



Sand Creek Massacre National Historic Site Exotic Plants Monitoring Summary—2022

Purpose: To briefly summarize the results of the 2022 field season of Exotic Plant-Early Detection Protocol monitoring at Sand Creek Massacre National Historic Site.

Contacts: Please direct any questions to Vegetation Ecologist Merran Owen, at merran_owen@partner.nps.gov

Disclaimer: Data presented in this report are considered provisional and are for internal use only.

Grid Points Surveyed: 300 out of 300 possible

Transects Surveyed: None

Number of Extra-Area Surveys Completed: None

Field Crew: M. Owen (crew lead), C. Barry, A. Pingatore, S. Singley

Dates of Survey: July 21–26, 2022

Data Availability: All data are available to view and download through the Southwest Network Collaboration Exotics Dashboard, hosted on the NPS ArcGIS Portal.



Exotic plant monitoring at Sand Creek Massacre National Historic Site, 2022.

Monitoring Protocol

Each year, the Southern Plains Inventory & Monitoring Network (SOPN) monitors pathways of exotic plant introduction at Sand Creek Massacre National Historic Site (NHS) (SAND) and other network parks. The areas sampled are typically linear transects along roads, trails, boundary lines, and stream channels that are at high risk for exotic plant invasion and infestation. The transects for each park are divided into three panels, with one panel sampled each year. In select years, exotic plant data are also collected at predetermined grid points spaced 150 meters (m) apart and covering the entire park acreage, with areas excluded for safety or difficulty of access. Grid-point surveys are done to determine the extent and distribution of exotic plants within the park interior landscape. All transect and grid-point locations at SAND are shown in Map A-1. Surveys of additional areas, referred to as “extra-area surveys,” may also be completed upon request from park staff.

To sample transects, surveyors walk the transect length and map exotic plant infestations that occur within 30 m of the center line. Infestations are documented as points or polygons. Points are recorded as one of three size classes: under 1-m radius, 1.1 to 5-m radius, and 5.1 to 10-m radius. Infestations larger than a 10-m radius or those that exist as long, continuous stretches are recorded as polygons. Data collected for infestations include plant species name, the size of the patch, canopy cover, number of plants present in the patch, phenology (e.g., flowering or fruiting stage), and level of site disturbance. At grid points, surveyors record the exotic plant species found within a 10-m radius of the point, as well as canopy cover and phenology for each species.

The Southern Plains Network surveys for a short list of species that is customized to each park. Our intent is to document infestations for which we recommend treatment and monitor species of high concern. The monitoring list for SAND (Table 1) was drawn from the park’s Natural Resource Condition Assessment (NRCA), completed by Struthers et al. (2013). In the NRCA, exotic plants found in 2010–2012 SAND surveys were ranked across a series of factors, following a system designed by Hiebert and Stubbendieck (1993). Factors included the plant’s level of impact (current abundance, distribution, and known or perceived ecological effect), its innate pest potential (reproductive abilities, germination requirements, and competitive abilities), and the feasibility of control (the plant’s abundance versus the ease of applying control measures). The six highest-ranking plants were designated as high priority species for the park, all of which are included in our monitoring list. For further detail, see the SAND NRCA (Struthers et al. 2013).

Please contact the Vegetation Ecologist (see above) for further customization of the SAND monitoring list (Table 1). Additional species will be added as requested.

Monitoring Results

In 2022, we completed a grid-point survey at SAND. No transects were sampled. A 300-point grid covering the entire park was surveyed in July 2022 (Map A-1). Exotic plants were detected at 35% of the points surveyed (n=105). A total of five exotic plant species were recorded, all of which are high priority species for the park (Table 2). All five species have been observed at SAND in previous exotic surveys.

To compare results of the 2022 survey to previous grid-point surveys at SAND, this report includes data and maps (see Table 2 and Appendix A) summarizing results for the same five species in our 2015 survey, conducted June 26–July 1. The full results of the 2015 survey are available on the Southwest

Network Collaboration (SWNC) Exotics Dashboard, hosted on the NPS ArcGIS Portal. The 2015 survey was conducted before the addition of the parcel south of County Road W and therefore included less acreage, affecting our ability to make a direct comparison. Both surveys used the same 150-m grid, but the 2015 survey covered 2,386 acres and 236 grid points, while the 2022 survey covered 3,025 acres and 300 grid points. To mitigate for the difference in area surveyed, our maps present both positive results and non-detects. Frequency for each species, calculated as the percentage of grid points at which a given species occurred, is shown for both years (Table 2), but the numbers are not directly comparable because the total number of points surveyed was different for each year.

