National Park Service
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Natural Resource Stewardship and Science

Invasive Exotic Plant Monitoring at Colorado National Monument

2021 Field Season

Natural Resource Report NPS/NCPN/NRR—2022/2444



ON THE COVER

Yellow salsify (*Tragopogon dubius*).
Photo by Bruce Bosley, Colorado State University, Bugwood.org.

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Executive Summary

Invasive exotic plant (IEP) species are a significant threat to natural ecosystem integrity and biodiversity, and controlling them is a high priority for the National Park Service. The Northern Colorado Plateau Network (NCPN) selected the early detection of IEPs as one of 11 monitoring protocols to be implemented as part of its long-term monitoring program. This report represents work completed at Colorado National Monument during 2021. During monitoring conducted June 9–15, a total of 15 priority IEP species in 395 patches were detected on 53.6 kilometers (33.3 mi) of monitoring routes. An additional four species were detected in transects. Yellow salsify (*Tragopogon dubius*), ripgut brome (*Anisantha diandra*), jointed goatgrass (*Cylindropyrum cylindricum*), and tamarisk (*Tamarix* sp.) were the most commonly detected priority IEPs along monitoring routes, representing 74% of all priority patches. Except for ripgut brome and broad-leaf pepperwort (*Cardaria latifolia*), most patches of priority IEPs were less than 40 m^2. Ninety-five percent of tree patches were classified as seedlings or saplings, which require less effort to control than mature trees. Cheatgrass (*Anisantha tectorum*) was the most common IEP in transects, found in >63% of transects along every route surveyed. When segments of monitoring routes consistently surveyed from 2005 to 2021 were analyzed, Red Canyon, Wedding Canyon, and Fruita Canyon all had the highest number of IEPs per 100 meters during the entire monitoring period. Increases were driven by jointed goatgrass on all three routes, by yellow salsify in Wedding Canyon, and tamarisk in Red Canyon. Jointed goatgrass appears to be rapidly expanding, increasing from 8 patches in 2019 to 42 patches in 2021 (though the routes surveyed were not all the same). In addition, three species not seen in recent years—Canada thistle (*Breea arvensis*), bull thistle (*Cirsium vulgare*), and broad-leaf pepperwort—were detected, but in fewer than 10 patches each. These species should be prioritized for control. The No Thoroughfare, Ute Canyon, and Monument Canyon routes all have stayed relatively stable over time, but at least one patch of jointed goatgrass was found on each. Network staff plans to return to re-sample monitoring routes in 2023.

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1 Introduction

Invasive exotic species fragment native ecosystems, displace native plants and animals, and alter ecosystem function. Invasive species are second only to habitat loss as threats to global biodiversity (Scott and Wilcove 1998) and represent one of the most serious threats to natural ecosystem integrity (NRC 2002). Biological invasions are occurring at accelerated rates in nearly every major ecosystem (Mooney and Hobbs 2000).

Exotic plants negatively affect park resources and visitor enjoyment by altering landscapes and fire regimes, reducing native plant communities and animal habitat, and increasing trail-maintenance needs (see Loope 1992). Recognizing these challenges, national parks of the Northern Colorado Plateau Network (NCPN) identified invasive exotic plants (IEPs) as a high-priority vital sign for long-term monitoring (O'Dell et al. 2005).

IEPs are a subset of exotic plants "whose introduction does or is likely to cause economic or environmental harm or harm to human health" (Executive Order 13112). With the aim of facilitating strategic control approaches, the NCPN monitoring program detects early invasions, identifies existing invasions, and, to the extent possible, tracks changes in the abundance and distribution of IEPs in parks along key invasive pathways.

Invasive exotic plants can spread into national parks via a number of different pathway types. Predictable IEP pathways include roads, trails, and riparian corridors. Long-distance dispersal through cargo containers and air freight are examples of sudden pathways. Anthropogenic pathways include horticultural escapes and seeds transported on shoes and in restoration seed mixes. For the National Park Service (NPS), the consequences of these plant invasions present a significant challenge to the agency's ability to maintain natural resources "unimpaired for the enjoyment of future generations."

Because regular, comprehensive monitoring of the distribution and abundance of all exotic plant species within NCPN units is beyond the fiscal capabilities of the network and parks, the NCPN focuses on the most likely areas where a broad range of invasive exotic plants may occur: riparian corridors, roads, trails, areas of high visitor impact (e.g., campgrounds), and park boundaries. This approach is cost-effective for finding many new invasions in areas where they are most likely to occur, but it may miss exotic plants dispersed to the interior areas of large parks by wind and/or animals.

Specific objectives of NCPN invasive exotic plant monitoring are:

1. To detect incipient populations and new introductions of invasive plant species before they become established in areas of management significance and invasion pathways; and
2. To determine status and trends of selected invasive plant populations of management significance.

This report summarizes the 2021 field season at Colorado National Monument.

2 Methods

Field work followed the invasive exotic plant monitoring protocol developed by the NCPN (Perkins et al. 2016). The protocol emphasizes the quick collection of IEP location and abundance data in order to maximize the amount of area searched, thus increasing our chances of finding a higher percentage of both new invasions and established IEPs. By focusing on roads, trails, and waterways, which are major vectors for invasive plants, we capture the greatest amount of information (i.e., benefit) with the least amount of time and effort (i.e., cost).

After NCPN staff reviewed and updated the list of priority invasive exotic plants for the park, we established a series of co-located monitoring routes and transects along all roads, major drainages, and trails. The transects, which are composed of three quadrats sampled in a quantitative manner, are used to make inference to the percent cover of priority IEPs located along the park's invasive pathways (i.e., the monitoring routes) and allow us to estimate trends in selected IEP percent cover over time. The monitoring routes are used to increase the spatial coverage of mapping performed, with the goal of maximizing opportunities for detecting IEPs.

2.1 Developing the priority invasive exotic plant list

Prior to the start of monitoring, NCPN and park staff reviewed the list of priority IEPs (Table 2-1). The original list was developed by reviewing past park literature and state and county weed lists, and consulting with park staff and county weed managers. The priority IEP list includes existing IEPs and potential IEPs of high management concern. Because these methods were designed to be rapid, field crews were trained to develop a focused search image on the priority IEPs, instead of looking for every possible invasive plant species. The likelihood of eradicating these priority species or containing them within a park is generally high. Cheatgrass (*Anisantha tectorum*) has been recorded in transect quadrats since 2011. Tumble mustard (*Sisymbrium altissimum*), Russian thistle

Table 2-1. Priority invasive plant list, Colorado National Monument.

Scientific name	Common name
Acosta diffusa	diffuse knapweed
Acosta maculosa	spotted knapweed
Acroptilon repens	Russian knapweed
Anisantha diandra[1]	ripgut brome
Arctium minus	burdock
Breea arvense	Canada thistle
Cardaria sp.[2]	hoary cress
Cardaria latifolia[3]	broad-leaf pepperwort
Carduus acanthoides	plumeless thistle
Carduus nutans	musk thistle
Chorispora tenella[4]	blue mustard
Cirsium vulgare	bull thistle
Convolvulus arvensis	field bindweed
Cylindropyrum cylindricum	jointed goatgrass
Cynoglossum officinale[4]	common hounds-tongue
Descurainia sophia[4]	flixweed
Elaeagnus angustifolia	Russian olive
Isatis tinctoria	dyer's woad
Leucantha solstitialis	yellow starthistle
Linaria vulgaris	butter-and-eggs
Lythrum salicaria	purple loosestrife
Melilotus officinale[5]	yellow sweet-clover
Onopordum acanthium	Scotch thistle
Tamarix spp.	tamarisk
Tithymalus esula	leafy spurge
Tragopogon dubius[4]	yellow salsify
Tribulus terrestris	puncturevine
Ulmus pumila	Siberian elm
Verbascum thapsus	woolly mullein

[1]Added in 2019.
[2]*Cardaria draba* was specified until 2017, when it was converted to *Cardaria* sp. *C. latifolia* continues to be identified as a separate species.
[3]*C. latifolia* is listed separately from *Cardaria* sp. because it is easy to differentiate from other *Cardaria* species. Also, *C. latifolia* can require different control strategies than other *Cardaria* species.
[4]Added in 2015.
[5]Added in 2011.

(*Salsola* sp.), and redstem filaree (*Erodium cicutarium*) were recorded in transect quadrats starting in 2017. Ripgut brome (*Anisantha diandra*) was added to the priority list in 2019.

2.2 Monitoring routes

2.2.1 Minimum detection target size

The minimum detection target size (MDTS) represents the patch size that is large enough to be detected with a high level of confidence (typically at least 90% of the total number of patches of that size and larger in the monitoring area) under actual field conditions, but small enough so that any missed patches smaller than the MDTS could still feasibly be eradicated if not found until the next scheduled monitoring visit. We established an MDTS of 40 m^2 (0.01 acres or approximately 20 × 20 ft) for all IEPs. Use of the MDTS was necessary because field technicians were not expected to find every single plant of every priority IEP species during route surveys. Although searching for single mature plants of some species, such as Russian olive (*Elaeagnus angustifolia*) and tamarisk (*Tamarix* sp.), is possible due to their large size, single plants of other species, such as field bindweed (*Convolvulus arvensis*), or even seedlings of the aforementioned species, are nearly impossible to detect in most field conditions.

2.2.2 Effective detection distance

The effective detection distance (EDD) is the maximum distance from which a searcher can consistently detect (i.e., see and recognize) the MDTS of the least-visible priority species with at least 90% efficiency. Crew members calibrated themselves by walking away from a targeted patch size of the least-visible species and determining the maximum distance from which they could consistently see and recognize the patch with complete confidence. The distance was measured either by pacing or using a laser rangefinder. The EDD for Colorado NM in 2021 was 4–8 meters, due to vegetation that could obscure some patches (Figure 2-1).

2.2.3 Effective detection swath width

Effective detection swath width (EDSW) is the maximum width of a linear search swath (band transect) in which a walking observer is confident of visually detecting 90% of all priority species of the MDTS. The effective detection swath width (EDSW) is equal to two times the EDD, because the surveyor is able to effectively detect IEPs for one EDD on either side of his/her search route. The EDSW for Colorado NM in 2021 ranged from 8 to 16 meters (see Figure 2-1).

