>Rosa arkansana</i>	prairie rose	–
Rosaceae	ROWO	<i>Rosa woodsii</i>	Woods' rose	–
Rosaceae	RUSA99	<i>Rubus sachalinensis</i>	common red raspberry	–
Rubiaceae	GAAP2	<i>Galium aparine</i>	stickywilly	–
Santalaceae	COUM	<i>Comandra umbellata</i>	bastard toadflax	–
Scrophulariaceae	CASE5	<i>Castilleja sessiliflora</i>	downy paintedcup	–
Scrophulariaceae	PEGR5	<i>Penstemon gracilis</i>	lilac penstemon	–
Scrophulariaceae	PEGR7	<i>Penstemon grandiflorus</i>	large beardtongue	–
Scrophulariaceae	VEAR	<i>Veronica arvensis</i>	corn speedwell	Exotic
Scrophulariaceae	VEPE2	<i>Veronica peregrina</i>	neckweed	–
Scrophulariaceae	VETH	<i>Verbascum thapsus</i>	common mullein	Exotic; Noxious- Custer
Selaginellaceae	SEDE2	<i>Selaginella densa</i>	lesser spikemoss	–

Table 4 (continued). A list of all plant species identified in Wind Cave National Park's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. Species considered to be rare are marked with the appropriate state conservation ranks. If a species is considered noxious in the state of South Dakota, it is indicated in the notes column as Noxious - SD. If a species is considered noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name.

Family	Symbol	Scientific Name	Common Name	Notes
Solanaceae	PHL04	<i>Physalis longifolia</i>	longleaf groundcherry	–
Solanaceae	PHV15	<i>Physalis virginiana</i>	Virginia groundcherry	–
Ulmaceae	ULAM	<i>Ulmus americana</i>	American elm	–
Unknown family	UNKFORB	<i>Unknown forb</i>	unknown forb	Exotic
Unknown family	UNKFORB	<i>Unknown annual forb</i>	unknown annual forb	Exotic
Urticaceae	PAPE5	<i>Parietaria pensylvanica</i>	Pennsylvania pellitory	–
Verbenaceae	VEBR	<i>Verbena bracteata</i>	bigbract verbena	–
Verbenaceae	VEST	<i>Verbena stricta</i>	hoary verbena	–
Violaceae	VINU2	<i>Viola nuttallii</i>	Nuttall's violet	–
Violaceae	VIOLA	<i>Viola</i>	violet	Exotic
Vitaceae	PAV15	<i>Parthenocissus vitacea</i>	woodbine	–

Based on the total count of unique species observed in all plots in 2018, PCM_0018 had the highest number with 71 total species, followed by PCM_0009 with 59 species (Table 5). PCM_0018 had the most native species, totaling 61. Four plots visited in 2018 had more than 50 unique species each. Absolute cover calculations (Table 6) showed that plots visited by NGPN and NGPFire were on average more native than exotic. Plot PCM_2052, had no exotic species recorded using the point-intercept method. Plot PCM_0016 had the highest absolute cover of exotic species, and PCM_0020 had the highest absolute cover of native species at 218%, with an exotic absolute cover of 1%.

Table 5. Total number of plant species identified in plots monitored at Wind Cave National Park in 2018. This is a count of all unique species identified in the plot using species data from point-intercept, quadrat, woody species, and early detection exotic species protocols.

Protocol	Plot	Burn Unit	Native Species	Exotic Species	Total Species
All Protocols	PCM_0008	–	36	4	40
	PCM_0009	–	50	9	59
	PCM_0010	–	40	8	48
	PCM_0011	–	49	3	52
	PCM_0012	–	41	13	54
	PCM_0013	–	43	10	53
	PCM_0014	–	45	6	51
	PCM_0015	–	31	14	45
	PCM_0016	–	34	10	44
	PCM_0017	–	33	15	48
	PCM_0018	–	61	10	71

Table 5 (continued). Total number of plant species identified in plots monitored at Wind Cave National Park in 2018. This is a count of all unique species identified in the plot using species data from point-intercept, quadrat, woody species, and early detection exotic species protocols.

