



Bent's Old Fort National Historic Site Invasive Plant Monitoring Summary—2024

Summary

In August 2024, the Southern Plains Inventory & Monitoring Network (SOPN) completed an invasive plant grid-point survey of Bent's Old Fort National Historic Site (BEOL). Grid-point surveys are an element of our Exotic Plant–Early Detection Protocol and provide data on the extent and distribution of invasive plants within the park interior landscape. At each grid point, we surveyed a 10-m-radius circle for 13 high-priority invasive plants and estimated canopy cover for the species found. The most frequently found species were two annual forbs: kochia and Russian thistle, recorded at 76% and 63% of grid points, respectively. The remaining species were found at lower frequencies (8% of grid points or less), but included aggressive species of concern, such as tamarisk, Russian knapweed, and Canada thistle. Bermudagrass, Russian olive, and perennial pepperweed were recorded in our grid-point surveys for the first time, though all were previously known to occur at BEOL. We recommend kochia as a primary target for long-term management and control, and, as resources permit, we recommend initiating management of the growing number of invasives in the park bottomlands, beginning with perennial pepperweed. Maps showing distribution and canopy cover for all recorded species can be found in Appendix A.



Invasive plant monitoring at Bent's Old Fort National Historic Site, 2024. NPS/MERRAN OWEN

Dates of Survey: August 1–2, 2024

Field Crew: K. Fahey (lead), E. Ormand

Data Availability: All data are available to view through the Southwest Network Collaboration (SWNC) Exotics Dashboard, hosted on the NPS Geospatial Portal.

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Monitoring Results

In early August of 2024, we surveyed a 150-m grid covering the full extent of BEOL, minus any areas unsafe or under water. Grid-point locations are shown in Map A-1. This survey was performed as a part of SOPN's Exotic Plant–Early Detection Protocol and has been performed before, in 2013 and 2017, using the same 111 sampling points. Our intent is to monitor species of high concern and document infestations for which we recommend treatment. At each grid point, we sampled a 10-m-radius circle for a customized list of 13 invasive species (see Monitoring Protocol section for further detail). Frequency, calculated as the percentage of grid points at which a given species occurred, is shown in [Table 1](#), and maps showing species distribution and cover are presented in Appendix A (in alphabetical order by scientific name, Map A-2 to A-11). To facilitate the comparison of invasive species distribution and cover over time, we included results from SOPN's earliest, 2013, survey in this report's maps and tabular summaries.

Key Points

- We recorded occurrences for 10 out of the 13 species ([Table 1](#)). Two annual forbs, kochia (*Kochia scoparia*) and Russian thistle (*Salsola tragus*), were by far the most frequent.
- Nearly all species found showed slight to moderate increases in frequency from 2013. Only tamarisk (*Tamarix* spp.) and cheatgrass (*Bromus tectorum*) showed a decline.
- We detected four species that were not observed in 2013: Bermudagrass (*Cynodon dactylon*), Russian olive (*Elaeagnus angustifolia*), perennial pepperweed (*Lepidium latifolium*), and smooth brome (*Bromus inermis*). All were previously known to occur in the park, and smooth brome was found in the intervening, 2017, grid survey. None of the four were widely distributed, but their new presence in grid-point surveys suggests they may be spreading.
- We did not record any occurrences of cheatgrass (*Bromus tectorum*), Japanese brome (*Bromus japonicus*), or Johnsongrass (*Sorghum halepense*). The two bromes have been seen along park entrance and service roads, and Johnsongrass is established along the irrigation canal adjacent to the park's northern boundary. We will continue to monitor for Johnsongrass, as it could become problematic if it were to spread into park wetlands.
- Our results indicate a growing presence and diversity of perennial, patch-forming invasives in the park bottomlands. This includes species such as Russian knapweed (*Rhaponticum repens*) and Canada thistle (*Cirsium arvense*), in addition to the Bermudagrass, perennial pepperweed, and smooth brome listed above. These species are rhizomatous, meaning that they have extensive networks of creeping roots, giving them the potential to establish dense, clonal patches. This behavior is most apparent in the dense ring of Canada thistle surrounding the park wetlands. Once

monocultures have formed, they are costly to control and often require revegetation for a return to native species.

Treatment Recommendations

We discussed treatment recommendations for kochia and perennial pepperweed in our 2022 Exotic Plant Monitoring Summary (Owen et al. 2022), but we reemphasize a few points here. Given the growing abundance and diversity of species difficult to control, we recommend a systematic, adaptive approach to management, in coordination with the regional NPS Invasive Plant Management Team (IPMT).

Kochia

- The most abundant invasives found in our survey were kochia (Map A-6) and Russian thistle (Map A-9). Kochia has a significant presence in the park bottomlands and revegetated areas, while Russian thistle is more pervasive in dry soils such as the park's sand sage shrubland. Both species showed an increase in frequency from 2013. Without active control, populations this size may displace native plants and affect wildlife habitat. Kochia and Russian thistle are well known to the park, and kochia has been identified as a priority for management.
- Kochia is an annual forb, meaning that each year's population germinates in Spring and early Summer, flowers, sets seed, and dies by the end of the growing season. These plants reproduce only by seed, which they produce by the tens of thousands (Friesen et al. 2009). The common strategy used to control invasive annual forbs is to prevent adult plants from setting seed.
- Chemical treatments will control kochia if applied while the plants are young and actively growing. However, kochia is a common agricultural weed and many herbicide-resistant biotypes have evolved (Friesen et al. 2009). Herbicide mixtures are now often necessary for control (Burton et al. 2014). Given the difficulty of controlling kochia through herbicide, we recommend consulting with IPMT before implementing any chemical treatments.
- Although mowing does not kill the plant or necessarily prevent it from producing a crop of seed, it may temper seed production if done at the correct life stage (Friesen et al. 2009). 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). Populations can recover quickly if left unmonitored, and mowing at the incorrect life stage is less effective.

Perennial Pepperweed

- We recommend the park initiate control for rhizomatous invasive species that are still low in cover and not yet widely distributed across the park. This would make perennial pepperweed the most feasible choice for control. Our crews have not yet observed this species forming dense patches, as we have with all other rhizomatous invasives at the park.
- Perennial pepperweed is an opportunistic plant that invades seasonally wet soils with a history of disturbance (e.g., plowing, inappropriate grazing). To control infestations, the root rhizomes must be killed. Even if the visible portion of the plant is killed, new shoots may re-emerge within the

course of a season if the roots are left alive to reproduce. It often takes multiple years of chemical control to exhaust and fully kill a rhizomatous root network (Renz 2002, Young et al. 1995).

