



Plant Community Composition and Structure Monitoring at Agate Fossil Beds National Monument *2018 Data Report*

Natural Resource Data Series NPS/NGPN/NRDS—2019/1203



**ON THIS PAGE**

Plant Community Composition and Structure Monitoring plot AGFO_LPCM_4 at Agate Fossil Beds National Monument, May 2018.
Photograph courtesy of the National Park Service.

ON THE COVER

Plant Community Composition and Structure Monitoring plot AGFO_PCM_0021 at Agate Fossil Beds National Monument, May 2018.
Photograph courtesy of the National Park Service.

Plant Community Composition and Structure Monitoring at Agate Fossil Beds National Monument

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Abstract

This report presents the results of vegetation monitoring efforts in 2018 at Agate Fossil Beds National Monument (AGFO) by the Northern Great Plains Inventory and Monitoring Network (NGPN) and the Northern Great Plains Fire Effects Program (NGPFire). This was the eighth year of field work conducted by NGPN at AGFO.

In 2018, crew members from NGPN visited six long-term plant community monitoring (PCM) plots, four legacy plant community monitoring (LPCM) plots, and NGPFire visited one additional PCM plot to collect data on plant communities at AGFO. This collaborative effort is part of a long-term monitoring program established to better understand the condition of the mixed-grass prairie and riparian regions in AGFO. NGPN staff collected species richness, herb-layer height, native and exotic (non-native) species abundance, ground cover, and site disturbance data at each of the six PCM plots. The NGPFire crew collected herb-layer height, native and exotic species abundance, and ground cover data at their PCM plot. An additional eleven riparian community monitoring (RCM) plots were evaluated for species richness and cover of native and exotic species.

Monitoring crews identified 143 unique plant species from a total of 22 monitoring plots. Of those species, 25 were exotic species and one, Canada thistle (*Cirsium arvense*), is a noxious species in Nebraska. Pale yellow iris (*Iris pseudacorus*), which is monitored as an exotic species of concern, was found in five of the eleven visited RCM plots. Overall, both upland and riparian monitoring plots were more native than exotic in absolute cover. The most common disturbances recorded in plots visited by NGPN were small mammal use and soil disturbances.



Agate Fossil Beds National Monument (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 AGFO, particularly AJ LaGault for providing logistical support and safety checks. The 2018 NGPN vegetation field crew of S. Rockwood, I. Ashton, C. Davis, R. Manuel, M. Davis, T. Schaffner, and R. Oltjenbruns with the assistance of the NGPFire crew of D. Swanson, J. Roy, I. Muirhead, and K. Ronsani collected all the data included in this report.

Introduction

Agate Fossil Beds National Monument was established in 1965 to protect and preserve a large concentration of ancient mammal fossils. The monument contains 2,270 acres of mixed-grass prairie intersected by riparian vegetation along the Niobrara River. Vegetation monitoring began in AGFO in 1998 by the Heartland Inventory & Monitoring Program (James 2010a) and the Northern Great Plains Fire Ecology Program (FireEP; Wienk et al. 2011). In 2010, AGFO was incorporated into the Northern Great Plains Inventory & Monitoring Network (NGPN). At this time, vegetation monitoring protocols and plot locations (Figure 1) were revised to better represent the entire monument and to coordinate efforts with the FireEP (Symstad et al. 2011), and sampling efforts began in 2011 (Ashton et al. 2011). In 2012, the NGPN began monitoring additional plots within the riparian corridor of the Niobrara River system to assess riparian condition.

This report provides summaries of the data collected in 2018 from eleven upland plots and eleven riparian plots. For a more in-depth data report on long-term trends of vegetation at AGFO, refer to the 2011-2015 summary report (Ashton and Davis, 2016).

Methods

The NGPN Plant Community Composition and Structure Monitoring Protocol (Symstad et al. 2012) 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, which is 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 AGFO using a spatially balanced probability design (Generalized Random Tessellation Stratified [GRTS]; Stevens and Olsen 2003, 2004). Using a GRTS design, NGPN selected 16 randomly located sites within the upland grasslands of AGFO to become Plant Community Monitoring plots (PCM plots). An NGPN crew visits two panels (six PCM plots) in late May and early June every year, using a rotating sampling scheme that consists of three sites visited the previous year and three sites that have not been visited for four years. Data from these randomly selected sites can be used to estimate condition of vegetation communities for the whole park, and over time to discern trends in condition. A similar GRTS design was used to select 17 additional plots that fell within the riparian zone along the Niobrara River, called riparian community monitoring (RCM) plots. Additional data is collected at five legacy plant community monitoring (LPCM) sites using a protocol carried over from the Heartland Inventory and Monitoring Network to provide continuity of a long-term data set. The five plots that were first installed in 1998 and are concentrated in the southeast corner of the park and represent a portion of a long-term effort to monitor native grasslands after the installation of the Fossil Hills trail (Figure 1).