Protocol	Plot	Burn Unit	Native Species	Exotic Species	Total Species
All Protocols (continued)	PCM_0019	–	33	10	43
	PCM_0020	–	37	1	38
	PCM_0021	–	51	6	57
	PCM_2052	–	19	1	20
	PCM_2053	–	49	4	53
	PCM_2054	–	52	6	58
	PCM_2055	–	43	10	53
Point-intercept and early detection exotic species protocols only	PCM_0006	Red Valley	26	1	27
	PCM_0022	Hidden Valley	22	3	25
Point-intercept, woody species, and early detection exotic species protocols only	PCM_0002	Hidden Valley	17	2	19
	PCM_0024	Boland Ridge	22	2	24
	PCM_0036	Red Valley	25	1	26
Woody species and early detection exotic species protocols only	PCM_0038	Hidden Valley	1	3	4
	PCM_0051	Hidden Valley	1	3	4
	PCM_0054	Hidden Valley	0	3	3
	PCM_0056	Boland Ridge	1	1	2
	PCM_0058	Boland Ridge	2	1	3
	PCM_0072	Boland Ridge	4	3	7
	PCM_0088	Boland Ridge	1	0	1
	PCM_0090	Red Valley	0	1	1
	PCM_0102	Hidden Valley	1	4	5
	PCM_0103	Hidden Valley	2	5	7
	PCM_0115	Hidden Valley	1	3	4
	PCM_0118	Hidden Valley	2	4	6

Table 6. Absolute percent cover of native and exotic plant species in plots monitored at Wind Cave National Park in 2018. Absolute percent cover is calculated using the point-intercept data. This includes overlapping species canopies, which can result in values greater than 100%. Any plot visited by Northern Great Plains Fire Effects Program is indicated with its associated burn unit listed.

Plot	Burn Unit	Absolute Cover %	
		Exotic	Native
PCM_0002	Hidden Valley	5	87
PCM_0006	Red Valley	16	180
PCM_0008	–	5	97
PCM_0009	–	57	103
PCM_0010	–	79	143

Table 6 (continued). Absolute percent cover of native and exotic plant species in plots monitored at Wind Cave National Park in 2018. Absolute percent cover is calculated using the point-intercept data. This includes overlapping species canopies, which can result in values greater than 100%. Any plot visited by Northern Great Plains Fire Effects Program is indicated with its associated burn unit listed.

Plot	Burn Unit	Absolute Cover %	
		Exotic	Native
PCM_0011	–	16	134
PCM_0012	–	57	176
PCM_0013	–	50	79
PCM_0014	–	2	131
PCM_0015	–	90	112
PCM_0016	–	124	104
PCM_0017	–	13	157
PCM_0018	–	52	163
PCM_0019	–	34	187
PCM_0020	–	1	218
PCM_0021	–	40	157
PCM_0022	Hidden Valley	51	198
PCM_0024	Boland Ridge	53	188
PCM_0036	Red Valley	28	193
PCM_2052	–	0	35
PCM_2053	–	10	119
PCM_2054	–	20	170
PCM_2055	–	77	104

The NGPN and NGPFire crews collected woody species data at 18 plots in 2018. Five unique species of trees and shrubs were observed, with ponderosa pine (*Pinus ponderosa*) as the dominant cover (Table 7). American elm (*Ulmus americana*), chokecherry (*Prunus virginiana*), and green ash (*Fraxinus pennsylvanica*) regeneration was observed in seven plots.

Table 7. Woody species densities from 18 long-term monitoring plots visited at Wind Cave National Park in 2018. DBH categories are tree (DBH > 15 cm), pole (2.54 cm ≤ DBH ≤ 15 cm), and seedling (DBH < 2.54 cm).

Plot Name	Common Name	DBH	Status	Density/ha.
PCM_0002	ponderosa pine	Pole	Live	32
PCM_0002	ponderosa pine	Tree	Live	32
PCM_0002	ponderosa pine	Seedling	Live	350
PCM_0008	ponderosa pine	Pole	Dead	96
PCM_0008	ponderosa pine	Tree	Dead	140
PCM_0008	ponderosa pine	Tree	Live	20
PCM_0009	ponderosa pine	Pole	Live	510

Table 7 (continued). Woody species densities from 18 long-term monitoring plots visited at Wind Cave National Park in 2018. DBH categories are tree (DBH > 15 cm), pole (2.54 cm ≤ DBH ≤ 15 cm), and seedling (DBH < 2.54 cm).