Dominant Exotic Species

The majority of exotic plant cover detected in our survey came from two annual forbs: kochia (*Kochia scoparia*; Map A-4 [left map]) and Russian thistle (*Salsola tragus*; Map A-7 [left map]). Kochia occurred at 26% of grid points, and Russian thistle at 24% (Table 2). The distribution of these two species was similar—both were found across the northern section of the park and along the creek bed and canals east of the visitor center. Kochia was often higher in cover. Kochia and Russian thistle were not as widely distributed in 2022 as they were in the 2015 survey, and they do not appear to be expanding to new areas of the park (Maps A-4 [left and right] and A-7 [left and right]). However, we cannot assume this represents a downward trend. As annual plants, these species germinate en masse in spring and early summer, flower, set seed, and die by the end of the growing season. The number of plants emerging each spring is sensitive to the timing and amount of precipitation, meaning that population size may fluctuate widely from year to year (Beckie and Francis 2009, Friesen et al. 2009).

Kochia and Russian thistle were both designated as high priority species for SAND due to their pest potential and ecological impact (Table 1). Kochia is slightly higher in priority (Struthers et al. 2013).

Treatment Recommendations

Research on kochia and Russian thistle control in non-agricultural settings is limited. As annual forbs, kochia and Russian thistle have similar life cycles and require similar methods of control. Both species reproduce only by seed, which they produce by the thousands, but seeds remain viable for only a few years (Beckie and Francis 2009, Friesen et al. 2009). Mowing is an effective form of control for kochia, but it does not kill the plants or necessarily prevent them from producing a second crop of seed. To best control seed production, we recommend mowing when flowers first appear. A study in North Dakota demonstrated that mowing in late July or early August significantly reduced kochia in the following year and allowed seeded perennial grasses to grow and establish (Iverson and Wali 1987). Some of the success of mowing may be due to the short-lived seed banks of these species, but populations can recover quickly if left unmonitored.

Chemical treatments will also effectively control kochia and Russian thistle, but broadleaf herbicides often reduce the cover and biodiversity of native forbs as well. Since kochia and Russian thistle are common agricultural weeds, many herbicide-resistant biotypes have evolved (Beckie and Francis 2009, Friesen et al. 2009).

Data Availability

Data for all exotic plant species recorded in 2022 are summarized in maps in Appendix A, and data for these species from 2015 are shown as well. Maps showing species distributions are presented in

alphabetical order by scientific name. All data are available to SAND park staff and Invasive Plant Management Teams through the SWNC Exotics Dashboard (Figure 1), hosted on the NPS ArcGIS Portal. The dashboard is a user-friendly place to download spatial files showing exact locations and sizes of infestation points and polygons. You can also view, subset, and filter the data in the Portal interface. Exotic plant data collected by SOPN since 2009 may be accessed there. To open the dashboard, activate or sign-in to your ArcGIS Portal account, contact the SOPN Vegetation Ecologist to request your name be added to the SWNC Exotics Dashboard group, and then open this group on the ArcGIS Portal. There are two dashboards available: one including data from 2009–2019, collected under a previous protocol, and one with data from 2020 to the present, collected under the protocol described in this report.

To further discuss the results of the 2022 Exotic Plant-Early Detection survey, please contact the SOPN Vegetation Ecologist or Invasive Plant Management Team staff.