In May 2018, the NGPN crew visited six PCM plots (panel 2 & 3), four LPCM plots, and NGP-Fire visited one PCM plot in the River Middle burn unit. The NGPN crew visited eleven RCM plots in late August (Figure 1). Sampling of PCM and LPCM plots were completed by three-four person crews in approximately 110 crew hours, and sampling of RCM plots was completed by two 2-person crews in approximately 40 crew hours (Table 1). These totals do not include the drive time between Rapid City and AGFO. Monitoring crews lodged at AGFO in park housing while completing PCM and LPCM plots, and the Sage Motel in Harrison, NE while completing RCM plots.

Table 1. Field journal for Northern Great Plains Network (NGPN) plant community monitoring at Agate Fossil Beds National Monument in 2018. An NGPN crew of three to four members completed ten plots in May and eleven plots in August.

Date Visited	Plot Name	Field Notes
5/31/2018	LPCM_3	–
5/30/2018	LPCM_4	–
5/30/2018	LPCM_5	–
5/31/2018	LPCM_7	–
5/30/2018	PCM_004	–

Table 1 (continued). Field journal for Northern Great Plains Network (NGPN) plant community monitoring at Agate Fossil Beds National Monument in 2018. An NGPN crew of three to four members completed ten plots in May and eleven plots in August.

Date Visited	Plot Name	Field Notes
5/24/2018	PCM_005	–
5/23/2018	PCM_008	–
5/30/2018	PCM_010	River Middle Burn Unit, visited by NGP-FE
5/31/2018	PCM_019	–
5/23/2018	PCM_020	–
5/29/2018	PCM_021	–
8/22/2018	RCM-257	25 m transect
8/22/2018	RCM-258	–
8/22/2018	RCM-259	–
8/22/2018	RCM-260	–
8/23/2018	RCM-261	–
8/23/2018	RCM-262	–
8/22/2018	RCM-263	–
8/23/2018	RCM-264	–
8/23/2018	RCM-265	–
8/22/2018	RCM-266	–
8/23/2018	RCM-267	–
8/23/2018	RCM-268	wet, ran 40 m transect

Plot Layout and Sampling

At each upland 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 in the six PCM plots they visited. 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 also collected species richness and cover data using the point-intercept method, but did not use the quadrat method for collection of species presence data.

NGPN monitored riparian plant communities in AGFO in riparian plant community monitoring (RCM) plots. At RCM plots, vegetation was measured using the point-intercept method as described

above, along a single 50 m transect that ran perpendicular to the river channel. These plots are not permanently marked and are relocated using GPS coordinates.

