



Washita Battlefield 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 Washita Battlefield National Historic Site.

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

Grid Points Surveyed: 256 out of 281 possible

Transects Surveyed: None

Number of Extra-Area Surveys Completed: None

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

Dates of Survey: June 9–14, 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 Washita Battlefield National Historic Site, 2022. NPS/MERRAN OWEN

Monitoring Protocol

Each year, the Southern Plains Inventory & Monitoring Network (SOPN) monitors pathways of exotic plant introduction at Washita Battlefield National Historic Site (NHS) (WABA) 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 100 meters (m) apart, 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 WABA are shown in Map A-1 (in the appendix). 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 WABA (Table 1) was drawn from the park’s Natural Resource Condition Assessment (NRCA), completed by Struthers et al. (2014). In the NRCA, exotic plants found in 2009–2012 WABA 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 eleven 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 WABA NRCA (Struthers et al. 2014).

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

Monitoring Results

In 2022, we completed a grid-point survey at WABA. No transects were sampled. A 281-point grid covering the majority of the park was surveyed in June 2022; grid points in areas of thick brush, poison ivy (*Toxicodendron* spp.), or water were excluded (Map A-2). The survey was not fully completed due to time constraints, but the crew was able to visit 256 of the 281 points attempted. Exotic plants were detected at 93% of points surveyed (n=238) in 2022. A total of 11 exotic plant species were recorded, eight of which are designated as high priority species for the park (Tables 1–2). All 11 species have been observed at WABA in previous exotic plant surveys.

To compare results of the 2022 survey to previous grid-point surveys at WABA, this report includes data and maps (see Table 2 and Appendix A) summarizing the results for the same 11 species in our 2012 survey, conducted May 30th–June 2nd. The full results of the 2012 survey are available on the Southwest Network Collaboration (SWNC) Exotics Dashboard, hosted on the NPS ArcGIS Portal. Both surveys (2022 and 2012) used the same 100-m grid, but data were collected at a higher number of grid points (312) in 2012, affecting our ability to make a direct comparison. 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

In 2022, Japanese brome (*Bromus japonicus*; Map A-5 [top]) was the most frequently detected exotic plant—found at 46% of grid points (Table 2). This species was distributed across the park bottomlands and in the southeastern uplands. Its close relative, cheatgrass (*Bromus tectorum*), was far less common and located mainly along the southeast boundary and near the railroad grade (Map A-5 [bottom]). Both species are exotic annual grasses ranked as high priority species for the park, and both have a strong potential to impact native grasses and forbs (Struthers et al. 2014). While annual brome infestations recorded in 2022 were widespread and significant, there was a notable decrease in frequency from the 2012 grid-point survey (Table 2, Map A-6). However, this should not be taken as a downward trend. As annual plants, these species germinate en masse in fall and early spring, flower, set seed, and die by the end of the growing season. The number of plants emerging each year is sensitive to the timing and amount of precipitation, meaning that population size may fluctuate widely from year to year (Northup et al. 2002). The NRCA completed by Struthers et al. (2014) describes 2012 as a banner year for annual bromes (with abnormally high populations) due to the specific pattern of precipitation.

Johnsongrass (*Sorghum halepense*; Map A-12 [top]) was our second most frequently detected exotic plant in 2022, with infestations recorded at 40% of grid points (Table 2). Johnsongrass thrives in disturbed, moist soils with full sun exposure (Klein and Smith 2021, Travlos et al. 2019) and is distributed throughout the park bottomlands. This species is an extremely aggressive rhizomatous grass highly capable of outcompeting native plants in disturbed soils, and as such was ranked as a high priority species for the park (Struthers et al. 2014). The distribution of Johnsongrass within the park appears to have contracted a small amount since 2012 (Table 2, Map A-12).

Yellow bluestem (*Bothriochloa ischaemum*; Map A-4 [top]) was detected at 26% of grid points in 2022. Its frequency and canopy cover have increased from 2012 (Map A-4 [bottom]), and we recorded several points of moderate to high cover in both park uplands and bottomlands. Yellow bluestem is a drought-tolerant, perennial grass with the capability to form monocultures in disturbed soils. It was also ranked as a high priority species by Struthers et al. (2014).

Treatment Recommendations

We recommend Japanese brome and Johnsongrass as primary targets for long-term management and control. Given its expansion within the park over the last ten years, we recommend adding yellow bluestem as a primary target as resources become available.

Exotic annual bromes are hypothesized to increase in Great Plains grasslands in the absence of natural disturbances such as fire and grazing. The lack of disturbance allows litter to accumulate and creates a hospitable environment for annual bromes to germinate and establish (Kirsch and Kruse 1972, Whisenant and Uresk 1990). Consequently, prescribed fire and targeted grazing have proven to be effective methods for reducing litter loads and controlling annual brome populations (Harmony 2007, Whisenant and Uresk 1990). In heavily invaded areas, fire alone is not as effective as fire used in concert with chemical treatments (Symstad et al. 2021).

Research on Johnsongrass control in non-agricultural settings is limited. Management plans must account for the fact that it reproduces and spreads through both seed and rhizomes. Rhizomes are a network of below-ground stems from which the plant sends up shoots and establishes dense, clonal patches, and in the case of Johnsongrass, the root/rhizome network may account for over half the plant's biomass (Klein and Smith 2021). Mowing, used as a proxy for grazing, is known to weaken Johnsongrass rhizomes and improve the efficacy of chemical treatments. Repeated mowing, followed by herbicide application, is necessary for control. Mowing is also effective at preventing seed formation and dispersal. Johnsongrass seeds are viable for up to 10 years and will form a seed bank if allowed (Klein and Smith 2021, Travlos et al. 2019).

To reduce the cover of yellow bluestem, studies have shown good results through multiple chemical treatments within the same growing season. For example, Robertson et al. (2013) achieved a significant reduction of cover in western Oklahoma through glyphosate applications performed in May, August, and September of the same year. Mowing alone does not provide control, nor does a single herbicide treatment each year. Revegetation with native perennial grasses is recommended after such an intense regime of chemical control (Robertson et al. 2013) to prevent reinvasion of yellow bluestem or other exotic plant species.

Data Availability

Data for all exotic plant species recorded in 2022 are summarized in maps in Appendix A, and data for these species from 2012 are shown as well. Maps showing species distributions are presented in alphabetical order by scientific name. All data are available to WABA 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.

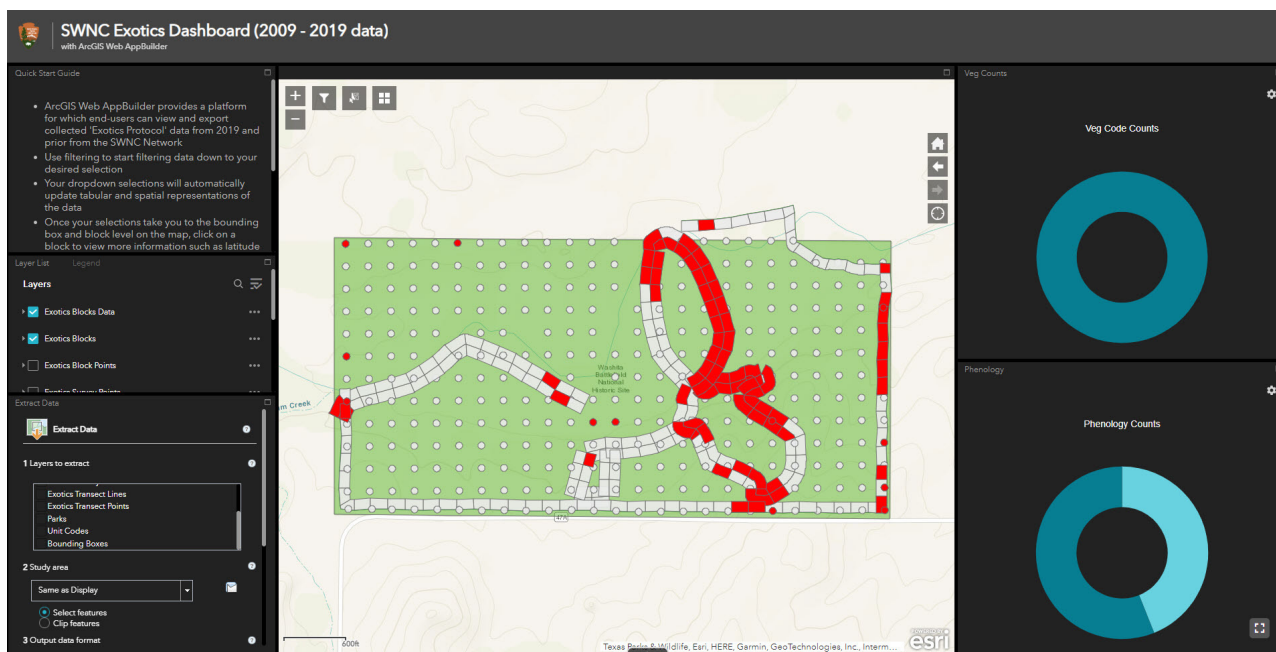


Figure 1. Screen shot of the Southwest Network Collaboration (SWNC) Exotics Dashboard, hosted on the NPS ArcGIS Portal, which can be used to view and download spatial files showing locations and sizes of exotic plant infestations.