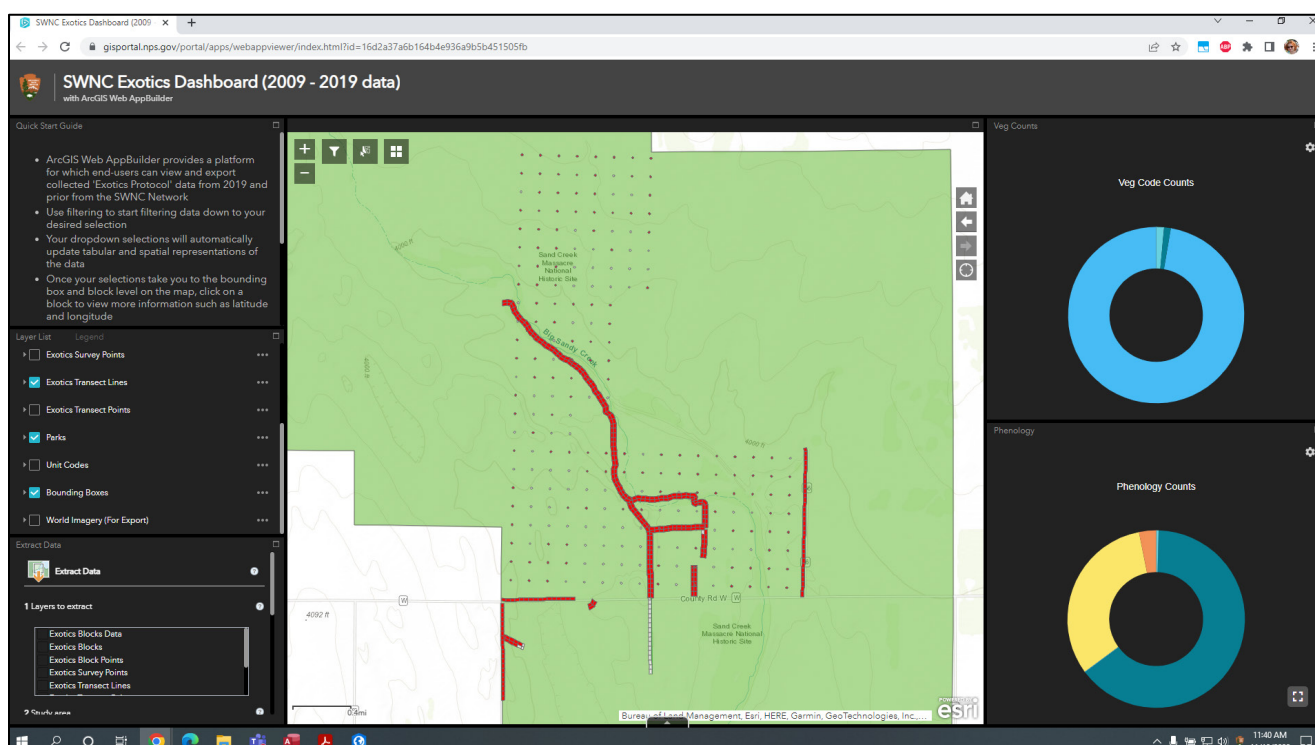


Figure 1. Screen shot of the Southwest Network Collaboration (SWNC) Exotics Dashboard, hosted on the NPS ArcGIS Portal, which can be used to view and download spatial files showing locations and sizes of exotic plant infestations.

Table 1. Exotic plant species included in the 2022 SAND Exotic Plant-Early Detection survey. Species determined as high priority in the Natural Resource Condition Assessment are marked with an asterisk. Level of impact, pest potential, and feasibility of control were the factors used to determine priority status. The quantitative ranges for each factor are as follows: level of impact ranges from –8 to 50, pest potential from 4 to 50, and feasibility of control from 3 to 100. Higher rankings indicate a higher level of impact, a greater pest potential, and a greater feasibility of control, respectively (Struthers et al. 2013).

Scientific Name	Common Name	Level of Impact	Pest Potential	Feasibility of Control
<i>Bromus japonicus</i>	Japanese brome	NA	NA	NA
<i>Bromus tectorum</i> *	Cheatgrass	14	41	31
<i>Cirsium arvensis</i>	Canada thistle	9	34	41
<i>Convolvulus arvensis</i> *	Bindweed	14	46	15
<i>Euphorbia esula</i>	Leafy spurge	NA	NA	NA
<i>Kochia scoparia</i> *	Kochia	20	32	35
<i>Linaria vulgaris</i>	Yellow toadflax	–8	48	40
<i>Melilotus</i> sp.* ¹	Sweetclover	26	29	26
<i>Poa pratensis</i> *	Kentucky bluegrass	7	50	41
<i>Salsola tragus</i> *	Russian thistle	17	29	23

¹ Species of *Melilotus* are identified to genus only in SOPN Exotic Plant-Early Detection surveys.

Table 2. Exotic plant species observed in the 2022 SAND Exotic Plant-Early Detection survey. Species determined as high priority in the Natural Resource Condition Assessment (Struthers et al. 2013) are marked with an asterisk. Frequency is calculated as the percentage of grid points at which a given species occurred. Frequencies of these species in the 2015 survey are also shown, although the results are not directly comparable. An additional 658 acres and 64 grid points were surveyed in 2022.

Scientific Name	Common Name	Life Form	Duration	Frequency 2022	Frequency 2015
<i>Kochia scoparia</i> *	Kochia	Forb ²	Annual ³	26%	38%
<i>Salsola tragus</i> *	Russian thistle	Forb	Annual	24%	53%
<i>Melilotus</i> sp.* ¹	Sweetclover	Forb	Biennial ⁴	3%	1%
<i>Convolvulus arvensis</i> *	Bindweed	Vine	Perennial	0.7%	0.4%
<i>Poa pratensis</i> *	Kentucky bluegrass	Grass	Perennial	0.3%	0%

¹ Species of *Melilotus* are identified to genus only in SOPN Exotic Plant-Early Detection surveys.