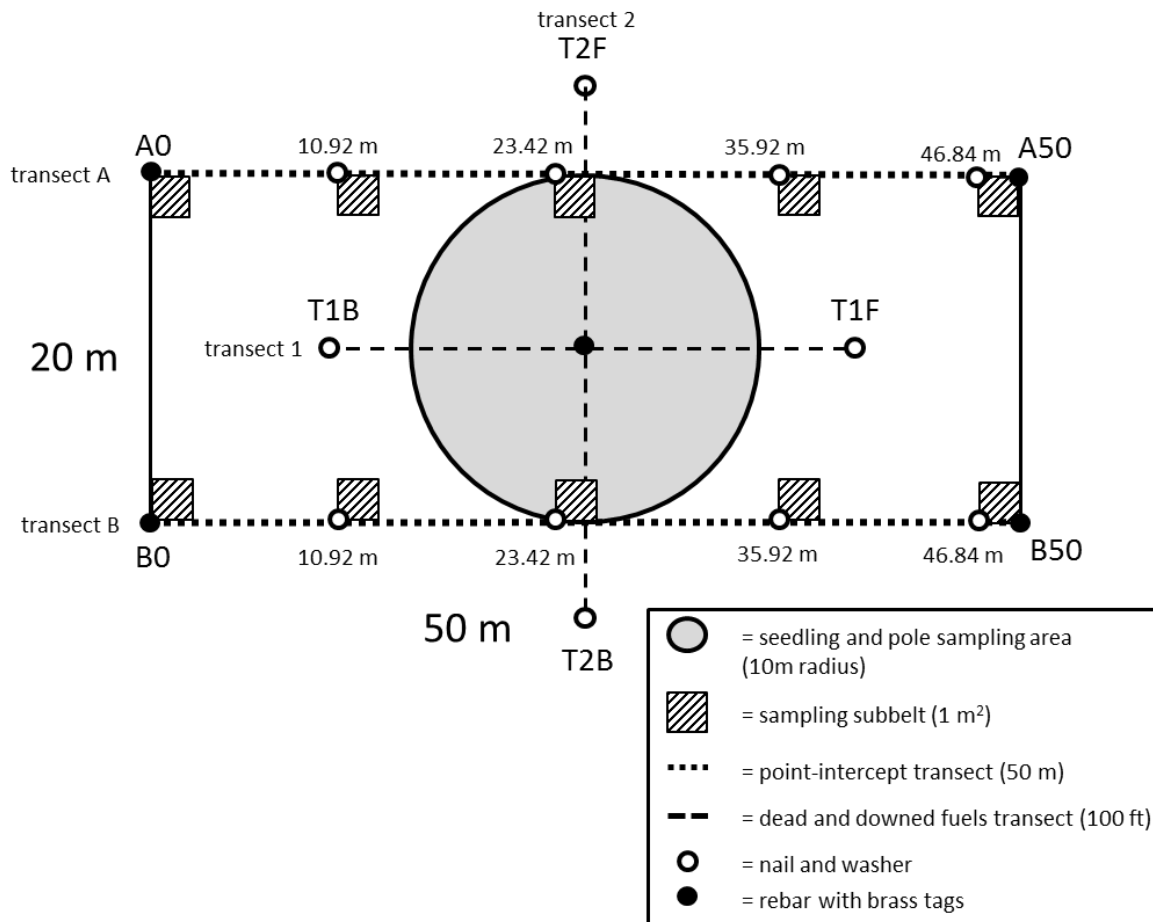


Figure 2. Long-term monitoring plot layout used for sampling vegetation used by the Northern Great Plains Inventory and Monitoring vegetation crew.

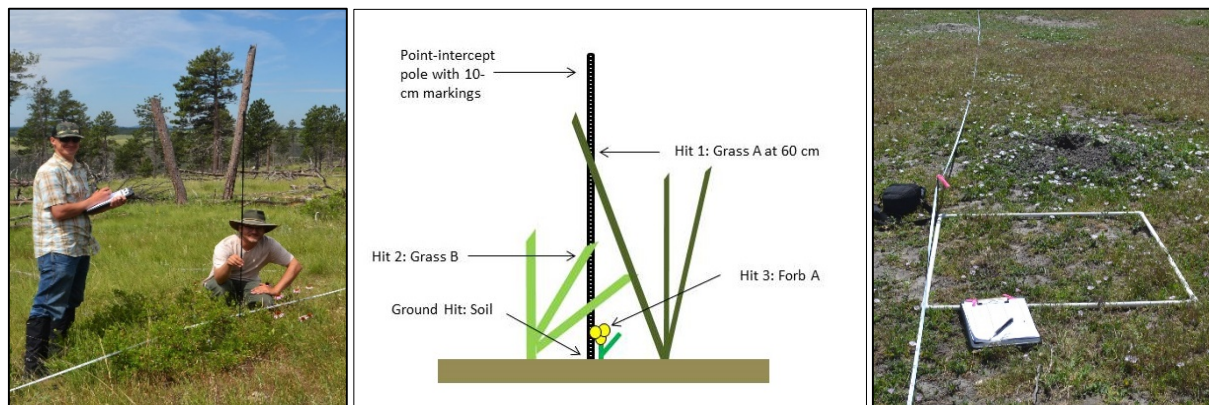


Figure 3. The Northern Great Plains Inventory & Monitoring vegetation crew used point-intercept (left and center panel) and quadrats (right panel) to document plant diversity and abundance.

The NGPN crew assessed and documented common disturbances at each plot. The type, which included rodent mounds, animal trails, and fire, and the approximate area (m²) of each disturbance was recorded. In 2018, a new category of disturbance, Soil Disturbance, was added to provide an estimate of the amount of loose, exposed soil at a site. 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 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 2. Exotic species included in the Northern Great Plains Network's early detection and rapid response program.

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

Legacy Monitoring

In addition to the monitoring described above, four plots established in 1998 by the Heartland Inventory & Monitoring Program were revisited in 2018. At each of these plots, point-intercept, disturbance, and target species data were collected as described above. The five plots chosen represent native mixed-grass prairie (LPCM-4 and -5) and an area within the same management unit impacted by construction of a paved trail (LPCM-3 and -7). All of these sites were impacted by a prescribed fire in May 2009 (James 2010). The crew intended to visit LPCM-2 but ran out of time.