2.2.4 Patch separation resolution

We defined patch separation resolution (PSR) as the minimum distance between plants that must be considered members of separate patches or patches. Individuals or clusters of a priority species separated by the PSR distance or more were recorded as separate patches. We considered plants separated by less than the PSR to be a single patch. The PSR was set at 50 meters, based

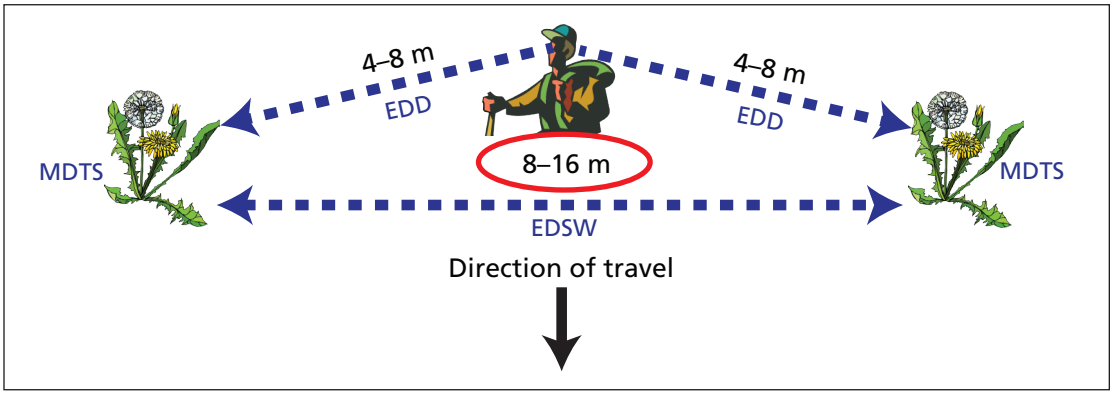


Figure 2-1. The maximum effective detection distance (EDD) at Colorado NM ranged from 4 to 8 meters in 2021, making the effective detection swath width (EDSW) 8–16 meters.

on the assumption that plants or groups of plants separated by less than 50 meters are typically considered to be one patch during planning and implementation of IEP control operations. If a patch was continuous for more than 50 meters, then cover estimates were made every 50 meters to aid in developing an effective management strategy for the entire patch.

2.2.5 Data collection methods

For East Glade Park Road, we walked one meter out from one side of the road and then returned to the starting point by walking back one meter from the road on the other side. In some cases, due to topography and property boundaries, it was not possible to walk one meter from the road. For single-track trails and drainages, we walked the center of the trail or drainage in only one direction.

While walking, we searched for selected IEPs by visually scanning (side-to-side) all of the land within the borders of the swath. However, if the terrain was uneven or steep, and the observer had to glance frequently at the ground to ensure safe foot placement, then searchers stopped approximately every 8–16 meters (the length of one EDSW) and visually scanned the area in all directions. As monitoring routes were traversed, locations of all priority species were documented using global positioning system (GPS) units with at least five-meter accuracy.

Only IEPs designated as priority were consistently recorded on monitoring routes. Survey crew members were given the latitude to record non-priority IEP species if they were noteworthy. When a priority IEP was discovered, we recorded the following information: (1) monitoring route, (2) location, (3) patch size class (see below), (4) whether the plant was pulled by the observer, and (5) cover class (see below). If several IEP species were present with similar distributions at a single point, then we recorded a point for each individual IEP species and assigned it its own sequential identification number.

Patch size class was estimated as follows:

1. 1–3 plants (used for isolated single plants or very small patches (≤ 2 × 2 m)
2. 4 plants–40 m^2 (48 yd^2)
3. 40–400 m^2 (48–478 yd^2)
4. 400–1,000 m^2 (0.1–0.25 acre)
5. 1,000–2,000 m^2 (0.25–0.5 acre).

We recorded cover class by estimating the amount, or "percentage," of ground covered by the vertical projection of plant matter as visualized from a bird's-eye view of the vegetation (Elzinga et al. 1998). This estimate included both the living and dead standing material of the vegetation of a single plant species. Cover class of a patch was recorded using the following classes:

1. Trace (<1%)
2. Low (1–5%)
3. Moderate (6–25%)
4. High (26–50%)
5. Majority (51–100%).

We recorded the following ancillary information with every patch: the growth stage of exotic trees (i.e., sapling, seedling, mature), evidence of prior treatment, and evidence of disturbances (e.g., recent fire, flood, small mammal disturbance).

2.3 Monitoring transects

2.3.1 Transect and quadrat establishment

Our methods for sampling quadrats were based on Stohlgren et al. (2005). We established transects with three vegetation quadrats every 500 meters along monitoring routes. Quadrats were centered at 0.5, 5, and 10 meters away from the route being walked. They were placed on the same side as the route being walked for roads, and on alternating sides for riparian areas, small roads, or trails. This differed slightly from 2009, when quadrats were placed at 3, 8, and 13 meters from the route. To sample cover of vegetation and soil-surface features, a 1-m^2

quadrat (sample frame of PVC pipe) was placed on the right side of the transect line as the technician walked from the monitoring route. In some cases. If there was not enough space between the route and a topographic feature or property boundary to conduct the three quadrats, then only the quadrats that could be placed between the route and the feature/boundary were recorded.

2.3.2 Data collection methods

Observers recorded all priority IEP species observed in the monitoring quadrats. In addition, cheatgrass has been recorded in transect quadrats since 2011. Tumble mustard, Russian thistle, and redstem filaree have been recorded in transect quadrats since 2017.

For each quadrat, we recorded percent cover of each IEP using the following classes: <1, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 20, 30, 40, 50, 60, 70, 80, 90, or 100%. Classes in between these numbers were rounded to the nearest class. This differed slightly from 2009, when cover classes were <1, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11–25, 26–50, 51–75, or >75%. However, only three transects would have been recorded differently in 2009 had the current framework been used in that year. We also recorded percent cover of dominant soil-surface features (i.e., dead wood, dung, fungus, lichen, litter/duff, live root/bole, mineral soil/sediment, moss, biological soil crust, road, rock, standing water/flooded, stream, or trash/junk) using the same classes.

2.4 Analyses

We calculated the number of patches per 100 meters for monitoring routes. Percent cover and frequency values were generated from the quadrat data, from which we calculated the mean and standard error of percent cover by species.

3 Results

3.1 Invasive exotic plant species detected

A total of 27 IEP species were recorded on monitoring routes and transects in 2021 (Table 3-1). Fifteen were priority species. Twenty-three IEP species (15 priority species) were recorded on monitoring routes. Ten IEP species were recorded in monitoring transects (4 priority species, 4 transect species). We monitored 53.6 kilometers (33.3 mi) of monitoring routes in 2021.

3.2 Monitoring routes

A total of 395 patches of 15 priority IEP species were detected along 20 monitoring routes in 2021 (Table 3-2; Figures 3-1 to 3-11; Appendix A). An additional 26 patches of eight non-priority IEP species were detected along these same routes. Most routes followed riparian zones in canyons, while two routes followed hiking trails.

Priority IEPs were found in highest numbers along the Red Canyon (1.29 patches/100 m), Monument Canyon (1.25 patches/100 m), Hydro 82 (1.06 patches/100 m) and Wed-

Table 3-1. Invasive exotic plants detected at Colorado National Monument, June 9–15, 2021.

Scientific name	Common name	Method detected[1]		Priority?[2]
		Route	Transect	
Anisantha diandra	ripgut brome	X	X	Yes
Arctium minus	burdock	X	–	Yes
Breea arvensis	Canada thistle	X	–	Yes
Cardaria latifolia	broad-leaf pepperwort	X	X	Yes
Chorispora tenella	blue mustard	X	–	Yes
Cirsium vulgare	bull thistle	X	–	Yes
Convolvulus arvensis	field bindweed	X	–	Yes
Cylindropyrum cylindricum	jointed goatgrass	X	–	Yes
Descurainia sophia	flixweed	X	–	Yes
Elaeagnus angustifolia	Russian olive	X	–	Yes
Onopordum acanthium	Scotch thistle	X	–	Yes
Tamarix sp.	tamarisk	X	–	Yes
Tragopogon dubius	yellow salsify	X	X	Yes
Ulmus pumila	Siberian elm	X	–	Yes
Verbascum thapsus	woolly mullein	X	X	Yes
Anisantha tectorum	cheatgrass	–	X	Transects
Erodium cicutarium	stork's bill	–	X	Transects
Salsola sp.	Russian thistle	–	X	Transects
Sisymbrium altissimum	tumble mustard	–	X	Transects
Agropyron cristatum	crested wheatgrass	X	X	No
Asparagus officinalis	asparagus	X	–	No
Bromus japonicus	Japanese chess	X	–	No
Lactuca serriola	prickly lettuce	X	X	No
Plantago major	broadleaf plantain	X	–	No
Populus alba	white poplar	X	–	No
Sonchus sp.	sowthistle	X	–	No
Triticum aestivum	common wheat	X	–	No

[1] "X" = Yes; "–" = No.
[2] Transect species are recorded only in transects.

Table 3-2. Monitoring routes surveyed, route type, length, number of invasive exotic plant patches, and number of patches/100 m, Colorado National Monument, June 9–15, 2021.

Route	Route type	Length (m)	Priority/ Total patches detected	Patches/100 m
			Total	Total
Columbus Canyon	Riparian	1,028.6	5/5	0.49/0.49
Fruita Canyon	Riparian	2,562.4	9/9	0.35/0.35
Gold Star Canyon	Riparian	1,866.8	7/7	0.37/0.37
Hydro 03	Riparian	421.4	4/4	0.95/0.95
Hydro 11	Riparian	1,298.9	5/6	0.38/0.46
Hydro 82	Riparian	1,598.1	17/20	1.06/1.25
Hydro 85	Riparian	402.3	1/1	0.25/0.25
Hydro 86	Riparian	1,014.5	7/7	0.69/0.69
Hydro 88	Riparian	710.6	0/0	0.00/0.00
Hydro 95	Riparian	2,735.7	26/26	0.95/0.95
Kodels Canyon	Riparian	1,061.2	1/1	0.09/0.09
Limekin Gulch	Riparian	503.2	0/0	0.00/0.00
Lizard Canyon	Riparian	1,396.2	5/5	0.36/0.36
Monument Canyon	Riparian	9,683.1	121/127	1.25/1.31
No Thoroughfare Canyon	Riparian	8,058.1	41/44	0.51/0.55
Red Canyon	Riparian	4,119.1	53/53	1.29/1.29
Ute Canyon	Riparian	7,388.1	51/64	0.69/0.87
Wedding Canyon	Riparian	3,030.0	31/31	1.02/1.02
Kodels Canyon Route	Trail	660.0	0/0	0.00/0.00
No Thoroughfare	Trail	4,021.8	11/11	0.27/0.27
Riparian Totals	–	48,878.2	384/410	0.79/0.84
Trails Totals	–	4,681.9	11/11	0.23/0.23

