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Natural Resource Stewardship and Science

Plant Community Composition and Structure Monitoring at Jewel Cave National Monument

2019 Data Report

Natural Resource Data Series NPS/JECA/NRDS—2019/1246

ON THIS PAGE

The small and unique flowers of the green shinleaf, *Pyrola chlorantha,* were spotted in plot PCM_011 in Jewel Cave National Monument in 2019. Photograph courtesy of Stephanie Rockwood, National Park Service.

ON THE COVER

Northern Great Plains Inventory & Monitoring crew members identifying plants at a vegetation monitoring plot at Jewel Cave National Monument in 2019. Photograph courtesy of the National Park Service.

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2019 Data Report

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Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of those protocols.

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Abstract

This report presents the results of vegetation monitoring in 2019 at Jewel Cave National Monument (JECA) by the Northern Great Plains Inventory and Monitoring Network (NGPN) and the Northern Great Plains Fire Ecology (NGPFire) program. This was the ninth year of combined monitoring efforts.

Crew members from NGPN visited five long-term monitoring plots to collect data on the plant communities at JECA. Data collection at a scheduled sixth plot was not performed due to it being in an active construction zone. This work is part of a long-term monitoring effort designed to provide a better understanding of the condition of the vegetation community and how it changes over time. NGPN staff measured species richness, herb-layer height, native and non-native species abundance, ground cover, and site disturbance at each of the plots. In plots where woody species were present, tree regeneration, tall shrub density, tree density, and woody fuel loads were also measured. The NGPFire crew visited an additional seven plots to collect pre- and post-burn data relating to herb-layer, ground cover, site disturbance, and woody species composition.

In 2019, monitoring crews identified 132 unique plant species in twelve plots. Of those species, 16 were exotic species. On average, the absolute cover of native species was much greater than the absolute cover of exotic species. No rare species were observed in any of the six plots, however crews observed yellow toadflax (*Linaria vulgaris*), which is listed as an early-detection target exotic plant, as well as a Custer County noxious weed. NGPN and NGPFire crews collected tree regeneration and fuel load data in all plots. Five tree and shrub species were present; however, ponderosa pine was the dominant species. Ground disturbances included animal use, a road, and soil disturbance.

Acknowledgments

We thank all the authors of the NGPN Plant Community Monitoring Protocol, particularly A. Symstad, for outstanding guidance on data collection and reporting. Thank you to the staff at JECA for providing logistical support and safety checks, especially L. Filipi. We thank the seasonal staff and SCA volunteers at JECA—A. Conway and A. Burke—for their help with field work. We also thank M. Bynum for assistance in the field. The 2019 NGPN vegetation field crew—R. Manuel, T. Schaffner, S. Rockwood, E. Duda, T. Bortz, and C. Knudtson—and the NGPFire crew—I. Muirhead, D. Swanson, M. Pahler, and L. Badertscher—collected the data included in this report.

Introduction

Jewel Cave National Monument (JECA) is located in the southwestern Black Hills of South Dakota. It was established in 1908 with the mission to preserve Jewel Cave through management of the surface and subsurface ecosystem, while providing opportunities for the pursuit of scientific interests and public enjoyment. While covering a relatively small area (516 ha, 1274 ac), JECA contains diverse native ponderosa forest and grassland communities (Marriot and Hartman 1986, Ashton et al. 2012a). The Jasper Fire greatly impacted the park in 2000, moderately to severely burning 75% of the landscape and resulting in more than 50% mortality of trees in the park (Lentile et al. 2005). Ninety-five percent of the monument was affected by this forest fire (NPS 2004), resulting in a patchwork of intact and entirely consumed ponderosa pine stands.

The Northern Great Plains Inventory & Monitoring Program (NGPN) began annual vegetation monitoring efforts in JECA in 2011 (Ashton et al. 2012a). Vegetation monitoring protocols and plot locations were chosen to represent the entire park and to coordinate efforts with the Northern Great Plains Fire Ecology Program (NGPFire; Figure 1). In this report, we provide summaries of the vegetation data collected in 2019 from twelve monitoring plots. For a more in-depth data report on long-term vegetation trends at JECA, refer to the 2011-2017 summary report (Ashton et al. 2018).

