



Plant Community Composition and Structure Monitoring for Badlands National Park *2017 Data Report*

Natural Resource Data Series NPS/NGPN/NRDS—2018/1153



**ON THIS PAGE**

Northern Great Plains Network crew returning from Plant Community Composition and Structure Monitoring plot PCM_0007 at Badlands National Park, June 2017.

Photograph courtesy of Ryan Manuel, National Park Service.

ON THE COVER

Plant Community Composition and Structure Monitoring plot PCM_0013 at Badlands National Park, June 2017.

Photograph courtesy of the National Park Service.

Plant Community Composition and Structure Monitoring for Badlands National Park

2017 Data Report

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Abstract

This report presents the results of vegetation monitoring efforts in 2017 at Badlands National Park (BADL) by the Northern Great Plains Network Inventory and Monitoring program (NGPN).

During the seventh full year of field work, crew members from NGPN visited twenty long-term plant community monitoring (PCM) plots to collect data on the plant communities at BADL. This effort is part of a long-term monitoring program in order to better understand the condition of the sparsely vegetated badland, woody draw, and mixed-grass prairie regions in BADL. NGPN staff recorded data relating to species richness, herb-layer height, abundance of individual native and non-native species, ground cover, and site disturbance on each of the twenty plots. In plots where woody species were present, crews also measured tree regeneration, tall shrub and tree density, and woody fuel load.

Our 2017 findings can be summarized as follows: Monitoring crews recorded 134 species across 26 monitoring plots visited in 2017 at BADL. Of those species, 25 were exotic. None of the exotics identified were on the target list for the early detection and rapid response program in the NGPN parks. No rare native species were documented. Trees, poles, and seedlings were only located at a single plot and woody fuel loads were recorded at one of the twenty-six plots. The most common disturbances observed were animal use and erosion.

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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 staff at BADL for providing logistical support and safety checks. The 2017 NGPN vegetation field crew C. Davis, S. Rockwood, W. Vogel, M. Davis, I. Ashton, R. Oltjenbruns, R. Manuel, and L. LaFleur, with the assistance of H. Baldwin (USGS-NPWRC), and B. Rockwood (volunteer), collected all the data included in this report.

Introduction

Badlands National Park (BADL) was established in 1939 as a National Monument, and in 1978 became a National Park to protect and preserve 242,756 acres of rugged badlands, mixed-grass prairie, and rich fossil deposits. The vegetation is a mosaic of sparsely vegetated badlands, native mixed-grass prairie, woody draws, and exotic grasslands. Vegetation monitoring began at BADL in 1998 by the Northern Great Plains Fire Ecology Program (NGPFire; Wienk et al. 2011). The Northern Great Plains Inventory & Monitoring Program (NGPN) began vegetation monitoring within BADL during 2011 (Ashton et al. 2012). 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). A total of 127 plots were established by NGPFire and NGPN in BADL, and combined sampling efforts began in 2011 (Ashton et al. 2012). In this report, we provide summaries of the data collected at 26 plots during the spring and summer of 2017.

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>.

NGPN Monitoring Plots 2017

The NGPN team implemented a survey to monitor plant community structure and composition in BADL using a spatially balanced probability design (Generalized Random Tessellation Stratified [GRTS]; Stevens and Olsen 2003, 2004). Using a GRTS design, NGPN selected 100 randomly located sites within the north unit of BADL where Community Monitoring (PCM) plots would be established. The NGPN aims to visit 20 of 100 PCM plots every year using a rotating sampling scheme, where 10 sites were visited in the previous year and 10 sites are new visits. This allows each plot to be visited for two consecutive years and then rested for eight years, on a ten-year rotating basis. After 5 years (2011-2015), 50 PCM plots were visited at least twice during the survey season (generally mid-June). With the current sampling scheme, it will take the NGPN 20 years to monitor all 100 plots. In 2017, June 6th to June 17th, the NGPN crew visited PCM plots in panel 1, panel 2, panel 6, and panel 7 (Figure 1) (Table 1). The NGPFire crew visited 6 plots on June 12th and June 13th, 2017. In November 2017, two monitoring plots were established by the NGPN crew, vegetation data will be collected at these plots in 2018.