² A forb is a herbaceous (non-woody) flowering plant that is not a grass. The colloquial term is “wildflower.”

³ Annual plants germinate, flower, produce seed, and die in the space of one growing season, while perennials flower and produce seed for many years.

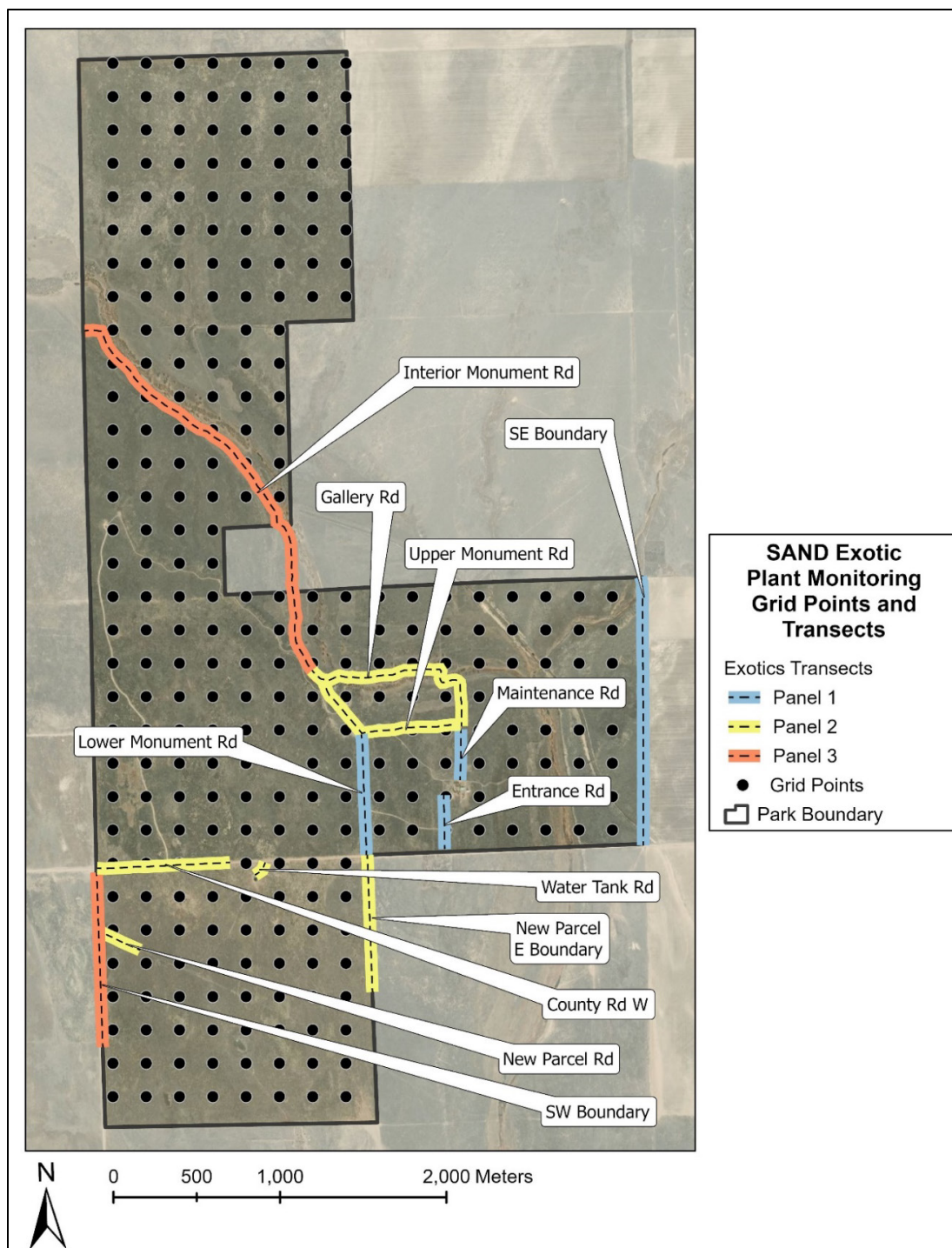
⁴ Biennial plants complete their life cycle in two years and generally do not flower in their first year.