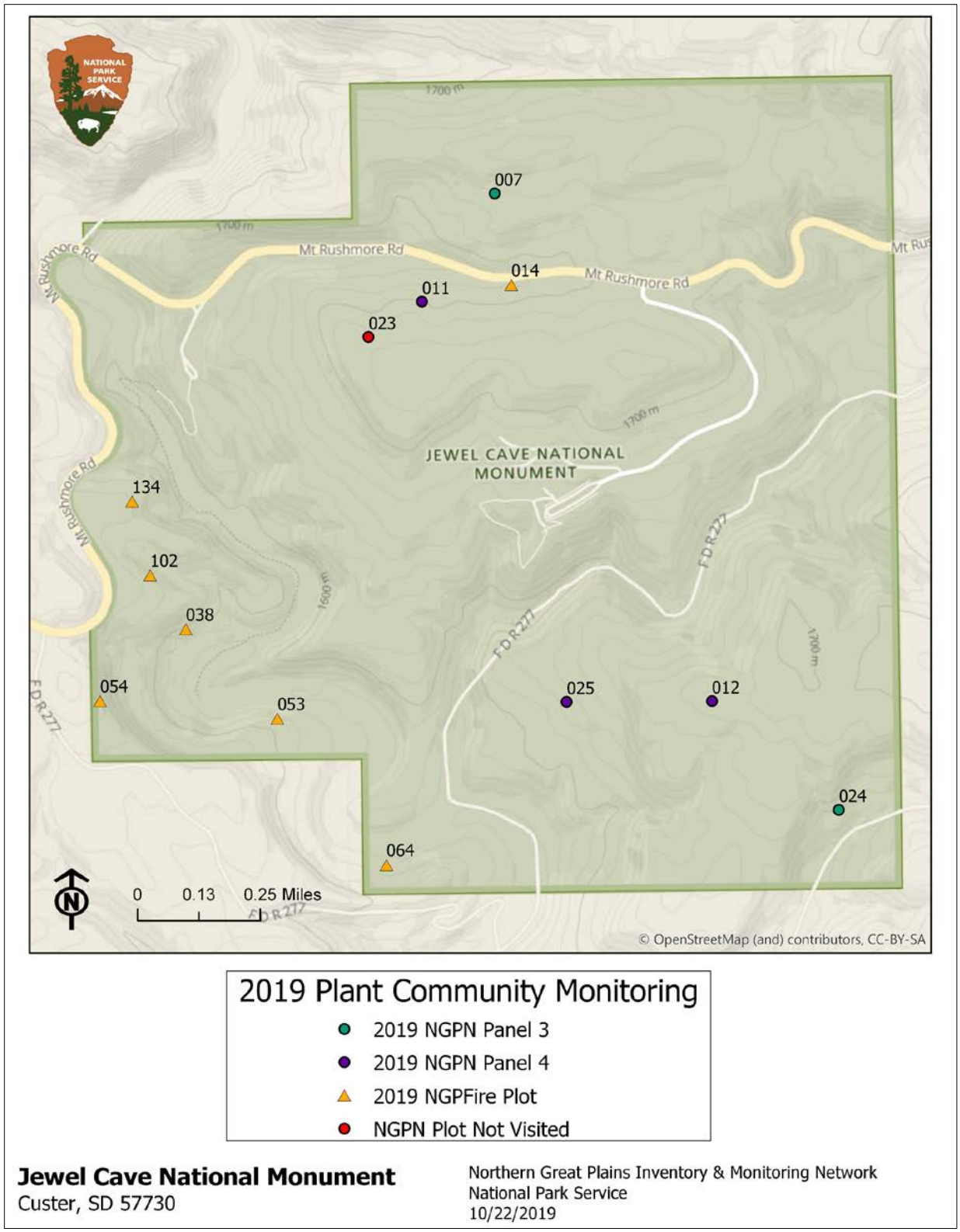

Figure 1. Map of Jewel Cave National Monument plant community monitoring plots visited in 2019 by the Northern Great Plains Network Inventory & Monitoring Program (NGPN) and the Northern Great Plains Fire Ecology Program (NGPFire).

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. The general approach is briefly described below. For more detail, please see Symstad et al. 2012a, available at https://www.nps.gov/im/ngpn/plant-communities.htm.

Sample Design

The NGPN team implemented a survey to monitor plant community structure and composition at JECA using a spatially balanced probability design (Generalized Random Tessellation Stratified [GRTS]; Stevens and Olsen 2003, 2004). Using a GRTS design, 15 randomly located sites were selected within JECA to be established as Plant Community Monitoring plots (PCM plots). These sites were split into five panels containing three sites each. An NGPN crew visits two panels (six PCM plots) during early July every year, using a rotating sampling scheme that consists of three plots visited the previous year and three plots that have not been visited for four years. Data from these randomly selected sites can be used to estimate the condition of vegetation communities for the whole park and to discern trends in condition over time. In 2019, the NGPN crew visited sites in panel 3 and panel 4 (Figure 1). Sampling was completed by two NGPN crews, with help from JECA staff and volunteers, in approximately 150 crew hours (Table 1).

Table 1. Field journal for plant community monitoring plot visits at Jewel Cave National Monument in 2019. A total of 5 plots were visited by the Northern Great Plains Network Inventory & Monitoring crews.

Date Visited	Plot Name	Field Notes
July 1, 2019	PCM_011	3 person crew
July 1, 2019	PCM_024	4 person crew (includes help from park staff)
July 2, 2019	PCM_012	4 person crew (includes help from park staff)
July 2, 2019	PCM_025	4 person crew (includes help from park staff)
July 3, 2019	PCM_007	7 person crew (includes help from park staff)
June 25, 2019	PCM_023	Dormant; Not visited at park's request, due to active construction site

When a site was located within an active burn unit, NGPFire added additional visits based on a pre-burn, 1, 2, 5, and 10-year post-burn sampling schedule using the GRTS sampling schema, and establishing fire plant community monitoring (FPCM) plots. Post-burn monitoring by the NGPFire crew took place at six plots in the Canyon burn unit, and a pre-burn survey was performed in one plot in the Hilltop burn unit. (Table 2).

Table 2. Field journal for fire plant community monitoring plot visits at Jewel Cave National Monument in 2019. A total of 7 plots were visited by the Northern Great Plains Fire Ecology Program (NGPFire) crew.