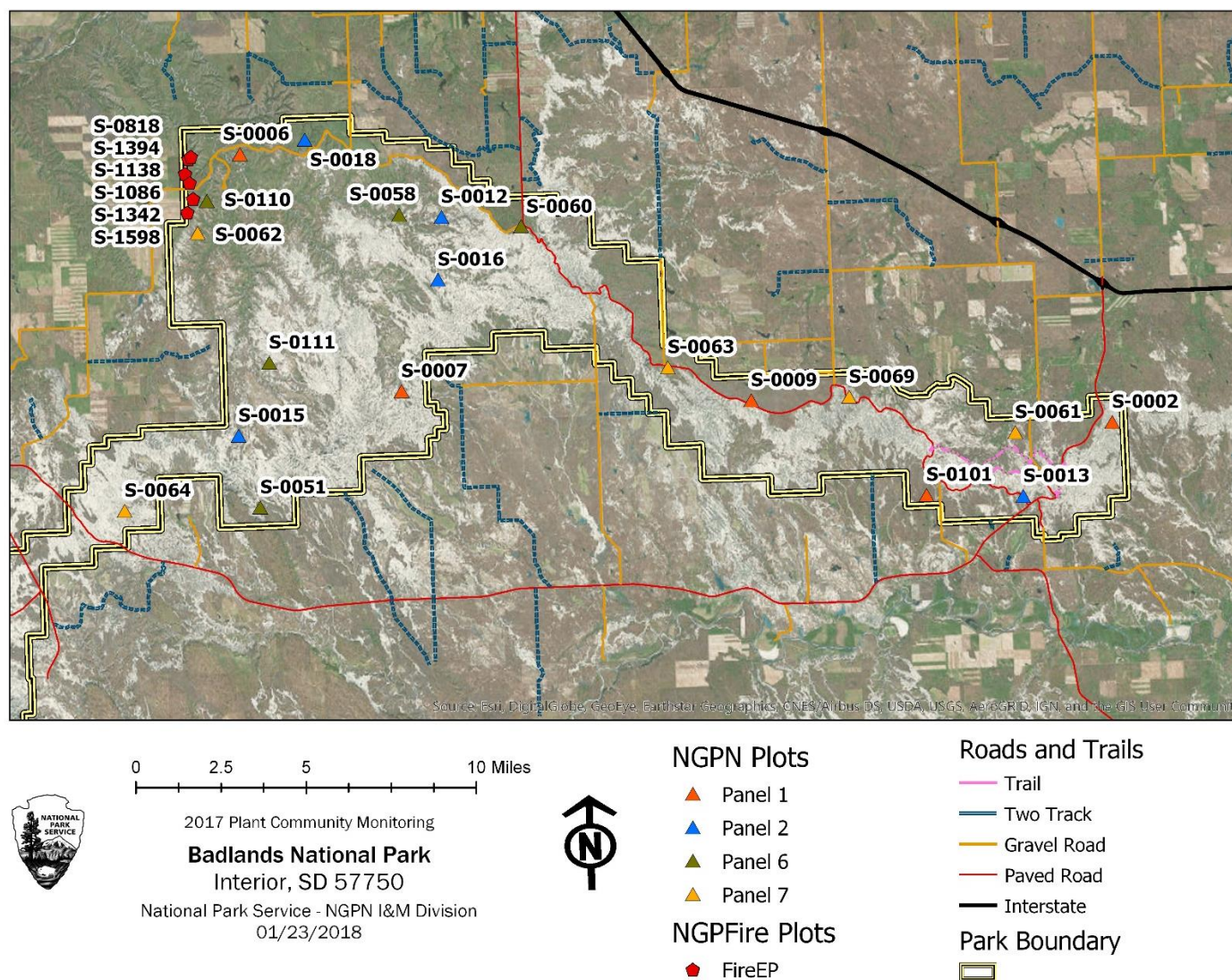


Figure 1. Map of Badlands National Park plant community monitoring (PCM) plots visited in 2017. Twenty PCM plots and six fire plant community monitoring (FPCM) plots were monitored in 2017. Five Panel 1 plots (red triangles), five Panel 2 plots (blue triangles), five Panel 6 plots (brown triangles), and five Panel 7 plots (yellow triangles) were visited by NGPN. Six FPCM plots were visited by NGPFire (red pentagons)

Table 1. Vegetation monitoring field schedule in Badlands National Park during the 2017 field season. The 20 PCM monitoring plots were completed with a crew of three or more from the Northern Great Plains Network. FPCM plots were completed by the Fire Effects Program. Notes include crew size, time spent at each plot, and additional plot information.

Date	Plot read	Notes
6/6/2017	PCM_0006	4 person crew, 2.25 hrs
	PCM_0009	3 person crew, 2 hrs
	PCM_0063	3 person crew, 2.5 hrs
	PCM_0101	3 person crew, 1 hr
	PCM_0018	4 person crew, 4 hrs
6/7/2017	PCM_0007	4 person crew, 1.75 hrs
	PCM_0051	4 person crew + volunteer, 1.5 hrs
	PCM_0060	4 person crew, 1.5 hrs
6/8/2017	PCM_0013	4 person crew, 3.5 hrs
	PCM_0062	3 person crew, 1.5 hrs
	PCM_0069	4 person crew, 3.5 hrs
	PCM_0110	3 person crew, 2 hrs
6/12/2017	PCM_0012	4 person crew, 1.5 hrs
	PCM_0016	3 person crew, 2 hrs
	PCM_0058	4 person crew, 1.5 hrs
	FPCM_1086	4 person crew, Quinn Table, no quadrats
	FPCM_0818	4 person crew, Quinn Table, no quadrats
6/13/2017	PCM_0002	4 person crew + H. Baldwin (USGS), 1 hr
	PCM_0061	4 person crew + H. Baldwin (USGS), 1.5 hrs
	FPCM_1138	4 person crew, Quinn Table, no quadrats
	FPCM_1394	4 person crew, Quinn Table, no quadrats
	FPCM_1342	4 person crew, Quinn Table, no quadrats
	FPCM_1598	4 person crew, Quinn Table, no quadrats
6/14/2017	PCM_0015	4 person crew, 1.5 hrs
	PCM_0111	4 person crew + H. Baldwin (USGS), 2 hrs
6/15/2017	PCM_0064	4 person crew, 1 hr; completed on 2nd visit due to rain/plot conditions
11/14/2017	PCM_0072	3 person crew, installed plot, no photographs or data collected
	PCM_0077	3 person crew, installed plot, no photographs or data collected