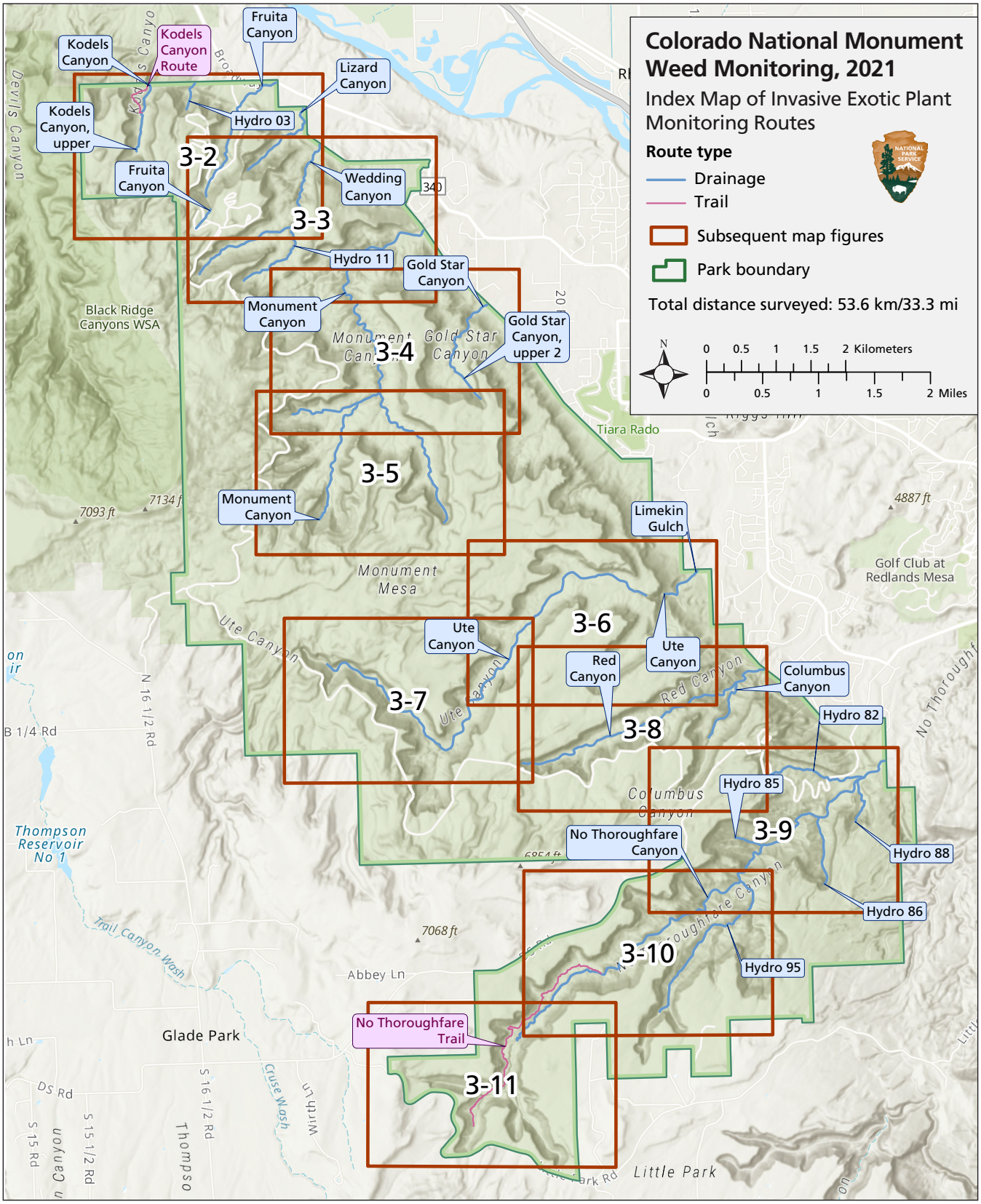


Figure 3-1. Invasive exotic plant monitoring routes, Colorado National Monument, June 9–15, 2021.

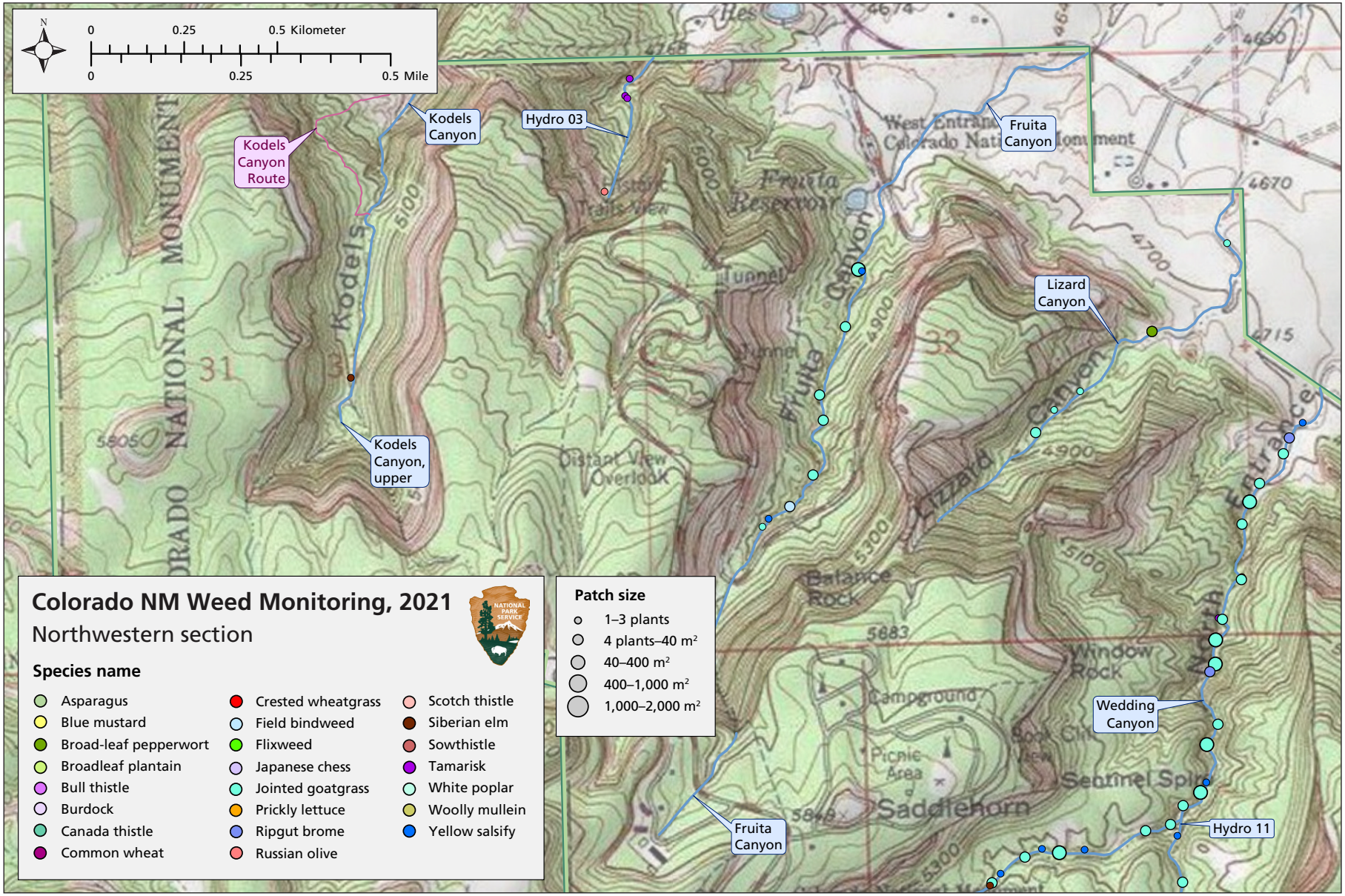


Figure 3-2. Invasive exotic plants detected on monitoring routes in the northwestern section of Colorado National Monument, June 9–15, 2021.

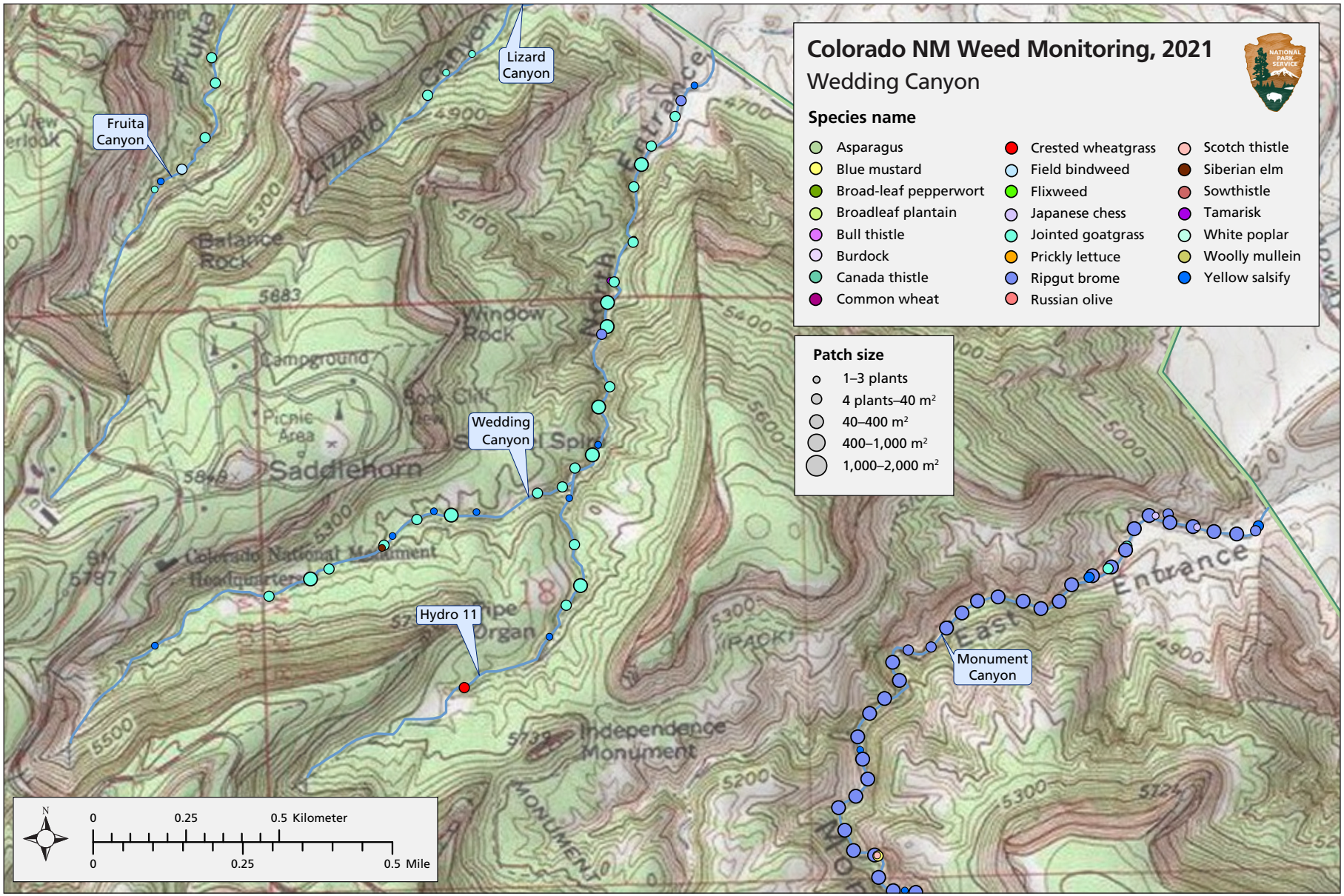


Figure 3-3. Invasive exotic plants detected on monitoring routes in Wedding Canyon, Colorado National Monument, June 9–15, 2021.