Date Visited	Plot Name	Burn Unit	Field Notes
July 1, 2019	PCM_038	Canyon	5 person crew; Post-Burn Year 5
July 1, 2019	PCM_054	Canyon	5 person crew; Post-Burn Year 5
July 2, 2019	FPCM_102	Canyon	3 person crew; Post-Burn Year 5
July 2, 2019	PCM_014	Hilltop	4 person crew; Pre-Burn
July 3, 2019	PCM_134	Canyon	4 person crew; Post-Burn Year 5
August 23, 2019	PCM_053	Canyon	3 person crew; Post-Burn Year 5
August 22, 2019	PCM_064	Canyon	2 person crew; Post-Burn Year 5

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 2). 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. NGPFire collected only point-intercept data at four of the fire plots, and did not collect species presence data from any plot.

When woody species were present within 38 m of plot center, tree regeneration and tall shrub density data were collected within a 10 m radius subplot centered in the larger 50 m x 20 m (0.1 ha) plot. Trees within the entire 0.1 ha plot with a diameter at breast height (DBH) of > 15 cm were mapped and tagged. For each tree, the species, DBH, status (live or dead), and condition (e.g., leaf-discoloration, insect-damaged) were recorded. For all poles (2.54 ≤ DBH ≤ 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. In 2019, NGPN changed the way these species counts were made. Stump sprouts (stems originating between ground level and 137 cm on the bole of trees that have died or been cut) were previously tallied individually, resulting in an over-representation of seedling recruitment. Now crews only count one sprout per dead tree stump based on the tallest height class present. If a sprout is attached to a live tree, it is not a seedling and therefore not counted. 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 2), 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.

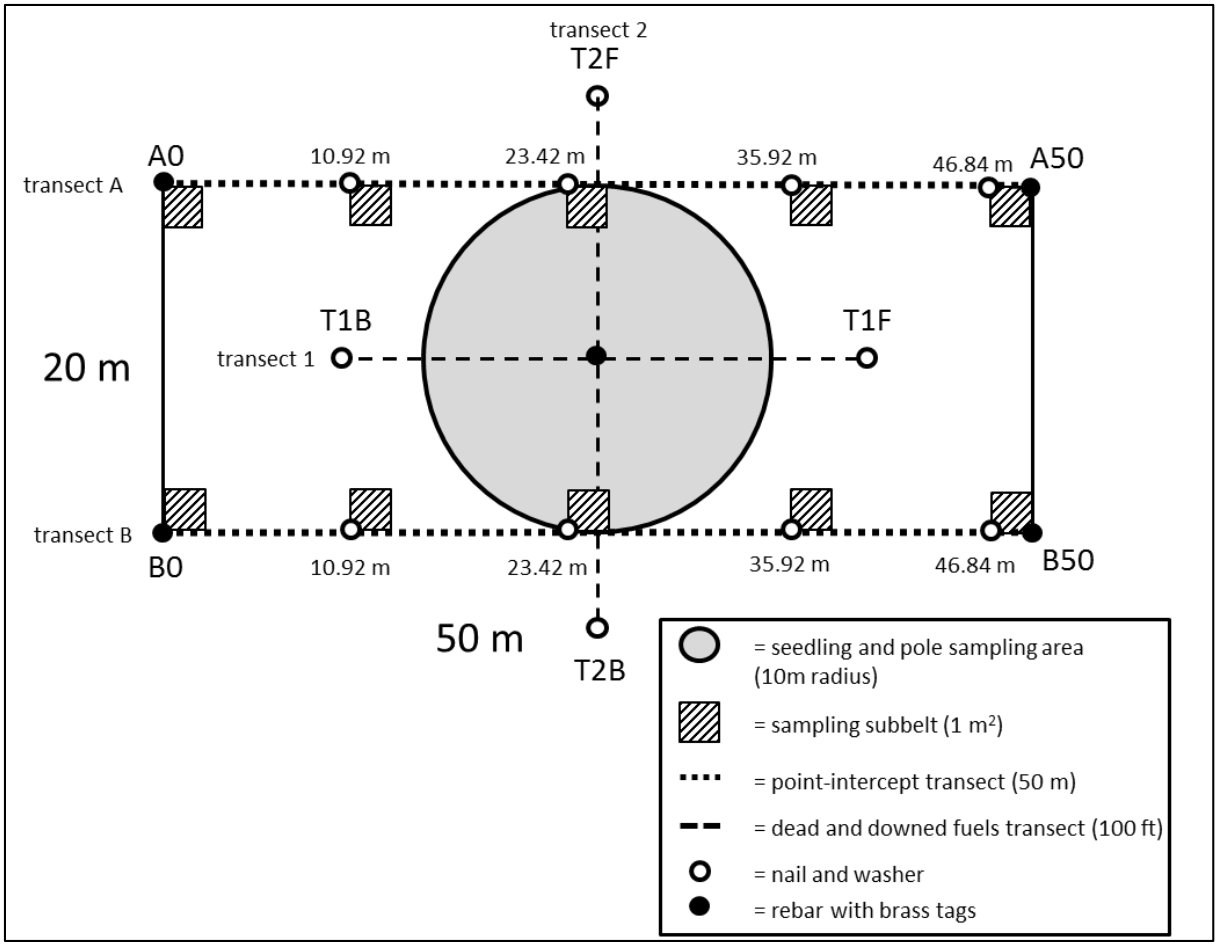

Figure 2. Long-term monitoring plot layout used for sampling vegetation used by the Northern Great Plains Inventory and Monitoring vegetation crew.

