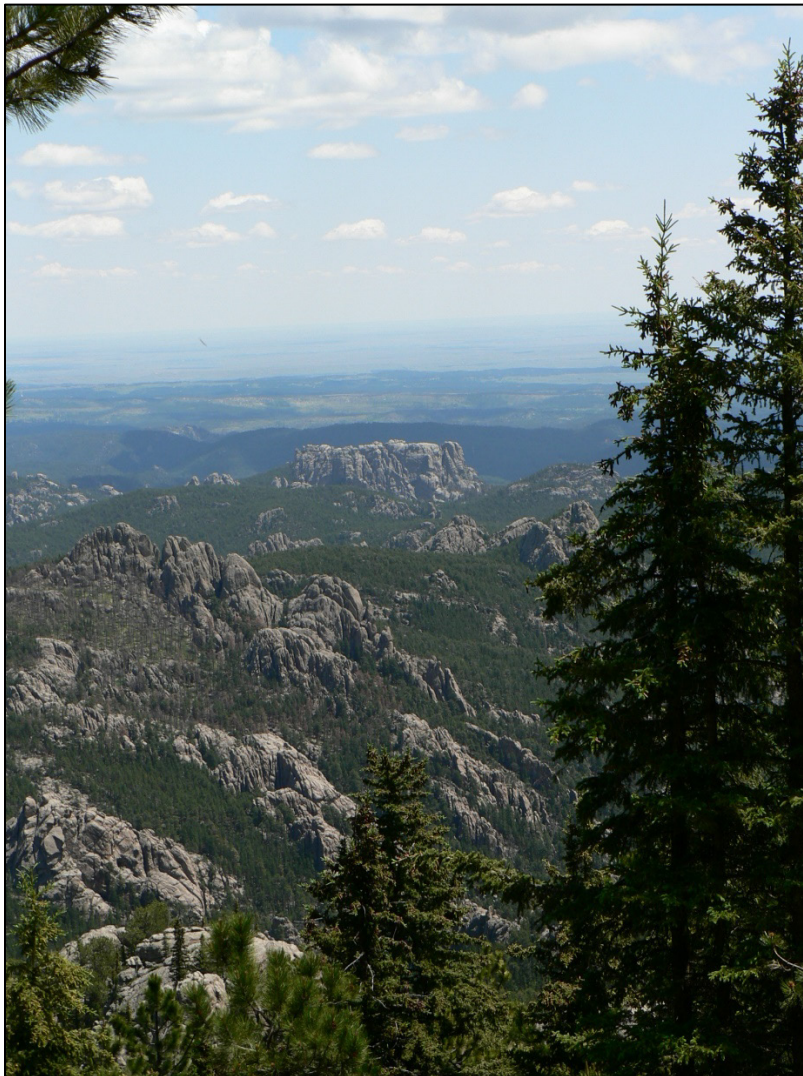




Plant Community Composition and Structure Monitoring at Mount Rushmore National Memorial

2021 Data Report

Natural Resource Data Series NPS/NGPN/NRDS—2022/1366



**ON THIS PAGE**

Overview picture of PCM_008 in Mount Rushmore National Memorial.

Photograph courtesy of the National Park Service.

ON THE COVER

Black Hills spruce trees in the far-right side of an image with the back of Mount Rushmore in the distance.

Photograph courtesy of the National Park Service.

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2021 Data Report

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Abstract

This report presents the results of vegetation monitoring efforts in 2021 at Mount Rushmore National Memorial (MORU) by the Northern Great Plains Inventory and Monitoring Network (NGPN) and Northern Great Plains Fire Effects (NGPFire) program.

During the twelfth full year of field work at MORU, the NGPN and NGPFire field crews visited 17 long-term plant community monitoring (PCM) plots to collect plant community data. Crews collected data relating to species richness, herb-layer height, native and non-native species abundance, tree density, ground cover, and site disturbance from 6 plots. The NGPFire crew visited and collected vegetation data at an additional 11 plots. These collective efforts are part of long-term monitoring to help better understand the condition of the plant communities, forests, and the effects of prescribed fire on vegetation at MORU.

Monitoring crews identified 83 vascular plant species in plots, of which 11 were exotic species in 2021. Average absolute cover of exotic species ranged from 0%-20%. Two species considered rare on the Black Hills National Forest state species list were observed. Seedlings ($DBH < 2.54$) or poles ($2.54 \text{ cm} \leq DBH \leq 15 \text{ cm}$), and trees ($DBH > 15 \text{ cm}$) were found in all seventeen plots. Disturbances were observed in five of seventeen plots, with soil disturbance as the most common.



Field work at Mount Rushmore National Memorial (NPS).

Acknowledgments

We thank the authors of the NGPN Plant Community Monitoring Protocol, particularly A. Symstad, for outstanding guidance on data collection and reporting. Thank you to the staff at MORU, particularly Rene Ohms for logistical assistance. The 2021 NGPN vegetation field crew—M. Davis, T. Bortz, A. Kuczera and A. Dahms—and the NGPFire crew—D. Swanson, I. Muirhead, M. Pahler, C. Fossum, and Jennifer McCoy—collected the data included in this report.

Introduction

Mount Rushmore National Memorial (MORU) is in the central Black Hills and was established in 1941 with a mission to preserve and protect the sculptured visages of George Washington, Thomas Jefferson, Theodore Roosevelt, and Abraham Lincoln, as well as the surrounding land. Though it is a relatively small area (517 ha, 1278 ac), MORU contains the second-largest area of old-growth ponderosa pine forest in the Black Hills (Symstad and Bynum 2007). Ponderosa pine is the dominant plant throughout the park, and there are 456 vascular plant species listed on the park's certified species list ([MORU species list](#)). Plant diversity is highest in the small areas of the park that contain wetlands and deciduous canopy cover. There is a lower diversity of plants found under the closed canopy of ponderosa pines, but the pristine condition of the older forest stands provides a valuable reference condition for Black Hills forests (Hoffman and Hansen 1986).