Plot Layout and Sampling

At each of the sites visited, monitoring crews 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 along two 50 m transects (the long sides of the plot) using a point-intercept method. At 50 locations along each transect, once every 1 meter, a pole was dropped to the ground and all species that touched the pole were recorded, along with ground cover and canopy height (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 and Figure 3). In FPCM plots, data from quadrats were not collected.

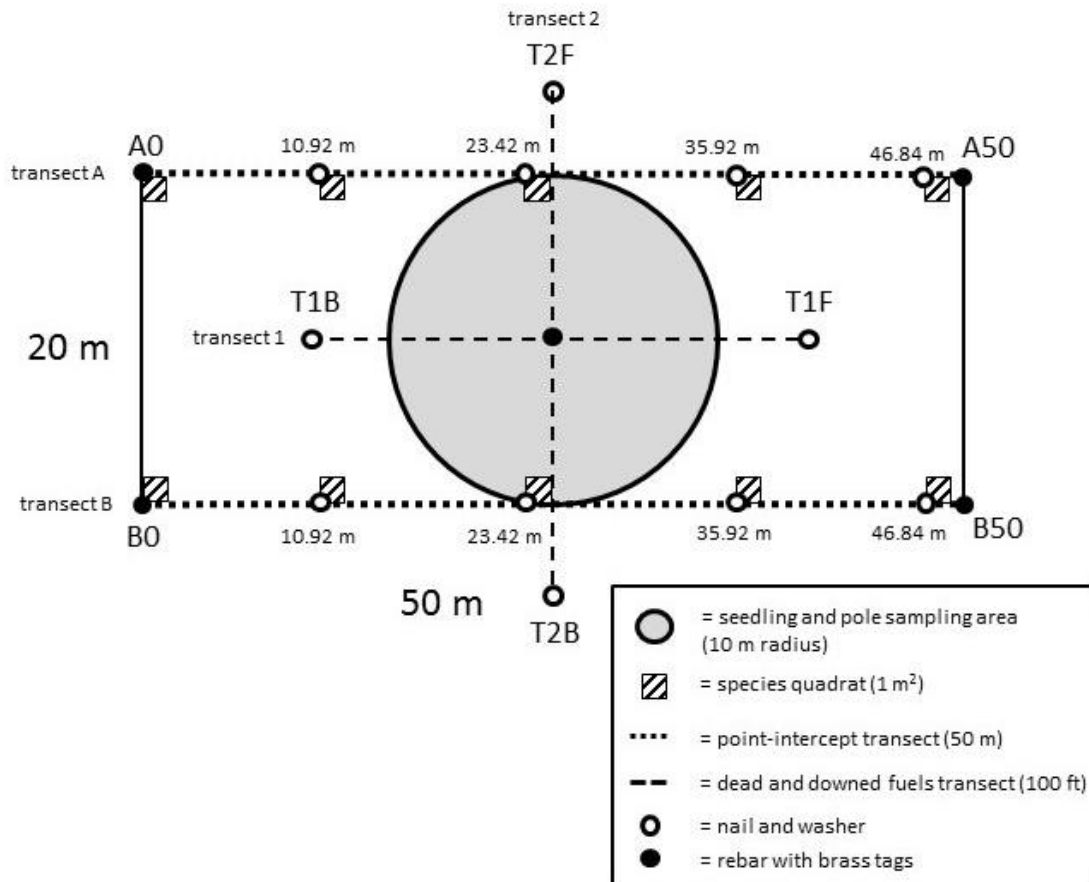


Figure 2. Long-term monitoring plot layout used for sampling vegetation in Badlands National Park.

When woody species were also 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 within the 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. Dead and downed woody fuel load data were also collected at these forested plots along two perpendicular, 100 foot (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). Trees are rare in BADL, and were only observed in one plot in 2017 (PCM_110).