- Research in California has shown that chemical treatments of glyphosate or chlorsulfuron applied in the spring, before the plant blooms, will significantly reduce populations. Mowing does not control perennial pepperweed and is only necessary to open up the canopy of large, dense infestations (Renz 2002, Young et al. 1995).

Data Availability

Distribution and cover of all invasive plant species recorded in 2024 are summarized in maps in Appendix A—presented in alphabetical order by scientific name. All data are available to BEOL park staff and IPMTs through the Southwest Network Collaboration (SWNC) Exotics Dashboard (Figure 1), hosted on the NPS Geospatial Portal. The dashboard is a user-friendly place to view spatial files showing exact locations and sizes of infestation points and polygons. You can also subset and filter the data in the Portal interface. Invasive plant data collected by SOPN since 2009 may be accessed there. To open the dashboard, activate or sign-in to your Geospatial Portal account, contact the SOPN Data Manager to request that your name be added to the SWNC Exotics Dashboard group, and then open this group on the Geospatial 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 2024 invasive plant survey, please contact the SOPN Vegetation Ecologist or IPMT staff.

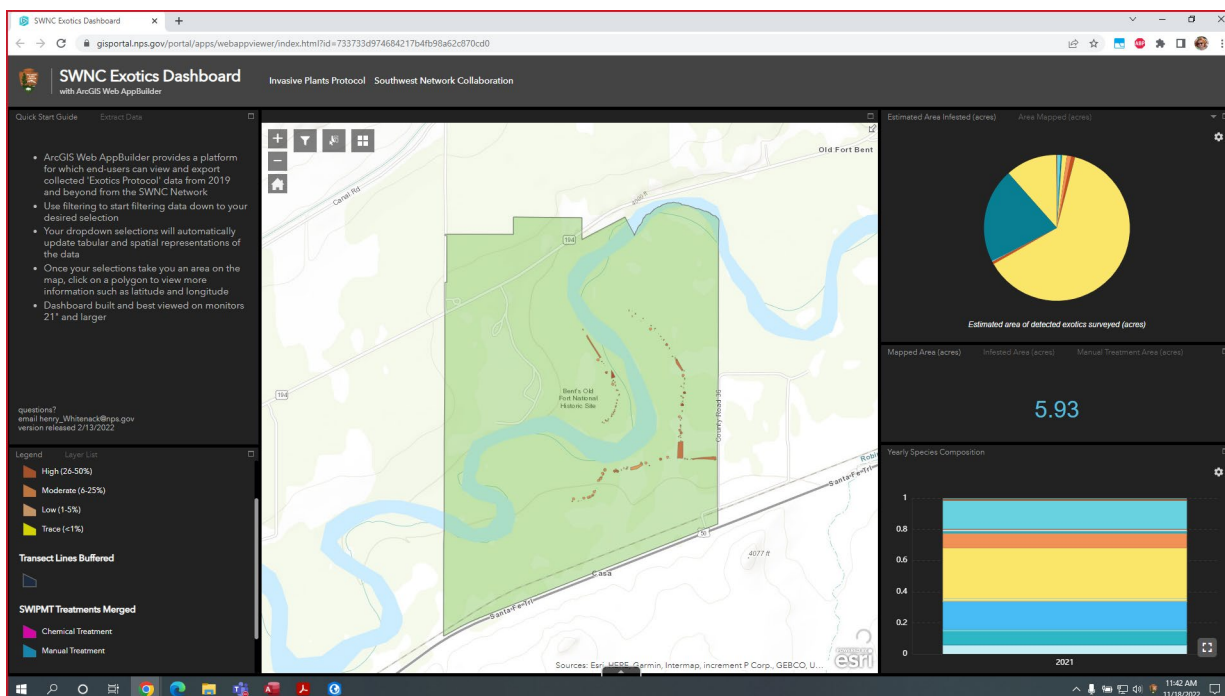


Figure 1. Screen shot of the Southwest Network Collaboration Exotics Dashboard, hosted on the NPS Geospatial Portal, which can be used to view and download spatial files showing locations and sizes of invasive plant infestations.

Monitoring Protocol

The Southern Plains Inventory & Monitoring Network monitors pathways of invasive plant introduction at network parks according to the SWNC Exotic Plant–Early Detection Protocol (currently unpublished). The areas sampled are typically linear transects along roads, trails, boundary lines, and stream channels that are at high risk for invasive plant invasion and infestation. In select years, invasive plant data are also collected at predetermined grid points spaced 150 m apart, covering the entire park acreage minus any areas excluded for safety or difficulty of access. All transect and grid-point locations at BEOL 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 grid points, surveyors record the invasive plant species found within a 10-m radius of the point, as well as canopy cover and phenology (e.g., flowering or fruiting stage) for each species. When sampling transects, surveyors walk the transect length and map invasive 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, and level of site disturbance.

The Southern Plains Network surveys for a short list of species that is customized to each park. The monitoring list for BEOL (see Table 1) was drawn from the park’s Natural Resource Condition Assessment (NRCA), completed by Struthers et al. (2015). In the NRCA, invasive plants found in 2010–2013 BEOL surveys were ranked across a series of factors, following a system designed by Morse et al. (2004). Factors included the plant’s ecological impact, management difficulty, current distribution and abundance, and trends in distribution and abundance. The rankings were then used to classify plants into the following categories: highest concern, high concern, medium concern, and low concern. For further detail, see the BEOL NRCA (Struthers et al. 2015). We have begun adapting the original NRCA list to include aggressive invasives found at low levels in our vital signs monitoring, as well as new species found at the park and treated by the regional IPMT.

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

Table 1. Invasive plant species included in the 2024 BEOL invasive plant survey. Frequency is calculated as the percentage of grid points at which a given species occurred. Frequencies of these species are shown from both the 2024 and 2013 surveys. Both surveys used the same 150-m grid and sampled 111 points. The 2024 survey was conducted in early August, and the 2013 survey in late June.