Data Management and Analysis

FFI (FEAT/FIREMON Integrated; <http://frames.gov/ffi/>) was the primary software environment used for managing our sampling data. FFI is used by a variety of agencies (e.g., NPS, USDA Forest Service, U.S. Fish and Wildlife Service), has a national-level support system, and generally conforms to the [Natural Resource Database Template](#) standards established by the Inventory and Monitoring Program. Species scientific names, codes, common names, and native status are from the USDA Plants Database (USDA-NRCS 2017). However, nomenclature follows the [Integrated Taxonomic Information System](#) (ITIS). In the few cases where ITIS recognizes a new name that was not in the USDA PLANTS database, the new name was used, and a unique plant code was assigned. In the case where there is not enough evidence for genus and species identification, a special code for the unknown species was created. These are then designated as an exotic species in the total count, but omitted from the species list.

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

Data summaries were produced using the FFI reporting and query tools. The number of species encountered in each plot was calculated using data from point-intercept, quadrat, 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 AGFO in 2018 was determined by cross-referencing with the NatureServe conservation status list, as well as the Nebraska rare plant species list. For the purpose of this report, a species was considered rare or of conservation concern if its state or global conservation status rank was critically imperiled (S1/G1), imperiled (S1/G2), or vulnerable (S3/G3). More information on conservation ranks can be found at the [NatureServe](#) website. The 2018 species list was also cross-referenced with the list of noxious weeds for the entire state, maintained by the [Nebraska Department of Agriculture](#).

Results

There are a total of 453 plant species on the AGFO species list, and the NGPN and NGPFire monitoring crews identified 143 species from seven upland monitoring plots, four legacy monitoring plots, and eleven riparian monitoring plots visited in 2018 (Table 3). The 2018 species list was cross-referenced with state-wide rare and noxious species lists for Nebraska. There were 25 exotic species found in the monumnet, of which one, Canada thistle (*Cirsium arvense*), was a noxious weed species for Nebraska. Pale yellow iris (*Iris pseudacorus*), which is monitored as an exotic species of concern, was found in five of the eleven RCM plots visited. 18 plant species observed in 2018 are classified as rare in Nebraska. Ten of these species are considered potentially vulnerable (S3S5) at the state level, including winterfat (*Krascheninnikovia lanata*), common duckweed (*Lemna minor*), tansyleaf tansyaster (*Machaeranthera tanacetifolia*) and witchgrass (*Panicum capillare*). One species, spotted fritillary (*Fritillaria atropurpurea*; Figure 4), is considered imperiled (S2) in Nebraska. Other species NGPN observed, hairy false goldenaster (*Heterotheca villosa*; Figure 4), hoary tansyaster (*Dieteria canescens*), slender wheatgrass (*Elymus trachycaulus*), and western tansymustard (*Descurainia pinnata*) are considered critically imperiled (S1). However, the classifications for hairy false goldenaster, western tansymustard, and ten other species found are based on an infraspecific (subspecies or variety) level of species identification. While taxon like (*H. villosa* variety *minor*, and *D. pinnata* subspecies *halictorum*) have the potential to be found in western Nebraska, NGPN crews do not identify plant species to that taxonomic level due to difficulty and time restraints in the field (NGPN identifies plants only to the species level).



Figure 4. Two plant species observed at AGFO in 2018, the spotted fritillary (*Fritillaria atropurpurea*, left) and the hairy false goldenaster (*Heterotheca villosa*, right), classified as rare in the state of Nebraska. Photographs courtesy of the National Park Service.

Table 3. A list of all plant species identified in Agate Fossil Beds National Monument’s long-term plant community monitoring plots in 2018. ‘Exotic’ in the notes column indicates that the species is invasive, or non-native. “Noxious” indicates a state-wide noxious weed species for Nebraska. Species considered to be rare are marked with the appropriate global or state conservation ranks.