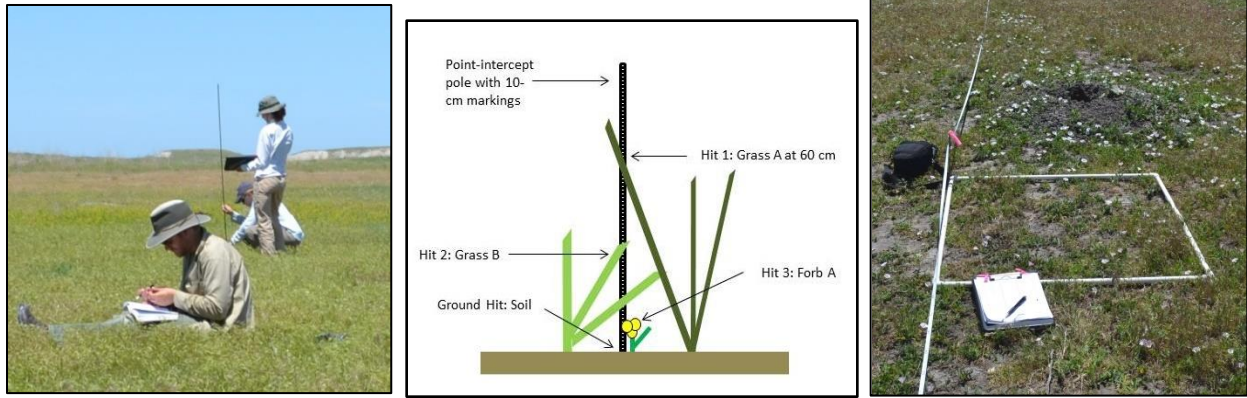


Figure 3. The Northern Great Plains Network Inventory & Monitoring vegetation crew used point-intercept (left and center panel) and 1m² quadrats (right panel) to document plant diversity and abundance.

Disturbances and target species of interest were also assessed and documented at each plot visited by the NGPN field crew. Common disturbances included animal use and erosion. At each plot, the type, severity, and approximate area (m²) of the disturbances was recorded. The NGPN crew also surveyed the area for early-detection exotic species, which have the potential to spread into the park and cause significant ecological impacts (Table 2). 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 present, 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. In addition to NGPN’s list of early-detection exotic species, the South Dakota Department of Agriculture maintains a list of noxious exotic species in the state (<http://sdda.sd.gov/ag-Services/weed-and-pest-control>) and BADL also has a list of exotic species of management concern (Table 2).

Table 2. Exotic species included in the Northern Great Plains Network’s early detection and rapid response program and exotic species identified as species of management concern by Badlands National Park. An “SD” in the “State Status” column indicates species listed on South Dakota’s noxious species list.

System	Habitat	Species Name	Common Name	State Status
NGPN Early Detection and Rapid Response	Riparian	<i>Polygonum cuspidatum</i> ; <i>P. sachalinense</i> ; <i>P. x bohemicum</i>	knotweeds	SD
	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	–
	Upland	<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	SD
	Upland	<i>Linaria dalmatica</i> ; <i>L. vulgaris</i>	toadflax	SD
	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	–
Badlands National Park Exotic Species of Management Concern	Riparian	<i>Elaeagnus angustifolia</i>	Russian olive	–
	Riparian	<i>Tamarix</i> spp.	tamarisk	–
	Upland	<i>Euphorbia esula</i>	leafy spurge	–
	Upland	<i>Falcaria vulgaris</i>	sickleweed	–
	Upland	<i>Poa bulbosa</i>	bulbous bluegrass	–
	Upland	<i>Potentilla recta</i>	sulphur cinquefoil	SD
	Upland	<i>Rhaponticum repens</i>	Russian knapweed	–
	Upland	<i>Sideritis montana</i>	mountain ironwort	–
	Upland	<i>Tanacetum vulgare</i> *	common tansy	SD
	Upland	<i>Thymelaea passerina</i>	spurge flax	–

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 **Error! Not a valid bookmark self-reference.** for a detailed definition of each conservation status rank.

Table 3. Definitions of state and global species conservation status ranks. Adapted from NatureServe status assessment table (<http://www.natureserve.org/conservation-tools/conservation-status-assessment>)

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.

Data Management and Analysis

FFI (FEAT/FIREMON Integrated; <http://frames.gov/ffi/>) was used as the primary software environment for managing the 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 2012). 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. 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 identified by the crew or the automated queries, changes were made to the original datasheets and the FFI database as needed. At the time this report was completed, all NGPN data had been verified but the NGPFire data had not been 10% checked or run through automated queries. Therefore, the NGPFire data should be considered preliminary and interpreted with caution.

Results

There are a total of 634 plant species recorded on the [BADL species list](#), and monitoring crews recorded 134 species across 26 monitoring plots visited in 2017 at BADL (Table 4). Of the plant species observed, 25 are exotic species at BADL. All exotics recorded were either forbs or graminoids (grasses, sedges, and rushes). All trees and shrubs were native species. No target early detection exotic species were documented in 2017 (Table 2), and no rare native species were observed or recorded at BADL in 2017.