Scientific Name	Common Name	Level of Concern ¹	Life Form	Duration	Frequency 2024	Frequency 2013
<i>Kochia scoparia</i>	Kochia	High	Forb ²	Annual ³	76%	50%
<i>Salsola tragus</i>	Russian thistle	Moderate	Forb	Annual	63%	49%
<i>Rhaponticum repens</i>	Russian knapweed	Highest	Forb	Perennial	8%	6%
<i>Cirsium arvense</i>	Canada thistle	High	Forb	Perennial	6%	4%
<i>Tamarix</i> sp. ⁴	Tamarisk	Highest	Shrub/Tree	Perennial	4%	8%
<i>Cynodon dactylon</i>	Bermudagrass	NYA ⁵	Grass	Perennial	2%	0%
<i>Elaeagnus angustifolia</i>	Russian olive	NYA ⁵	Shrub/Tree	Perennial	2%	0%
<i>Ulmus pumila</i>	Siberian elm	NYA ⁵	Shrub/Tree	Perennial	1%	1%
<i>Bromus inermis</i>	Smooth brome	NYA ⁵	Grass	Perennial	1%	0%
<i>Lepidium latifolium</i>	Perennial pepperweed	High	Forb	Perennial	1%	0%
<i>Bromus japonicus</i>	Japanese brome	NYA ⁵	Grass	Annual	0%	0%
<i>Bromus tectorum</i>	Cheatgrass	Highest	Grass	Annual	0%	0%
<i>Sorghum halepense</i>	Johnsongrass	High	Grass	Perennial	0%	0%

¹ Level of Concern is taken from the Natural Resource Condition Assessment and is based on ecological impact, management difficulty, and distribution and abundance of the invasive plant. Categories include Highest Concern, High Concern, Medium Concern, and Low Concern (Struthers et al. 2015).

² A forb is an 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 Species of *Tamarix* are identified to genus only in SOPN Invasive Plant–Early Detection surveys.

⁵ NYA = Not yet assessed.

Literature Cited

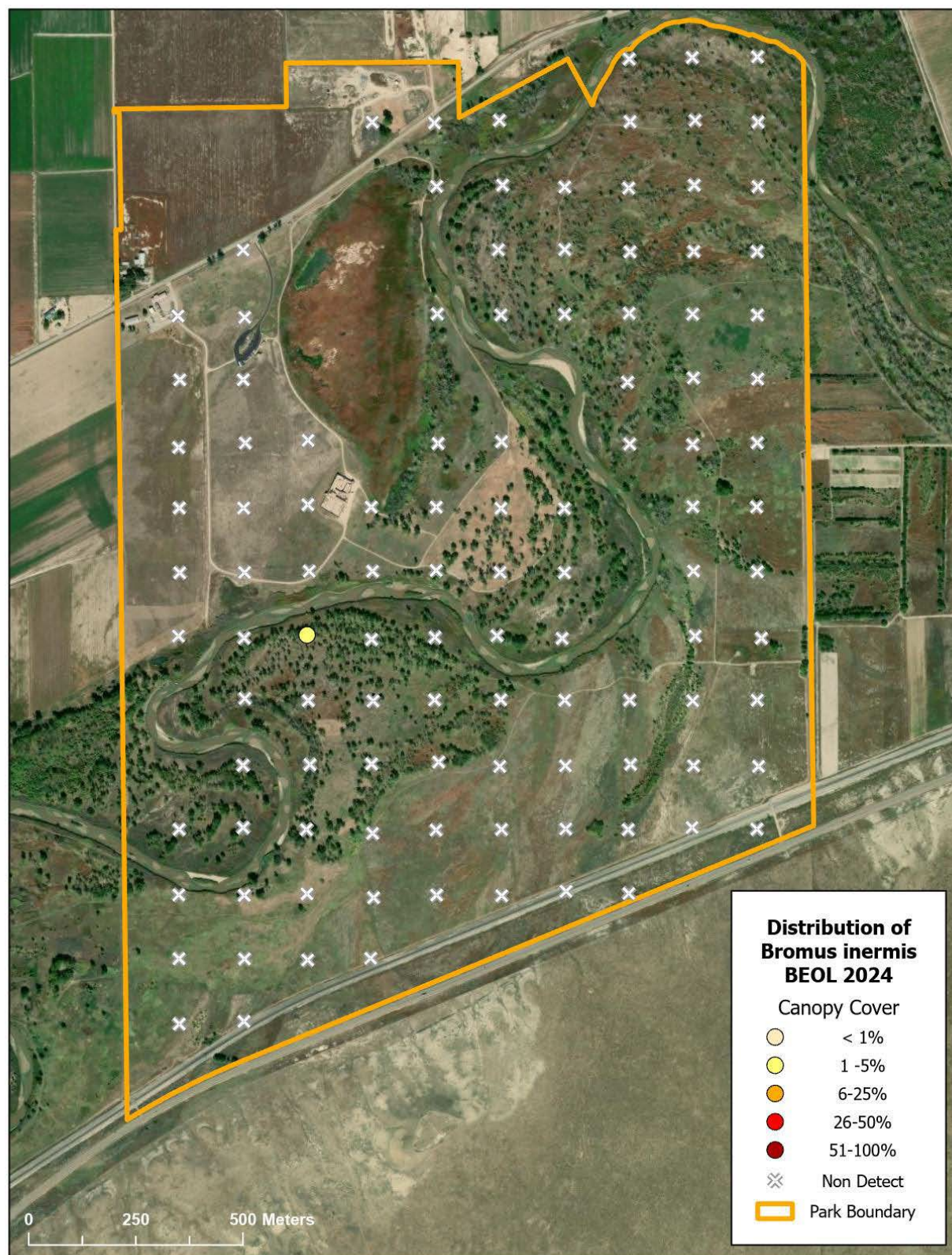
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Appendix A. Bent's Old Fort National Historic Site Invasive Plant–Early Detection Survey Maps, 2024

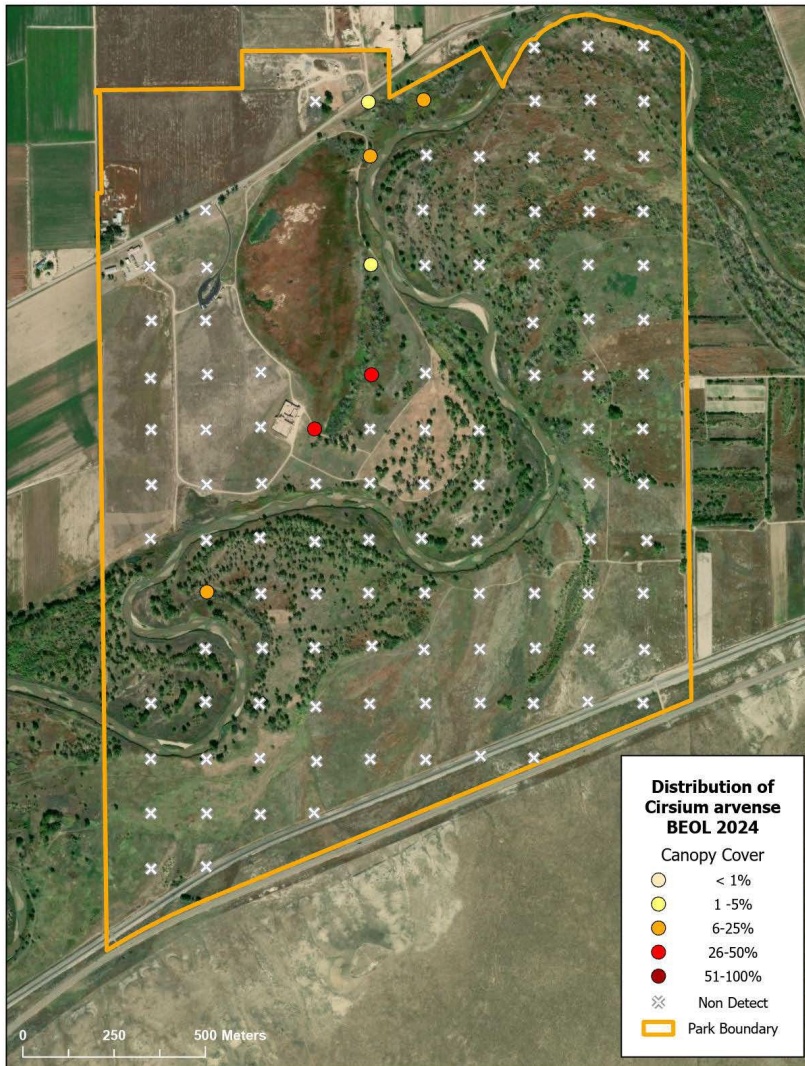
Map A-1. Map showing all invasive plant transect and grid-point locations at Bent's Old Fort National Historic Site. Grid points are 150 m apart, and areas with water or with >30% slope are excluded.