Family	Symbol	Scientific Name	Common Name	Notes
Agavaceae	YUGL	<i>Yucca glauca</i>	soapweed yucca	–
Alismataceae	SACU	<i>Sagittaria cuneata</i>	arumleaf arrowhead	–
Anacardiaceae	RHTR	<i>Rhus trilobata</i>	skunkbush sumac	–
Asclepiadaceae	ASIN	<i>Asclepias incarnata</i>	swamp milkweed	–
Asclepiadaceae	ASSP	<i>Asclepias speciosa</i>	showy milkweed	–
Asteraceae	AMPS	<i>Ambrosia psilostachya</i>	Cuman ragweed	–
Asteraceae	ARCA12	<i>Artemisia campestris</i>	field sagewort	S3S5*
Asteraceae	ARFR4	<i>Artemisia frigida</i>	fringed sagewort	–
Asteraceae	BIFR	<i>Bidens frondosa</i>	devil's beggartick	–
Asteraceae	CIAR4	<i>Cirsium arvense</i>	Canada thistle	Exotic, Noxious
Asteraceae	CICA11	<i>Cirsium canescens</i>	prairie thistle	–
Asteraceae	CIFL	<i>Cirsium flodmanii</i>	Flodman's thistle	–
Asteraceae	COCA5	<i>Conyza canadensis</i>	horseweed	–
Asteraceae	CYXA	<i>Cyclachaena xanthifolia</i>	giant sumpweed	–
Asteraceae	DICA18	<i>Dieteria canescens</i>	hoary tansyaster	S1/S2S4*
Asteraceae	ERIGE2	<i>Erigeron</i>	fleabane	–
Asteraceae	GRSQ	<i>Grindelia squarrosa</i>	curlycup gumweed	S1*
Asteraceae	GUSA2	<i>Gutierrezia sarothrae</i>	broom snakeweed	–
Asteraceae	HELIA3	<i>Helianthus</i>	sunflower	Exotic
Asteraceae	HEAN3	<i>Helianthus annuus</i>	common sunflower	–
Asteraceae	HEVI4	<i>Heterotheca villosa</i>	hairy false goldenaster	S1*
Asteraceae	HYFI	<i>Hymenopappus filifolius</i>	fineleaf hymenopappus	–
Asteraceae	LASE	<i>Lactuca serriola</i>	prickly lettuce	Exotic
Asteraceae	LYJU	<i>Lygodesmia juncea</i>	rush skeletonplant	–
Asteraceae	MATA2	<i>Machaeranthera tanacetifolia</i>	tanseyleaf tansyaster	S3S5
Asteraceae	MUOB99	<i>Mulgedium oblongifolium</i>	blue lettuce	–
Asteraceae	SOCA6	<i>Solidago canadensis</i>	Canada goldenrod	S3S5
Asteraceae	SOGI	<i>Solidago gigantea</i>	giant goldenrod	–
Asteraceae	SOAR2	<i>Sonchus arvensis</i>	field sowthistle	Exotic

*Indicates the rare global/state conservation rank is for a specific subspecies or variety, but the plant was only identified down to the genus and/or species.

Table 3 (continued). A list of all plant species identified in Agate Fossil Beds National Monument's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. "Noxious" indicates a state-wide noxious weed species for Nebraska. Species considered to be rare are marked with the appropriate global or state conservation ranks.

Family	Symbol	Scientific Name	Common Name	Notes
Asteraceae	SYMPH4	<i>Symphyotrichum</i>	aster	–
Asteraceae	SYER	<i>Symphyotrichum ericoides</i>	white heath aster	S3S5*
Asteraceae	SYLA6	<i>Symphyotrichum lanceolatum</i>	white panicle aster	–
Asteraceae	TAOF	<i>Taraxacum officinale</i>	common dandelion	Exotic
Asteraceae	TEAC	<i>Tetranneuris acaulis</i>	stemless four-nerve daisy	–
Asteraceae	TRDU	<i>Tragopogon dubius</i>	yellow salsify	Exotic
Boraginaceae	CRCI3	<i>Cryptantha cinerea</i>	James' cryptantha	–
Boraginaceae	LAOC3	<i>Lappula occidentalis</i>	flatspine stickseed	–
Boraginaceae	LIIN2	<i>Lithospermum incisum</i>	narrowleaf stoneseed	–
Brassicaceae	ALDE	<i>Alyssum desertorum</i>	desert madwort	Exotic
Brassicaceae	BOCO4	<i>Boechera collinsii</i>	Collins' rockcress	–
Brassicaceae	CAMI2	<i>Camelina microcarpa</i>	littlepod false flax	Exotic
Brassicaceae	DEPI	<i>Descurainia pinnata</i>	western tansymustard	S1/S2S4/S3S5*
Brassicaceae	DRRE2	<i>Draba reptans</i>	Carolina draba	–
Brassicaceae	ERCA14	<i>Erysimum capitatum</i>	sanddune wallflower	–
Brassicaceae	LEDE	<i>Lepidium densiflorum</i>	common pepperweed	–
Brassicaceae	PHLU99	<i>Physaria ludoviciana</i>	foothill bladderpod	–
Brassicaceae	SIAL2	<i>Sisymbrium altissimum</i>	tall tumbledustard	Exotic
Cactaceae	OPFR	<i>Opuntia fragilis</i>	brittle pricklypear	–
Caryophyllaceae	ERHO13	<i>Eremogone hookeri</i>	Hooker's sandwort	S3S5*
Caryophyllaceae	PADE4	<i>Paronychia depressa</i>	spreading nailwort	–
Caryophyllaceae	SIDR	<i>Silene drummondii</i>	Drummond's campion	–
Chenopodiaceae	ATMI2	<i>Atriplex micrantha</i>	twoscale saltbush	Exotic
Chenopodiaceae	CHENO	<i>Chenopodium</i>	goosefoot	Exotic
Chenopodiaceae	KOSC	<i>Kochia scoparia</i>	burningbush; kochia	Exotic
Chenopodiaceae	KRLA2	<i>Krascheninnikovia lanata</i>	winterfat	S3S5
Chenopodiaceae	SATR12	<i>Salsola tragus</i>	prickly Russian thistle	Exotic
Cleomaceae	PESE99	<i>Peritoma serrulata</i>	Rocky Mountain beeplant	–
Commelinaceae	TROC	<i>Tradescantia occidentalis</i>	prairie spiderwort	–

*Indicates the rare global/state conservation rank is for a specific subspecies or variety, but the plant was only identified down to the genus and/or species.