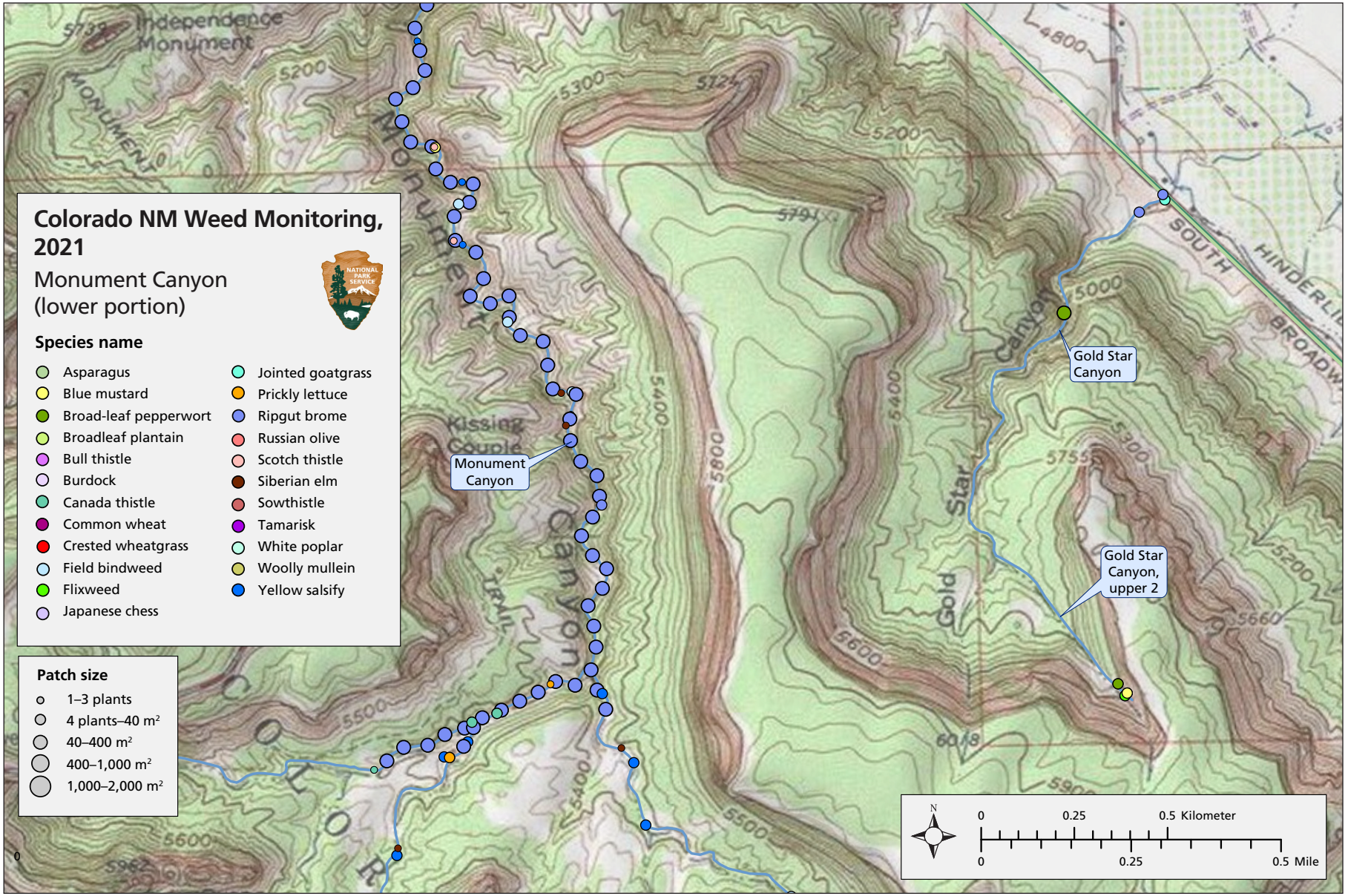


Figure 3-4. Invasive exotic plants detected on monitoring routes in the lower section of Monument Canyon, Colorado National Monument, June 9–15, 2021.

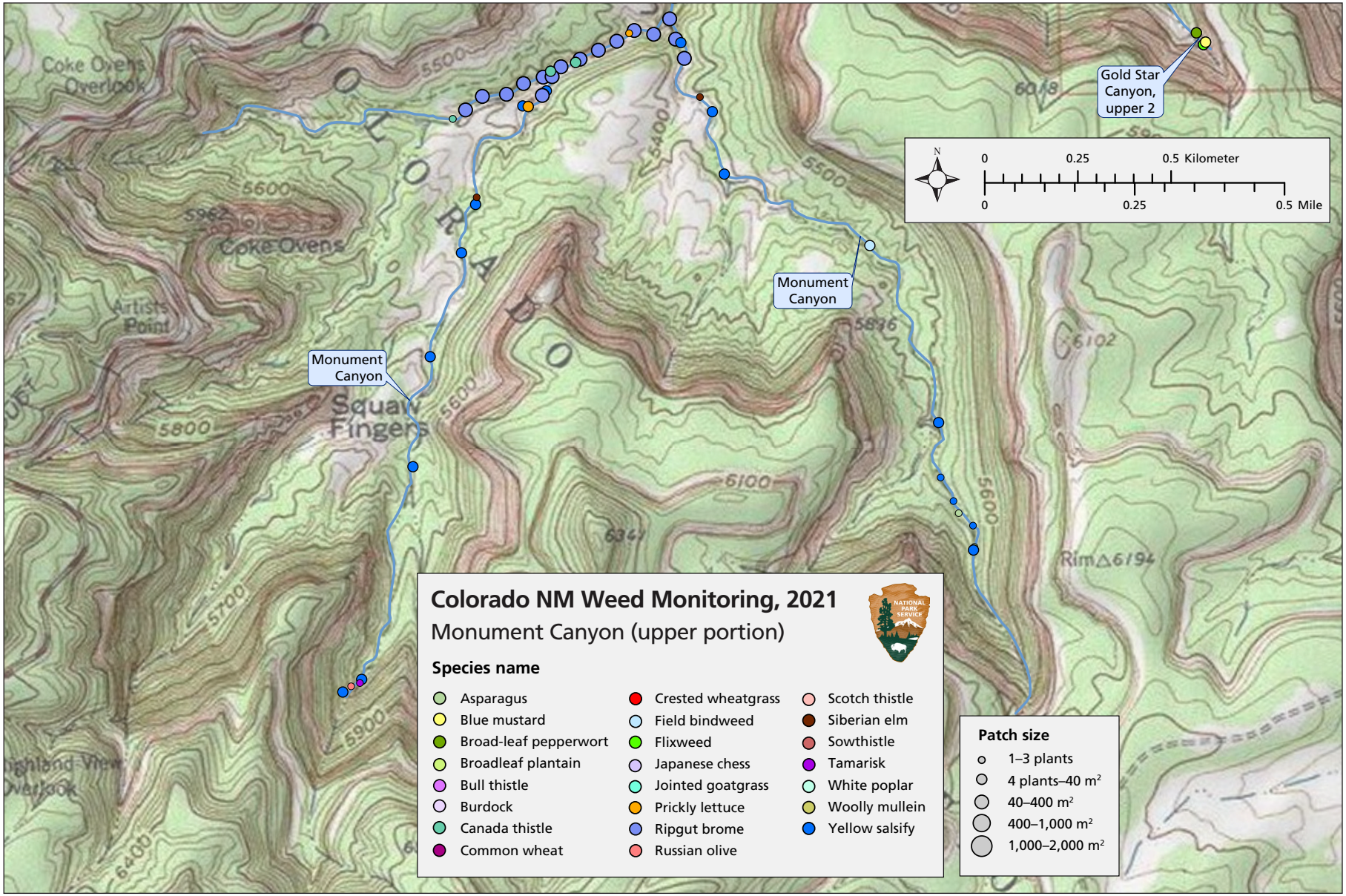


Figure 3-5. Invasive exotic plants detected on monitoring routes in the upper section of Monument Canyon, Colorado National Monument, June 9–15, 2021.

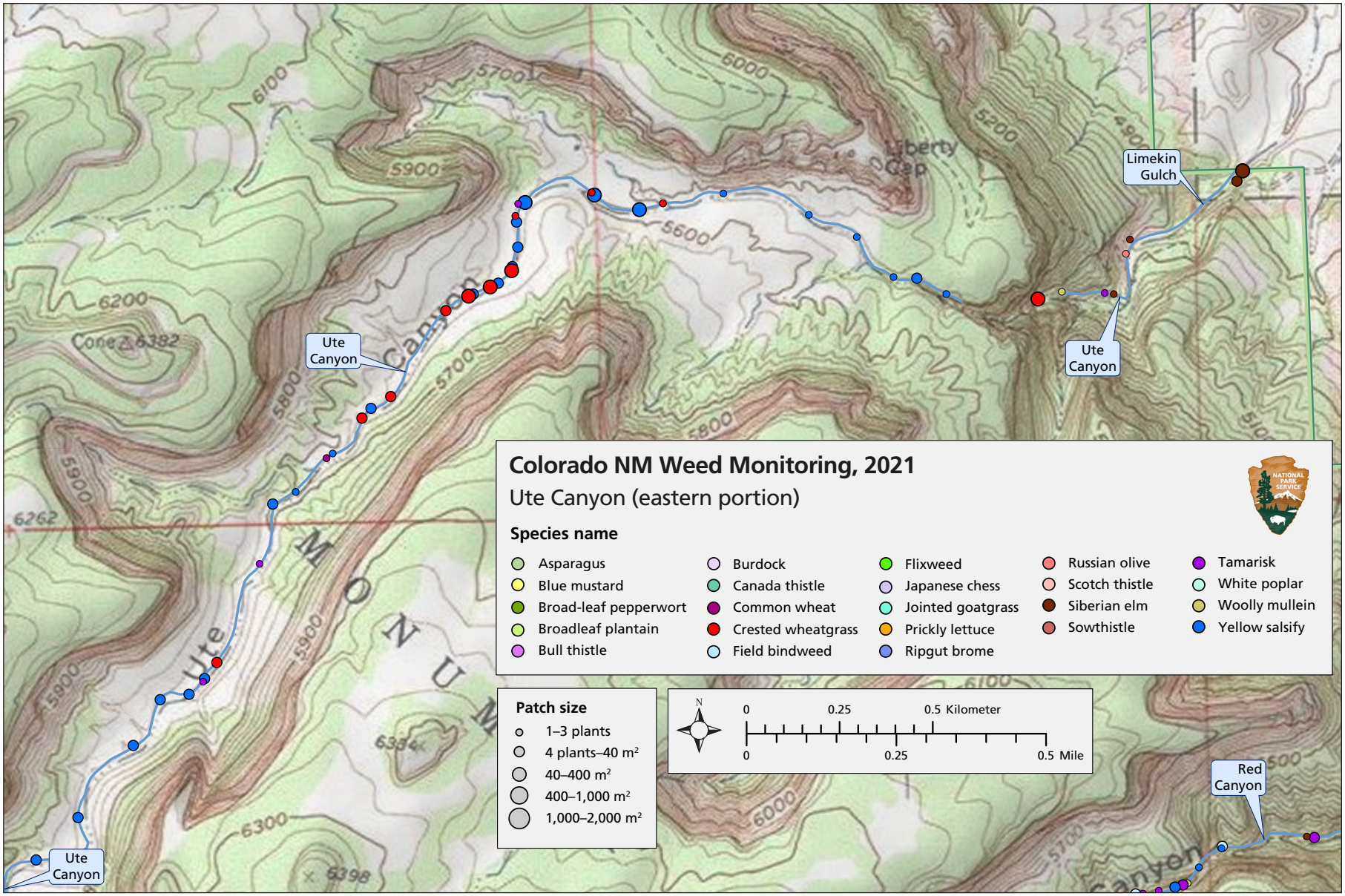


Figure 3-6. Invasive exotic plants detected on monitoring routes in the eastern section of Ute Canyon, Colorado National Monument, June 9–15, 2021.