Plot Name	Common Name	DBH	Status	Density/ha.
PCM_0009	ponderosa pine	Tree	Dead	10
PCM_0009	ponderosa pine	Tree	Live	80
PCM_0009	ponderosa pine	Seedling	Live	955
PCM_0011	ponderosa pine	Tree	Live	20
PCM_0011	ponderosa pine	Seedling	Live	32
PCM_0012	ponderosa pine	Tree	Live	20
PCM_0013	ponderosa pine	Tree	Dead	100
PCM_0013	ponderosa pine	Tree	Live	110
PCM_0013	ponderosa pine	Seedling	Live	15913
PCM_0016	ponderosa pine	Tree	Live	10
PCM_0038	ponderosa pine	Seedling	Live	95
PCM_0051	ponderosa pine	Tree	Live	64
PCM_0056	chokecherry	Seedling	Live	24570
PCM_0058	American elm	Seedling	Live	796
PCM_0058	chokecherry	Seedling	Live	8880
PCM_0072	Rocky Mountain juniper	Pole	Dead	191
PCM_0072	ponderosa pine	Pole	Dead	2038
PCM_0072	ponderosa pine	Tree	Dead	318
PCM_0072	ponderosa pine	Pole	Live	32
PCM_0072	ponderosa pine	Tree	Live	96
PCM_0072	green ash	Seedling	Live	64
PCM_0072	chokecherry	Seedling	Live	796
PCM_0088	chokecherry	Seedling	Live	1814
PCM_0102	ponderosa pine	Pole	Dead	32
PCM_0103	ponderosa pine	Pole	Dead	32
PCM_0103	ponderosa pine	Pole	Live	223
PCM_0103	ponderosa pine	Tree	Live	287
PCM_0103	ponderosa pine	Seedling	Live	1496
PCM_0103	chokecherry	Seedling	Live	32
PCM_0115	ponderosa pine	Tree	Live	382
PCM_0115	ponderosa pine	Seedling	Live	64
PCM_0118	ponderosa pine	Tree	Live	191
PCM_0118	chokecherry	Seedling	Live	95
PCM_2052	Rocky Mountain juniper	Pole	Live	32
PCM_2052	ponderosa pine	Pole	Dead	96
PCM_2052	ponderosa pine	Pole	Live	6369
PCM_2052	ponderosa pine	Tree	Dead	30

Table 7 (continued). Woody species densities from 18 long-term monitoring plots visited at Wind Cave National Park in 2018. DBH categories are tree (DBH > 15 cm), pole (2.54 cm ≤ DBH ≤ 15 cm), and seedling (DBH < 2.54 cm).

Plot Name	Common Name	DBH	Status	Density/ha.
PCM_2052	ponderosa pine	Tree	Live	80
PCM_2052	Rocky Mountain juniper	Seedling	Live	318
PCM_2052	ponderosa pine	Seedling	Live	1464
PCM_2053	Rocky Mountain juniper	Tree	Live	10
PCM_2053	ponderosa pine	Pole	Dead	32
PCM_2053	ponderosa pine	Tree	Live	10
PCM_2053	ponderosa pine	Seedling	Live	32
PCM_2055	Rocky Mountain juniper	Tree	Dead	10
PCM_2055	Rocky Mountain juniper	Tree	Live	40
PCM_2055	ponderosa pine	Tree	Live	20
PCM_2055	ponderosa pine	Seedling	Live	127
PCM_2055	American elm	Seedling	Live	1209
PCM_2055	chokecherry	Seedling	Live	700

Dead and downed wood and surface fuels provide foraging habitat and refugia for small wildlife species, as well as substrate for mosses and fungi. Downed wood sometimes also provides “nursery” logs for vascular plant establishment. However, when surface fuels are too abundant in a forest they can increase the risk of high intensity fires. NGPN observed measurable surface fuels in 7 plots at WICA in 2018 (Table 8).

Table 8. Surface fuels summary for 7 plots visited in 2018 at Wind Cave National Park by Northern Great Plains Network.