Literature Cited

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- Friesen, L. F., H. J. Beckie, S. I. Warwick, and R. C. Van Acker. 2009. The biology of Canadian weeds. 138. *Kochia scoparia* (L.) Schrad. Canadian Journal of Plant Science 89:141–167.
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Appendix A. Sand Creek Massacre National Historic Site Exotic Plant-Early Detection Survey Maps, 2022 (and 2015)

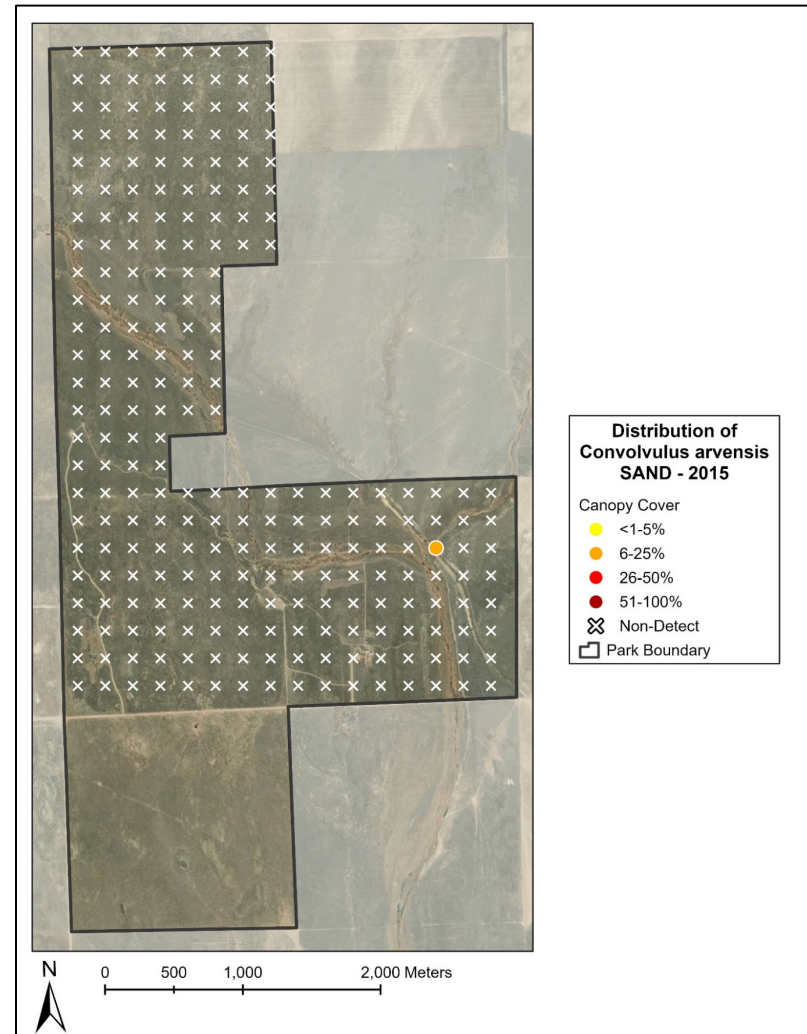
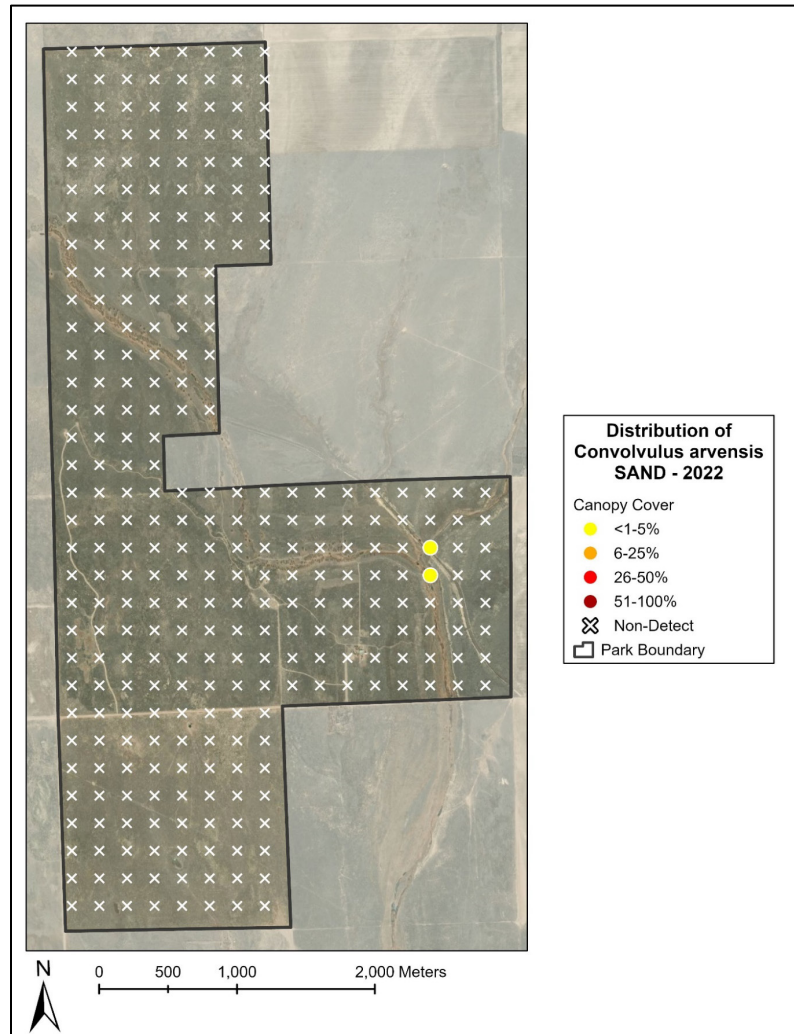
Map A-1. Map showing all exotic plant transect and grid-point locations for Sand Creek Massacre NHS. Transects are broken into three panels, with one panel surveyed each year. Grid points are 150 m apart, and areas with >30% slope are excluded.