Table 1. Exotic plant species included in the 2022 WABA Exotic Plant-Early Detection survey. Species determined as high priority in the Natural Resource Condition Assessment (Struthers et al. 2014) 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.

Scientific Name	Common Name	Level of Impact	Pest Potential	Feasibility of Control
<i>Bothriochloa ischaemum</i> *	Yellow bluestem	35	41	27
<i>Bromus japonicus</i> *	Japanese brome	31	29	28
<i>Bromus tectorum</i> *	Cheatgrass	35	41	18
<i>Cirsium arvensis</i>	Canada thistle	–8	48	36
<i>Cirsium vulgare</i>	Bull thistle	10	34	44
<i>Convolvulus arvensis</i> *	Bindweed	12	46	14
<i>Cynodon dactylon</i> *	Bermudagrass	26	29	17
<i>Melilotus</i> sp.* ¹	Sweetclover	28	29	25
<i>Kochia scoparia</i>	Kochia	15	32	33
<i>Sorghum halepense</i> *	Johnsongrass	32	45	23
<i>Tamarix</i> sp.* ¹	Tamarisk	36	48	42
<i>Ulmus pumila</i> *	Siberian elm	41	32	8

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

Table 2. Exotic plant species observed in the 2022 WABA Exotic Plant-Early Detection survey. Species determined as high priority in the Natural Resource Condition Assessment (Struthers et al. 2014) 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 2012 survey are also shown, although the results are not directly comparable. Data were collected at 312 grid points in 2012 and 256 grid points in 2022, with both surveys using the same 100-m grid.

Scientific Name	Common Name	Life Form	Duration	Frequency 2022	Frequency 2012
<i>Bromus japonicus</i> *	Japanese brome	Grass	Annual ²	46%	N/A ³
<i>Sorghum halepense</i> *	Johnsongrass	Grass	Perennial	40%	42%
<i>Bothriochloa ischaemum</i> *	Yellow bluestem	Grass	Perennial	26%	7%
<i>Melilotus</i> sp.* ¹	Sweetclover	Forb ⁴	Annual/Biennial ⁵	22%	5%
<i>Salsola tragus</i>	Russian thistle	Forb	Annual	18%	2%
<i>Ulmus pumila</i> *	Siberian elm	Shrub/Tree	Perennial	17%	36%
<i>Bromus tectorum</i> *	Cheatgrass	Grass	Annual	12%	N/A ³
<i>Tragopogon dubius</i>	Salsify	Forb	Annual/Biennial ⁵	8%	7%
<i>Cynodon dactylon</i> *	Bermudagrass	Grass	Perennial	7%	3%
<i>Kochia scoparia</i>	Kochia	Forb	Annual	7%	5%
<i>Convolvulus arvensis</i> *	Bindweed	Vine	Perennial	0.4%	0%

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

² Annual plants germinate, flower, produce seed, and die in the space of one growing season, while perennials flower and produce seed for many years.

³ In 2012, surveyors did not distinguish between *B. japonicus* and *B. tectorum*. The combined frequency for both species was 99%. In 2022, the combined frequency was 52%.

⁴ A forb is a herbaceous (non-woody) flowering plant that is not a grass. The colloquial term is “wildflower.”

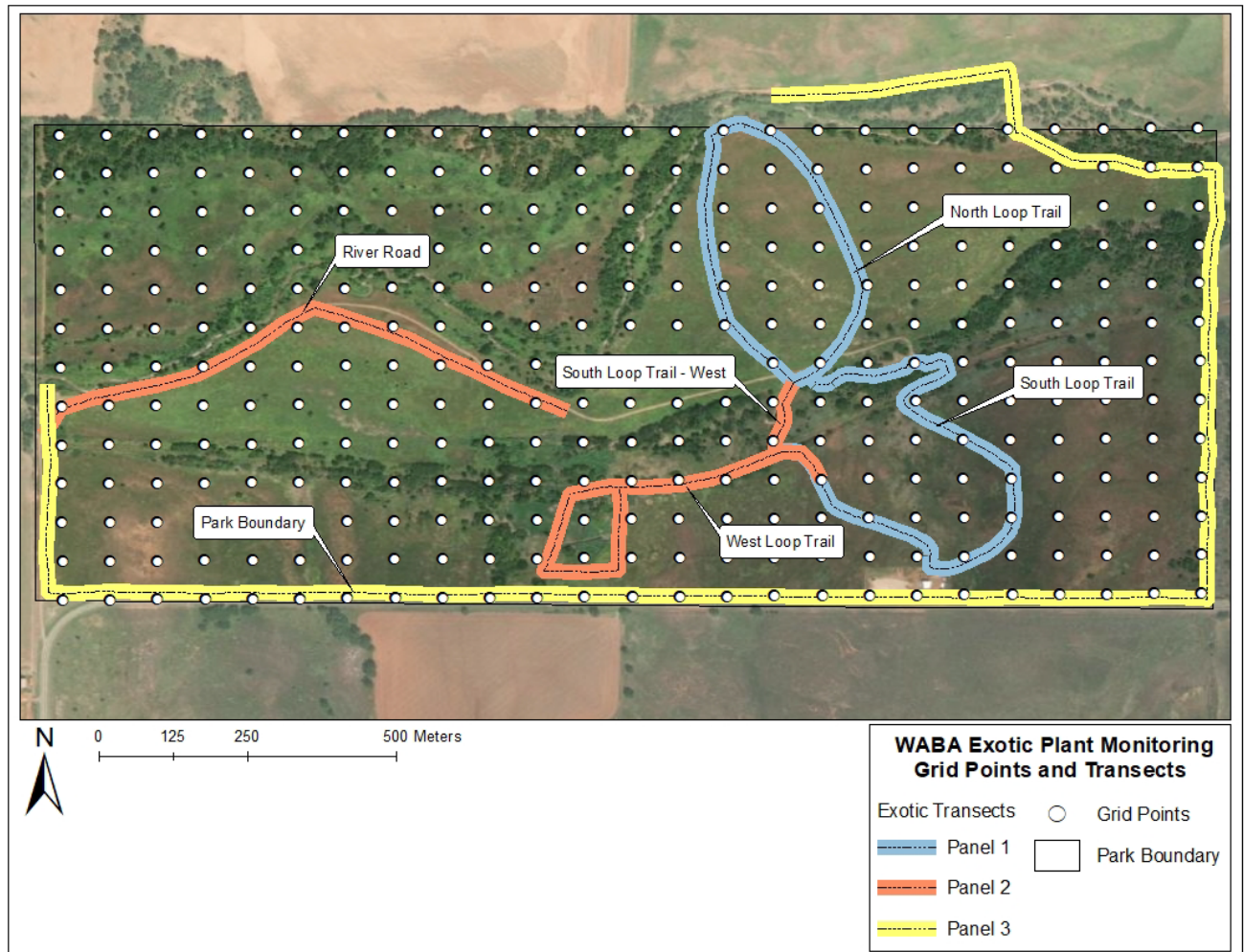
⁵ Biennial plants complete their life cycle in two years and generally do not flower in their first year.