The Northern Great Plains Inventory & Monitoring Program (NGPN) began two vegetation monitoring efforts in MORU in 2010: one program to monitor understory vegetation annually (Ashton et al. 2013) and another program to survey of forest conditions that is repeated every five years (Ashton et al. 2019). 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 data collected at seventeen plots visited at MORU in 2021.

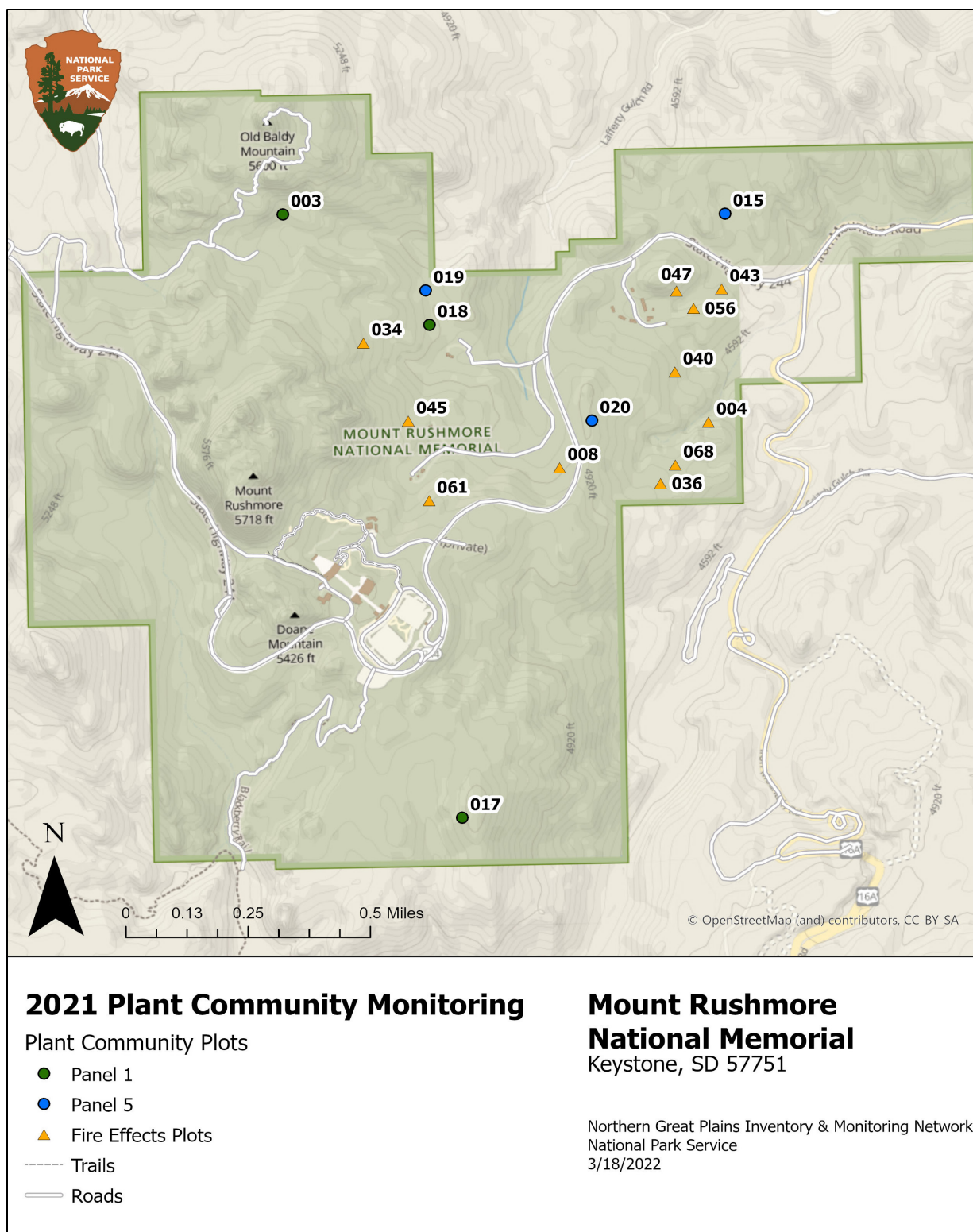


Figure 1. Map of Mount Rushmore National Memorial long-term monitoring plots visited in 2021. Three Panel 1 and three Panel 5 Plant Community Monitoring plots were visited by the Northern Great Plains Inventory & Monitoring (NGPN) crew. Eleven plots were visited by the Northern Great Plains Fire Effects (NGPFire) crew.

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 <https://www.nps.gov/im/ngpn/plant-communities.htm>

Sample Design

The NGPN and NGPFire implemented a survey to monitor plant community structure and composition at Mount Rushmore National Memorial using a spatially balanced probability design (Generalized Random Tessellation Stratified [GRTS]; Stevens and Olsen 2003, 2004). Using the GRTS design, NGPN selected 15 randomly located sites within MORU to install Plant Community Monitoring (PCM) plots. These 15 sites are organized into five panels containing three sites each. NGPN crews visit two panels (6 sites total) every year using a rotating sampling scheme, so that after five years all 15 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. The NGPN crew visited six sites, three in panel one and three in panel five between May 12th and July 7th (Figure 1). The crew commuted from Rapid City to MORU daily. Sampling was completed by a four person NGPN crew in approximately 40 working hours (Table 1). This total does include weather delays and drive time between Rapid City and MORU.