Table 4. List of all plant species identified in BADL long-term plant community monitoring plots in 2017. The species are grouped by plant family. In the notes column ‘Exotic’ means that 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. Species on South Dakota’s list of noxious species are indicated with “SD” in the notes column. Species of conservation concern in South Dakota are marked in the final column and the state conservation ranks are provided. Conservation rank definitions are in Table 3 of this report

Family	Code	Scientific	Common_Name	Notes
Anacardiaceae	RHTR	<i>Rhus trilobata</i>	skunkbush sumac	–
Apiaceae	LOFO	<i>Lomatium foeniculaceum</i>	desert biscuitroot	–
	MUDI	<i>Musineon divaricatum</i>	leafy wildparsley	–
Asclepiadaceae	ASPU	<i>Asclepias pumila</i>	plains milkweed	–
Asteraceae	ACMI2	<i>Achillea millefolium</i>	common yarrow	–
	ARCA13	<i>Artemisia cana</i>	silver sagebrush	–
	ARDR4	<i>Artemisia dracunculus</i>	tarragon	–
	ARFR4	<i>Artemisia frigida</i>	prairie sagewort	–
	ARLU	<i>Artemisia ludoviciana</i>	white sagebrush	–
	CIUN	<i>Cirsium undulatum</i>	wavyleaf thistle	–
	COCA5	<i>Conyza canadensis</i>	Canadian horseweed	–
	CORA4	<i>Conyza ramosissima</i>	dwarf horseweed	–
	DYPA	<i>Dyssodia papposa</i>	fetid marigold	–
	ECAN2	<i>Echinacea angustifolia</i>	blacksamson echinacea	–
	ERST3	<i>Erigeron strigosus</i>	prairie fleabane	–
	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	Exotic
	LASE	<i>Lactuca serriola</i>	prickly lettuce	Exotic
	LOAR5	<i>Logfia arvensis</i>	field cottonrose	–

Table 4 (continued). List of all plant species identified in BADL long-term plant community monitoring plots in 2017. The species are grouped by plant family. In the notes column 'Exotic' means that 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. Species on South Dakota's list of noxious species are indicated with "SD" in the notes column. Species of conservation concern in South Dakota are marked in the final column and the state conservation ranks are provided. Conservation rank definitions are in Table 3 of this report

Family	Code	Scientific	Common_Name	Notes
Asteraceae, cont.	MUOB99	<i>Mulgedium oblongifolium</i>	blue lettuce	–
	PAPL12	<i>Packera plattensis</i>	prairie groundsel	–
	RACO3	<i>Ratibida columnifera</i>	upright prairie coneflower	–
	SOAR2	<i>Sonchus arvensis</i>	field sowthistle	Exotic
	SOMI2	<i>Solidago missouriensis</i>	Missouri goldenrod	–
	SOMO	<i>Solidago mollis</i>	velvety goldenrod	–
	SYMPH4	<i>Symphyotrichum</i>	aster	–
	SYOB	<i>Symphyotrichum oblongifolium</i>	aromatic aster	–
	TAOF	<i>Taraxacum officinale</i>	common dandelion	Exotic
	TEAC	<i>Tetaneuris acaulis</i>	stemless four-nerve daisy	–
	TRDU	<i>Tragopogon dubius</i>	yellow salsify	Exotic
	XASP99	<i>Xanthisma spinulosum</i>	lacy tansyaster	–
	SORI2	<i>Solidago rigida</i>	stiff goldenrod	–
Boraginaceae	LAOC3	<i>Lappula occidentalis</i>	flatspine stickseed	–
	LASQ	<i>Lappula squarrosa</i>	European stickseed	Exotic
	LIIN2	<i>Lithospermum incisum</i>	narrowleaf stoneseed	–
Brassicaceae	ALDE	<i>Alyssum desertorum</i>	desert madwort	Exotic
	ARHI	<i>Arabis hirsuta</i>	hairy rockcress	–
	CAMI2	<i>Camelina microcarpa</i>	littlepod false flax	Exotic
	DEPI	<i>Descurainia pinnata</i>	western tansymustard	–
	DESO2	<i>Descurainia sophia</i>	herb sophia	Exotic
	DRRE2	<i>Draba reptans</i>	Carolina draba	–
	PHLU99	<i>Physaria ludoviciana</i>	foothill bladderpod	–
	SIAL2	<i>Sisymbrium altissimum</i>	tall tumbledmustard	Exotic
Cactaceae	OPMA2	<i>Opuntia macrorhiza</i>	twistspine pricklypear	–
	OPPO	<i>Opuntia polyacantha</i>	plains pricklypear	–
Caprifoliaceae	SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry	–
Caryophyllaceae	CEAR4	<i>Cerastium arvense</i>	field chickweed	–

Table 4 (continued). List of all plant species identified in BADL long-term plant community monitoring plots in 2017. The species are grouped by plant family. In the notes column 'Exotic' means that 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. Species on South Dakota's list of noxious species are indicated with "SD" in the notes column. Species of conservation concern in South Dakota are marked in the final column and the state conservation ranks are provided. Conservation rank definitions are in Table 3 of this report