Literature Cited

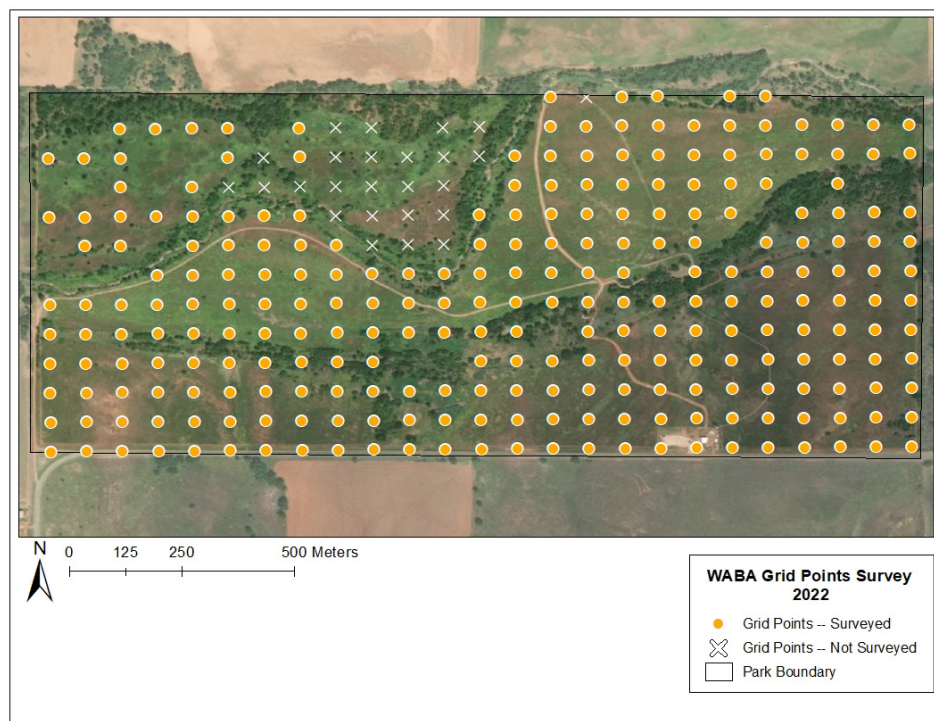
- Harmony, K. R. 2007. Grazing and burning Japanese brome (*Bromus japonicus*) on mixed grass rangelands. *Rangeland Ecology and Management* 60(5):479–486.
- Hiebert, R. D., and J. Stubbendieck. 1993. Handbook for ranking exotic plants for management and control. Natural Resources Report NPS/NRMWRO/NRR/93/08. National Park Service, Midwest Regional Office, Omaha, Nebraska, and University of Nebraska, Department of Agronomy, Lincoln, Nebraska.
- Kirsch, L. M., and A. D. Kruse. 1972. Prairie fires and wildlife. Tall Timbers Research Station.
- Klein, P., and C. M. Smith. 2021. Invasive Johnsongrass, a threat to native grasslands and agriculture. *Biologia* 76(2):413–420.
- Northup, B. K., J. M. Schneider, and J. A. Daniel. 2002. The effects of management and precipitation on forage composition of a southern tallgrass prairie. In *Proceedings of the 15th Conference on Biometeorology and Aerobiology, Kansas City, Missouri, USA (Vol. 27)*.
- Robertson, S., H. R. Hickman, K. R. Harmony, and D. M. Leslie, Jr. 2013. Combining glyphosate with burning or mowing improves control of yellow bluestem (*Bothriochloa ischaemum*). *Rangeland Ecology and Management* 66(3):376–381.
- Struthers, K., R. E. Bennetts, N. Chambers, T. Folts-Zettner, H. Sosinski, and P. Valentine-Darby. 2014. Washita Battlefield National Historic Site: Natural resource condition assessment. Natural Resource Report NPS/SOPN/NRR—2014/748. National Park Service, Fort Collins, Colorado.
- Symstad, A. J., D. A. Buhl, and D. J. Swanson. 2021. Fire controls annual bromes in northern Great Plains grasslands—up to a point. *Rangeland Ecology and Management* 75:17–28.
- Travlos, I. S., J. M. Montull, G. Kukorelli, G. Malidza, M. N. Dogan, N. Cheimona, N. Antonopoulos, P. J. Kanatas, S. Zannopoulos, and G. Peteinatos. 2019. Key aspects on the biology, ecology and impacts of Johnsongrass [*Sorghum halepense* (L.) Pers] and the role of glyphosate and non-chemical alternative practices for the management of this weed in Europe. *Agronomy* 9(11):717.
- Whisenant, S. G., and D. W. Uresk. 1990. Spring burning Japanese brome in a western wheatgrass community. *Rangeland Ecology and Management/Journal of Range Management* 43(3):205–208.

Appendix A. Washita Battlefield National Historic Site Exotic Plant-Early Detection Survey Maps, 2022 (and 2012)

Map A-1. Map showing all exotic plant transect and grid-point locations for Washita Battlefield NHS. Transects are broken into three panels, with one panel surveyed each year. Grid points are 100 m apart, and areas with >30% slope are excluded.



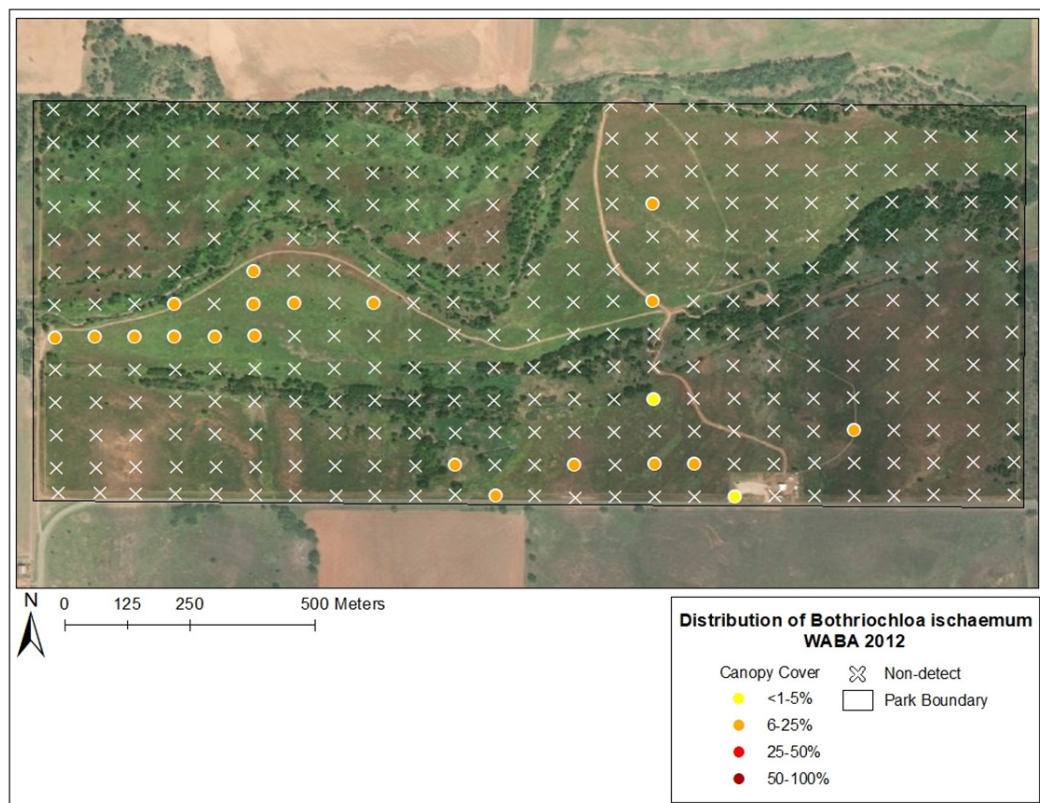
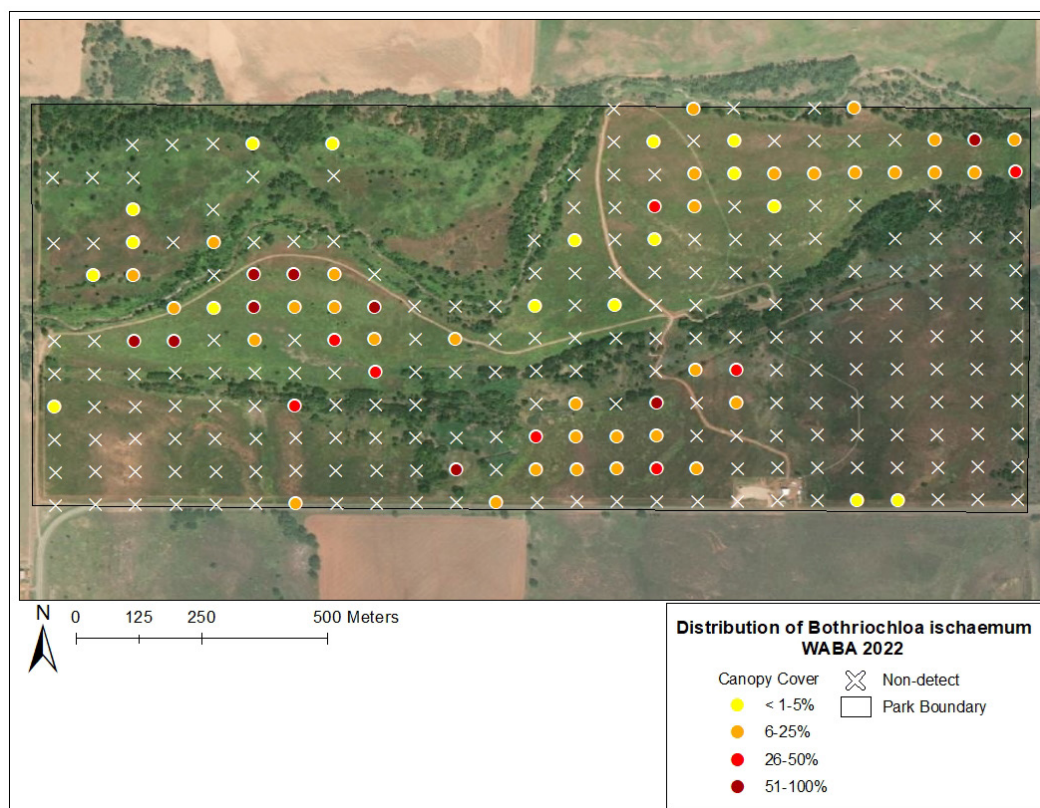
Map A-2. Grid points included in the June 2022 SOPN exotic plant survey. The survey was not fully completed due to time constraints. Grid points the crew were unable to visit are marked as “not surveyed” below. The 2022 grid did not cover the entire park, as points in areas of thick brush, poison ivy, or water were excluded. We attempted to survey 281 points but were able to complete 256 points.