Table 1. Field journal for Northern Great Plains Network (NGPN) plant community monitoring at Mount Rushmore National Memorial in 2021.

Plot Name	Date Visited	Program	Field Notes
PCM_003	7/7/2021	NGPN	Panel 1
PCM_004	5/5/2021	FX	Postburn read
PCM_004	7/7/2021	FX	Year 1 postburn read
PCM_008	7/7/2021	FX	Year 2 postburn read
PCM_015	7/1/2021	NGPN	Panel 5
PCM_017	7/7/2021	NGPN	Panel 1
PCM_018	7/6/2021	NGPN	Panel 1
PCM_019	7/6/2021	NGPN	Panel 5
PCM_020	5/12/2021	NGPN	Panel 5 – NGPN collected Fuels data for T1 and T2.
PCM_020	5/13/2021	FX	Year 1 postburn read
PCM_034	10/5/2021	FX	Year 2 postburn read
PCM_036	4/30/2021	FX	Postburn read
PCM_036	10/5/2021	FX	Year 1 postburn read
PCM_040	4/28/2021	FX	Postburn read
PCM_040	10/4/2021	FX	Year 1 postburn read
PCM_043	4/28/2021	FX	Postburn read
PCM_043	10/5/2021	FX	Year 1 postburn read
PCM_045	10/5/2021	FX	Year 2 postburn read
PCM_047	4/28/2021	FX	Postburn read
PCM_047	10/4/2021	FX	Year 1 postburn read
PCM_056	4/26/2021	FX	Postburn read
PCM_056	10/4/2021	FX	Year 1 postburn read
PCM_061	10/5/2021	FX	Year 2 postburn read
PCM_068	4/30/2021	FX	Postburn read
PCM_068	10/5/2021	FX	Year 1 postburn read

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). 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.

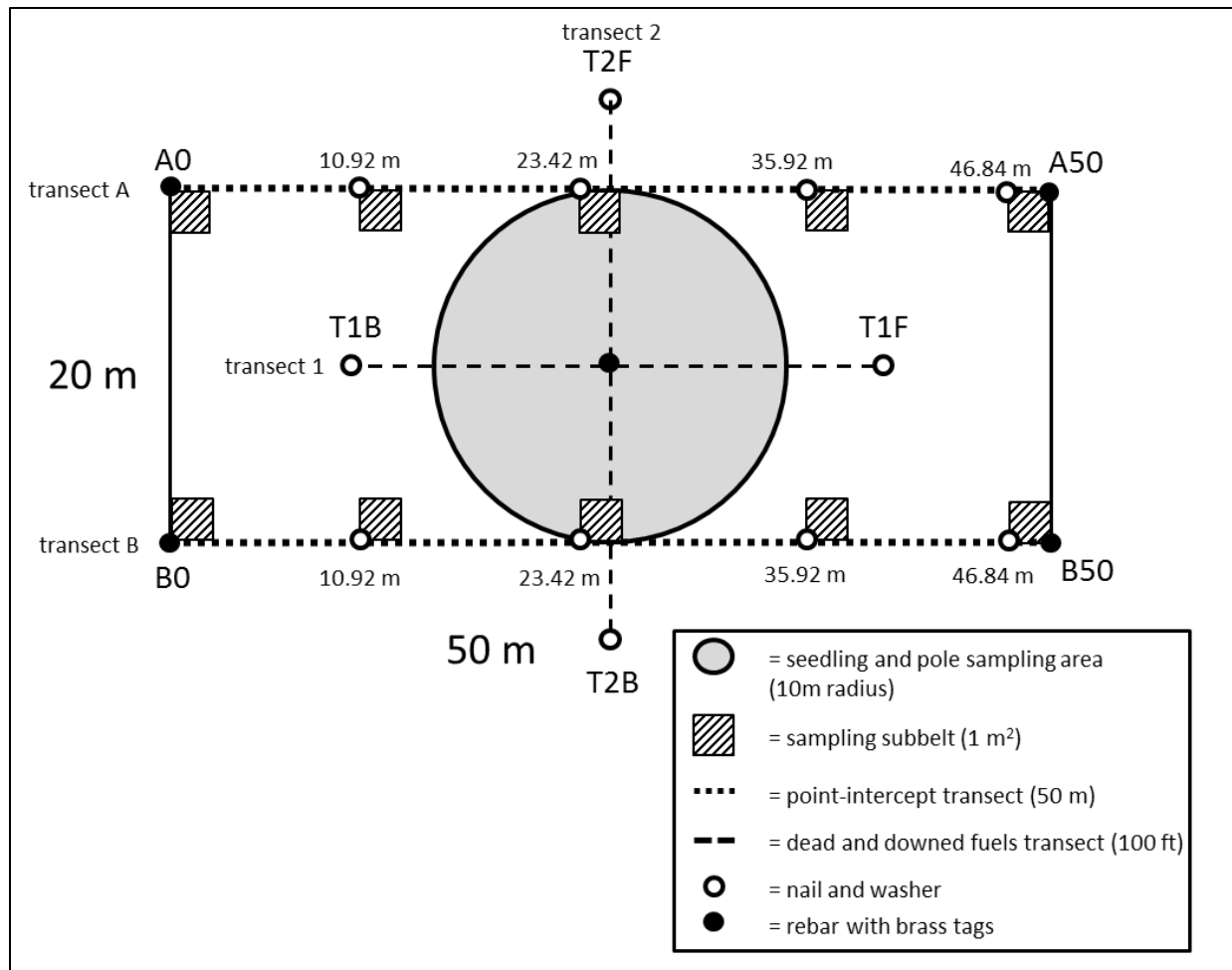


Figure 2. Long-term monitoring plot layout used for sampling vegetation used by the Northern Great Plains Inventory and Monitoring vegetation crew.