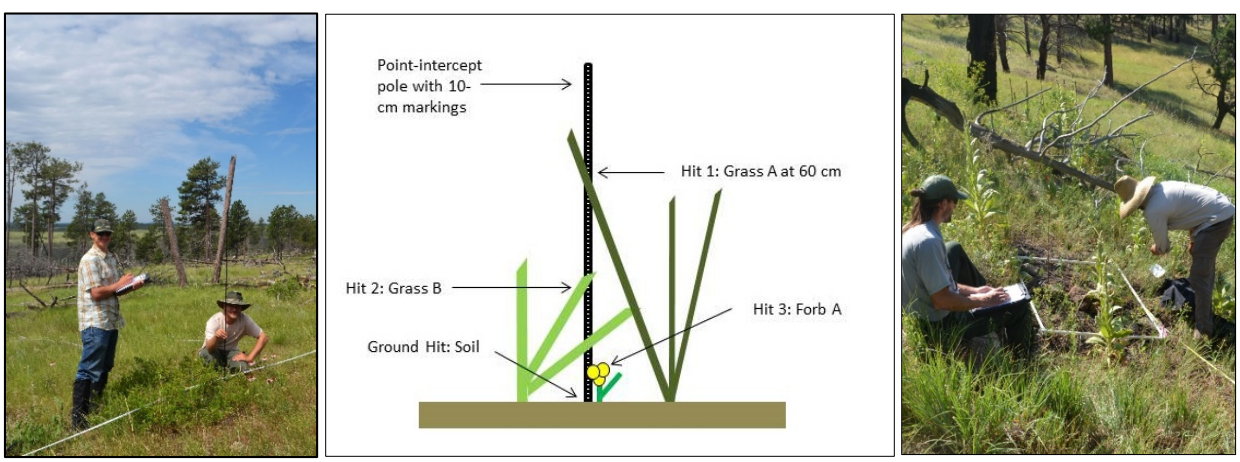

Figure 3. The Northern Great Plains Inventory & Monitoring vegetation crew used point-intercept (left and center panel) and quadrats (right panel) to document plant diversity and abundance.

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

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 2018). However, nomenclature follows the Integrated Taxonomic Information System (ITIS). In the few cases where ITIS recognized a new name that was not in the USDA PLANTS database, the new name was used, and a unique plant code was assigned.

After data 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. 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, as well as R software (R version 3.6.1). 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 JECA in 2019 was determined by cross-referencing with the NatureServe conservation status list, the U.S. Forest Service Rare Plant Profile regional list, and the South Dakota rare plant species list. For the purpose of this report, a species is considered rare or of conservation concern if its global (G) or state (S) conservation status rank is classified as critically imperiled (G1/S1), imperiled (G2/S2), or vulnerable (G3/S3). The 2019 species list was also cross-referenced with the list of noxious weeds maintained by the South Dakota Department of Agriculture.

Results

There are 397 vascular plant species on the JECA species list, and NGPN and NGPFire monitoring crews identified a total of 132 species from twelve monitoring plots in 2019 (Table 4). Of these species, 16 are exotic species for the park. The 2019 species list was cross-referenced with state- and county-wide rare and noxious exotic species lists for South Dakota. Two species matched the South Dakota exotic species list: Canada thistle (*Cirsium arvense*) and leafy spurge (*Euphorbia esula*). Yellow toadflax (*Linaria vulgaris*) and common mullein (*Verbascum thapsus*) are listed as noxious species in Custer County. Yellow toadflax is also an early-detection target species (Table 3), with one individual documented in PCM_024. No rare plant species were identified by either crew. Plant species identified in 2019 were also cross-referenced with the NPSpecies list for JECA, which resulted in three potential new species for the park: yellow toadflax, manystem pea (*Lathyrus polymorphus*), and alpine milkvetch (*Astragalus alpinus*). Samples of these species were collected this year, or will be collected during a future field season, for verification.

Table 4. List of all plant species identified in Jewel Cave National Monument plant community monitoring plots in 2019. In the Notes column, “Exotic” indicates a species is not native to the park or, in the case where only the genus was identified, there are some species within that genus that are exotic. Also in the Notes column, plants are designated as: “Noxious” and “Early Detection Target” for state or county weed species; “Rare” for species on state, USFS regional, and global rare plant lists, along with their conservation rank; and “New” for species not on the NPSpecies list.

Family	Symbol	Scientific Name	Common Name	Notes
Anacardiaceae	RHAR4	*Rhus aromatica*	fragrant sumac	–
Apiaceae	LOFO	*Lomatium foeniculaceum*	desert biscuitroot	–
Apocynaceae	APAN2	*Apocynum androsaemifolium*	spreading dogbane	–
Asclepiadaceae	ASPU	*Asclepias pumila*	plains milkweed	–
Asteraceae	ACMI2	*Achillea millefolium*	common yarrow	–
Asteraceae	ANPA4	*Antennaria parvifolia*	small-leaf pussytoes	–
Asteraceae	ARFR4	*Artemisia frigida*	fringed sagewort	–
Asteraceae	ARLU	*Artemisia ludoviciana*	white sagebrush	–
Asteraceae	CIAR4	*Cirsium arvense*	Canada thistle	Exotic; Noxious
Asteraceae	CIUN	*Cirsium undulatum*	wavyleaf thistle	–
Asteraceae	COCA5	*Conyza canadensis*	horseweed	–
Asteraceae	ECAN2	*Echinacea angustifolia*	blacksamson echinacea	–
Asteraceae	EUME17	*Eurybia merita*	subalpine aster	–
Asteraceae	HELIA3	*Helianthus spp.*	sunflower	–
Asteraceae	HEPA19	*Helianthus pauciflorus*	stiff sunflower	–
Asteraceae	HEVI4	*Heterotheca villosa*	hairy false goldenaster	–
Asteraceae	LASE	*Lactuca serriola*	prickly lettuce	Exotic
Asteraceae	LIPU	*Liatris punctata*	dotted blazing star	–