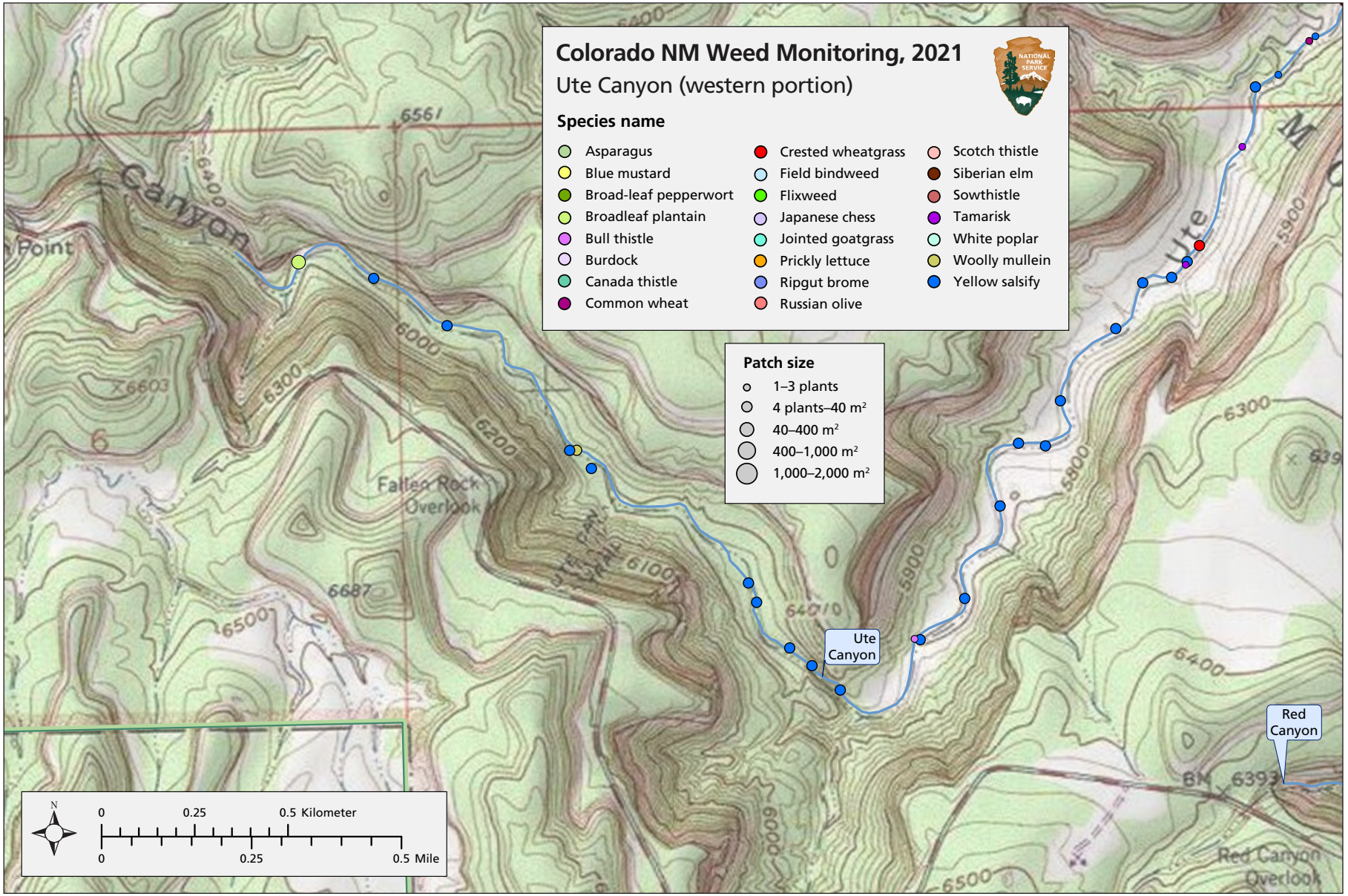


Figure 3-7. Invasive exotic plants detected on monitoring routes in the western section of Ute Canyon, Colorado National Monument, June 9–15, 2021.

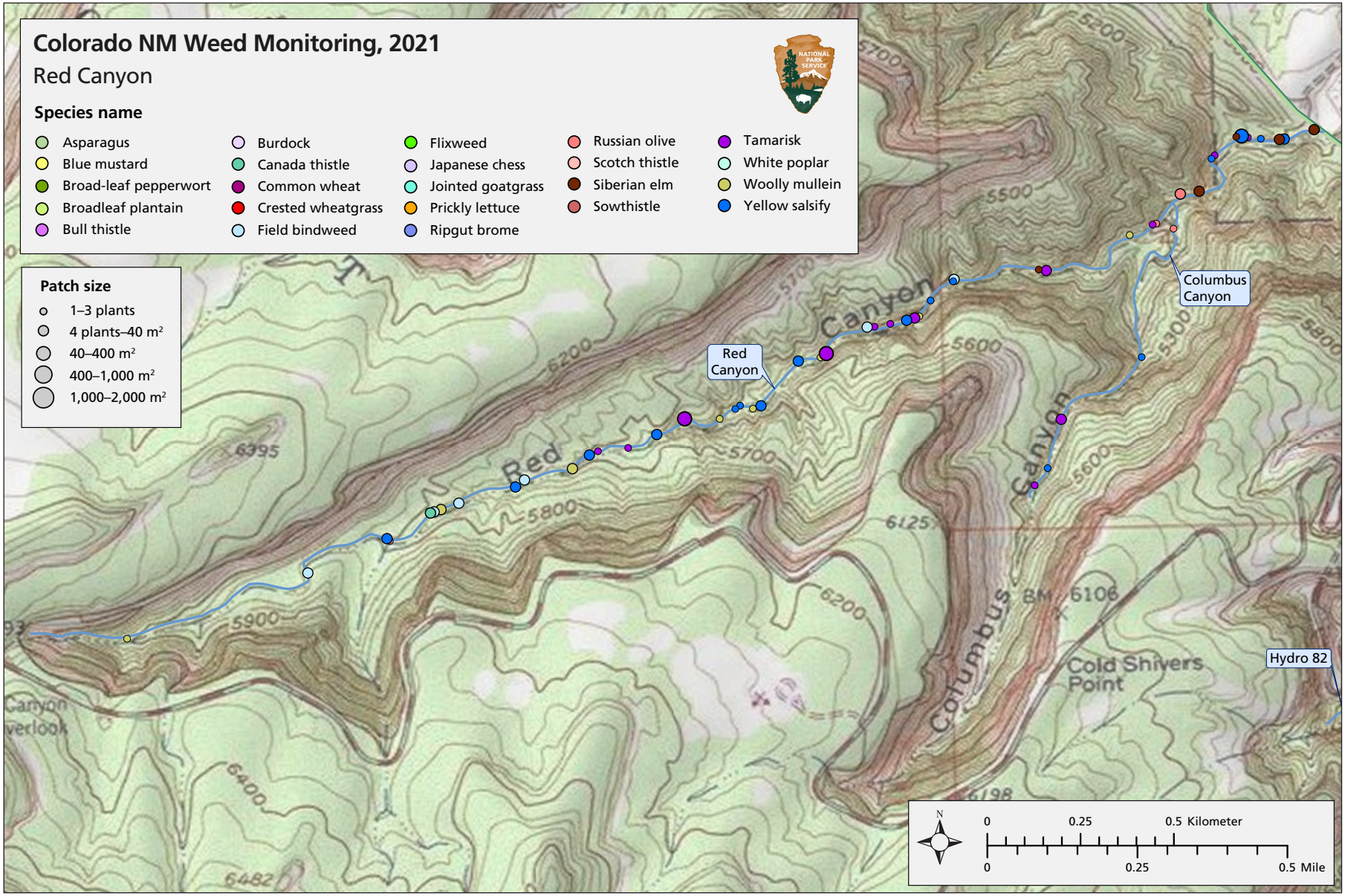


Figure 3-8. Invasive exotic plants detected on monitoring routes in Red Canyon, Colorado National Monument, June 9–15, 2021.

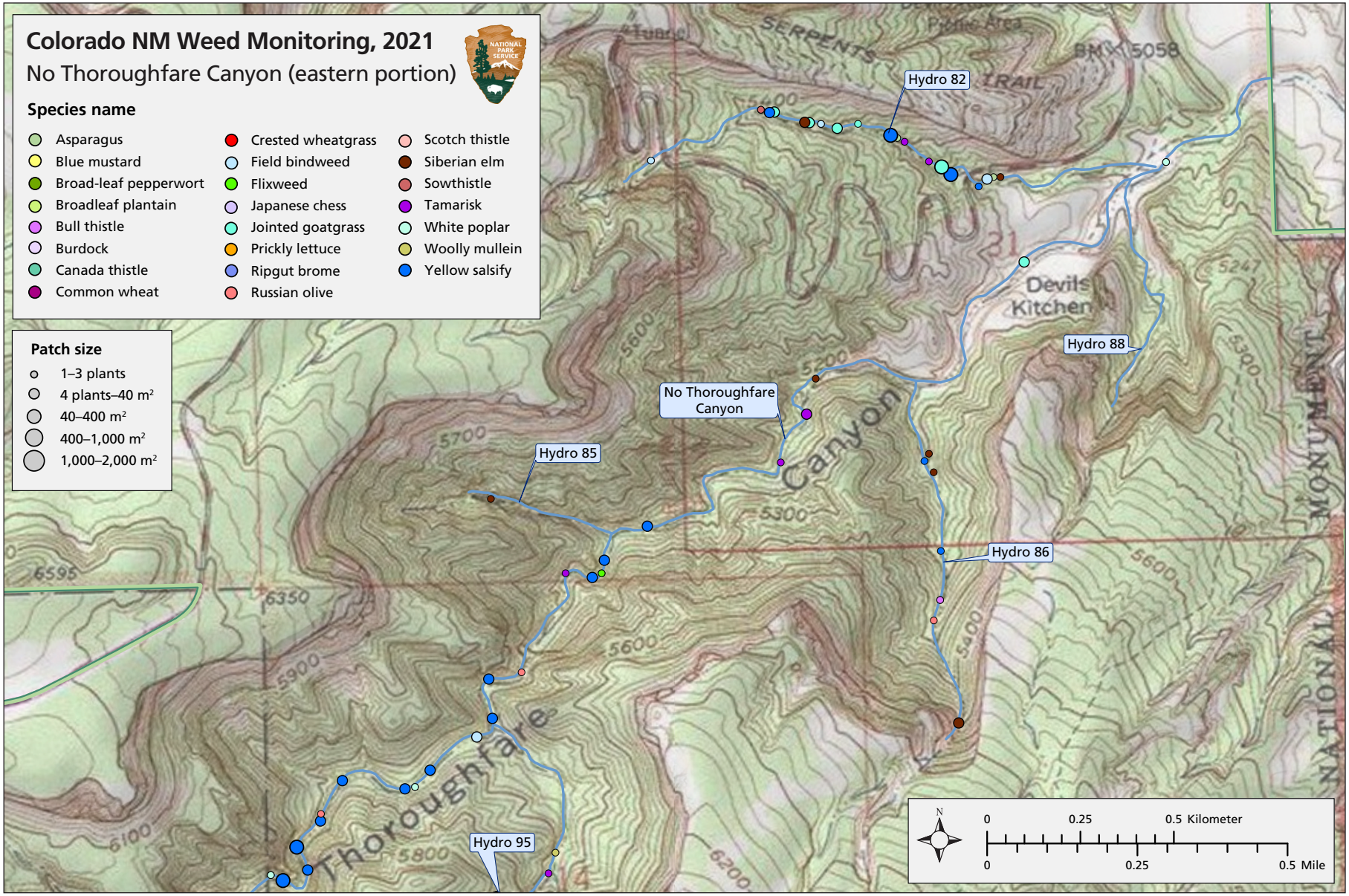


Figure 3-9. Invasive exotic plants detected on monitoring routes in eastern section of No Thoroughfare Canyon, Colorado National Monument, June 9–15, 2021.