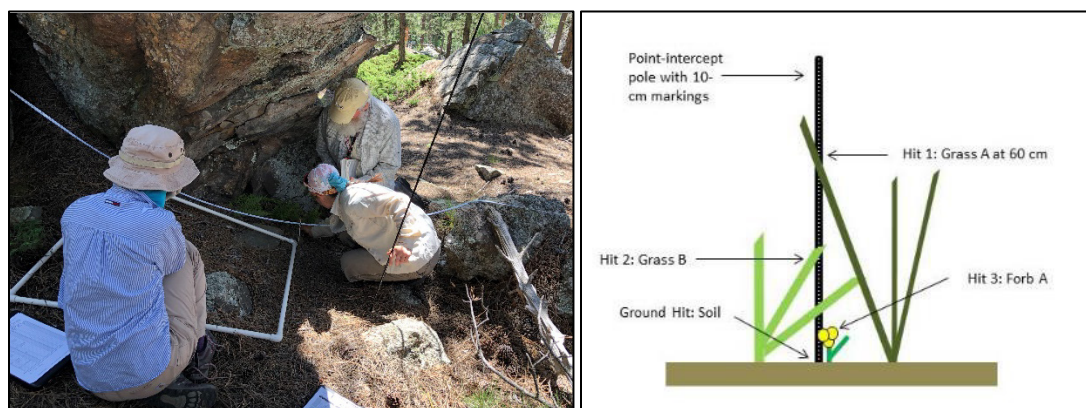


Figure 3. The Northern Great Plains Inventory & Monitoring vegetation crew used point-intercept (left and right panel) and quadrats (right panel) to document plant diversity and abundance.

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 $\text{DBH} < 2.54$ cm (seedlings) were tallied by species within the 10 m radius subplot. In 2019, NGPN changed the way these seedling counts were made. Previously, stump sprouts (stems originating between ground level and 137 cm on the bole of trees that have died or been cut) were tallied individually, often resulting in a high number of stump sprouts counted. As of 2019, only one sprout per stump is 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.

The NGPN and NGPFire crews 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. For disturbances that were likely to affect the whole area (e.g., windstorm) we recorded 'present' rather than a defined area. Plots were also assessed for the presence and abundance of target exotic species (Table 2), 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 Invasive 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 2. Exotic species included in the Northern Great Plains Network's early detection and rapid response program.

Habitat	Scientific Name	Common Name
Riparian	<i>Heracleum mantegazzianum</i>	giant hogweed
Riparian	<i>Alliaria petiolata</i>	garlic mustard
Riparian	<i>Lepidium latifolium</i>	perennial pepperweed
Riparian	<i>Pueraria montana</i> var. <i>lobata</i>	kudzu
Riparian	<i>Myriophyllum spicatum</i>	Eurasian Watermilfoil
Riparian	<i>Iris pseudacorus</i>	yellow iris
Riparian	<i>Arundo donax</i>	giant reed
Riparian	<i>Polygonum cuspidatum</i> ; <i>P. sachalinense</i> ; <i>P.x bohemicum</i>	knotweeds
Riparian	<i>Rhamnus cathartica</i>	common buckthorn
Riparian	<i>Ailanthus altissima</i>	tree of heaven
Upland	<i>Falcaria vulgaris</i>	Sickle Weed
Upland	<i>Pastinaca sativa</i>	Wild Parsnip
Upland	<i>Acroptilon repens</i>	Russian Knapweed
Upland	<i>Centaurea solstitialis</i>	yellow star thistle
Upland	<i>Centaurea virgata</i> ; <i>C. diffusa</i> ; <i>C. jacea</i>	knapweeds
Upland	<i>Chondrilla juncea</i>	rush skeletonweed
Upland	<i>Hieracium aurantiacum</i> ; <i>H. caespitosum</i> ; <i>H. piloselloides</i>	orange, meadow, and tall hawkweed
Upland	<i>Senecio jacobaeae</i>	Tansy Ragwort
Upland	<i>Isatis tinctoria</i>	Dyer's woad
Upland	<i>Gypsophila paniculata</i>	baby's breath
Upland	<i>Dipsacus fullonum</i> & <i>D. laciniatus</i>	common teasel
Upland	<i>Euphorbia myrsinites</i> & <i>E. cyparissias</i>	myrtle spurge
Upland	<i>Salvia aethiopis</i> ; <i>S. pratensis</i>	Mediterranean and Meadow sage
Upland	<i>Lythrum salicaria</i>	Purple Loosestrife
Upland	<i>Taeniatherum caput-medusae</i>	medusahead
Upland	<i>Ventenata dubia</i>	African wiregrass
Upland	<i>Ranunculus acris</i>	Tall Buttercup
Upland	<i>Linaria dalmatica</i> ; <i>L. vulgaris</i>	toadflax
Upland	<i>Thymelaea passerina</i>	Spurge Flax

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 2022). 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 unknown species are designated as an exotic species for cover calculation but omitted from species counts.