Table 4 (continued). List of all plant species identified in Jewel Cave National Monument plant community monitoring plots in 2019. In the Notes column, “Exotic” indicates a species is not native to the park or, in the case where only the genus was identified, there are some species within that genus that are exotic. Also in the Notes column, plants are designated as: “Noxious” and “Early Detection Target” for state or county weed species; “Rare” for species on state, USFS regional, and global rare plant lists, along with their conservation rank; and “New” for species not on the NPSpecies list.

Family	Symbol	Scientific Name	Common Name	Notes
Asteraceae	LOAR5	*Logfia arvensis*	field cottonrose	Exotic
Asteraceae	LYJU	*Lygodesmia juncea*	rush skeletonplant	–
Asteraceae	MUOB99	*Mulgedium oblongifolium*	blue lettuce	–
Asteraceae	PACA15	*Packera cana*	woolly groundsel	–
Asteraceae	PAPL12	*Packera plattensis*	prairie groundsel	–
Asteraceae	SOMI2	*Solidago missouriensis*	Missouri goldenrod	–
Asteraceae	SONE	*Solidago nemoralis*	gray goldenrod	–
Asteraceae	SORI2	*Solidago rigida*	stiff goldenrod	–
Asteraceae	SYLA3	*Symphyotrichum laeve*	smooth blue aster	–
Asteraceae	SYMPH4	*Symphyotrichum*	aster	–
Asteraceae	SYOB	*Symphyotrichum oblongifolium*	aromatic aster	–
Asteraceae	TAOF	*Taraxacum officinale*	common dandelion	Exotic
Asteraceae	TEAC	*Tetraneuris acaulis*	stemless four-nerve daisy	–
Asteraceae	TRDU	*Tragopogon dubius*	yellow salsify	Exotic
Boraginaceae	CYOF	*Cynoglossum officinale*	houndstongue	Exotic
Boraginaceae	MELA3	*Mertensia lanceolata*	prairie bluebells	–
Boraginaceae	ONBE	*Onosmodium bejariense*	soft-hair marbleseed	–
Brassicaceae	ARPY4	*Arabis pycnocarpa*	creamflower rockcress	–
Brassicaceae	CAMI2	*Camelina microcarpa*	littlepod false flax	Exotic
Brassicaceae	DRRE2	*Draba reptans*	Carolina draba	–
Brassicaceae	PHLU99	*Physaria ludoviciana*	foothill bladderpod	–
Campanulaceae	CARO2	*Campanula rotundifolia*	bluebell bellflower	–
Caprifoliaceae	SYAL	*Symphoricarpos albus*	common snowberry	–
Caprifoliaceae	SYOC	*Symphoricarpos occidentalis*	western snowberry	–
Cupressaceae	JUSC2	*Juniperus scopulorum*	Rocky Mountain juniper	–
Cyperaceae	CADU6	*Carex duriuscula*	needleleaf sedge	–
Cyperaceae	CAFI	*Carex filifolia*	threadleaf sedge	–
Cyperaceae	CAIN9	*Carex inops*	sun sedge	–
Cyperaceae	CARI	*Carex richardsonii*	Richardson's sedge	–
Elaeagnaceae	SHCA	*Shepherdia canadensis*	russet buffaloberry	–
Ericaceae	ARUV	*Arctostaphylos uva-ursi*	kinnikinnick	–

Table 4 (continued). List of all plant species identified in Jewel Cave National Monument plant community monitoring plots in 2019. In the Notes column, “Exotic” indicates a species is not native to the park or, in the case where only the genus was identified, there are some species within that genus that are exotic. Also in the Notes column, plants are designated as: “Noxious” and “Early Detection Target” for state or county weed species; “Rare” for species on state, USFS regional, and global rare plant lists, along with their conservation rank; and “New” for species not on the NPSpecies list.