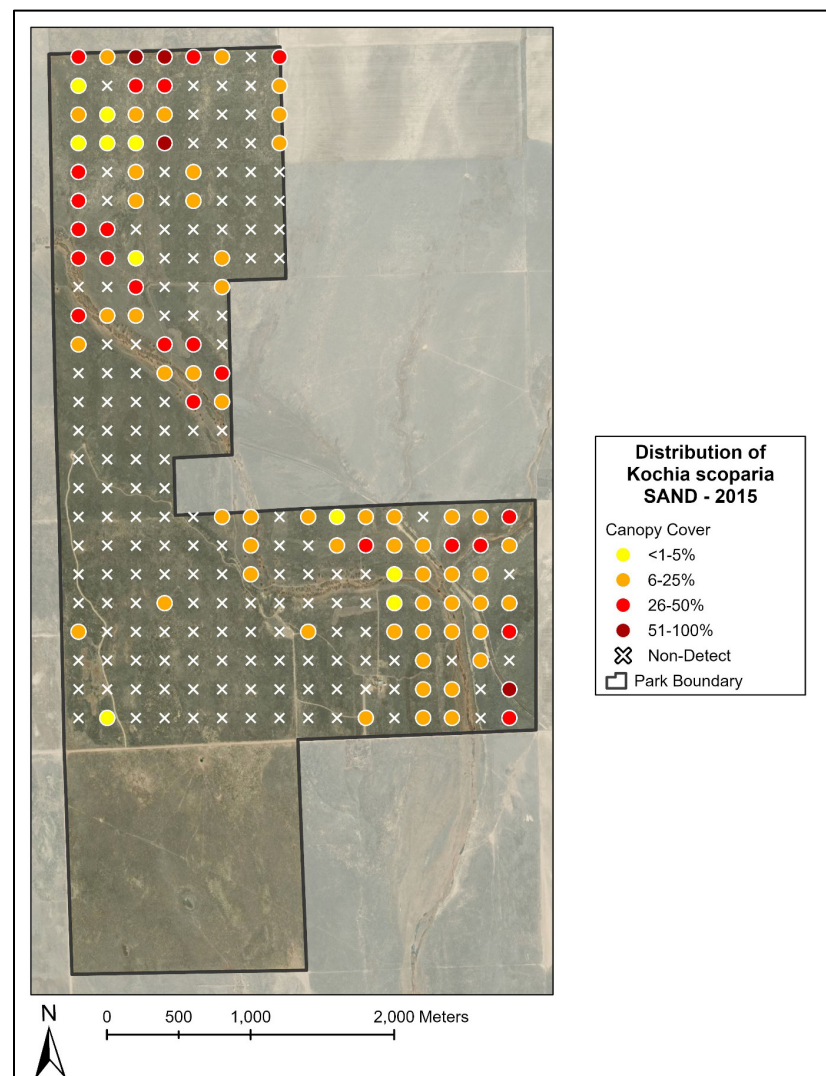
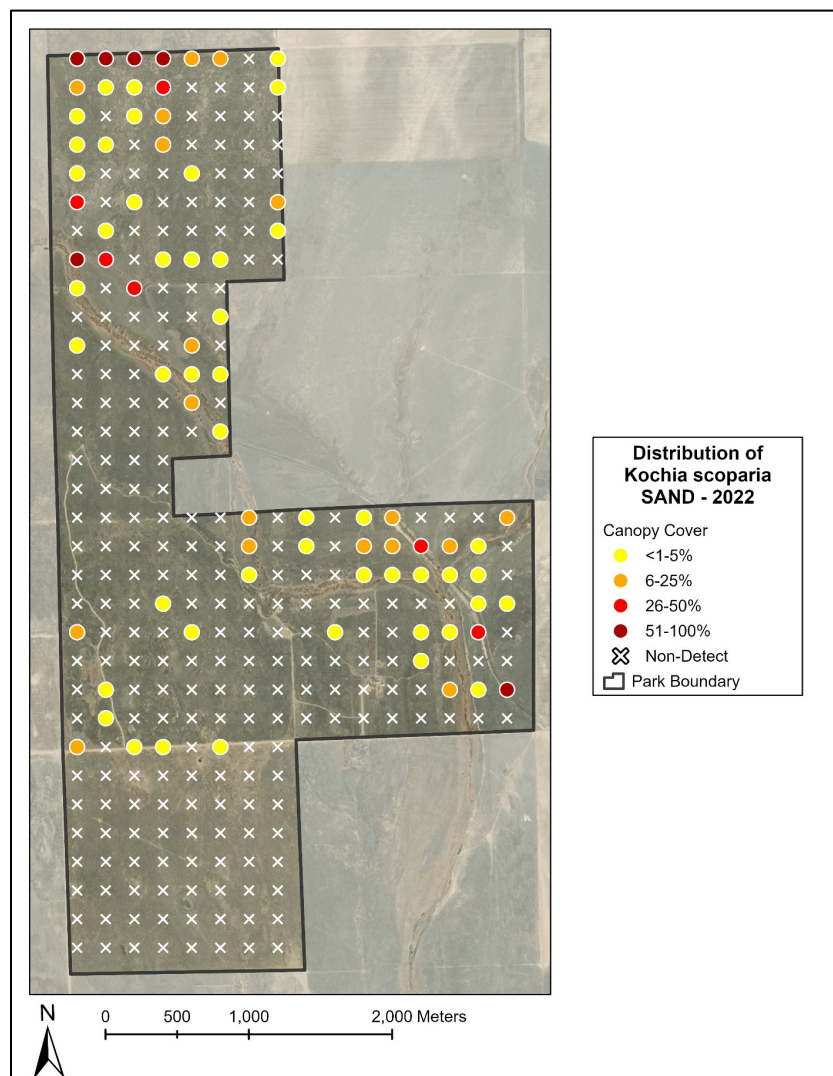
Map A-2. Grid points included in the June 24–July 1, 2015 Sand Creek Massacre NHS exotic plant survey. Grid points are 150 m apart, and areas with >30% slope are excluded.