Macroplot	Average Tons per Acre										Avg. Depth (in.)		
	1-hr	10-hr	100-hr	1-100-hr	1000-hr sound	1000-hr rotten	1-1000-hr	Duff	Litter	Total	Duff	Litt	Total
PCM_0008	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.56	0.0	0.1	0.1
PCM_0009	0.08	0.41	2.18	2.67	0.00	0.00	2.67	3.70	2.82	9.18	0.2	0.7	0.9
PCM_0011	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	1.30	2.79	0.1	0.3	0.4
PCM_0012	0.00	0.00	0.74	0.74	0.00	2.44	3.18	0.44	1.54	5.16	0.0	0.4	0.4
PCM_0013	0.12	2.31	7.27	9.70	0.25	1.15	11.10	3.08	1.64	15.82	0.2	0.4	0.6
PCM_2052	0.29	0.95	5.08	6.33	0.00	3.55	9.88	20.86	3.75	34.50	1.2	0.9	2.1
PCM_2055	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.49	4.79	9.28	0.3	1.2	1.5

NGP Fire visited 13 plots at WICA in 2018 with measureable surface fuels (Table 9). Eight plots were located in the Hidden Valley unit which burned in the Rankin wildfire (September 2017) and five plots were located in either the Boland Ridge or South Boland Ridge units that were burned in the Legion Lake wildfire (December 2017).

Table 9. Surface fuels summary for 13 plots visited in 2018 at Wind Cave National Park by Northern Great Plains Fire.

Wildfire	Macroplot	Average Tons per Acre							Avg. Depth (in.)					
		1-hr	10-hr	100-hr	1-100-hr	1000-hr sound	1000-hr rotten	1-1000-hr	Duff	Litter	Total	Duff	Litt	Total
Rankin wildfire	PCM_0002	0.02	0.00	0.00	0.02	0.00	0.00	0.02	0.79	0.38	1.19	0.0	0.1	0.1
	PCM_0038	0.02	0.41	0.00	0.43	0.49	0.00	0.92	0.09	0.26	1.27	0.0	0.1	0.1
	PCM_0051	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.16	0.0	0.0	0.0
	PCM_0054	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.44	1.06	0.0	0.1	0.1
	PCM_0102	0.00	0.56	0.00	0.56	2.30	0.38	3.24	0.79	0.44	4.47	0.0	0.1	0.2
	PCM_0103	0.00	0.69	0.73	1.42	5.17	0.00	6.59	5.28	2.18	14.05	0.3	0.5	0.8
	PCM_0115	0.00	0.00	0.73	0.73	0.00	0.00	0.73	5.37	1.22	7.31	0.3	0.3	0.6
	PCM_0118	0.04	0.14	0.00	0.18	0.26	0.00	0.43	1.32	1.02	2.77	0.1	0.3	0.3
Legion Lake wildfire	PCM_0035	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.55	1.22	3.77	0.1	0.3	0.5
	PCM_0059	0.04	0.00	0.00	0.04	0.00	0.00	0.04	0.70	0.72	1.46	0.0	0.2	0.2
	PCM_0068	0.00	0.00	0.00	0.00	0.25	0.00	0.25	0.62	0.12	0.99	0.0	0.0	0.1
	PCM_0072	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.26	0.61	0.0	0.1	0.1
	PCM_0099	0.02	0.00	0.00	0.02	0.00	0.00	0.02	0.79	0.18	0.99	0.0	0.0	0.1

Disturbances were observed in 31 of the 36 plots visited by NGPN and NGPFire in 2018 (Table 10). The most common disturbances were wildfire and animal use (grazing, animal trail, wallow, and prairie dog). All eight plots were also assessed for the presence of early detection exotic species, but none were found in 2018.

Table 10. Disturbance type and area observed in 31 plots visited at Wind Cave National Park by Northern Great Plains Network and Northern Great Plains Fire in 2018. The disturbance area was approximated out of a total area of 1000 m². Plots visited by Northern Great Plains Fire where only forest data was collected are approximated out of a total area of 750 m² and indicated with an asterisk.