Family	Symbol	Scientific Name	Common Name	Notes
Euphorbiaceae	EUES	*Euphorbia esula*	leafy spurge	Exotic; Noxious
Euphorbiaceae	EUGL3	*Euphorbia glyptosperma*	ribseed sandmat	–
Fabaceae	ASAL7	*Astragalus alpinus*	alpine milkvetch	New
Fabaceae	ASFL2	*Astragalus flexuosus*	flexile milkvetch	–
Fabaceae	ASLA27	*Astragalus laxmannii*	Laxmann's milkvetch	–
Fabaceae	ASMI10	*Astragalus missouriensis*	Missouri milkvetch	–
Fabaceae	DACA7	*Dalea candida*	white prairie clover	–
Fabaceae	DAPU5	*Dalea purpurea*	purple prairie clover	–
Fabaceae	GLLE3	*Glycyrrhiza lepidota*	American licorice	–
Fabaceae	LAPO2	*Lathyrus polymorphus*	manystem pea	New
Fabaceae	LUAR3	*Lupinus argenteus*	silvery lupine	–
Fabaceae	MELU	*Medicago lupulina*	black medick	Exotic
Fabaceae	MEOF	*Melilotus officinalis*	yellow sweetclover	Exotic
Fabaceae	OXLA3	*Oxytropis lambertii*	purple locoweed	–
Fabaceae	OXSE	*Oxytropis sericea*	white locoweed	–
Fabaceae	PEAR6	*Pediomelum argophyllum*	silverleaf Indian breadroot	–
Fabaceae	PEES	*Pediomelum esculentum*	large Indian breadroot	–
Fabaceae	PSTE5	*Psoralidium tenuiflorum*	slimflower scurfpea	–
Fabaceae	VIAM	*Vicia americana*	American vetch	–
Grossulariaceae	RIOX	*Ribes oxyacanthoides*	Canadian gooseberry	–
Iridaceae	IRMI	*Iris missouriensis*	Rocky Mountain iris	–
Iridaceae	SIMO2	*Sisyrinchium montanum*	strict blue-eyed grass	–
Lamiaceae	HEDR	*Hedeoma drummondii*	Drummond's false pennyroyal	–
Lamiaceae	HEHI	*Hedeoma hispida*	rough false pennyroyal	–
Lamiaceae	MOFI	*Monarda fistulosa*	wild bergamot	–
Liliaceae	ALTE	*Allium textile*	textile onion	–
Liliaceae	ANEL5	*Anticlea elegans*	mountain deathcamas	–
Liliaceae	CANU3	*Calochortus nuttallii*	sego lily	–
Liliaceae	LEMO4	*Leucocrinum montanum*	common starlily	–
Liliaceae	TOVE2	*Toxicoscordion venenosum*	meadow deathcamas	–
Linaceae	LILE3	*Linum lewisii*	Lewis flax	–

Table 4 (continued). List of all plant species identified in Jewel Cave National Monument plant community monitoring plots in 2019. In the Notes column, “Exotic” indicates a species is not native to the park or, in the case where only the genus was identified, there are some species within that genus that are exotic. Also in the Notes column, plants are designated as: “Noxious” and “Early Detection Target” for state or county weed species; “Rare” for species on state, USFS regional, and global rare plant lists, along with their conservation rank; and “New” for species not on the NPSpecies list.

Family	Symbol	Scientific Name	Common Name	Notes
Malvaceae	SPCO	*Sphaeralcea coccinea*	scarlet globemallow	–
Onagraceae	OESU99	*Oenothera suffrutescens*	scarlet beeblossom	–
Pinaceae	PIPO	*Pinus ponderosa*	ponderosa pine	–
Plantaginaceae	LIVU2	*Linaria vulgaris*	yellow toadflax	New; Exotic; Noxious-Custer County; Early Detection Target
Plantaginaceae	SYWY99	*Synthyris wyomingensis*	Wyoming kittentails	–
Poaceae	ACRI8	*Achnatherum richardsonii*	Richardson's needlegrass	–
Poaceae	ANGE	*Andropogon gerardii*	big bluestem	–
Poaceae	ARPU9	*Aristida purpurea*	purple threeawn	–
Poaceae	BOCU	*Bouteloua curtipendula*	sideoats grama	–
Poaceae	BOGR2	*Bouteloua gracilis*	blue grama	–
Poaceae	BOHI2	*Bouteloua hirsuta*	hairy grama	–
Poaceae	BOUTE	*Bouteloua spp.*	grama	–
Poaceae	BRAN	*Bromus anomalus*	nodding brome	–
Poaceae	BRCI2	*Bromus ciliatus*	fringed brome	–
Poaceae	BRIN2	*Bromus inermis*	smooth brome	Exotic
Poaceae	BRJA	*Bromus japonicus*	Japanese brome	Exotic
Poaceae	BROMU	*Bromus spp.*	brome	Exotic
Poaceae	DASP2	*Danthonia spicata*	poverty oatgrass	–
Poaceae	ELCA4	*Elymus canadensis*	Canada wildrye	–
Poaceae	ELTR7	*Elymus trachycaulus*	slender wheatgrass	–
Poaceae	ELYMU	*Elymus spp.*	wildrye	–
Poaceae	FESA	*Festuca saximontana*	Rocky Mountain fescue	–
Poaceae	HECO26	*Hesperostipa comata*	needle and thread	–
Poaceae	KOMA	*Koeleria macrantha*	prairie Junegrass	–
Poaceae	MUCU3	*Muhlenbergia cuspidata*	plains muhly	–
Poaceae	NAVI4	*Nassella viridula*	green needlegrass	–
Poaceae	PASM	*Pascopyrum smithii*	western wheatgrass	–
Poaceae	PIMI7	*Piptatherum micranthum*	littleseed ricegrass	–
Poaceae	POPR	*Poa pratensis*	Kentucky bluegrass	Exotic

Table 4 (continued). List of all plant species identified in Jewel Cave National Monument plant community monitoring plots in 2019. In the Notes column, “Exotic” indicates a species is not native to the park or, in the case where only the genus was identified, there are some species within that genus that are exotic. Also in the Notes column, plants are designated as: “Noxious” and “Early Detection Target” for state or county weed species; “Rare” for species on state, USFS regional, and global rare plant lists, along with their conservation rank; and “New” for species not on the NPSpecies list.