Table 3 (continued). A list of all plant species identified in Agate Fossil Beds National Monument's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. "Noxious" indicates a state-wide noxious weed species for Nebraska. Species considered to be rare are marked with the appropriate global or state conservation ranks.

Family	Symbol	Scientific Name	Common Name	Notes
Cyperaceae	CAREX	<i>Carex</i>	sedge	–
Cyperaceae	CAFI	<i>Carex filifolia</i>	threadleaf sedge	–
Cyperaceae	CAPE42	<i>Carex pellita</i>	woolly sedge	–
Cyperaceae	CAPR5	<i>Carex praegracilis</i>	clustered field sedge	–
Cyperaceae	SCPU10	<i>Schoenoplectus pungens</i>	common threesquare	–
Cyperaceae	SCTA2	<i>Schoenoplectus tabernaemontani</i>	softstem bulrush	–
Equisetaceae	EQLA	<i>Equisetum laevigatum</i>	smooth horsetail	–
Euphorbiaceae	CRTE4	<i>Croton texensis</i>	Texas croton	–
Euphorbiaceae	EUPHO	<i>Euphorbia</i>	spurge; sandmat	Exotic
Fabaceae	ASTRA	<i>Astragalus</i>	milkvetch	–
Fabaceae	ASCE	<i>Astragalus ceramicus</i>	painted milkvetch	–
Fabaceae	ASLO4	<i>Astragalus lotiflorus</i>	lotus milkvetch	–
Fabaceae	ASMI10	<i>Astragalus missouriensis</i>	Missouri milkvetch	–
Fabaceae	GLLE3	<i>Glycyrrhiza lepidota</i>	American licorice	–
Fabaceae	LAPO2	<i>Lathyrus polymorphus</i>	manystem pea	–
Fabaceae	LUPIN	<i>Lupinus</i>	lupine	–
Fabaceae	LUPL	<i>Lupinus plattensis</i>	Nebraska lupine	–
Fabaceae	LUPU	<i>Lupinus pusillus</i>	rusty lupine	–
Fabaceae	MESA	<i>Medicago sativa</i>	alfalfa	Exotic
Fabaceae	MEOF	<i>Melilotus officinalis</i>	yellow sweetclover	Exotic
Hydrophyllaceae	ELNY	<i>Ellisia nyctelea</i>	Aunt Lucy	–
Iridaceae	IRPS	<i>Iris pseudacorus</i>	pale yellow iris	Exotic, Noxious
Juncaceae	JUNCU	<i>Juncus</i>	rush	Exotic
Juncaceae	JUBA	<i>Juncus balticus</i>	Baltic rush	–
Lamiaceae	LYAM	<i>Lycopus americanus</i>	American bugleweed	–
Lamiaceae	LYAS	<i>Lycopus asper</i>	rough bugleweed	–
Lamiaceae	MEAR4	<i>Mentha arvensis</i>	wild mint	–
Lamiaceae	SCLA2	<i>Scutellaria lateriflora</i>	blue skullcap	–
Lemnaceae	LEMI3	<i>Lemna minor</i>	common duckweed	S3S5

*Indicates the rare global/state conservation rank is for a specific subspecies or variety, but the plant was only identified down to the genus and/or species.

Table 3 (continued). A list of all plant species identified in Agate Fossil Beds National Monument's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. "Noxious" indicates a state-wide noxious weed species for Nebraska. Species considered to be rare are marked with the appropriate global or state conservation ranks.