Family	Code	Scientific	Common_Name	Notes
Chenopodiaceae	ATCA2	<i>Atriplex canescens</i>	fourwing saltbush	–
	CHENO	<i>Chenopodium</i>	goosefoot	Exotic
	CHIN2	<i>Chenopodium incanum</i>	mealy goosefoot	–
	HAGL	<i>Halogeton glomeratus</i>	saltlover	Exotic
	SATR12	<i>Salsola tragus</i>	prickly Russian thistle	Exotic
Commelinaceae	TRBR	<i>Tradescantia bracteata</i>	longbract spiderwort	–
	TROC	<i>Tradescantia occidentalis</i>	prairie spiderwort	–
Convolvulaceae	COAR4	<i>Convolvulus arvensis</i>	field bindweed	SD
Cupressaceae	JUSC2	<i>Juniperus scopulorum</i>	Rocky Mountain juniper	–
Cyperaceae	CADU6	<i>Carex duriuscula</i>	needleleaf sedge	–
	CAFI	<i>Carex filifolia</i>	threadleaf sedge	–
	CAIN9	<i>Carex inops</i>	long-stolon sedge	–
	CAREX	<i>Carex</i>	sedge	–
Euphorbiaceae	CHAMA15	<i>Chamaesyce</i>	sandmat	Exotic
	EUPHO	<i>Euphorbia</i>	spurge	Exotic
	EUSP	<i>Euphorbia spathulata</i>	warty spurge	–
Fabaceae	AMCA6	<i>Amorpha canescens</i>	leadplant	–
	ASLA27	<i>Astragalus laxmannii</i>	Laxmann's milkvetch	–
	ASMI10	<i>Astragalus missouriensis</i>	Missouri milkvetch	–
	ASRA2	<i>Astragalus racemosus</i>	cream milkvetch	–
	ASTRA	<i>Astragalus</i>	milkvetch	–
	DAPU5	<i>Dalea purpurea</i>	purple prairie clover	–
	LAPO2	<i>Lathyrus polymorphus</i>	manystem pea	–
	MEOF	<i>Melilotus officinalis</i>	yellow sweetclover	Exotic
	PEAR6	<i>Pedimelum argophyllum</i>	silverleaf Indian breadroot	–
	PECU3	<i>Pedimelum cuspidatum</i>	largebract Indian breadroot	–
	PEES	<i>Pedimelum esculentum</i>	large Indian breadroot	–
	PSTE5	<i>Psoralidium tenuiflorum</i>	slimflower scurfpea	–

Table 4 (continued). List of all plant species identified in BADL long-term plant community monitoring plots in 2017. The species are grouped by plant family. In the notes column 'Exotic' means that 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. Species on South Dakota's list of noxious species are indicated with "SD" in the notes column. Species of conservation concern in South Dakota are marked in the final column and the state conservation ranks are provided. Conservation rank definitions are in Table 3 of this report

Family	Code	Scientific	Common_Name	Notes
Fabaceae, cont.	VIAM	<i>Vicia Americana</i>	American vetch	–
Lamiaceae	HEHI	<i>Hedeoma hispida</i>	rough false pennyroyal	–
Liliaceae	ALTE	<i>Allium textile</i>	textile onion	–
	CANU3	<i>Calochortus nuttallii</i>	sego lily	–
	FRAT	<i>Fritillaria atropurpurea</i>	spotted fritillary	–
	MAST4	<i>Maianthemum stellatum</i>	starry false lily of the valley	–
Linaceae	LIRI	<i>Linum rigidum</i>	stiffstem flax	–
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	scarlet globemallow	–
Melanthiaceae	TOVE2	<i>Toxicoscordion venenosum</i>	meadow deathcamas	–
Nyctaginaceae	MILI3	<i>Mirabilis linearis</i>	narrowleaf four o'clock	–
Onagraceae	OENU	<i>Oenothera nuttallii</i>	Nuttall's evening primrose	–
Onagraceae	OESU99	<i>Oenothera suffrutescens</i>	scarlet beeblossom	–
Oxalidaceae	OXDI2	<i>Oxalis dillenii</i>	slender yellow woodsorrel	–
	OXST	<i>Oxalis stricta</i>	common yellow oxalis	–
Plantaginaceae	PLPA2	<i>Plantago patagonica</i>	woolly plantain	–
Poaceae	PIMI7	<i>Piptatherum micranthum</i>	littleseed ricegrass	–
	ACHY	<i>Achnatherum hymenoides</i>	Indian ricegrass	–
	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	–
	BRIN2	<i>Bromus inermis</i>	smooth brome	Exotic
	BRJA	<i>Bromus japonicus</i>	Japanese brome	Exotic
	BRTE	<i>Bromus tectorum</i>	cheatgrass	Exotic
	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed	–
	DISP	<i>Distichlis spicata</i>	saltgrass	–
	ELRE4	<i>Elymus repens</i>	quackgrass	Exotic
	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	–