Family	Symbol	Scientific Name	Common Name	Notes
Poaceae	SCSC	*Schizachyrium scoparium*	little bluestem	–
Poaceae	SPHE	*Sporobolus heterolepis*	prairie dropseed	–
Polemoniaceae	PHAL3	*Phlox alyssifolia*	alyssumleaf phlox	–
Polemoniaceae	PHAN4	*Phlox andicola*	prairie phlox	–
Polemoniaceae	PHHO	*Phlox hoodii*	spiny phlox	–
Polygalaceae	POAL4	*Polygala alba*	white milkwort	–
Ranunculaceae	ANCY	*Anemone cylindrica*	candle anemone	–
Ranunculaceae	ANMU	*Anemone multifida*	cutleaf anemone	–
Ranunculaceae	ANPA19	*Anemone patens*	eastern pasqueflower	–
Rosaceae	AMAL2	*Amelanchier alnifolia*	Saskatoon serviceberry	–
Rosaceae	FRVI	*Fragaria virginiana*	Virginia strawberry	–
Rosaceae	PHMO4	*Physocarpus monogynus*	mountain ninebark	–
Rosaceae	POCO13	*Potentilla concinna*	elegant cinquefoil	–
Rosaceae	PRVI	*Prunus virginiana*	chokecherry	–
Rosaceae	ROAC	*Rosa acicularis*	prickly rose	–
Rosaceae	ROAR3	*Rosa arkansana*	prairie rose	–
Rosaceae	ROWO	*Rosa woodsii*	Woods' rose	–
Rubiaceae	GABO2	*Galium boreale*	northern bedstraw	–
Rubiaceae	GATR3	*Galium triflorum*	fragrant bedstraw	–
Salicaceae	POTR5	*Populus tremuloides*	quaking aspen	–
Scrophulariaceae	VETH	*Verbascum thapsus*	common mullein	Exotic; Noxious-Custer County
Violaceae	VIAD	*Viola adunca*	hookedspur violet	–
Violaceae	VINU2	*Viola nuttallii*	Nuttall's violet	–

Based on the total count of unique species observed in all plots in 2019, PCM_007 (Figure 4) had the highest with a total of 175 species (Table 5). Unique species lists were compiled using species data from all plant community and woody species protocols. However, because crews completed only woody species protocols at PCM_053, PCM_054 and PCM_064, unique species totals did not reflect the overall diversity of the plot and were not included in Table 5. PCM_024 had the highest number of native species at a count of 65. Absolute cover calculations (Table 6) reflected a greater percent of native species cover compared to exotic species cover in all 12 vegetation monitoring plots.

PCM_014 had the highest absolute native species cover, and PCM_134 had the highest absolute exotic species cover.

Table 5. Total number of plant species identified in 9 plots monitored at Jewel Cave National Monument (JECA) in 2019. This is a count of all unique species identified in the plot using species data from point-intercept, quadrat, woody species, and target species protocols.

Plot	Exotic Species	Native Species	Total Species
JECA_FPCM_102	2	20	22
JECA_PCM_007	35	140	175
JECA_PCM_011	12	129	141
JECA_PCM_012	13	143	156
JECA_PCM_014	5	31	36
JECA_PCM_024	19	153	172
JECA_PCM_025	19	116	135
JECA_PCM_038	5	18	23
JECA_PCM_134	5	31	36

Table 6. Absolute percent cover of native and exotic plant species in plots monitored at Jewel Cave National Monument (JECA) in 2019. Absolute percent cover is calculated using the point-intercept data. This includes overlapping species canopies, which can result in values greater than 100%.

Plot	Absolute % Native Cover	Absolute % Exotic Cover
FPCM_102	123	27
PCM_007	123	35
PCM_011	74	5
PCM_012	111	14
PCM_014	139	51
PCM_024	112	12
PCM_025	90	47
PCM_038	109	32
PCM_134	92	61

Figure 4. PCM_007 had the highest number of unique species observed from any vegetation monitoring plot in 2019. Photograph courtesy of the National Park Service.

NGPN and NGPFire monitoring crews collected woody species data in eleven of the twelve plots visited in 2019 (Table 7). PCM_038 had no trees, poles, or seedling regeneration. Five unique species were observed in the plots, and most plots were dominated by ponderosa pine (*Pinus ponderosa*). Eight plots had seedling regeneration, with Saskatoon serviceberry (*Amelanchier alnifolia*) and chokecherry (*Prunus virginiana*) the most commonly observed species. Five of those plots also saw seedling regeneration of ponderosa pine, usually with a count under 30 seedlings per plot. However, NGPN counted 598 individual ponderosa pine seedlings in PCM_011.

Table 7. Woody species data from eleven long-term monitoring plots visited at Jewel Cave National Monument (JECA) in 2019. DBH categories are tree (DBH>15 cm), pole (2.54 cm<DBH>15 cm), and seedling (DBH<2.54 cm).