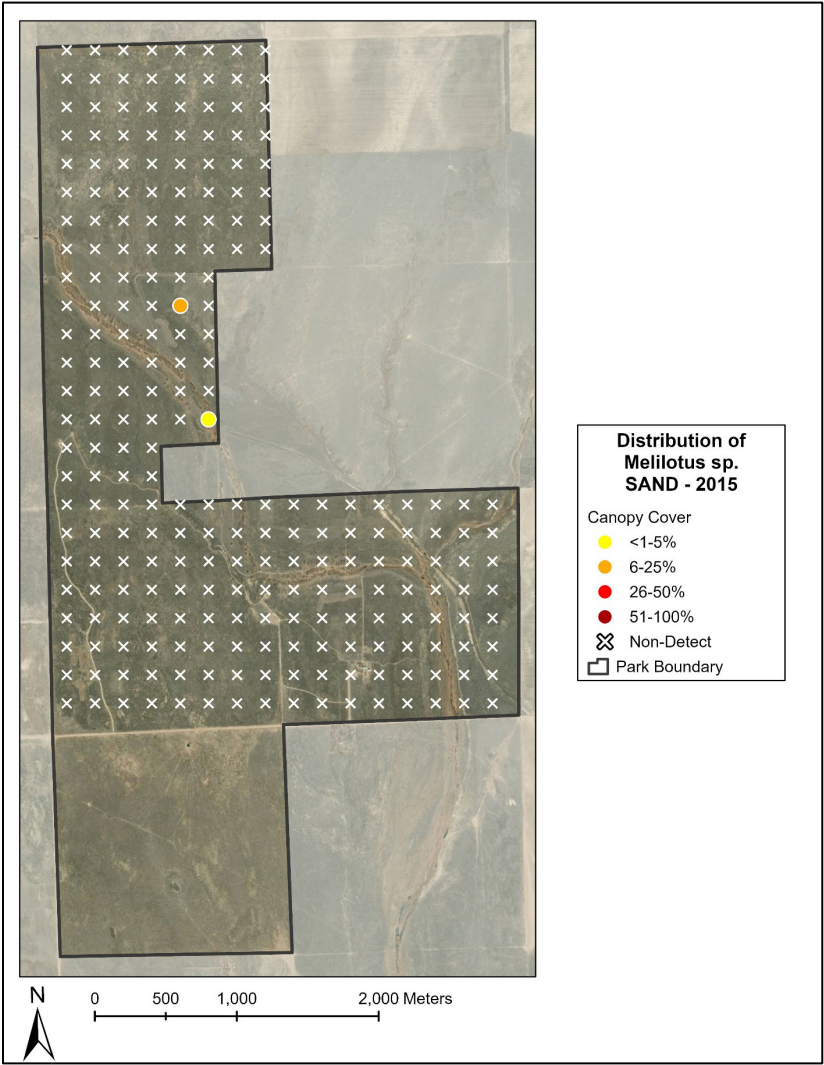
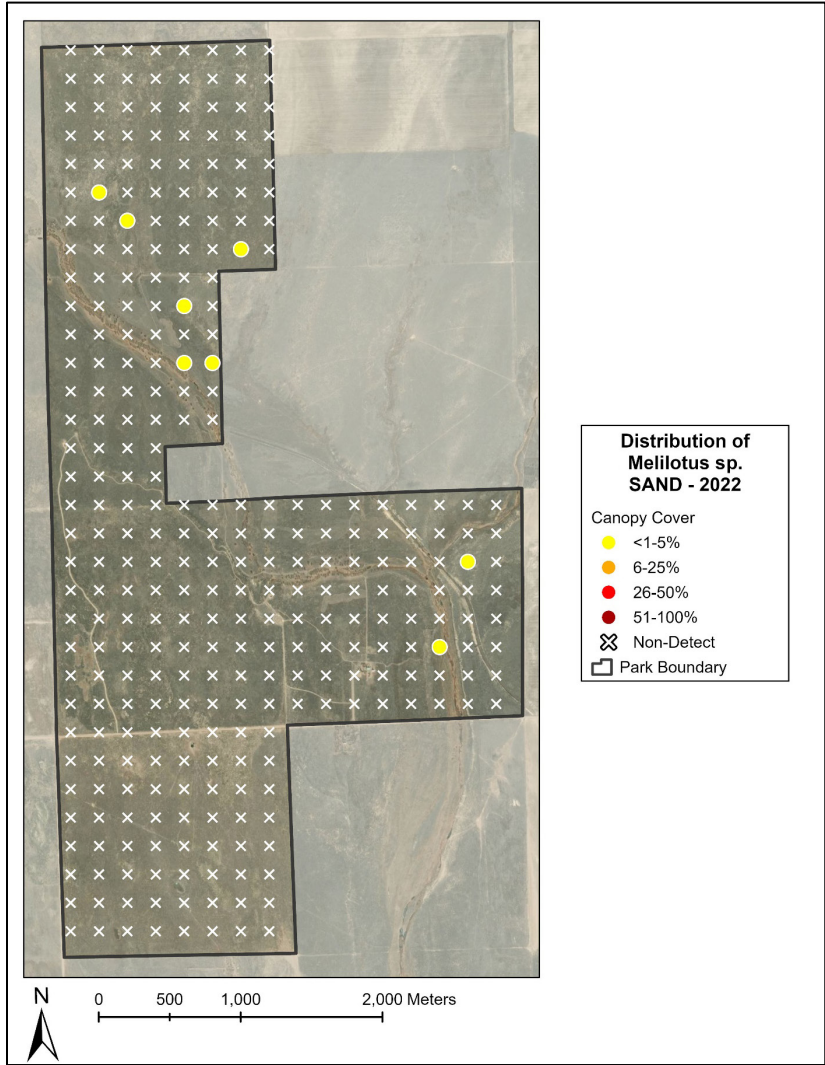
Map A-3. Bindweed (*Convolvulus arvensis*) distribution and canopy cover recorded in July 2022 surveys (left map) and June–July 2015 surveys (right).



Map A-4. *Kochia (Kochia scoparia)* distribution and canopy cover recorded in July 2022 surveys (left map) and June–July 2015 surveys (right map).



Map A-5. Sweetclover (*Melilotus* sp.) distribution and canopy cover recorded in July 2022 surveys (left map) and June–July 2015 surveys (right map).



Map A-6. Kentucky bluegrass (*Poa pratensis*) distribution and canopy cover recorded in July 2022 surveys. This species was not detected in June–July 2015 surveys.



Map A-7. Russian thistle (*Salsola tragus*) distribution and canopy cover recorded in July 2022 surveys (left map) and June–July 2015 surveys (right map).