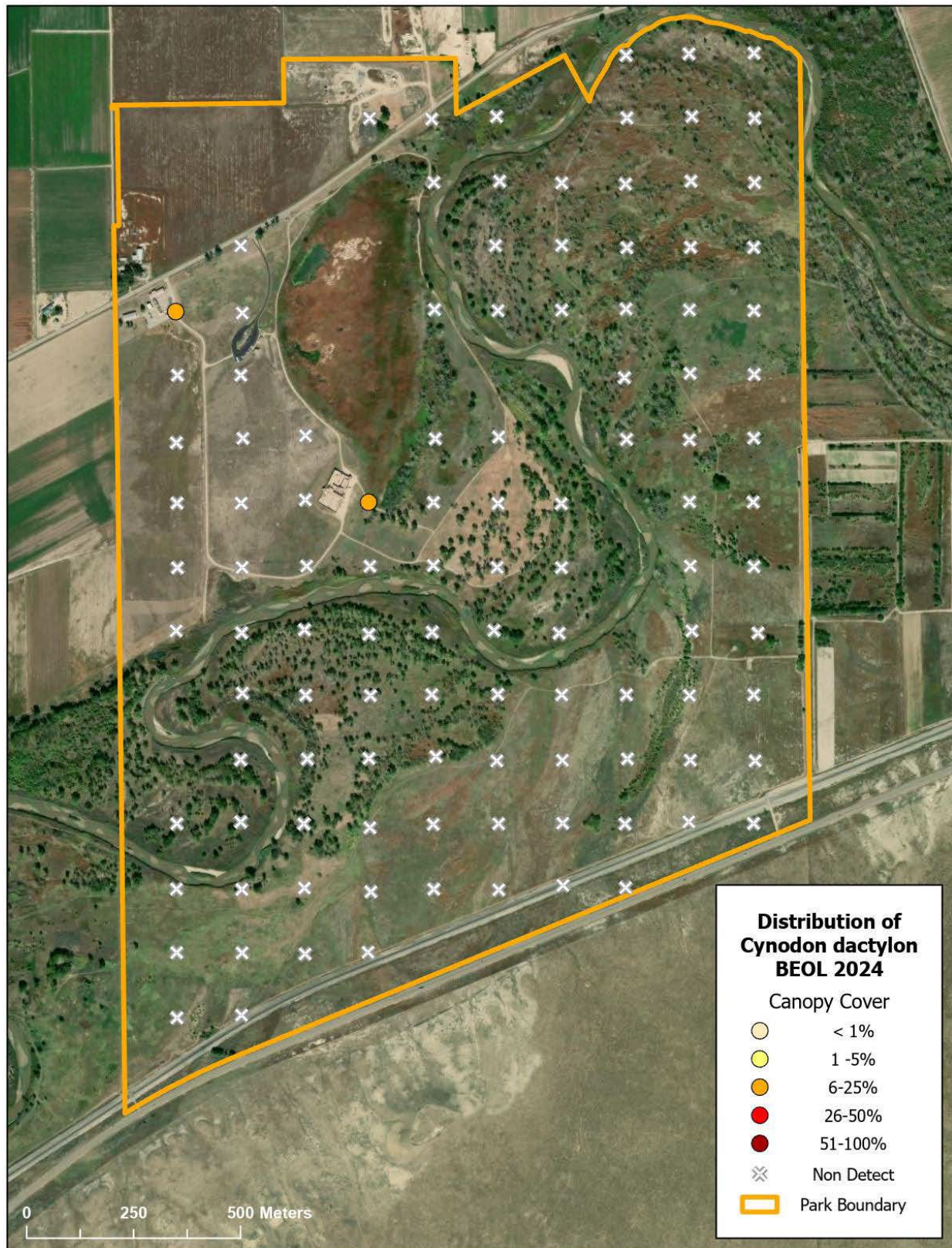
Map A-2. Smooth brome (*Bromus inermis*) distribution and canopy cover recorded in August 2024 surveys.



Map A-3. Canadian thistle (*Cirsium arvense*) distribution and canopy cover recorded in August 2024 (left) and June 2013 (right) surveys.