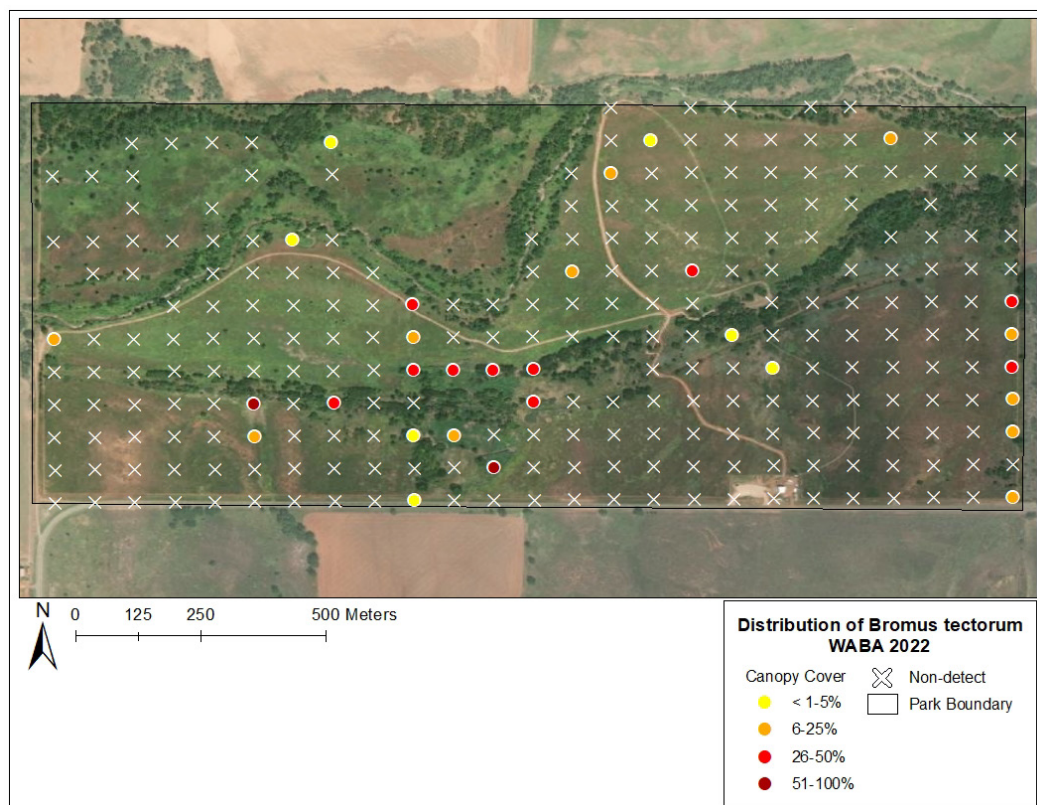
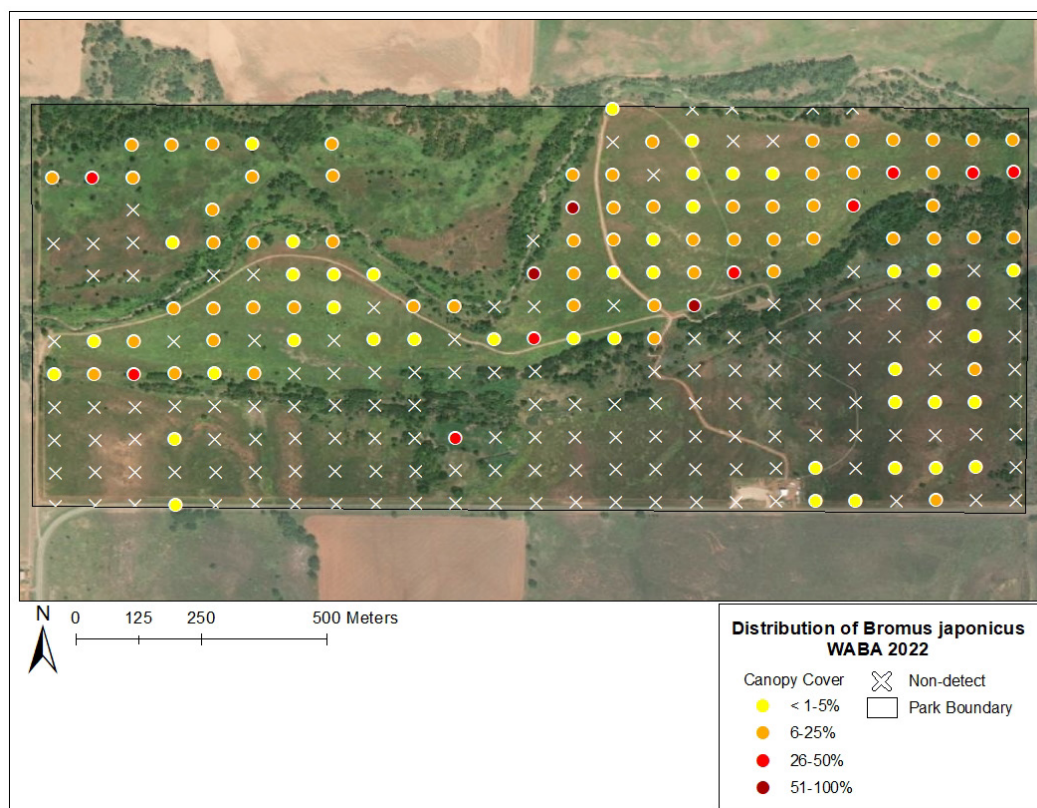
Map A-3. Grid points included in the May–June 2012 SOPN exotic plant survey. Data were collected at 312 grid points. Areas of water were excluded.