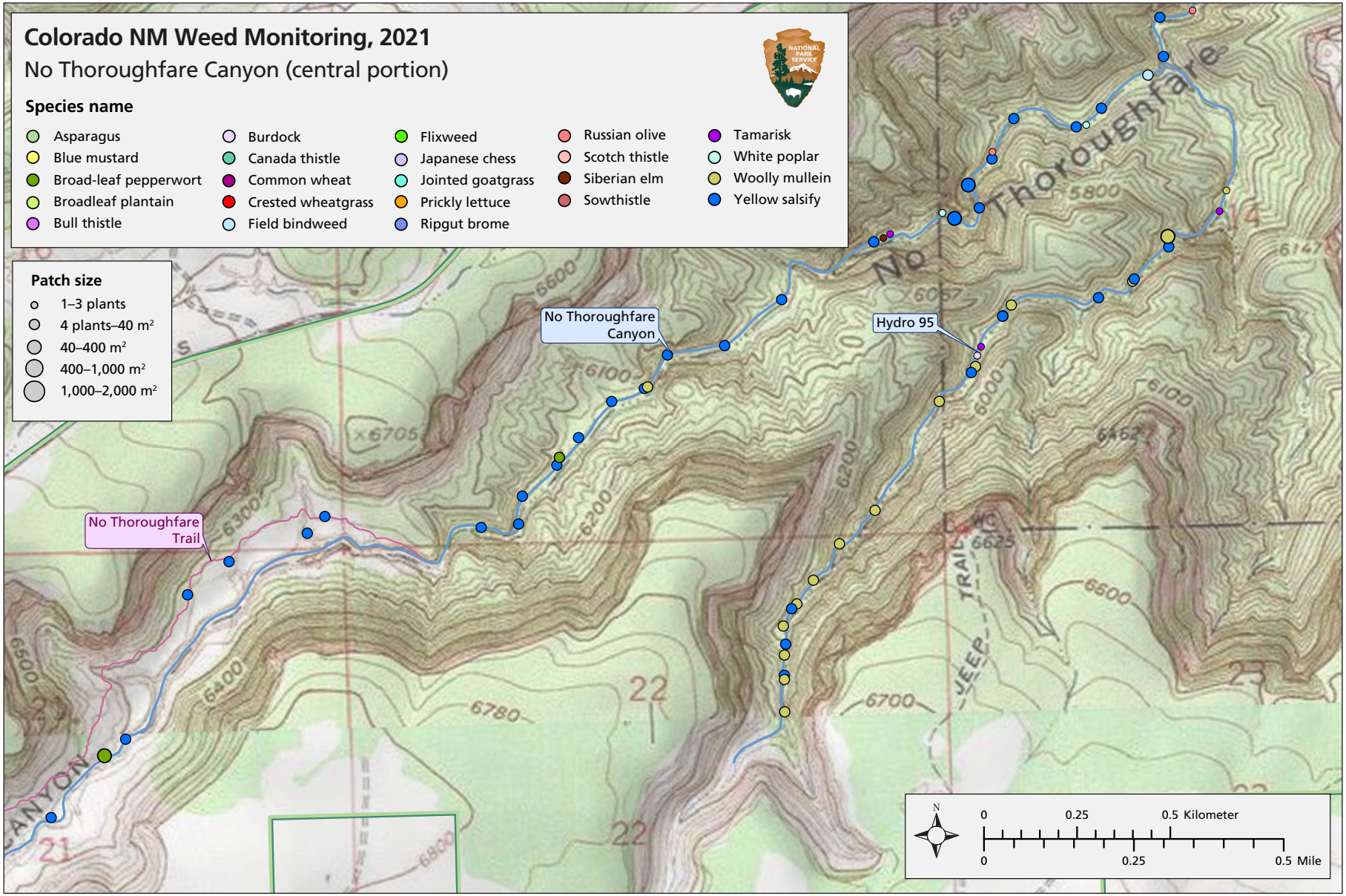


Figure 3-10. Invasive exotic plants detected on monitoring routes in the central section of No Thoroughfare Canyon, Colorado National Monument, June 9–15, 2021.

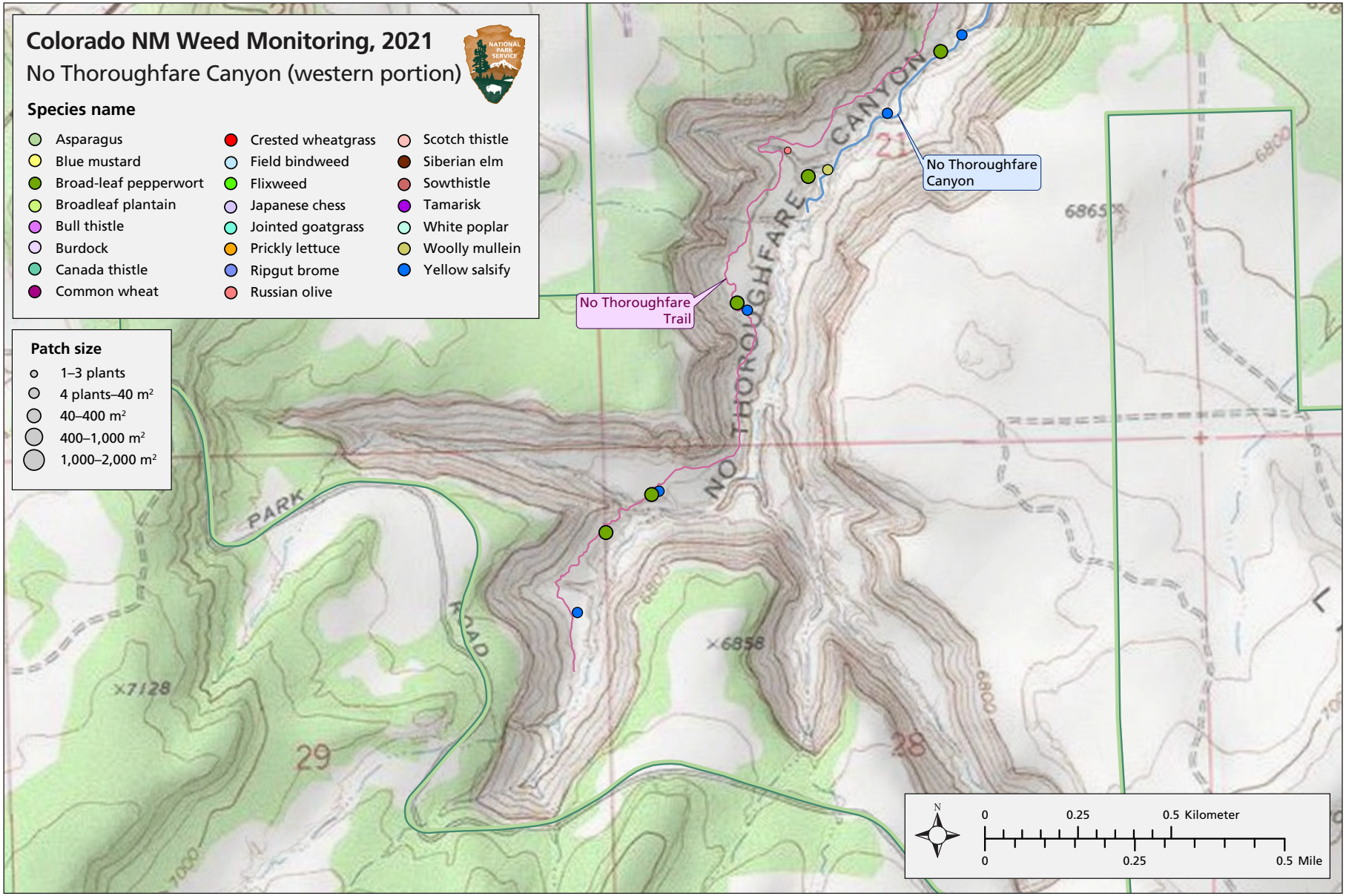


Figure 3-11. Invasive exotic plants detected on monitoring routes in the western section of No Thoroughfare Canyon, Colorado National Monument, June 9–15, 2021.

ding Canyon (1.02 patches/100 m) routes (see Table 3-2). The two trails monitored had the lowest numbers of IEPs, averaging 0.23 patches per 100 meters. There were no IEP patches recorded on the Hydro 88, Limekin Gulch, or Kodels Canyon routes.

Yellow salsify (*Tragopogon dubius*), ripgut brome (*Anisantha diandra*), jointed goatgrass (*Cylindropyrum cylindricum*), and tamarisk were the most commonly detected priority IEPs, representing 74% of all priority patches along monitoring routes (Table 3-3). Only priority species should be examined when comparing across areas, as these were the only species recorded consistently by all observers.

Scotch thistle (*Onopordum acanthium*) was recorded in two patches in Monument Canyon for the first time ever on NCPN monitoring routes and in the park. Jointed goatgrass was one of the most common species in 2021 but had not been recorded in monitoring since 2011, when it was found in three patches along Rimrock Drive. This route was not monitored in 2021. Broad-leaf pepperwort (*Cardaria latifolia*), recorded in nine patches along Lizard Canyon, Gold Star Canyon, No Thoroughfare Trail, and No Thoroughfare Canyon, had not previously been recorded since 2013, when it was recorded in two patches in Red Canyon.