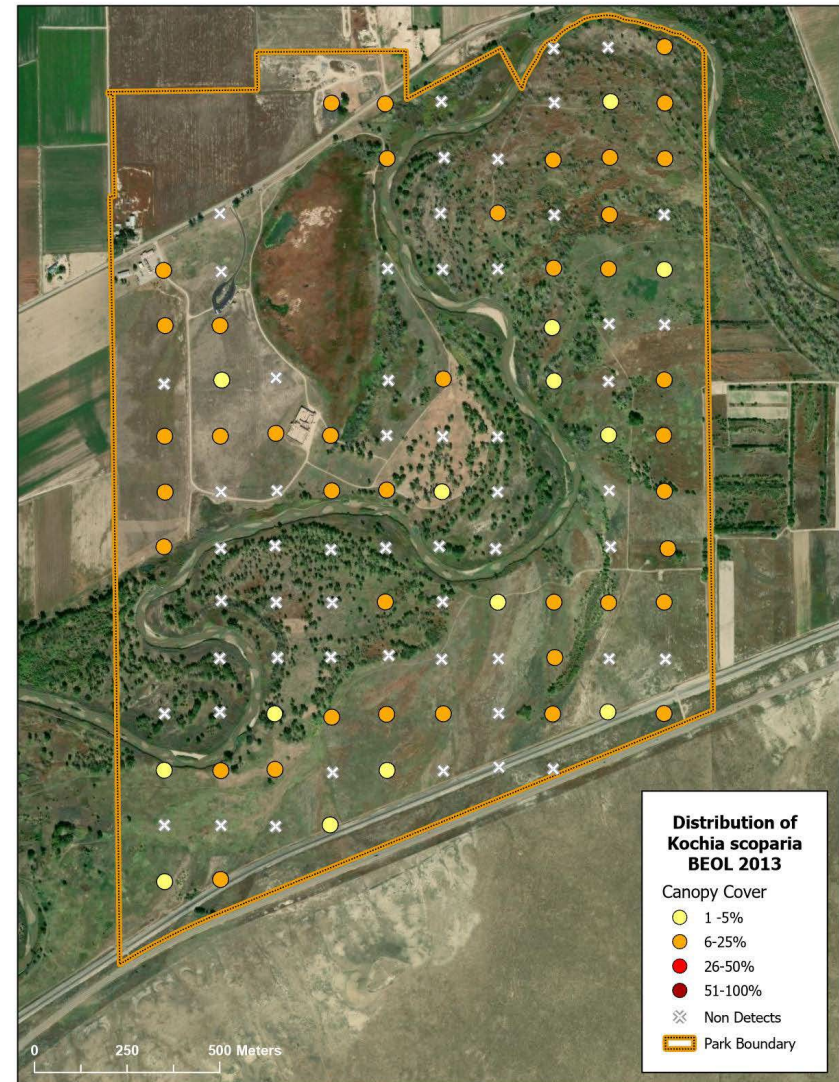
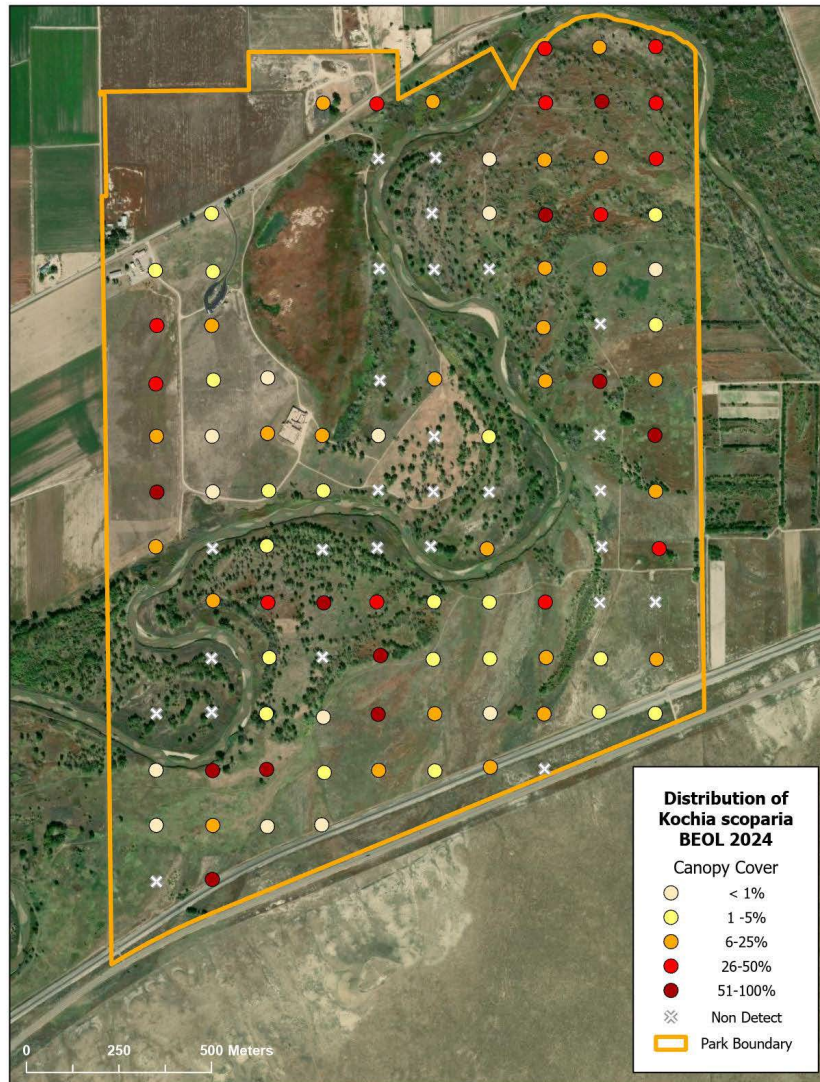
Map A-4. Bermuda grass (*Cynodon dactylon*) distribution and canopy cover recorded in August 2024 surveys.