Family	Symbol	Scientific Name	Common Name	Notes
Liliaceae	ALTE	<i>Allium textile</i>	textile onion	–
Liliaceae	FRAT	<i>Fritillaria atropurpurea</i>	spotted fritillary	S2
Linaceae	LIRI	<i>Linum rigidum</i>	stiffstem flax	S3S5*
Loasaceae	MEDE2	<i>Mentzelia decapetala</i>	tenpetal blazingstar	–
Malvaceae	SPCO	<i>Sphaeralcea coccinea</i>	scarlet globemallow	–
Onagraceae	EPLE2	<i>Epilobium leptophyllum</i>	bog willowherb	–
Onagraceae	OECU2	<i>Oenothera curtiflora</i>	velvetweed	–
Onagraceae	OESE3	<i>Oenothera serrulata</i>	yellow sundrops	–
Onagraceae	OESU99	<i>Oenothera suffrutescens</i>	scarlet beeblossom	–
Plantaginaceae	PLPA2	<i>Plantago patagonica</i>	woolly plantain	S2S4
Poaceae	ACHY	<i>Achnatherum hymenoides</i>	Indian ricegrass	–
Poaceae	ANGE	<i>Andropogon gerardii</i>	big bluestem	–
Poaceae	ARPU9	<i>Aristida purpurea</i>	purple threeawn	S3S5*
Poaceae	BOCU	<i>Bouteloua curtipendula</i>	sideoats grama	–
Poaceae	BOGR2	<i>Bouteloua gracilis</i>	blue grama	–
Poaceae	BRTE	<i>Bromus tectorum</i>	cheatgrass	Exotic
Poaceae	CAST36	<i>Calamagrostis stricta</i>	slimstem reedgrass	–
Poaceae	CALO	<i>Calamovilfa longifolia</i>	prairie sandreed	–
Poaceae	DISP	<i>Distichlis spicata</i>	saltgrass	–
Poaceae	ELYMU	<i>Elymus</i>	wildrye	Exotic
Poaceae	ELEL5	<i>Elymus elymoides</i>	squirreltail	–
Poaceae	ELLA3	<i>Elymus lanceolatus</i>	thickspike wheatgrass	S1
Poaceae	ELRE4	<i>Elymus repens</i>	quackgrass	Exotic
Poaceae	ELTR7	<i>Elymus trachycaulus</i>	slender wheatgrass	S1*
Poaceae	HECO26	<i>Hesperostipa comata</i>	needle and thread	–
Poaceae	HOJU	<i>Hordeum jubatum</i>	foxtail barley	–
Poaceae	KOMA	<i>Koeleria macrantha</i>	prairie Junegrass	–
Poaceae	LEOR	<i>Leersia oryzoides</i>	rice cutgrass	–
Poaceae	MUAS	<i>Muhlenbergia asperifolia</i>	scratchgrass; alkali muhly	–

*Indicates the rare global/state conservation rank is for a specific subspecies or variety, but the plant was only identified down to the genus and/or species.

Table 3 (continued). A list of all plant species identified in Agate Fossil Beds National Monument's long-term plant community monitoring plots in 2018. 'Exotic' in the notes column indicates that the species is invasive, or non-native. "Noxious" indicates a state-wide noxious weed species for Nebraska. Species considered to be rare are marked with the appropriate global or state conservation ranks.

Family	Symbol	Scientific Name	Common Name	Notes
Poaceae	MURA	<i>Muhlenbergia racemosa</i>	marsh muhly	–
Poaceae	PACA6	<i>Panicum capillare</i>	witchgrass	S3S5
Poaceae	PAVI2	<i>Panicum virgatum</i>	switchgrass	–
Poaceae	PASM	<i>Pascopyrum smithii</i>	western wheatgrass	–
Poaceae	POPR	<i>Poa pratensis</i>	Kentucky bluegrass	Exotic
Poaceae	SCSC	<i>Schizachyrium scoparium</i>	little bluestem	–
Poaceae	SPGR	<i>Spartina gracilis</i>	alkali cordgrass	–
Poaceae	SPPE	<i>Spartina pectinata</i>	prairie cordgrass	–
Poaceae	SPCR	<i>Sporobolus cryptandrus</i>	sand dropseed	–
Poaceae	VUOC	<i>Vulpia octoflora</i>	sixweeks fescue	–
Polemoniaceae	PHAN4	<i>Phlox andicola</i>	prairie phlox	–
Polemoniaceae	PHHO	<i>Phlox hoodii</i>	spiny phlox	–
Polygonaceae	ERAN4	<i>Eriogonum annuum</i>	annual buckwheat	–
Polygonaceae	ERFL4	<i>Eriogonum flavum</i>	alpine golden buckwheat	–
Polygonaceae	RUMEX	<i>Rumex</i>	dock	Exotic
Polygonaceae	RUVE2	<i>Rumex venosus</i>	veiny dock	–
Rubiaceae	GATI	<i>Galium tinctorium</i>	stiff marsh bedstraw	–
Salicaceae	SAIN3	<i>Salix interior</i>	sandbar willow	–
Scrophulariaceae	PEAN4	<i>Penstemon angustifolius</i>	broadbeard beardtongue	–
Solanaceae	PHHI8	<i>Physalis hispida</i>	prairie groundcherry	–
Typhaceae	TYAN	<i>Typha angustifolia</i>	narrowleaf cattail	–
Typhaceae	TYLA	<i>Typha latifolia</i>	broadleaf cattail	–
Unknown family	UNKFORB	<i>Unknown annual forb</i>	unknown annual forb	Exotic
Unknown family	UNKFORB	<i>Unknown forb</i>	unknown forb	Exotic
Urticaceae	URDI	<i>Urtica dioica</i>	stinging nettle	–
Verbenaceae	VEHA2	<i>Verbena hastata</i>	swamp verbena	–
Violaceae	VINU2	<i>Viola nuttallii</i>	Nuttall's violet	–

*Indicates the rare global/state conservation rank is for a specific subspecies or variety, but the plant was only identified down to the genus and/or species.