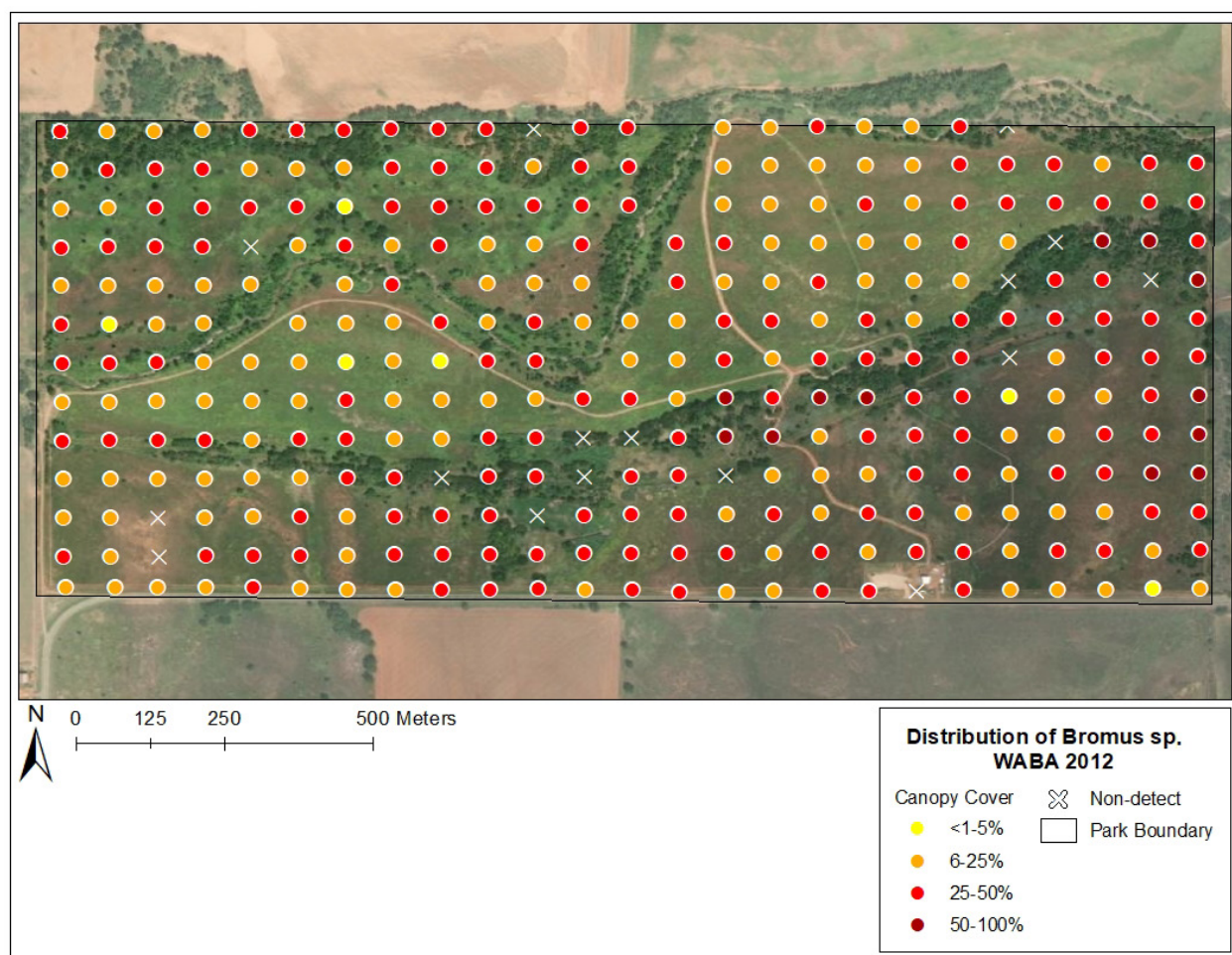
Map A-4. Yellow bluestem (*Bothriochloa ischaemum*) distribution and canopy cover recorded in June 2022 surveys (top map) and May–June 2012 surveys (bottom map).



Map A-5. Japanese brome (*Bromus japonicus*) distribution and canopy cover (top map) and cheatgrass (*Bromus tectorum*) distribution and canopy cover (bottom map) recorded in June 2022 surveys.



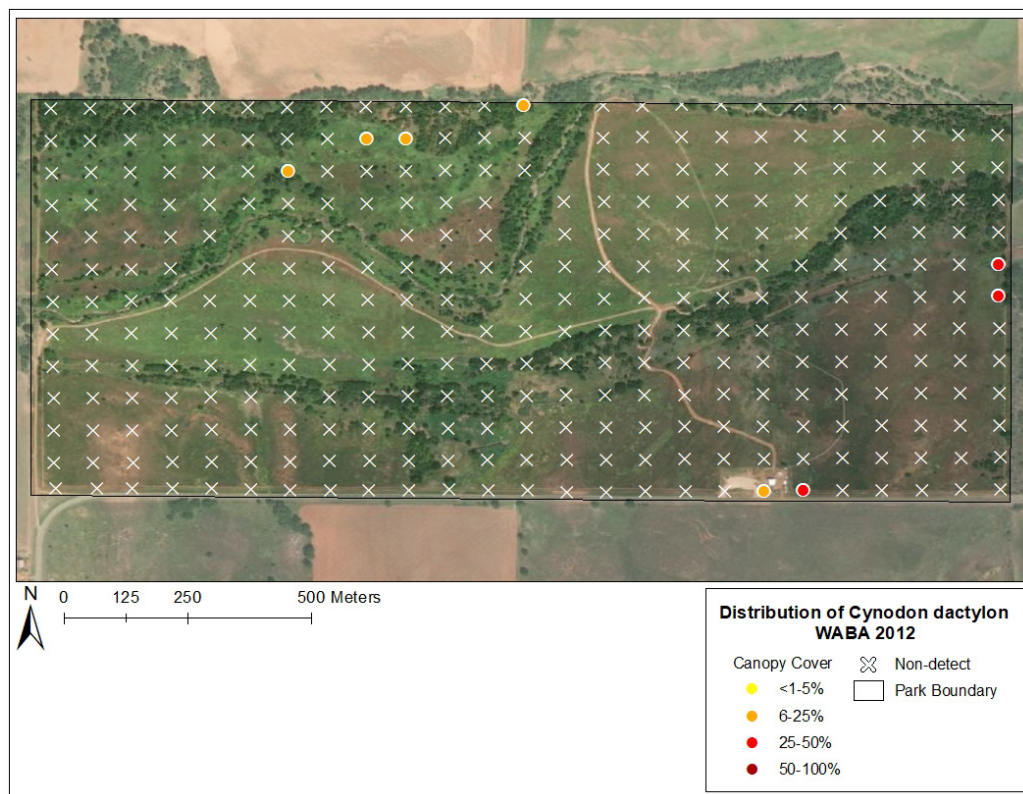
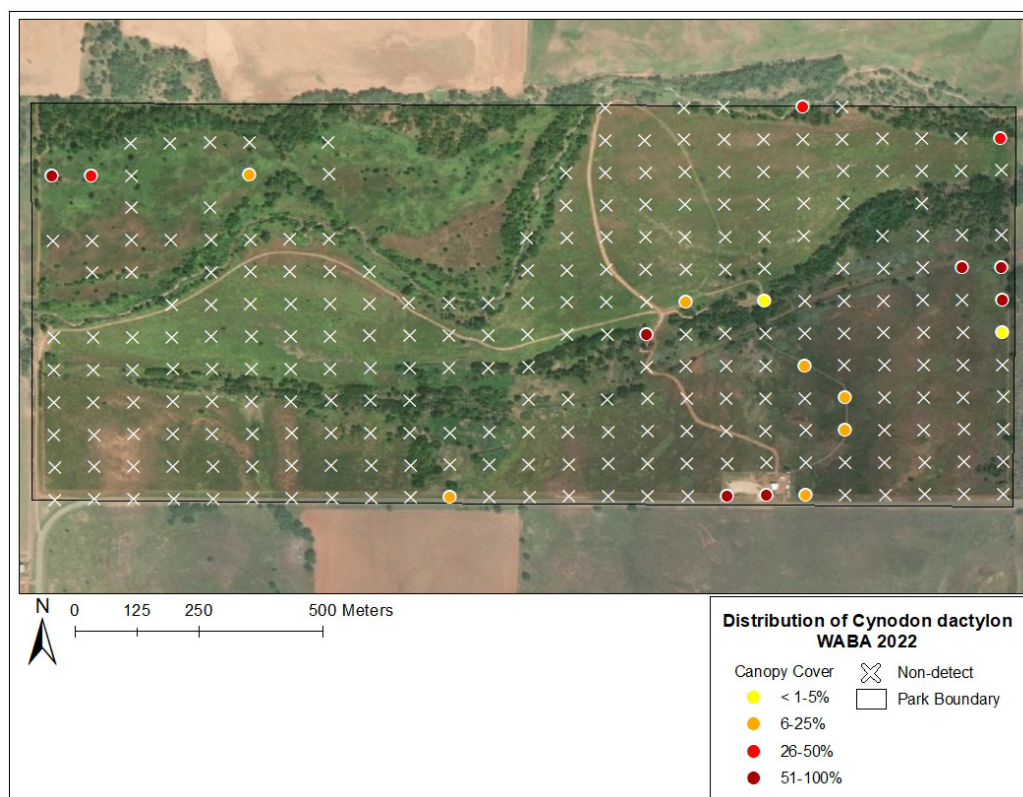
Map A-6. Annual brome (*Bromus japonicus* and *B. tectorum*) distribution and canopy cover recorded in May–June 2012 surveys. Surveyors did not distinguish between *B. japonicus* and *B. tectorum* in 2012.