Plot	Species	DBH	Count	Status	Density/Hectare
FPCM_102	Saskatoon serviceberry	Seedling	153	Live	4869.51
FPCM_102	chokecherry	Seedling	701	Live	22310.63
PCM_007	ponderosa pine	Tree	9	Dead	90
PCM_011	Saskatoon serviceberry	Seedling	447	Live	14226.61
PCM_011	chokecherry	Seedling	12	Live	381.92
PCM_011	ponderosa pine	Seedling	598	Live	19032.46
PCM_011	ponderosa pine	Pole	2	Dead	63.69
PCM_011	ponderosa pine	Tree	4	Dead	40
PCM_011	ponderosa pine	Tree	47	Live	470
PCM_012	ponderosa pine	Tree	2	Dead	20
PCM_012	ponderosa pine	Tree	1	Live	10
PCM_014	Saskatoon serviceberry	Seedling	440	Live	14003.82
PCM_014	chokecherry	Seedling	10	Live	318.27
PCM_014	ponderosa pine	Seedling	28	Live	891.15
PCM_014	ponderosa pine	Pole	1	Dead	101.42
PCM_014	ponderosa pine	Pole	1	Live	101.42
PCM_014	ponderosa pine	Tree	13	Live	414.01
PCM_024	Saskatoon serviceberry	Seedling	205	Live	6524.51
PCM_024	chokecherry	Seedling	2	Live	63.65
PCM_024	ponderosa pine	Seedling	3	Live	95.48
PCM_025	Saskatoon serviceberry	Seedling	24	Live	763.84
PCM_025	ponderosa pine	Seedling	8	Live	254.61
PCM_025	Rocky Mountain juniper	Tree	1	Dead	10
PCM_025	ponderosa pine	Tree	6	Dead	60
PCM_053	Saskatoon serviceberry	Seedling	499	Live	15881.6
PCM_053	chokecherry	Seedling	90	Live	2864.42
PCM_053	ponderosa pine	Seedling	9	Live	286.44
PCM_054	ponderosa pine	Pole	1	Live	101.42
PCM_054	ponderosa pine	Tree	2	Live	63.69
PCM_064	Saskatoon serviceberry	Seedling	414	Live	13176.32
PCM_064	chokecherry	Seedling	3	Live	95.48
PCM_134	quaking aspen	Seedling	116	Live	3691.92
PCM_134	Saskatoon serviceberry	Seedling	1	Live	31.83
PCM_134	chokecherry	Seedling	25	Live	795.67

Surface fuels and dead and downed wood provide foraging habitat and refugia for small wildlife species, as well as substrate for mosses and fungi. Downed wood can also provide “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. NGPFire developed a management target to maintain surface fuel loads between 2 and 10 tons per acre within the Black Hills parks. NGPN and NGPFire crews surveyed and measured surface fuels in 12 plots visited in JECA (Table 8).

Table 8. Surface fuels summary for twelve plots at Jewel Cave National Monument (JECA) in 2019.

	Average Tons per Acre										Avg. Depth (in.)		
Macroplot	**1-hr**	**10-hr**	**100-hr**	**1-100-hr**	**1000-hr sound**	**1000-hr rotten**	**1-1000-hr**	**Duff**	**Litt**	**Total**	**Duff**	**Litt**	**Total**
FPCM_102	0.08	0.69	4.61	5.37	4.36	4.32	14.05	1.41	0.40	15.86	0.1	0.1	0.2
PCM_007	0.00	0.00	2.19	2.19	8.20	20.92	31.31	1.41	0.96	33.68	0.1	0.2	0.3
PCM_011	0.02	1.10	2.96	4.08	8.04	4.34	16.45	9.33	3.03	28.82	0.5	0.8	1.3
PCM_012	0.00	0.27	0.00	0.27	2.15	1.33	3.75	2.29	1.38	7.41	0.1	0.3	0.5
PCM_014	0.00	0.54	0.73	1.27	13.52	10.59	25.37	2.11	0.76	28.25	0.1	0.2	0.3
PCM_024	0.10	1.63	8.04	9.77	3.04	18.23	31.04	3.70	0.96	35.69	0.2	0.2	0.5
PCM_025	0.00	0.14	3.64	3.78	10.44	11.77	25.99	0.18	1.66	27.83	0.0	0.4	0.4
PCM_038	0.04	0.27	0.73	1.04	1.08	0.00	2.11	0.26	0.24	2.62	0.0	0.1	0.1
PCM_053	0.04	0.68	5.89	6.61	6.42	2.21	15.24	0.88	0.52	16.64	0.1	0.1	0.2
PCM_054	0.06	0.27	3.66	4.00	1.06	0.00	5.06	0.45	0.70	6.20	0.0	0.1	0.2
PCM_064	0.06	0.41	1.45	1.92	5.70	4.87	12.49	1.85	1.92	16.25	0.1	0.5	0.6
PCM_134	0.00	0.28	2.90	3.18	2.36	1.61	7.15	0.62	1.22	8.98	0.0	0.3	0.3

Disturbance was infrequent in 2019, occurring in only two of the twelve plots visited by NGPN and NGPFire (Table 9). In 2018, NGPN began assessing the total area of exposed soil disturbance caused by a culmination of recorded disturbance types. In 2019 this was observed in PCM_011 as a result of frequent deer trampling. The off-road evidence observed in PCM_012 was likely due to an old fire road that follows the same ridge along which the plot is located.

Table 9. Disturbance types and occurrence observed from 12 vegetation monitoring plot visits in 2019 at Jewel Cave National Monument.

Plot	**Disturbance Type**	**Area (m^2)**
PCM_011	Animal Trail (Deer)	10
PCM_011	Soil Disturbance	5
PCM_012	Off-Road Travel	25

Further Analysis

This 2019 Data Report is intended to provide a basic review of the data collected during the 2019 vegetation monitoring visits by the NGPN and NGPFire crews at Jewel Cave National Monument. All data included in this report is available upon request from the Northern Great Plains Inventory and Monitoring Network, as well as in the archives found in the IRMA Data Store.

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