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 and R software (R version 4.1.2). 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 MORU in 2021 was determined by cross-referencing with the NatureServe conservation status list, the Black Hills Forest Service rare plant species list, as well as the South Dakota rare plant species list. For 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 2021 species list was also cross-referenced with the list of noxious weeds for the entire state and specifically Pennington County, maintained by the [South Dakota Department of Agriculture](#).

Results

There are 456 vascular plant species on the [MORU species list](#), and monitoring crews found 83 of these species in 2021 (Table 3). Of these plant species, 11 are exotic species at MORU. Most exotic plants identified were either forbs or graminoids (grasses, sedges, and rushes). There were two species found at MORU that are considered rare in the state of South Dakota or specifically the Black Hills Forest Service state rare plants list. These species are indicated with either UR – (unranked due to lack of information or due to substantially conflicting information about status or trends) or S4 – (Apparently secure). S4 is considered a fairly low risk of extirpation in the jurisdiction due to an extensive range and/or many populations or occurrences, but with possible cause for some concern because of local recent declines, threats, or other factors.

Table 3. A list of all plant species identified in Mount Rushmore National Memorial's long-term plant community monitoring plots in 2021. 'Exotic' in the notes column indicates that the species is invasive, or non-native. If a species is considered noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name. 'UR' indicates potentially rare but unranked. 'S4' indicates potentially rare but has a secured low risk.

Family	Symbol	ScientificName	CommonName	Nativity
Anacardiaceae	TORY	<i>Toxicodendron rydbergii</i>	western poison ivy	–
Apocynaceae	APAN2	<i>Apocynum androsaemifolium</i>	spreading dogbane	–
Asteraceae	ACMI2	<i>Achillea millefolium</i>	common yarrow	–
Asteraceae	ANNE	<i>Antennaria neglecta</i>	field pussytoes	–
Asteraceae	ANPA4	<i>Antennaria parvifolia</i>	small-leaf pussytoes	–
Asteraceae	ARLU	<i>Artemisia ludoviciana</i>	white sagebrush	–
Asteraceae	CIAR4	<i>Cirsium arvense</i>	Canada thistle	Exotic
Asteraceae	COCA5	<i>Conyza canadensis</i>	horseweed	–
Asteraceae	HICA3	<i>Hieracium canadense</i>	Canadian hawkweed	–
Asteraceae	LASE	<i>Lactuca serriola</i>	prickly lettuce	Exotic
Asteraceae	PACA15	<i>Packera cana</i>	woolly groundsel	–
Asteraceae	SERA	<i>Senecio rapifolius</i>	openwoods ragwort	–
Asteraceae	SOMI2	<i>Solidago missouriensis</i>	Missouri goldenrod	–
Asteraceae	SONE	<i>Solidago nemoralis</i>	gray goldenrod	–
Asteraceae	SOSP2	<i>Solidago speciosa</i>	showy goldenrod	–
Asteraceae	SYLA3	<i>Symphotrichum laeve</i>	smooth blue aster	–
Asteraceae	TAOF	<i>Taraxacum officinale</i>	common dandelion	Exotic
Betulaceae	BEPA	<i>Betula papyrifera</i>	paper birch	–
Boraginaceae	CRT04	<i>Cryptantha torreyana</i>	Torrey's cryptantha	–
Boraginaceae	CYOF	<i>Cynoglossum officinale</i>	houndstongue	Exotic, Noxious – Pennington Co.
Brassicaceae	SIAL2	<i>Sisymbrium altissimum</i>	tall tumblemustard	Exotic
Campanulaceae	CARO2	<i>Campanula rotundifolia</i>	bluebell bellflower	–

Table 3 (continued). A list of all plant species identified in Mount Rushmore National Memorial's long-term plant community monitoring plots in 2021. 'Exotic' in the notes column indicates that the species is invasive, or non-native. If a species is considered noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name. 'UR' indicates potentially rare but unranked. 'S4' indicates potentially rare but has a secured low risk.

Family	Symbol	ScientificName	CommonName	Nativity
Campanulaceae	TRPE4	<i>Triodanis perfoliata</i>	clasping Venus' looking-glass	–
Caprifoliaceae	SYOC	<i>Symphoricarpos occidentalis</i>	western snowberry	–
Caryophyllaceae	SIAN2	<i>Silene antirrhina</i>	sleepy silene	–
Chenopodiaceae	CHENO	<i>Chenopodium</i>	goosefoot	Exotic
Chenopodiaceae	CHSI2	<i>Chenopodium simplex</i>	mapleleaf goosefoot	–
Cupressaceae	JUCO6	<i>Juniperus communis</i>	common juniper	–
Cyperaceae	CABR10	<i>Carex brevior</i>	shortbeak sedge	–
Cyperaceae	CAFO3	<i>Carex foenea</i>	dryspike sedge	–
Cyperaceae	CAIN12	<i>Carex intumescens</i>	greater bladder sedge	–
Cyperaceae	CAIN9	<i>Carex inops</i>	sun sedge	–
Cyperaceae	CAREX	<i>Carex</i>	sedge	–
Cyperaceae	CARI	<i>Carex richardsonii</i>	Richardson's sedge	S4
Cyperaceae	CARO5	<i>Carex rossii</i>	Ross' sedge	–
Cyperaceae	CASI12	<i>Carex siccata</i>	dryspike sedge	–
Dryopteridaceae	ATFI	<i>Athyrium filix-femina</i>	common ladyfern	–
Dryopteridaceae	WOSC	<i>Woodsia scopulina</i>	Rocky Mountain cliff fern	–
Ericaceae	ARUV	<i>Arctostaphylos uva-ursi</i>	kinnikinnick	–
Fabaceae	GLLE3	<i>Glycyrrhiza lepidota</i>	American licorice	–
Fabaceae	LAOC2	<i>Lathyrus ochroleucus</i>	cream pea	–
Fabaceae	MELU	<i>Medicago lupulina</i>	black medick	Exotic
Fabaceae	THRH	<i>Thermopsis rhombifolia</i>	golden pea	–
Fabaceae	VIAM	<i>Vicia americana</i>	American vetch	–
Fagaceae	QUMA2	<i>Quercus macrocarpa</i>	bur oak	–
Grossulariaceae	RICE	<i>Ribes cereum</i>	wax currant	–
Iridaceae	SIMO2	<i>Sisyrinchium montanum</i>	strict blue-eyed grass	–
Liliaceae	MAST4	<i>Maianthemum stellatum</i>	starry false lily of the valley	–
Onagraceae	CHAN9	<i>Chamerion angustifolium</i>	fireweed	–
Onagraceae	EPCI	<i>Epilobium ciliatum</i>	fringed willowherb	–
Onagraceae	OEBI	<i>Oenothera biennis</i>	common evening primrose	–
Pinaceae	PIPO	<i>Pinus ponderosa</i>	ponderosa pine	–
Poaceae	PIMI	<i>Piptatherum micranthum</i>	littleseed ricegrass	–
Poaceae	PIPU9	<i>Piptatherum pungens</i>	mountain ricegrass	–
Poaceae	AGSC5	<i>Agrostis scabra</i>	rough bentgrass	–