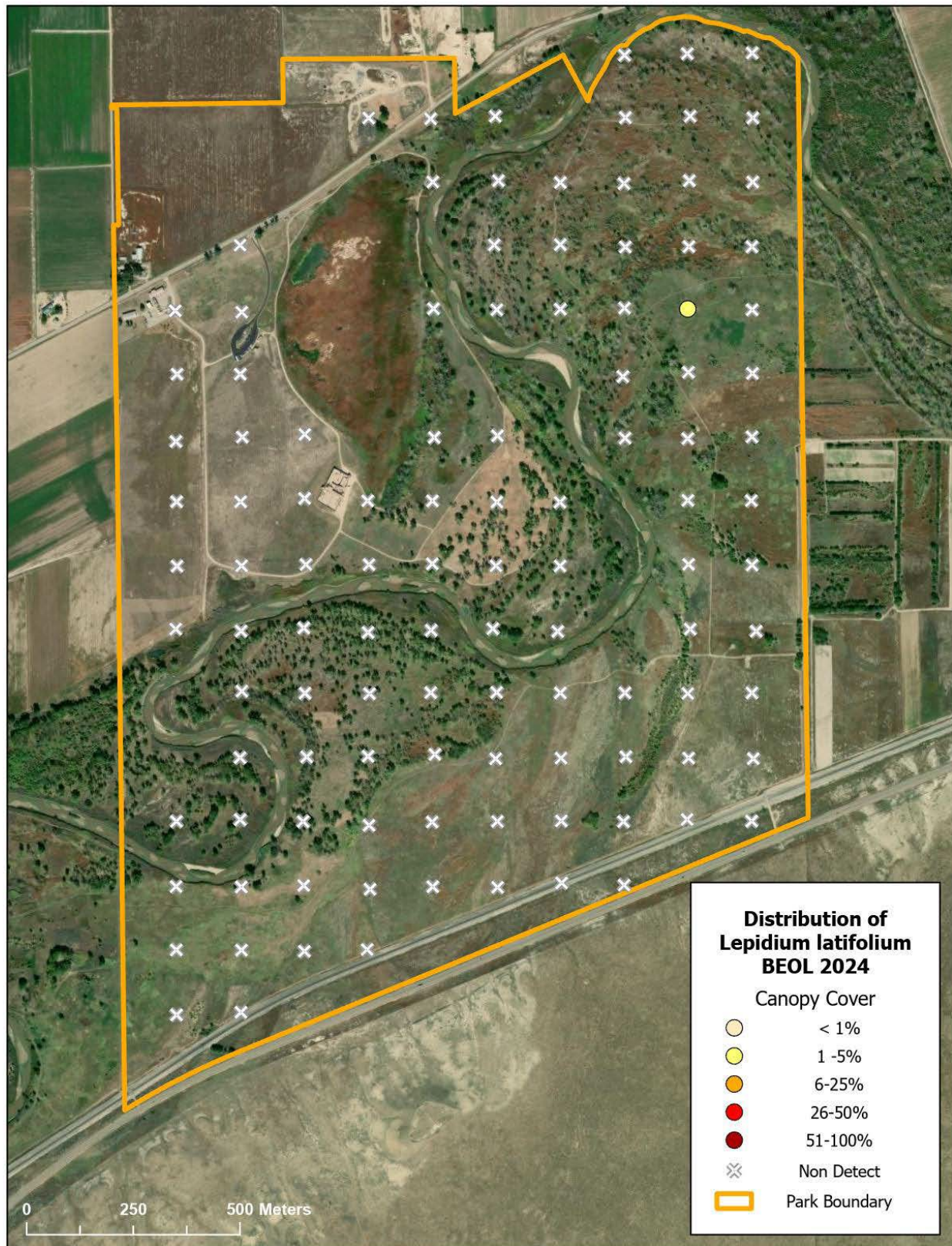
Map A-5. Russian Olive (*Elaeagnus angustifolia*) distribution and canopy cover recorded in August 2024 surveys.



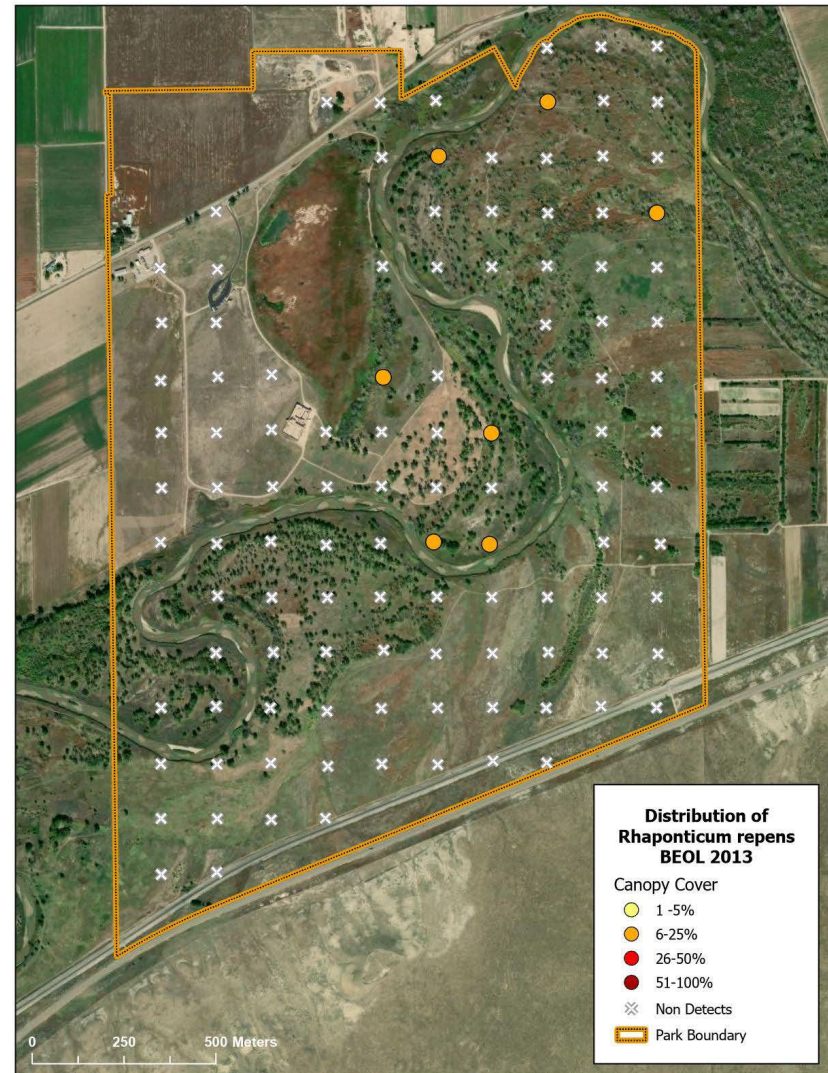
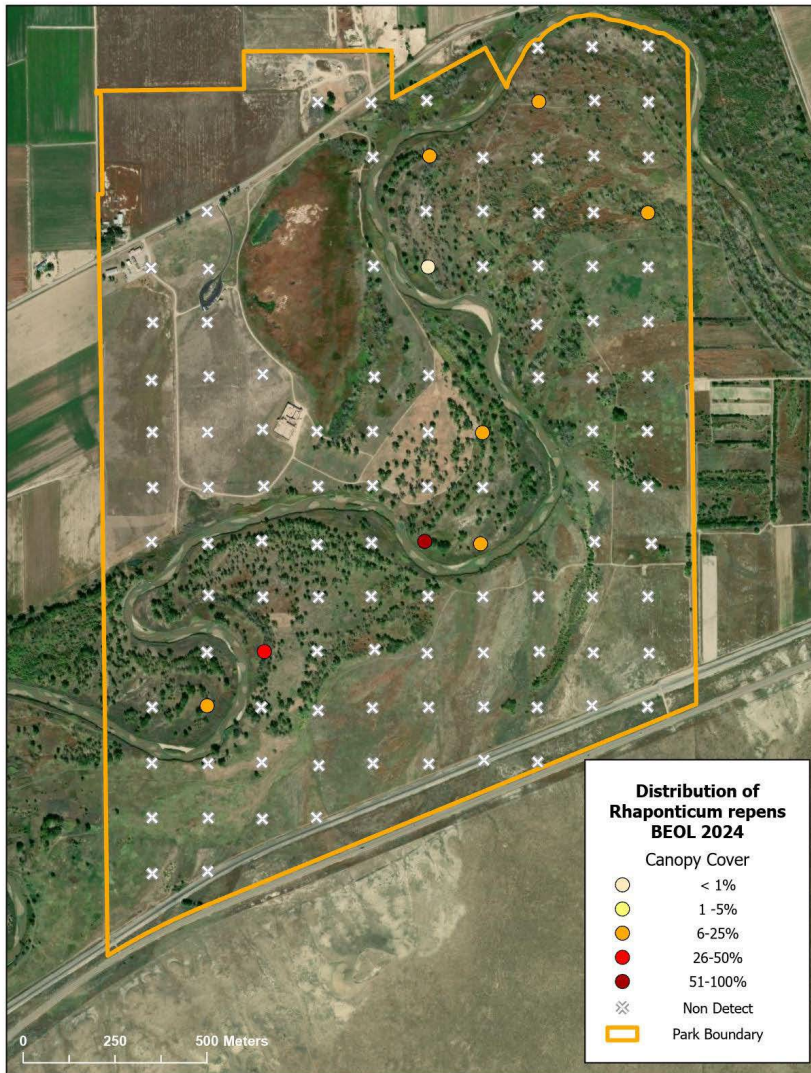
Map A-6. *Kochia (Kochia scoparia)* distribution and canopy cover recorded in August 2024 (left) and June 2013 (right) surveys.