Table 4 (continued). List of all plant species identified in BADL long-term plant community monitoring plots in 2017. The species are grouped by plant family. In the notes column 'Exotic' means that 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. Species on South Dakota's list of noxious species are indicated with "SD" in the notes column. Species of conservation concern in South Dakota are marked in the final column and the state conservation ranks are provided. Conservation rank definitions are in Table 3 of this report

Family	Code	Scientific	Common_Name	Notes
Poaceae, continued	HECO26	<i>Hesperostipa comate</i>	Needle and thread	–
	HOJU	<i>Hordeum jubatum</i>	Foxtail barley	–
	HOPU	<i>Hordeum pusillum</i>	little barley	–
	KOMA	<i>Koeleria macrantha</i>	prairie Junegrass	–
	MUCU3	<i>Muhlenbergia cuspidata</i>	plains muhly	–
	MUPA99	<i>Muhlenbergia paniculata</i>	tumblegrass	–
	NAVI4	<i>Nassella viridula</i>	green needlegrass	–
	PASM	<i>Pascopyrum smithii</i>	western wheatgrass	–
	PAVI2	<i>Panicum virgatum</i>	switchgrass	–
	POCO	<i>Poa compressa</i>	Canada bluegrass	Exotic
	POPR	<i>Poa pratensis</i>	Kentucky bluegrass	Exotic
	SCSC	<i>Schizachyrium scoparium</i>	little bluestem	–
	SPCO16	<i>Sporobolus compositus</i>	composite dropseed	–
	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed	–
Polemoniaceae	PHAN4	<i>Phlox andicola</i>	prairie phlox	–
	PHHO	<i>Phlox hoodii</i>	spiny phlox	–
Polygalaceae	POAL4	<i>Polygala alba</i>	white milkwort	–
Polygonaceae	ERPA9	<i>Eriogonum pauciflorum</i>	fewflower buckwheat	–
Primulaceae	ANOC2	<i>Androsace occidentalis</i>	western rockjasmine	–
Rosaceae	PRVI	<i>Prunus virginiana</i>	chokecherry	–
	ROAR3	<i>Rosa arkansana</i>	prairie rose	–
Rubiaceae	GAAP2	<i>Galium aparine</i>	stickywilly	–
Santalaceae	COUM	<i>Comandra umbellata</i>	bastard toadflax	–
Scrophulariaceae	VETH	<i>Verbascum thapsus</i>	common mullein	SD
Solanaceae	PHLO4	<i>Physalis longifolia</i>	longleaf groundcherry	–
	SOTR	<i>Solanum triflorum</i>	cutleaf nightshade	–
Unknown Family	UNKFORB	<i>Unknown forb</i>	unknown forb	Exotic
Verbenaceae	VEBR	<i>Verbena bracteata</i>	bigbract verbena	–
Violaceae	VINU2	<i>Viola nuttallii</i>	Nuttall's violet	–

Total number of plant species observed in each plot at BADL was compiled using data from point-intercept, quadrat, and woody species survey methods (Table 5). The most diverse plot, with a total of 49 species identified, was BADL_PCM_0110. This plot, located in the northwest side of the park near Sage Creek Campground, was a combination of upland mixed-grass and juniper-dominated woody draw vegetation types. Plot BADL_PCM_0110 also contained the highest number of native plant species.

Table 5. Number of plant species per plot observed in across 20 plant community monitoring (PCM) plots and 6 fire plant community monitoring plots (FPCM) at Badlands National Park in 2017. Note the total number of species identified in the FPCM plots is lower than the PCM plots because they do not include data from the 1m2 quadrats.

Plot Name	Native (number of plant species)	Invasive (number of plant species)	Total (number of species)
PCM_0002	11	5	16
PCM_0006	11	11	22
PCM_0007	14	3	17
PCM_0009	12	2	14
PCM_0012	21	5	26
PCM_0013	12	14	26
PCM_0015	12	8	20
PCM_0016	19	6	25
PCM_0018	42	1	43
PCM_0051	17	9	26
PCM_0058	17	5	22
PCM_0060	16	7	23
PCM_0061	30	10	40
PCM_0062	32	7	39
PCM_0063	12	9	21
PCM_0064	13	2	15
PCM_0069	2	3	5
PCM_0101	8	5	13
PCM_0110	41	8	49
PCM_0111	28	6	34
FPCM_1086	7	5	12
FPCM_0818	8	7	15
FPCM_1138	5	7	12
FPCM_1394	6	6	12
FPCM_1342	6	7	13
FPCM_1598	16	7	23

Calculations of absolute cover were done using only point-intercept data (Table 6).
 BADL_PCM_0007 had the highest absolute native cover. This plot is located in Sage Creek
 Wilderness area on a small grassy table.

Table 6. Absolute and relative cover of native and exotic species in plots monitored at Badlands National Park in 2017. Absolute cover includes overlapping canopies and can be greater than 100%.