Canada thistle (*Breea arvensis*), recorded in

Table 3-3. Species observed and patch size class detected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Scientific name	Common name	Priority?	Total patches	Patch size class[1]				
				1	2	3	4	5
Anisantha diandra	ripgut brome	Yes	84	0	9	75	0	0
Arctium minus	burdock	Yes	1	1	0	0	0	0
Breea arvensis	Canada thistle	Yes	4	1	3	0	0	0
Cardaria latifolia	broad-leaf pepperwort	Yes	9	0	3	6	0	0
Chorispora tenella	blue mustard	Yes	2	0	2	0	0	0
Cirsium vulgare	bull thistle	Yes	2	2	0	0	0	0
Convolvulus arvensis	field bindweed	Yes	15	2	13	0	0	0
Cylindropyrum cylindricum	jointed goatgrass	Yes	42	5	27	10	0	0
Descurainia sophia	flixweed	Yes	2	1	1	0	0	0
Elaeagnus angustifolia	Russian olive	Yes	11	10	1	0	0	0
Onopordum acanthium	Scotch thistle	Yes	2	2	0	0	0	0
Tamarix sp.	tamarisk	Yes	30	24	4	2	0	0
Tragopogon dubius	yellow salsify	Yes	137	38	91	8	0	0
Ulmus pumila	Siberian elm	Yes	26	19	6	1	0	0
Verbascum thapsus	woolly mullein	Yes	28	10	17	1	0	0
Agropyron cristatum	crested wheatgrass	No	12	3	5	4	0	0
Asparagus officinalis	asparagus	No	4	4	0	0	0	0
Bromus japonicus	Japanese chess	No	2	0	2	0	0	0
Lactuca serriola	prickly lettuce	No	2	1	1	0	0	0
Plantago major	common plantain	No	1	0	0	1	0	0
Populus alba	white poplar	No	3	3	0	0	0	0
Sonchus sp.	sowthistle	No	1	1	0	0	0	0
Triticum aestivum	common wheat	No	1	1	0	0	0	0
Priority species total	–	–	395	115	177	103	0	0
Non-priority species total	–	–	26	13	8	5	0	0

[1]Patch size classes: 1 = 1–a few plants (≤2 × 2 m), 2 = few plants–40 m^2 (48 yd^2), 3 = 40–400 m^2 (48–478 yd^2), 4= 400–1,000 m^2 (0.1–0.25 acre), 5 = 1,000–2,000 m^2

four patches in 2021 along Monument and Red canyons, had not been recorded since 2015, when it was found along Rim Rock Drive. Bull thistle (*Cirsium vulgare*), recorded in two patches in 2021, along Hydro 86 and Ute Canyon, had not previously been recorded since 2015, when it was recorded along Fruita Canyon, Hydro 95, Monument Canyon, No Thoroughfare Canyon, Red Canyon, Rim Rock Drive, Ute Canyon, and Wedding Canyon.

Of the 395 priority patches, only 103 (26%) were assigned to size classes larger than 40 m^2 (classes 3–5; see Table 3-3). Of these 103 patches, 75 were ripgut brome (89% of the patches of this species). Broad-leaf pepperwort (*Cardaria latifolia*) also had a large percentage of patches in the >40 m^2 size class. For all other species, more than 75% of patches were smaller than 40 m^2.

Three priority invasive tree species were detected: Russian olive, tamarisk, and Siberian elm (*Ulmus pumila*). Of the 11 Russian olive patches detected, 7 were seedlings, 3 were saplings, and 1 was a mature tree (Appendix B). There were 22 seedlings, 2 saplings, and 1 mature tree of Siberian elm. There were 26 tamarisk seedlings, 2 saplings, one mature tree, and one occurrence where the growth stage was not noted (see Appendix A).

3.3 Monitoring transects

IEPs were found in transects on all routes surveyed. Transect data from routes where at least eight transects were conducted are summarized in Table 3-4 (also see Appendix B). A total of 82 transects were sampled in 2021 (Figure 3-12). The only widespread priority or transect IEP species was cheatgrass, present in >63% of transects along every

Table 3-4. Total number of transects per route, number of transects where exotic plant species were detected, mean percent cover by species, and standard error for routes with at least eight transects, Colorado National Monument, June 9–15, 2021.

Route	Scientific name	Common name	# of transects detected/ Total transects	Percent cover	SE
Columbus/Red Canyon	*Anisantha tectorum*	cheatgrass	10/10	1.59	0.72
Monument Canyon[1]	*Anisantha diandra*	ripgut brome	6/18	0.34	0.17
Monument Canyon[1]	*Anisantha tectorum*	cheatgrass	12/18	0.23	0.06
Monument Canyon[1]	*Erodium cicutarium*	redstem filaree	3/18	0.03	0.02
Monument Canyon[1]	*Tragopogon dubius*	yellow salisfy	1/18	0.01	0.01
Monument Canyon[1]	*All species*	–	13/18	0.62	0.20
Ute Canyon[2]	*Anisantha tectorum*	cheatgrass	15/16	0.79	0.32
Ute Canyon[2]	*Erodium cicutarium*	redstem filaree	3/16	0.04	0.03
Ute Canyon[2]	*All species*	–	15/16	0.83	0.39
No Thoroughfare Canyon[3]	*Anisantha tectorum*	cheatgrass	21/27	0.73	0.27
No Thoroughfare Canyon[3]	*Cardaria latifolia*	broad-leaf pepperwort	1/27	0.01	0.01
No Thoroughfare Canyon[3]	*Erodium cicutarium*	redstem filaree	3/27	0.02	0.01
No Thoroughfare Canyon[3]	*Salsola* sp.	Russian thistle	1/27	0.01	0.01
No Thoroughfare Canyon[3]	*Sisymbrium altissimum*	tumble mustard	1/27	0.01	0.01
No Thoroughfare Canyon[3]	*Verbascum thapsus*	woolly mullein	1/27	0.02	0.03
No Thoroughfare Canyon[3]	*All species*	–	21/27	0.79	0.27
Wedding Canyon/Hydro 11	*Anisantha tectorum*	cheatgrass	5/8	0.38	0.21
All other routes	*Anisantha tectorum*	cheatgrass	10/13	2.00	1.33
All other routes	*Cardaria latifolia*	broad-leaf pepperwort	1/13	0.01	0.01
All other routes	*Erodium cicutarium*	redstem filaree	1/13	0.04	0.03
All other routes	*Salsola* sp.	Russian thistle	1/13	0.03	0.02
All other routes	*All species*	–	10/13	2.07	1.32

[1]Includes Hydro 88; [2]Includes Limekin Gulch; [3]Includes Hydros 82, 85, 86, and 95.

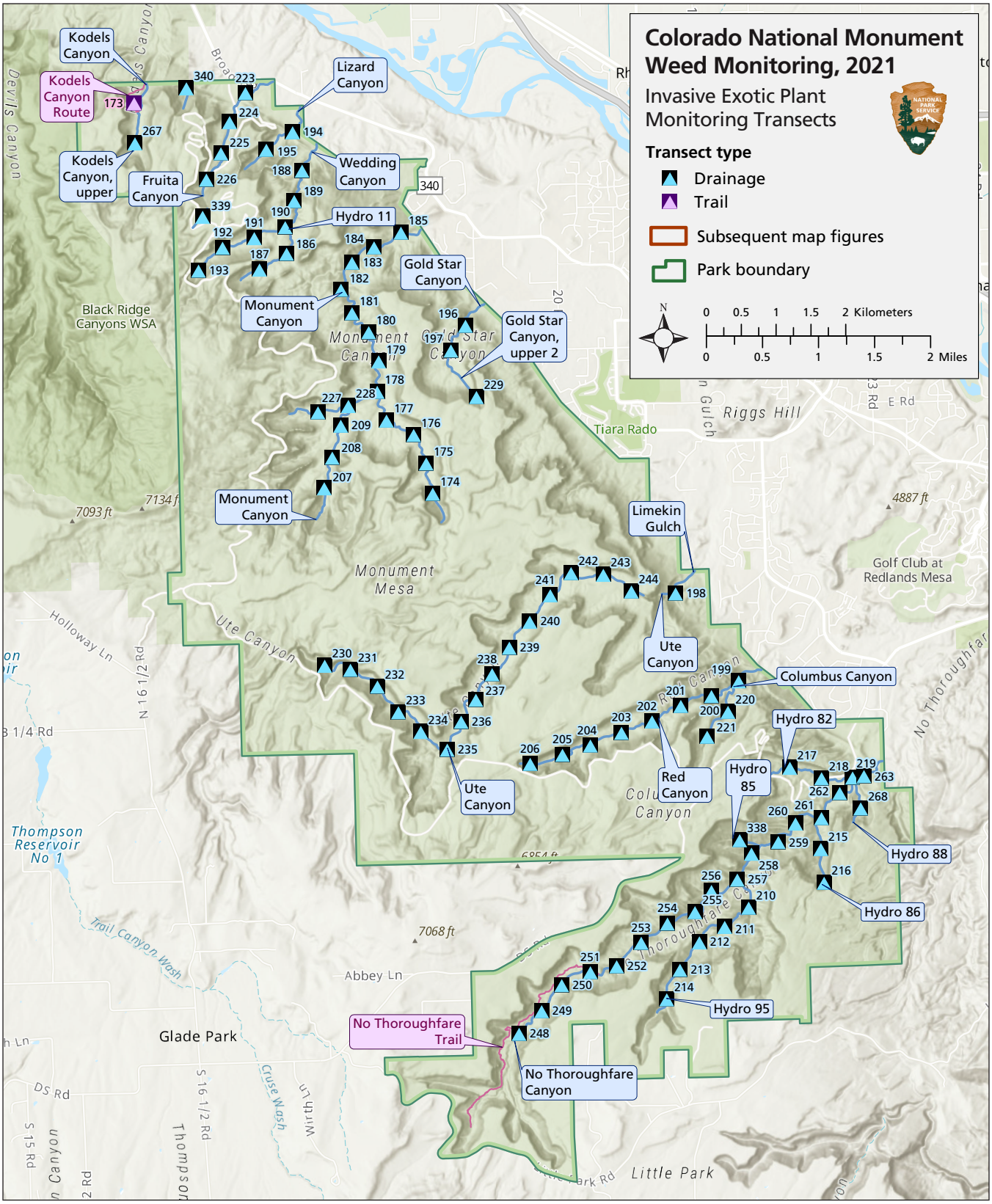


Figure 3-12. Invasive plant monitoring transects, Colorado National Monument, June 9–15, 2021.

route. Ripgut brome was found in 33% of transects in Monument Canyon. Redstem filaree (Erodium cicutarium) was found in 17% of transects in Ute Canyon. No other species was found in more than 11% of transects along any other route. All routes had at least one species in >63% of all transects. Percent cover of cheatgrass was between 0.23% and 2.00% in all areas. Ripgut brome averaged 0.34% cover in Monument Canyon. Percent cover of all other species was below 0.04% on all routes.

3.4 Status of IEPs over time, 2003–2021

Colorado National Monument was previously surveyed for IEPs in 2003, 2009, 2011, 2013, 2015, 2017, and 2019 (Dewey and Andersen 2005; Perkins 2010; Perkins 2012; Perkins 2014; Perkins 2016; Gommermann et al. 2019; Perkins 2021).