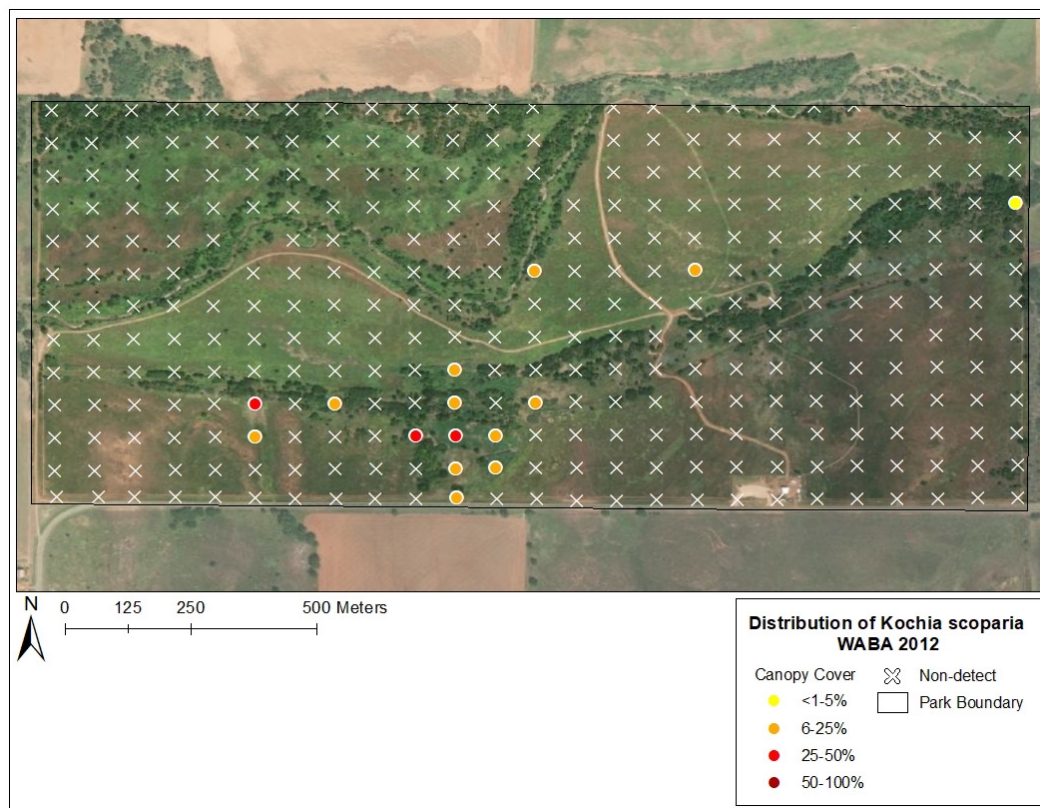
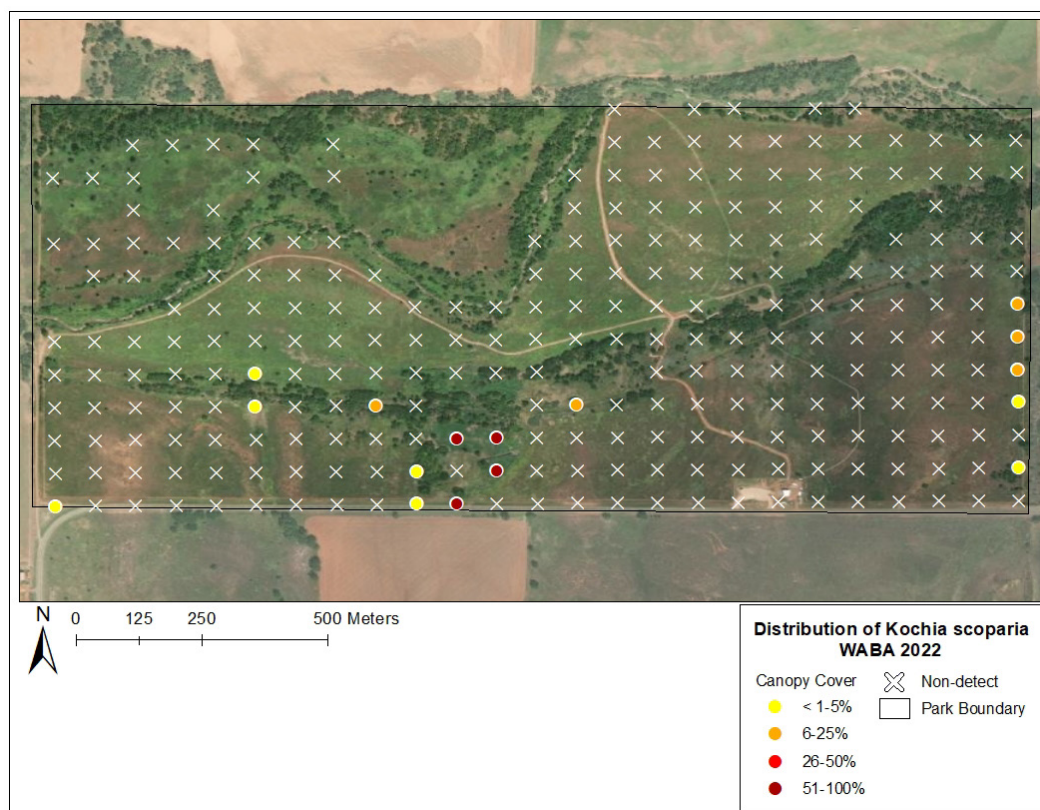
Map A-7. Bindweed (*Convolvulus arvensis*) distribution and canopy cover recorded in June 2022 surveys. Bindweed was not detected in May–June 2012 surveys.



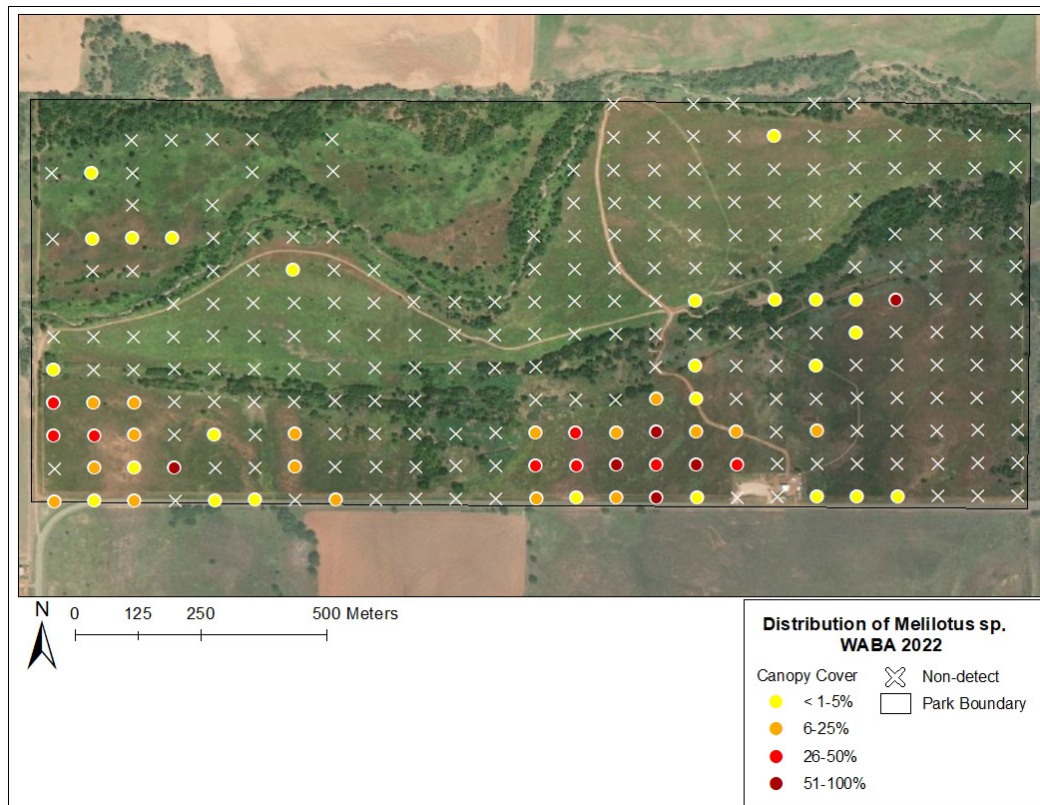
Map A-8. Bermudagrass (*Cynodon dactylon*) distribution and canopy cover recorded in June 2022 surveys (top map) and May–June 2012 surveys (bottom map).