Table 3 (continued). A list of all plant species identified in Mount Rushmore National Memorial's long-term plant community monitoring plots in 2021. 'Exotic' in the notes column indicates that the species is invasive, or non-native. If a species is considered noxious in an individual county within the state, it is indicated in the notes column as Noxious – County name. 'UR' indicates potentially rare but unranked. 'S4' indicates potentially rare but has a secured low risk.

Family	Symbol	ScientificName	CommonName	Nativity
Poaceae	ANGE	<i>Andropogon gerardii</i>	big bluestem	–
Poaceae	BOCU	<i>Bouteloua curtipendula</i>	sideoats grama	–
Poaceae	BOGR2	<i>Bouteloua gracilis</i>	blue grama	–
Poaceae	BRIN2	<i>Bromus inermis</i>	smooth brome	Exotic
Poaceae	BRKA2	<i>Bromus kalmii</i>	arctic brome	–
Poaceae	DASP2	<i>Danthonia spicata</i>	poverty oatgrass	–
Poaceae	DILE2	<i>Dichanthelium leibergii</i>	Leiberg's panicum	–
Poaceae	DILI2	<i>Dichanthelium linearifolium</i>	slimleaf panicgrass	–
Poaceae	ELRE4	<i>Elymus repens</i>	quackgrass	Exotic
Poaceae	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	–
Poaceae	FESA	<i>Festuca saximontana</i>	Rocky Mountain fescue	–
Poaceae	KOMA	<i>Koeleria macrantha</i>	prairie Junegrass	–
Poaceae	MURA	<i>Muhlenbergia racemosa</i>	marsh muhly	–
Poaceae	NAVI4	<i>Nassella viridula</i>	green needlegrass	–
Poaceae	ORAS	<i>Oryzopsis asperifolia</i>	roughleaf ricegrass	–
Poaceae	POPR	<i>Poa pratensis</i>	Kentucky bluegrass	Exotic
Poaceae	SCSC	<i>Schizachyrium scoparium</i>	little bluestem	–
Primulaceae	PRPA99	<i>Primula pauciflora</i>	darkthroat shootingstar	–
Rosaceae	AMAL2	<i>Amelanchier alnifolia</i>	Saskatoon serviceberry	–
Rosaceae	DRFI3	<i>Drymocallis fissa</i>	bigflower cinquefoil	–
Rosaceae	PRPE2	<i>Prunus pensylvanica</i>	pin cherry	–
Rosaceae	PRVI	<i>Prunus virginiana</i>	chokecherry	–
Rosaceae	SPBE2	<i>Spiraea betulifolia</i>	white spirea	–
Salicaceae	POTR5	<i>Populus tremuloides</i>	quaking aspen	–
Scrophulariaceae	COPA3	<i>Collinsia parviflora</i>	maiden blue eyed Mary	–
Scrophulariaceae	VETH	<i>Verbascum thapsus</i>	common mullein	Exotic
Selaginellaceae	SERU	<i>Selaginella rupestris</i>	northern selaginella	UR
Violaceae	VIOLA	<i>Viola</i>	violet	–

Based on the total count of unique species observed in all plots in 2021, PCM_003 had the highest number with 44 total species (Table 4). PCM_003 also had the most native species, totaling 42. Absolute cover calculations (Table 5) showed that plots visited by NGPN were more native than exotic. Six of seventeen plots visited had no exotic species recorded using both the point-intercept

and quadrat methods (Figure 4). Plot PCM_003 had the highest absolute cover of native species (113%). PCM_008 had the highest absolute cover of exotic species (20%).

Table 4. Total number of plant species identified in plots monitored at Mount Rushmore National Memorial in 2021. 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. Note that the NGPFire crew did not collect quadrat data from any plots visited in 2021, however the crew collected point-intercept data from PCM_004 and PCM-008, resulting in a lower species count.