Plot Name	Absolute Cover (%)	
	Native	Exotic
PCM_0002	42	24
PCM_0006	94	31
PCM_0007	190	16
PCM_0009	117	0
PCM_0012	106	8
PCM_0013	82	61
PCM_0015	138	27
PCM_0016	57	3
PCM_0018	121	0
PCM_0051	75	12
PCM_0058	77	5
PCM_0060	99	87
PCM_0061	140	59
PCM_0062	79	11
PCM_0063	12	46
PCM_0064	29	4
PCM_0069	8	3
PCM_0101	104	0
PCM_0110	100	5
PCM_0111	121	5
FPCM_1086	38	67
FPCM_0818	31	68
FPCM_1138	21	93
FPCM_1394	29	78
FPCM_1342	24	82
FPCM_1598	107	30

Live trees, poles and seedlings were present in only one of the twenty sites visited in 2017 (Table 7). Data collected included species name, size class based on diameter at breast height (DBH), status, total number of individuals, and density per hectare. DBH categories are tree (DBH>15 cm), pole (2.54 cm≤DBH≤15 cm), and seedling (DBH<2.54 cm). There was notable tree regeneration in plot PCM_0110.

Table 7. Woody species data recorded from the only wooded plot visited at Badlands National Park in 2017, BADL_PCM_0110. 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	Total Individuals	Density/ha.
BADL_PCM_0110	Rocky Mountain juniper	Tree	Alive	20	80.94
BADL_PCM_0110	Rocky Mountain juniper	Tree	Dead	1	4.05
BADL_PCM_0110	Rocky Mountain juniper	Pole	Alive	14	180.43
BADL_PCM_0110	Chokecherry	Pole	Alive	1	12.89
BADL_PCM_0110	Rocky Mountain juniper	Seedling	Alive	43	553.83
BADL_PCM_0110	Chokecherry	Seedling	Alive	24	309.12

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. Crews surveyed for and measured surface fuels in four plots, where there were juniper trees located either in or within 38 meters of plot center. Of the four plots surveyed, only one contained measurable surface fuels, plot PCM_0110.

Table 8. Surface fuels summary from one of twenty-six PCM and FPCM plots visited in 2017 at Badlands National Park.

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
BADL_PCM_0110	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.91	1.48	2.38	0.0	0.2	0.2

Disturbances occurred in nine out of thirty-two plant community monitoring plots at BADL during 2017 (

Table 9). The two most common disturbance types observed were erosion and animal use, which includes trails, wallows, grazing, and trampled or missing vegetation.

Table 9. Disturbance types and area sizes recorded in nine plots visited within Badlands National Park during 2017. The size was approximated out of a total area of 1000 m².

MacroPlot	Disturbance Type	Size (m ²)	Comments
BADL_PCM_0002	Flood	500	Recent rainstorm
	Erosion	1000	Badland erosion
BADL_PCM_0006	Grazing	1000	–
	Wallow	2	–
BADL_PCM_0007	Animal Trail	40	–
	Grazing	50	bison
BADL_PCM_0009	Off-Road	100	fresh ATV tracks through plot
	Prairie Dog	0	near; but not in plot
BADL_PCM_0012	Animal Trail	20	–
	Grazing	50	Bison
	Small Mammal	2	–
BADL_PCM_0015	Animal Trail	20	B to A line
	Grazing	20	–
BADL_PCM_0016	Erosion	250	Large wash in center of plot; B to A line
BADL_PCM_0051	Flood	100	seasonal flooding
BADL_PCM_0058	Animal Trail	20	–
	Grazing	30	Bison
	Wallow	10	–
BADL_PCM_0060	Fire	1000	Rx burn 2012
BADL_PCM_0061	Erosion	10	Erosion on hillside between A50 and B50
BADL_PCM_0062	Animal Trail	40	large game trails/scat
	Erosion	190	hillside runoff/light wash running across A-line @ 4 m to 11m down to B0
BADL_PCM_0063	Prairie Dog	1000	–
BADL_PCM_0064	Off-Road	5	Plot was muddy when first visited; plot set-up evidence
BADL_PCM_0064	Erosion	1000	Normal rainfall causing substantial soil movement and burying of rebar
BADL_PCM_0069	Erosion	1000	–
BADL_PCM_0101	Fire	1000	Sep 2010 Prescribed fire
BADL_PCM_0110	Animal Trail	20	–
	Erosion	20	light drainage/wash disturbance near B1 & B2
BADL_PCM_0111	Animal Trail	10	Bison
	Small Mammal	2	–



Figure 4. Three distinct biomes exist in Badlands National Park: sparsely-vegetated badlands (top-left), as seen in plot PCM_064; mixed-grass prairie (top-right), as seen in plot PCM_0006; and juniper-dominated woody draws (bottom), as seen in plot PCM_0110.

Further Analysis

This 2017 Data Report is intended to provide a basic review of the data collected during our visit to Badlands National Park in 2017. A more thorough analysis of natural resource condition and recent trends over time can be found in the 2011-2015 Summary Report (Ashton and Davis 2016). All the data included in this report is available from the Northern Great Plains Inventory and Monitoring Network upon request and is archived at <https://irma.nps.gov/DataStore>.

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