Plot	Disturbance Type	Area (m ²)
PCM_0002	Wildfire (Rankin)	1000
PCM_0006	Wildfire (Legion Lake)	1000
PCM_0006	Grazing	0.5
PCM_0008	Grazing	3
PCM_0008	Soil Disturbance	500
PCM_0008	Wildfire	1000
PCM_0009	Animal Trail	10
PCM_0009	Grazing	10
PCM_0009	Wallow	5
PCM_0009	Soil Disturbance	10
PCM_0010	Wildfire (Legion Lake)	1000
PCM_0012	Erosion	15
PCM_0012	Soil Disturbance	15
PCM_0015	Animal Trail	15
PCM_0015	Grazing	100
PCM_0015	Wallow	5
PCM_0015	Soil Disturbance	5
PCM_0015	Wildfire	1000
PCM_0016	Animal Trail	50
PCM_0016	Grazing	50
PCM_0016	Wallow	20
PCM_0016	Prairie Dog	110
PCM_0016	Soil Disturbance	65
PCM_0016	Other	2
PCM_0017	Grazing	1000
PCM_0017	Wallow	10
PCM_0017	Prairie Dog	1000
PCM_0017	Soil Disturbance	50
PCM_0018	Grazing	750
PCM_0018	Wallow	4
PCM_0018	Small Mammal	10
PCM_0018	Soil Disturbance	10
PCM_0019	Wildfire (Legion Lake)	1000

Table 10 (continued). Disturbance type and area observed in 31 plots visited at Wind Cave National Park by Northern Great Plains Network and Northern Great Plains Fire in 2018. The disturbance area was approximated out of a total area of 1000 m². Plots visited by Northern Great Plains Fire where only forest data was collected are approximated out of a total area of 750 m² and indicated with an asterisk.

Plot	Disturbance Type	Area (m ²)
PCM_0020	Grazing	20
PCM_0020	Small Mammal	1
PCM_0020	Soil Disturbance	1
PCM_0020	Wildfire (Legion Lake)	1000
PCM_0021	Off-Road	0
PCM_0021	Animal Trail	10
PCM_0021	Grazing	30
PCM_0021	Wallow	2
PCM_0021	Soil Disturbance	12
PCM_0024	Wildfire (Legion Lake)	1000
PCM_0036	Grazing	1
PCM_0036	Wallow	1.3
PCM_0036	Other	1.2
PCM_0036	Wildfire (Legion Lake)	1000
PCM_0038*	Wildfire (Rankin)	730
PCM_0051*	Grazing	15
PCM_0051*	Wildfire (Rankin)	730
PCM_0054*	Wildfire (Rankin)	730
PCM_0054*	Grazing	1
PCM_0054*	Soil Disurbance	0.3
PCM_0056*	Wildfire (Legion Lake)	730
PCM_0058*	Wildfire (Rankin)	730
PCM_0070*	Grazing	14
PCM_0070*	Wildfire (Legion Lake)	730
PCM_0072*	Animal Trail	20
PCM_0072*	Grazing	50
PCM_0072*	Wildfire (Legion Lake)	730
PCM_0088*	Wildfire (Legion Lake)	730
PCM_0088*	Animal Trail	18
PCM_0088*	Grazing	1
PCM_0090*	Animal Trail	35
PCM_0090*	Wildfire (Legion Lake)	730
PCM_0102*	Wildfire (Rankin)	730
PCM_0103*	Animal Trail	20
PCM_0103*	Grazing	15
PCM_0103*	Wildfire (Rankin)	730
PCM_0115*	Animal Trail	5
PCM_0115*	Grazing	27

Table 10 (continued). Disturbance type and area observed in 31 plots visited at Wind Cave National Park by Northern Great Plains Network and Northern Great Plains Fire in 2018. The disturbance area was approximated out of a total area of 1000 m². Plots visited by Northern Great Plains Fire where only forest data was collected are approximated out of a total area of 750 m² and indicated with an asterisk.

Plot	Disturbance Type	Area (m ²)
PCM_0115*	Wildfire (Rankin)	730
PCM_0118*	Grazing	12
PCM_0118*	Wildfire (Rankin)	730
PCM_2052	Animal Trail	15
PCM_2052	Soil Disturbance	5
PCM_2053	Erosion	50
PCM_2053	Soil Disturbance	50
PCM_2055	Flood	0

Further Analysis

This 2018 Data Summary Report is intended to provide a basic review of the data collected during the NGPN team's 2018 visit to Wind Cave National Park. All data included in this report is available upon request from the Northern Great Plains Inventory and Monitoring Network, and it is archived at <https://irma.nps.gov/DataStore>.

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NPS 108/150200, January 2019

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