Plot	Native Species	Exotic Species	Total Species
PCM_003	42	2	44
PCM_004	3	0	3
PCM_008	15	4	19
PCM_015	27	3	30
PCM_017	11	2	13
PCM_018	19	0	19
PCM_019	26	5	31
PCM_020	15	6	21
PCM_034	1	0	1
PCM_036	1	0	1
PCM_040	1	0	1
PCM_043	1	0	1
PCM_045	2	0	2
PCM_047	3	0	3
PCM_056	1	0	1
PCM_061	2	0	2
PCM_068	1	0	1

Table 5. Absolute percent cover of native and exotic plant species in plots monitored at Mount Rushmore National Memorial in 2021. 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
PCM_003	113	0
PCM_004	9	0
PCM_008	73	20
PCM_015	32	0
PCM_017	6	0
PCM_018	15	0
PCM_019	27	3
PCM_020	13	0



Figure 4. Long-term monitoring plot PCM_003 at Mount Rushmore with over 100% relative cover of native plants in 2021. Photograph courtesy of the National Park Service.

The NGPN and NGPFire crews collected woody species data at seventeen plots in 2021 (Table 6). Seven unique species of trees and shrubs were observed, with ponderosa pine (*Pinus ponderosa*) as the dominant cover. Plot PCM_015 had the highest tree density with 710 ponderosa pine per hectares. Regeneration, or seedlings present, was observed in fourteen of seventeen plots. Surface fuel data was collected at all seventeen plots (Table 7). Plot PCM_017 had the highest fuel loads totaling over 34 tons per acre.

Table 6. Woody species data from 17 long-term monitoring plots visited at Mount Rushmore National Memorial in 2021. DBH categories are tree (DBH > 15 cm), pole (2.54 cm ≤ DBH ≤ 15 cm), and seedling (DBH < 2.54 cm).

Plot	Common Name	Status	DBH	Count	Density/hectares
PCM_003	quaking aspen	Live	Pole	1	31.85
PCM_003	ponderosa pine	Live	Pole	1	31.85
PCM_003	ponderosa pine	Dead	Tree	5	50
PCM_003	ponderosa pine	Live	Tree	7	70
PCM_003	chokecherry	Live	Seedling	6	190.96
PCM_003	quaking aspen	Live	Seedling	6	190.96
PCM_003	ponderosa pine	Live	Seedling	45	1432.21
PCM_004	ponderosa pine	Dead	Pole	1	31.85
PCM_004	ponderosa pine	Live	Tree	17	541.4
PCM_008	ponderosa pine	Dead	Tree	4	127.39
PCM_008	ponderosa pine	Live	Pole	2	63.69
PCM_008	ponderosa pine	Live	Tree	12	382.17
PCM_015	ponderosa pine	Dead	Pole	11	350.32
PCM_015	ponderosa pine	Live	Pole	21	668.79
PCM_015	ponderosa pine	Dead	Tree	1	10
PCM_015	ponderosa pine	Live	Tree	71	710
PCM_015	ponderosa pine	Live	Seedling	5	159.13
PCM_017	ponderosa pine	Dead	Tree	2	20
PCM_017	ponderosa pine	Live	Tree	41	410
PCM_017	ponderosa pine	Live	Seedling	81	2577.98
PCM_018	ponderosa pine	Dead	Tree	1	10
PCM_018	ponderosa pine	Live	Tree	27	270
PCM_018	pin cherry	Live	Seedling	1	31.83
PCM_018	ponderosa pine	Live	Seedling	3	95.48
PCM_019	ponderosa pine	Dead	Tree	4	40
PCM_019	ponderosa pine	Live	Tree	23	230
PCM_019	chokecherry	Live	Seedling	68	2164.23
PCM_019	pin cherry	Live	Seedling	1	31.83
PCM_019	Saskatoon serviceberry	Live	Seedling	14	445.58
PCM_020	ponderosa pine	Live	Pole	2	63.69
PCM_020	ponderosa pine	Dead	Tree	3	30
PCM_020	ponderosa pine	Live	Tree	25	250
PCM_020	ponderosa pine	Live	Seedling	13	413.75
PCM_034	ponderosa pine	Dead	Tree	5	159.24
PCM_034	ponderosa pine	Live	Tree	5	159.24

Table 6 (continued). Woody species data from 17 long-term monitoring plots visited at Mount Rushmore National Memorial in 2021. DBH categories are tree (DBH > 15 cm), pole (2.54 cm ≤ DBH ≤ 15 cm), and seedling (DBH < 2.54 cm).

Plot	Common Name	Status	DBH	Count	Density/hectares
PCM_036	ponderosa pine	Dead	Tree	2	63.69
PCM_036	ponderosa pine	Live	Tree	15	477.71
PCM_036	ponderosa pine	Live	Seedling	6	190.96
PCM_040	ponderosa pine	Dead	Tree	2	63.69
PCM_040	ponderosa pine	Live	Tree	14	445.86
PCM_040	ponderosa pine	Live	Seedling	3	95.48
PCM_043	ponderosa pine	Live	Tree	16	509.55
PCM_045	ponderosa pine	Dead	Tree	2	63.69
PCM_045	ponderosa pine	Live	Tree	4	127.39
PCM_045	paper birch	Live	Seedling	1	31.83
PCM_045	ponderosa pine	Live	Seedling	4	127.31
PCM_047	bur oak	Live	Pole	1	31.85
PCM_047	ponderosa pine	Live	Tree	7	222.93
PCM_047	chokecherry	Live	Seedling	1	31.83
PCM_047	ponderosa pine	Live	Seedling	15	477.4
PCM_056	ponderosa pine	Live	Tree	12	382.17
PCM_061	ponderosa pine	Live	Pole	1	31.85
PCM_061	ponderosa pine	Live	Tree	13	414.01
PCM_061	paper birch	Live	Seedling	1	31.83
PCM_061	ponderosa pine	Live	Seedling	4	127.31
PCM_068	ponderosa pine	Dead	Pole	2	63.69
PCM_068	ponderosa pine	Dead	Tree	1	31.85
PCM_068	ponderosa pine	Live	Tree	19	605.1

Table 7. Surface fuels summary for 17 plots visited in 2021 at Mount Rushmore National Memorial by the Northern Great Plains Network.