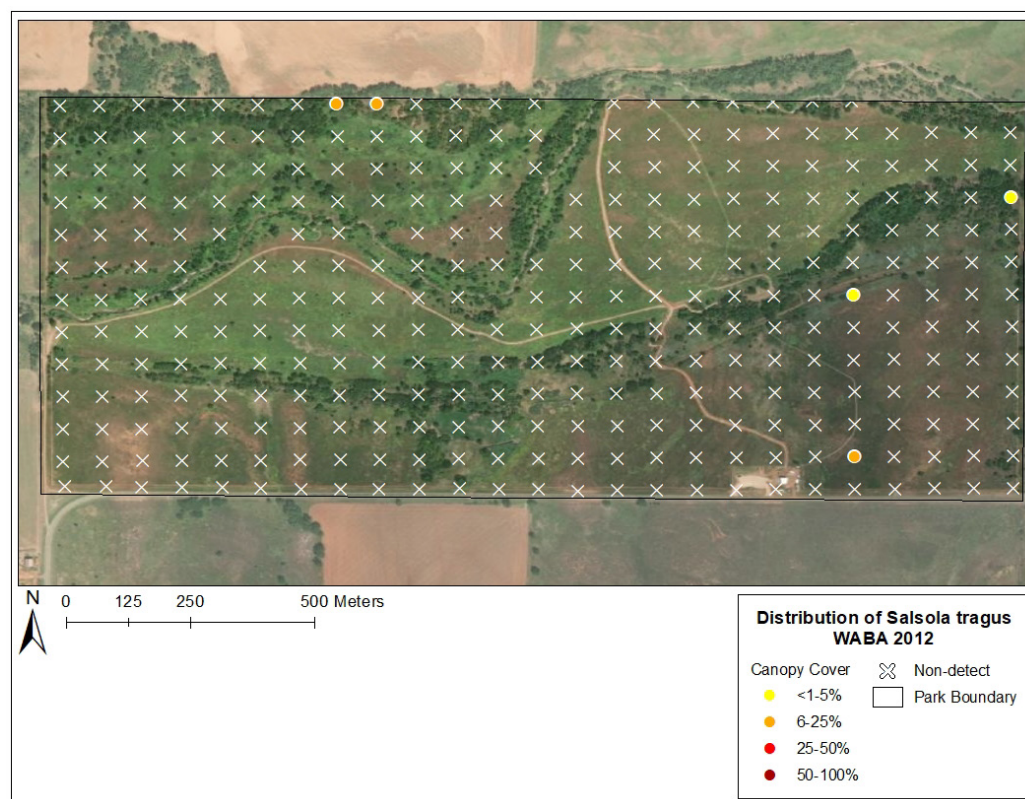
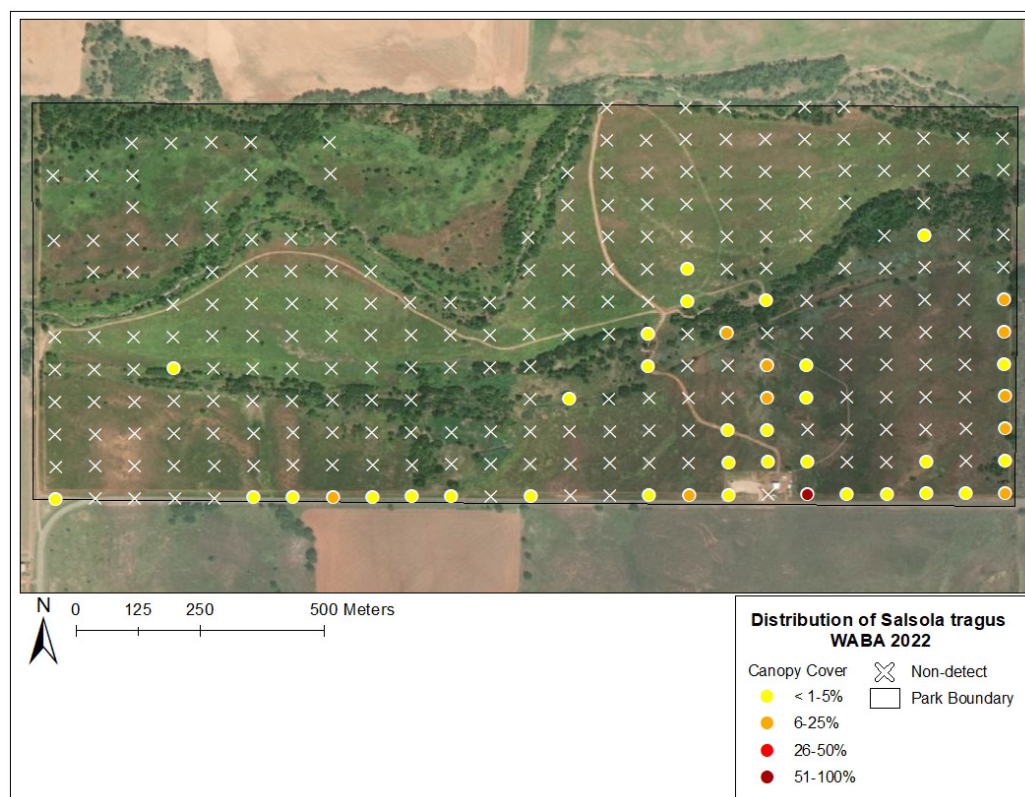
Map A-9. *Kochia* (*Kochia scoparia*) distribution and canopy cover recorded in June 2022 surveys (top map) and May–June 2012 surveys (bottom map).



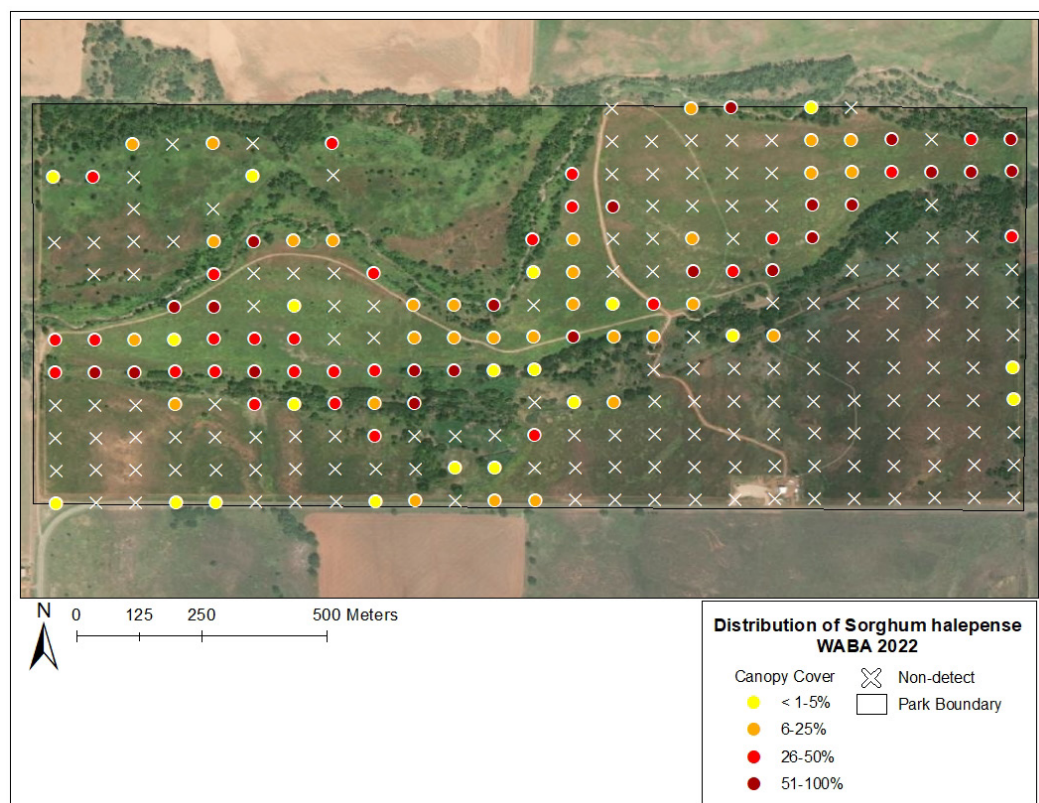
Map A-10. Sweetclover (*Melilotus* sp.) distribution and canopy cover recorded in June 2022 surveys (top map) and May–June 2012 surveys (bottom map).