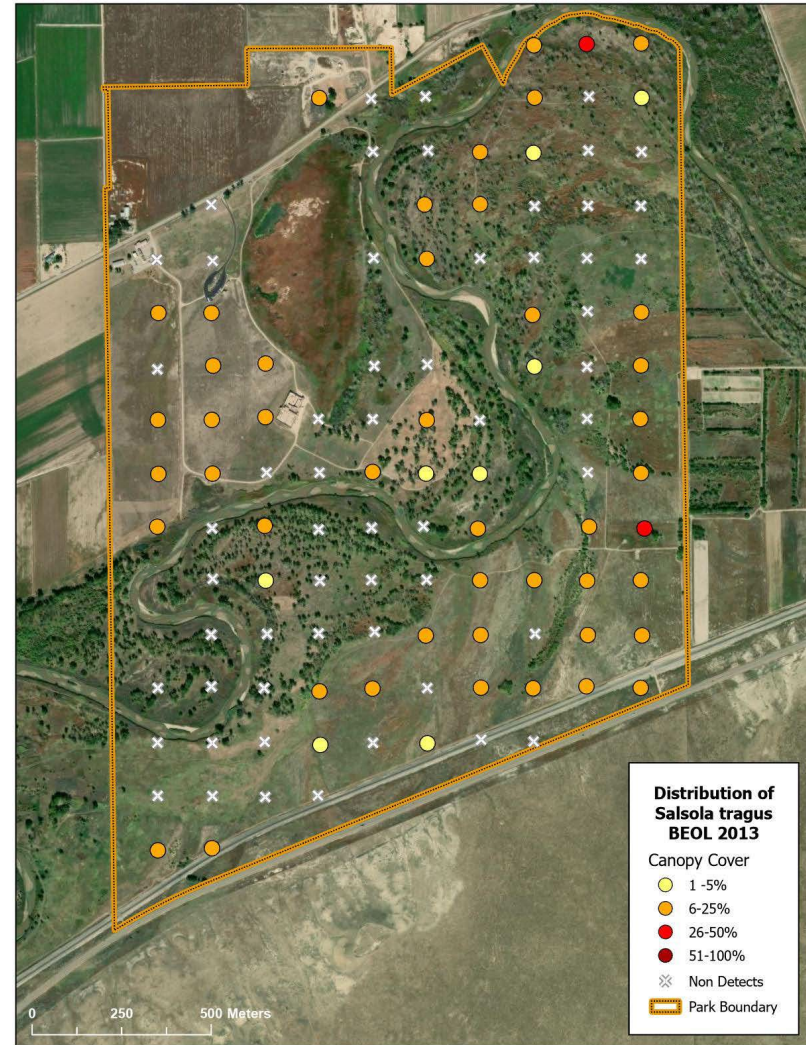
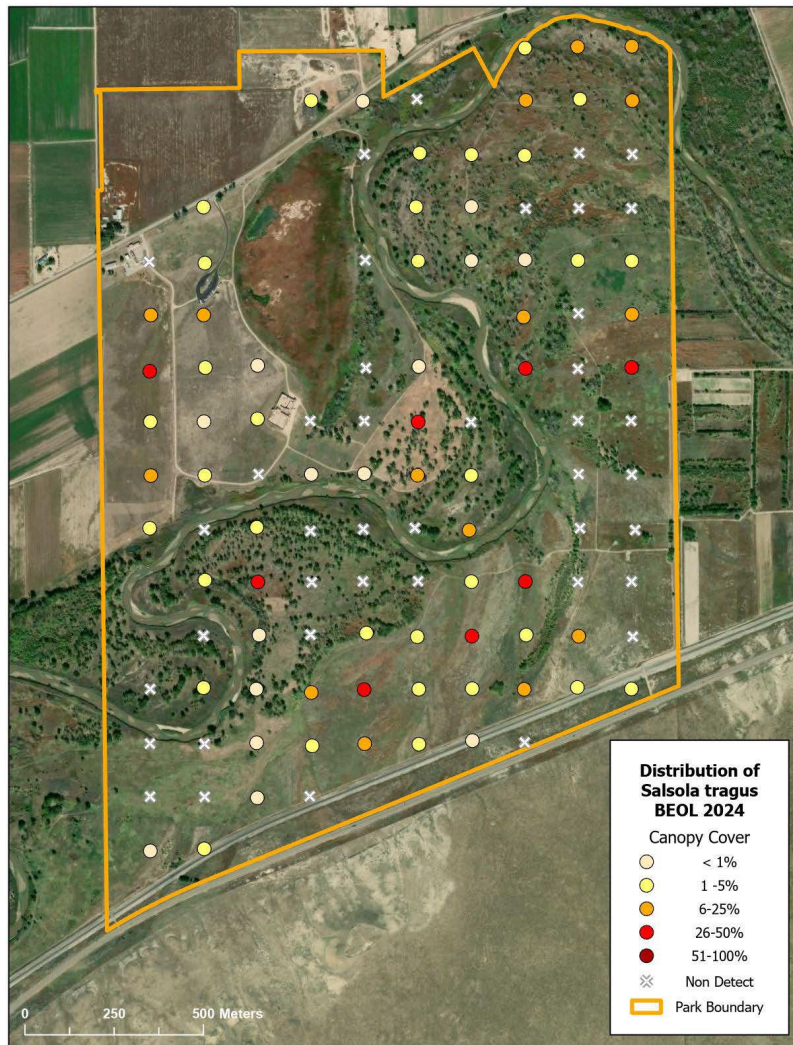
Map A-7. Perennial pepperweed (*Lepidium latifolium*) distribution and canopy cover recorded in August 2024 surveys.