Macroplot	Monitoring Status	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_003	2021_PlantCommunity	0.00	0.00	1.49	1.49	5.65	0.00	7.14	18.05	2.87	28.06	1.0	0.7	1.7
PCM_015	2021_PlantCommunity	0.04	0.27	2.22	2.53	0.23	1.54	4.29	7.66	3.79	15.75	0.4	1.0	1.4
PCM_017	2021_PlantCommunity	0.14	0.28	1.46	1.88	16.86	0.00	18.74	13.64	2.10	34.48	0.8	0.5	1.3
PCM_018	2021_PlantCommunity	0.00	0.42	0.75	1.16	0.00	0.00	1.16	10.74	0.98	12.88	0.6	0.2	0.9
PCM_019	2021_PlantCommunity	0.00	0.28	0.73	1.00	5.53	0.00	6.53	11.09	1.40	19.02	0.6	0.4	1.0
PCM_020	2021_PlantCommunity	0.00	0.00	0.00	0.00	12.10	0.00	12.10	2.99	1.36	16.45	0.2	0.3	0.5
PCM_004	01Post	0.06	1.23	1.48	2.78	0.22	0.00	3.00	11.00	1.20	15.20	0.6	0.3	0.9
PCM_004	01yr01	0.04	0.83	0.00	0.86	0.00	0.55	1.41	9.42	0.70	11.53	0.5	0.2	0.7
PCM_008	01yr02	0.00	0.68	0.00	0.68	11.00	1.93	13.62	6.16	0.98	20.76	0.4	0.2	0.6
PCM_020	01yr01	0.00	0.00	0.00	0.00	12.10	0.00	12.10	2.99	1.36	16.45	0.2	0.3	0.5
PCM_034	01yr02	0.00	1.09	0.75	1.84	0.00	0.37	2.21	29.67	1.48	33.35	1.7	0.4	2.1
PCM_036	01Post	0.00	1.37	2.91	4.28	1.21	0.54	6.02	12.06	1.50	19.58	0.7	0.4	1.1
PCM_036	01yr01	0.06	0.55	2.92	3.53	1.62	0.37	5.52	14.00	1.18	20.70	0.8	0.3	1.1
PCM_040	01Post	0.02	0.41	0.73	1.15	0.92	0.00	2.07	10.30	1.92	14.28	0.6	0.5	1.1
PCM_040	01yr01	0.00	0.70	0.73	1.43	2.38	0.00	3.80	10.12	2.26	16.18	0.6	0.6	1.1
PCM_043	01Post	0.14	0.27	1.53	1.94	0.00	0.82	2.76	12.32	1.63	16.71	0.7	0.4	1.1
PCM_043	01yr01	0.16	0.42	0.73	1.31	0.56	0.64	2.51	9.51	0.40	12.42	0.5	0.1	0.6
PCM_045	01yr02	0.04	0.69	0.74	1.48	3.74	0.00	5.22	18.57	2.14	25.93	1.1	0.5	1.6
PCM_047	01Post	0.02	0.29	0.77	1.08	0.00	0.00	1.08	4.84	0.58	6.50	0.3	0.1	0.4
PCM_047	01yr01	0.02	0.00	1.50	1.52	0.26	0.00	1.78	2.20	0.52	4.50	0.1	0.1	0.3
PCM_056	01Post	0.08	0.00	0.00	0.08	0.00	0.00	0.08	4.05	1.48	5.61	0.2	0.4	0.6
PCM_056	01yr01	0.06	0.14	0.00	0.20	0.00	0.00	0.20	5.02	0.36	5.58	0.3	0.1	0.4
PCM_061	01yr02	0.04	0.56	0.76	1.37	0.00	0.00	1.37	8.71	1.44	11.52	0.5	0.4	0.9
PCM_068	01Post	0.02	0.14	0.00	0.16	2.91	1.06	4.13	5.55	1.50	11.17	0.3	0.4	0.7
PCM_068	01yr01	0.00	0.00	0.00	0.00	3.08	0.55	3.63	5.63	0.82	10.08	0.3	0.2	0.5

Disturbances were observed in 5 of the 17 plots visited by NGPN in 2021 (Table 8). The most common disturbance was soil disturbance. The largest disturbances per square meter were tree removal and soil disturbance. Plot PCM_020's soil disturbance was crew related due to the steep terrain along the transects. All six plots visited by NGPN were also assessed for the presence of early detection exotic species, but none were found in 2021.

Table 8. Disturbance type and area observed in 5 of 17 plots visited at Mount Rushmore National Memorial by the Northern Great Plains Network in 2021. The disturbance area was approximated out of a total area of 1000 m² or recorded as present.

Plot	Disturbance Type	Area (m ²)
PCM_003	Grazing	10
PCM_017	Soil Disturbance	5
PCM_018	Soil Disturbance	3
PCM_019	Grazing	2
PCM_019	Soil Disturbance	4
PCM_020	Soil Disturbance (crew due to steep terrain)	50
PCM_020	Spring 2021 Fire	Present

Further Analysis

This 2021 Data Report is intended to provide a basic review of the data collected during the NGPN team's 2021 visit to Mount Rushmore National Memorial. All data included in this report are 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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