Based on the total count of unique species observed in all plots in 2018, PCM_021 had the highest number with 58 total species, followed by PCM_004 with 56 species (Table 4). PCM_021 also had the most native species, totaling 47. Absolute cover calculations (Table 5) showed that plots visited by NGPN were on average more native than exotic. Plot LPCM_5 had no exotic species recorded using the point-intercept method. Plot LPCM_7 had the highest absolute cover of native species (123%). While plot PCM_005 had the highest absolute cover of exotic species (113%).

Table 4. Total number of plant species identified in plots monitored at Agate Fossil Beds National Monument in 2018. This is a count of all unique species identified in the plot using species data from point-intercept, quadrat, woody species, and early detection exotic species protocols.

Plot	Native Species	Exotic Species	Total Species
LPCM_3	14	6	20
LPCM_4	16	4	20
LPCM_5	22	0	22
LPCM_7	21	1	22
PCM_004	46	10	56
PCM_005	14	14	28
PCM_008	22	6	28
PCM_010	9	6	15
PCM_019	12	7	19
PCM_020	29	7	36
PCM_021	47	11	58
RCM_257	7	2	9
RCM_258	13	7	20
RCM_259	7	3	10
RCM_260	10	3	13
RCM_261	16	5	21
RCM_262	5	1	6
RCM_263	11	8	19
RCM_264	14	4	18
RCM_265	10	6	16
RCM_266	12	3	15
RCM_267	13	5	18
RCM_268	7	1	8

Table 5. Absolute percent cover of native and exotic plant species in plots monitored at Agate Fossil Beds National Monument in 2018. Absolute percent cover is calculated using the point-intercept data. This includes overlapping species canopies, which can result in values greater than 100%.

Plot	Absolute Cover %		
	Exotic	Native	<i>Iris pseudacorus</i>
LPCM_3	12	115	–
LPCM_4	19	110	–
LPCM_5	0	84	–
LPCM_7	1	123	–
PCM_004	5	121	–
PCM_005	113	38	–
PCM_008	10	82	–
PCM_010	64	55	–
PCM_019	23	122	–
PCM_020	3	68	–
PCM_021	17	122	–
RCM_257	2	64	–
RCM_258	30	59	1
RCM_259	15	43	3
RCM_260	48	77	–
RCM_261	17	78	2
RCM_262	11	53	11
RCM_263	41	49	–
RCM_264	51	67	–
RCM_265	59	59	–
RCM_266	34	62	–
RCM_267	40	46	–
RCM_268	2	45	2

Disturbances were observed in all ten of the plots where disturbance data was collected in 2018 (Table 6). The most common disturbances were small mammal and soil disturbances (Table 6). The same ten plots were assessed for the presence of early detection exotic species, but none were found in 2018. Although no early detection exotic species were observed in the upland PCM and LPCM plots, yellow iris (*Iris pseudacorus*) was found in the point-intercept data collected at five of the eleven RPCM plots. It was most abundant in RCM_262 at 11% absolute cover (Table 5).

Table 6. Disturbance type and area observed in 10 plots visited at Agate Fossil Beds National Monument by the Northern Great Plains Network in 2018. The disturbance area was approximated out of a total area of 1000 m².

Plot	Disturbance Type	Area (m ²)
LPCM_3	Small Mammal	250
LPCM_3	Soil Disturbance	250
LPCM_4	Small Mammal	3
LPCM_4	Soil Disturbance	8
LPCM_5	Animal Trail	3
LPCM_5	Soil Disturbance	3
LPCM_7	Small Mammal	4
LPCM_7	Soil Disturbance	4
PCM_004	Small Mammal	10
PCM_004	Soil Disturbance	10
PCM_005	Small Mammal	250
PCM_005	Soil Disturbance	250
PCM_008	Small Mammal	50
PCM_008	Soil Disturbance	52
PCM_019	Small Mammal	8
PCM_019	Soil Disturbance	8
PCM_020	Small Mammal	13
PCM_020	Soil Disturbance	13
PCM_021	Small Mammal	10
PCM_021	Erosion	2
PCM_021	Soil Disturbance	12



NGPN crew monitoring a riparian plant community (RCM) plot at Agate Fossil Beds National Monument (NPS)

Further Analysis

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

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