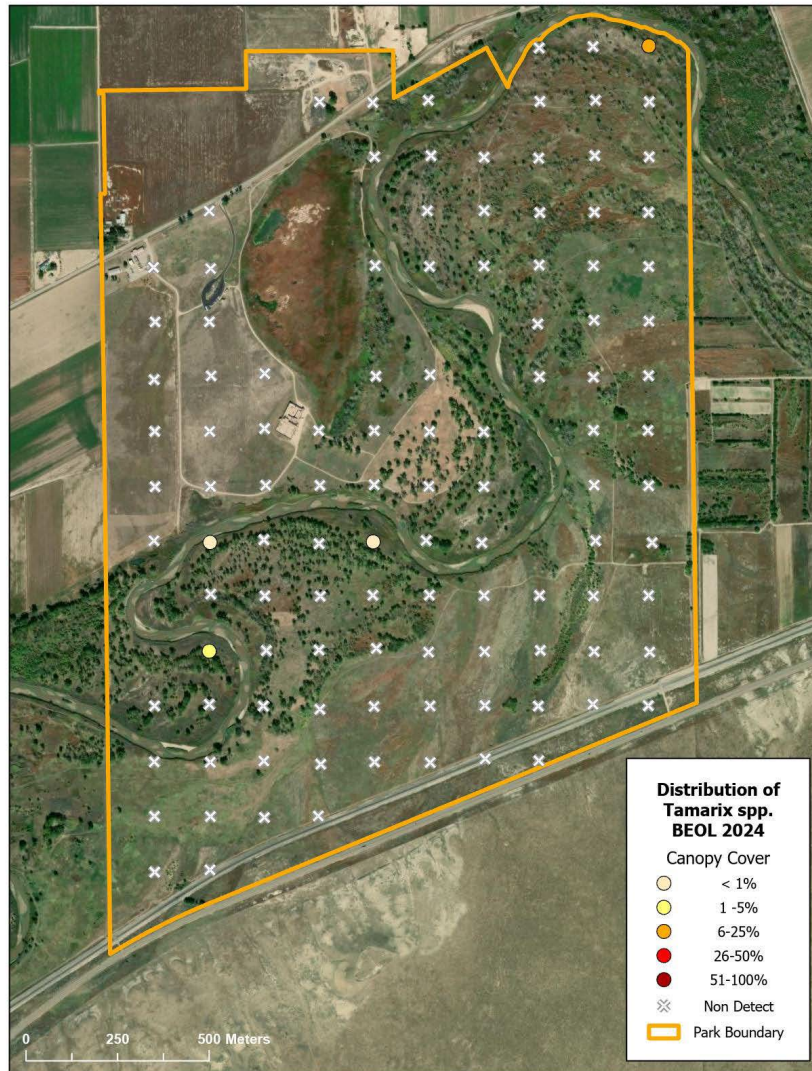
Map A-8. Russian knapweed (*Rhaponticum repens*) distribution and canopy cover recorded in August 2024 (left) and June 2013 (right) surveys.



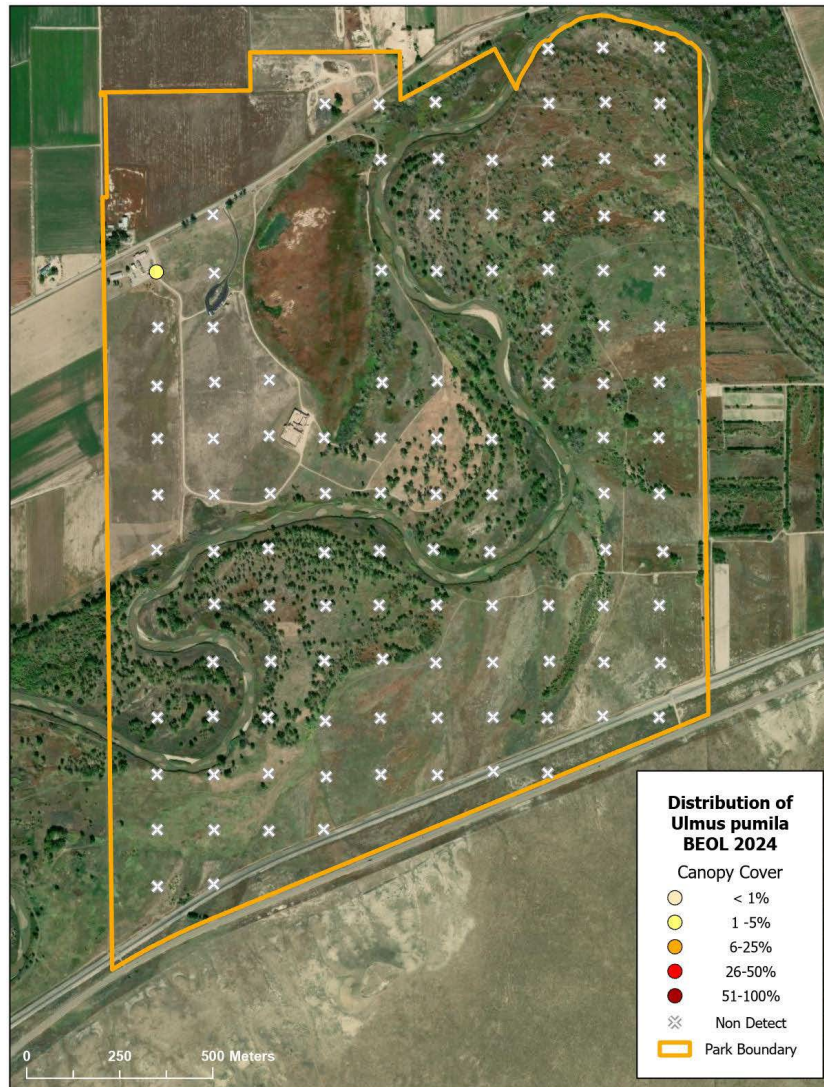
Map A-9. Russian thistle (*Salsola tragus*) distribution and canopy cover recorded in August 2024 (left) and June 2013 (right) surveys.



Map A-10. Tamarisk (*Tamarix* spp.) distribution and canopy cover recorded in August 2024 (left) and June 2013 (right) surveys.



Map A-11. Siberian elm (*Ulmus pumila*) distribution and canopy cover recorded in August 2024 (left) and June 2013 (right) surveys.



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.

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