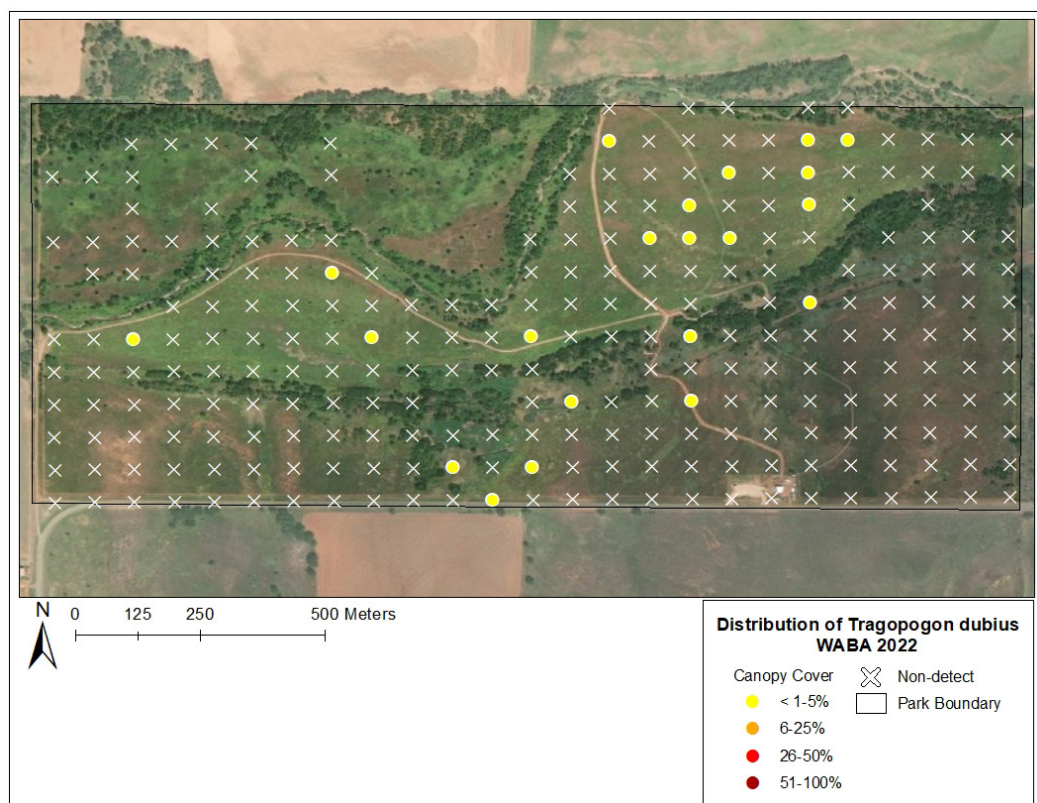
Map A-11. Russian thistle (*Salsola tragus*) distribution and canopy cover recorded in June 2022 surveys (top map) and May–June 2012 surveys (bottom map).



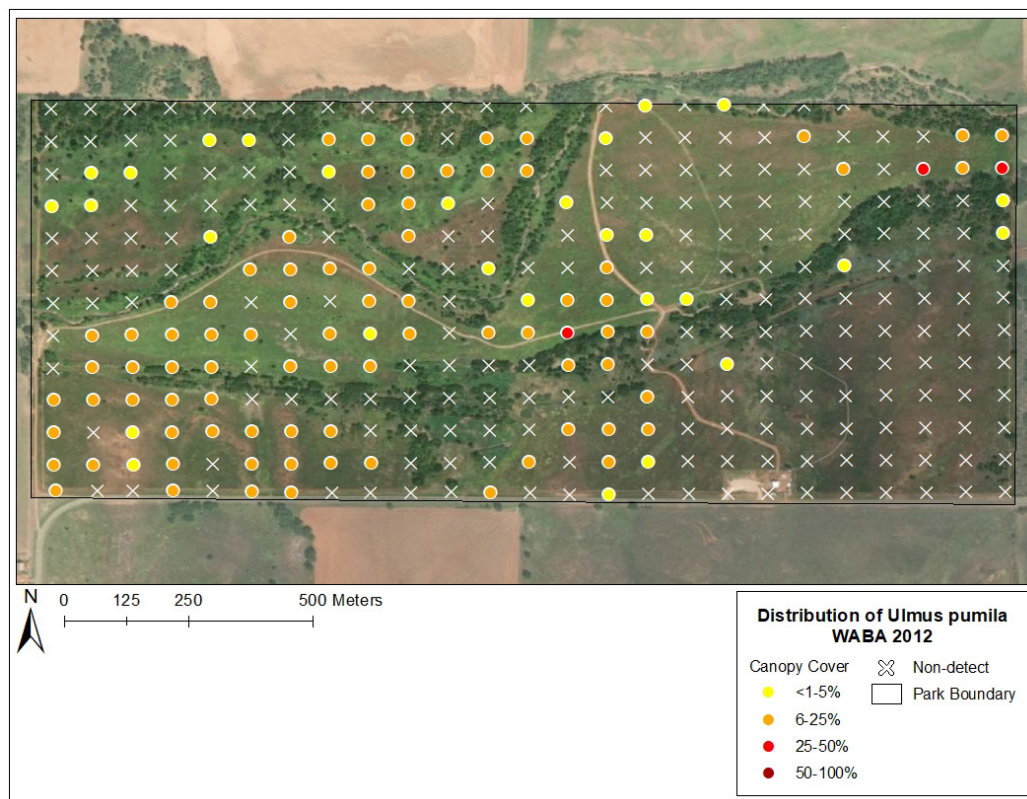
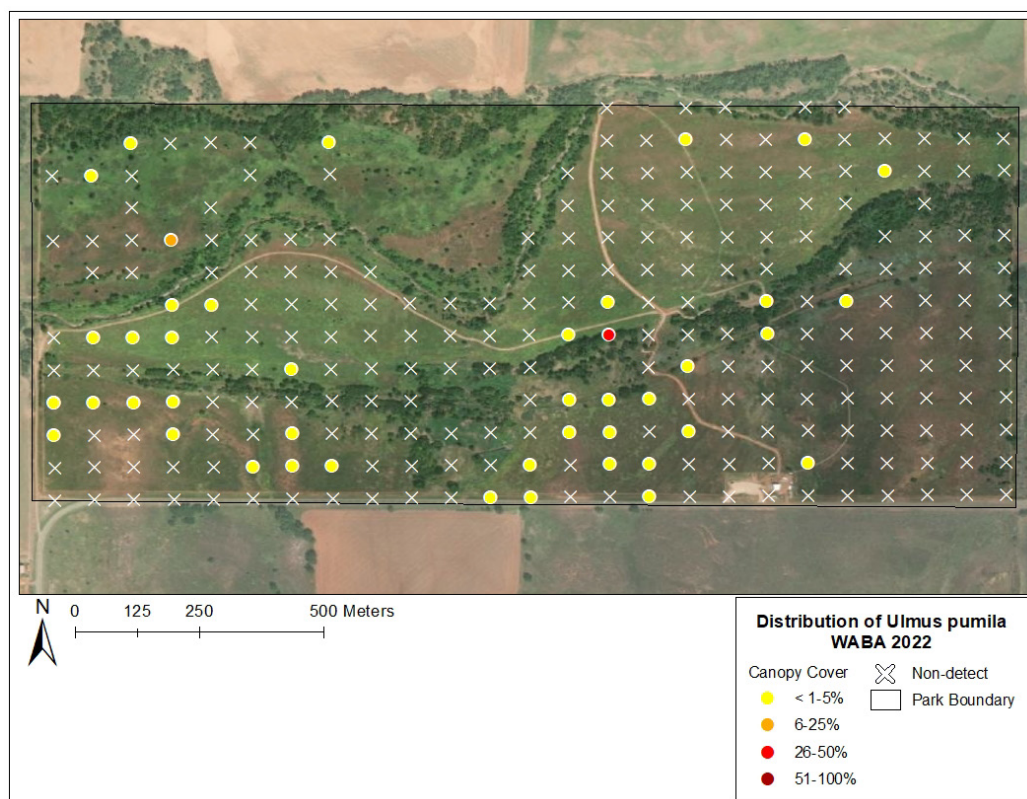
Map A-12. Johnsongrass (*Sorghum halepense*) distribution and canopy cover recorded in June 2022 surveys (top map) and May–June 2012 surveys (bottom map).



Map A-13. Western salsify (*Tragopogon dubius*) distribution and canopy cover recorded in June 2022 surveys (top map) and May–June 2012 surveys (bottom map).



Map A-14. Siberian elm (*Ulmus pumila*) distribution and canopy cover recorded in June 2022 surveys (top map) and May–June 2012 surveys (bottom map).



Report Disclaimer

This report received peer review by subject-matter experts who were not directly involved in the collection, analysis, or reporting of the data, and whose background and expertise put them on par technically and scientifically with the authors of the information. Peer review helps to ensure that the information is scientifically credible, technically accurate, appropriate to its intended audience, and effectively presented. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were summarized and interpreted within the guidelines of the protocols. Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.