Due to changing priority lists over time, the data were analyzed for two different time periods: 2009–2021 (Table 3-5, Figure 3-13) and 2015–2021 (Figure 3-14).

Table 3-5. Invasive exotic plant species that were common to all years within a sampling period.

Scientific name	Common name	Year[1]	
		2009–2021	2015–2021
Acosta diffusa	diffuse knapweed	X	X
Acosta maculosa	spotted knapweed	X	X
Acroptilon repens	Russian knapweed	X	X
Arctium minus	burdock	X	X
Breea arvense	Canada thistle	X	X
Cardaria sp.	hoary cress	X	X
Cardaria latifolia	broad-leaf pepperwort	X	X
Carduus acanthoides	plumeless thistle	X	X
Carduus nutans	musk thistle	X	X
Chorispora tenella	blue mustard	–	X
Cirsium vulgare	bull thistle	X	X
Convolvulus arvensis	field bindweed	X	X
Cylindropyrum cylindricum	jointed goatgrass	X	X
Cynoglossum officinale	common hounds-tongue	–	X
Descurainia sophia	flixweed	–	X
Elaeagnus angustifolia	Russian olive	X	X
Isatis tinctoria	dyer's woad	X	X
Leucantha solstitialis	yellow starthistle	X	X
Linaria vulgaris	butter-and-eggs	X	X
Lythrum salicaria	purple loosestrife	X	X
Onopordum acanthium	Scotch thistle	X	X
Tamarix spp.	tamarisk	X	X
Tithymalus esula	leafy spurge	X	X
Tragopogon dubius	yellow salsify	–	X
Tribulus terrestris	puncturevine	X	X
Ulmus pumila	Siberian elm	X	X
Verbascum thapsus	woolly mullein	X	X

[1] "X" = Yes; "–" = No.

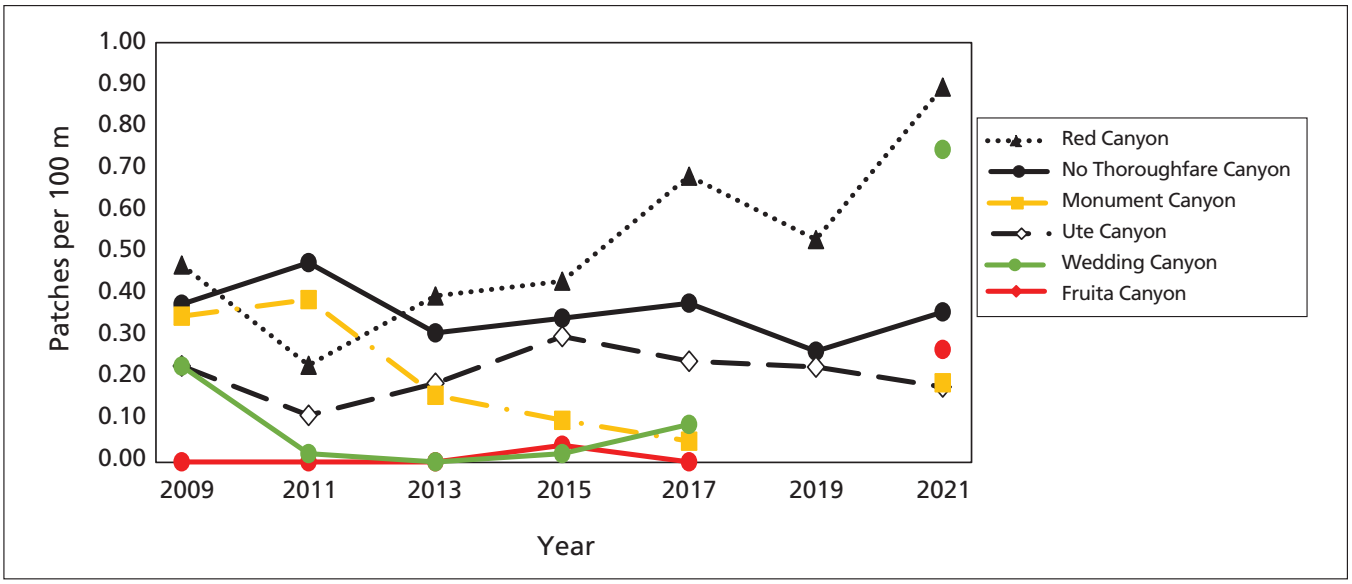


Figure 3-13. Patches per 100 meters for priority invasive exotic plant species detected on common monitoring routes in Colorado National Monument, 2009–2021.

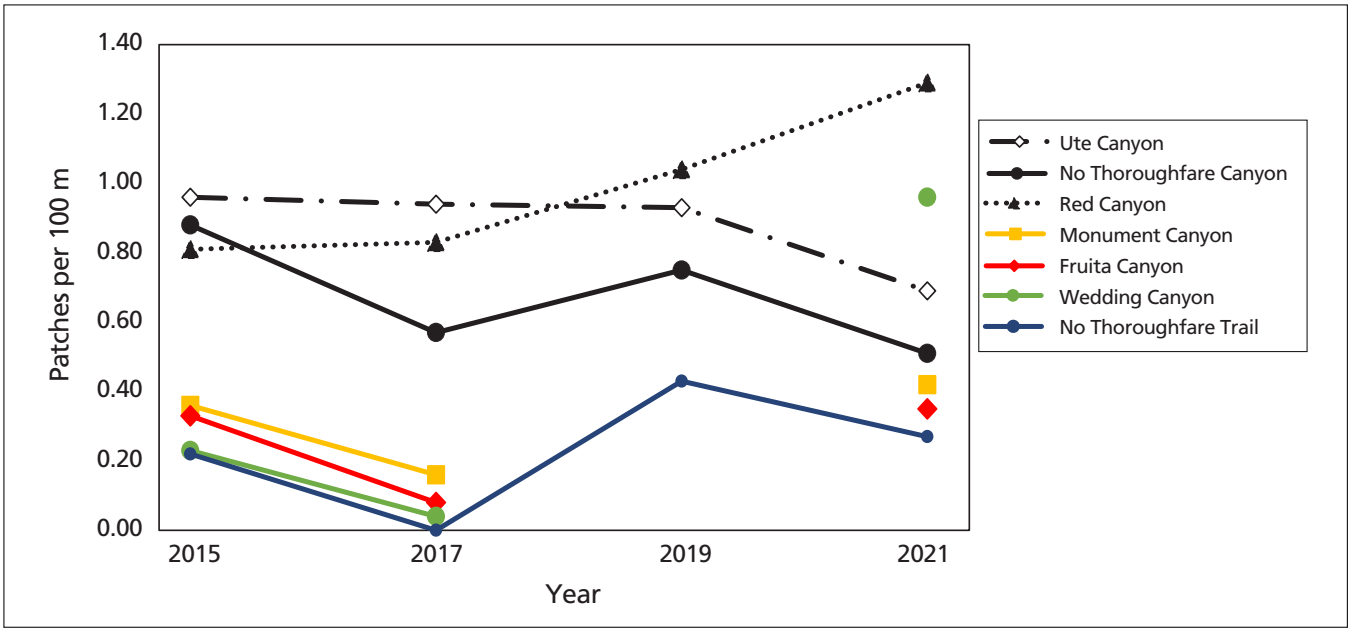


Figure 3-14. Patches per 100 meters for priority invasive exotic plant species detected on common monitoring routes in Colorado National Monument, 2015–2021.

The following IEP species were the most commonly observed from 2009 to 2021: bull thistle (*Cirsium vulgare*), Russian olive, tamarisk, Siberian elm, and woolly mullein.[1] During those years, the number of IEPs per 100 meters stayed relatively stable along the No Thoroughfare, Ute, and Monument canyon routes (see Figure 3-13). Monument Canyon was still within the range of past levels of IEPs over this time period, but did increase from 2017 due to an increase in yellow salsify (Table 3-6, see Figure 3-14).

Red, Wedding, and Fruita canyons all saw increases from the previous sampling period (in 2017 or 2019) to 2021. For all of these routes, more IEPs were recorded in 2021 than in any other sampling year (see Figures 3-13 and 3-14).

The increases in Wedding and Fruita canyons were largely driven by increases in jointed goatgrass. This species was not detected on monitoring routes in the monument from 2013 to 2017, but was present in eight patches in 2019 and 42 patches in 2021 (see Table 3-6). (No Thoroughfare, Ute, and Monument canyons had 1, 0, and 2 patches of jointed goatgrass in 2021, respectively.) There was a small increase in jointed goatgrass in Red Canyon, but the overall increase there was driven more by tamarisk. Wedding Canyon also had an increase in yellow salsify.

Ute Canyon, No Thoroughfare Canyon, and No Thoroughfare Trail all had small decreases or remained similar in IEP numbers from 2019 to 2021. Flixweed decreased in Ute Canyon, while yellow salsify decreased in No Thoroughfare Canyon from 2019 to 2021.

The following priority IEP species remain undetected since monitoring began in 2009: diffuse knapweed (*Acosta diffusa*), spotted knapweed (*Acosta maculosa*), plumeless thistle (*Carduus acanthoides*), musk thistle (*Carduus nutans*), yellow starthistle (*Leucantha solstitialis*), butter-and-eggs (*Linaria vulgaris*), purple loosestrife (*Lythrum salicaria*). Russian knapweed (*Acroptilon repens*), and puncturevine (*Tribulus terrestris*) remain unobserved since 2011. Common houndstongue (*Cynoglossum officinale*) remains unobserved since it was added to the priority list in 2015. One patch of leafy spurge (*Tithymalus esula*) was observed in 2015, but none was observed in 2017, 2019, or 2021.

[1]Yellow salsify, flixweed, ripgut brome, and yellow sweetclover were not priority species in 2009–2021. Ripgut brome and yellow sweetclover were not priority species in 2015–2021. Yellow sweetclover was added to the priority list in 2011. However, due to a miscommunication, the crew did not know it was still on the priority list in 2021, so it was not recorded and was removed from the priority list for that year. Yellow salsify and flixweed were added to the list in 2015.

Table 3-6. Number of patches/100 m of invasive exotic plants (minimum 5 detections in a year) observed along routes consistently surveyed between 2009 and 2021, Colorado National Monument.

			Year[1]						
Scientific name	**Common name**	**Route**	**2009**	**2011**	**2013**	**2015**	**2017**	**2019**	**2021**
Descurainia sophia	flixweed	Ute Canyon	ND	ND	ND	0.00	0.12	0.13	0.00
Elaeagnus angustifolia	Russian olive	No Thoroughfare Canyon[2]	0.14	0.05	0.00	0.05	0.02	0.01	0.02
Ulmus pumila	Siberian elm	No Thoroughfare Canyon[2]	0.02	0.07	0.04	0.08	0.00	0.01	0.05
Ulmus pumila	Siberian elm	Red Canyon	0.07	0.08	0.12	0.05	0.00	0.15	0.17
Tamarix spp.	tamarisk	No Thoroughfare Canyon[2]	0.08	0.08	0.04	0.03	0.03	0.04	0.06
Tamarix spp.	tamarisk	Ute Canyon	0.10	0.00	0.01	0.03	0.05	0.07	0.05
Tamarix spp.	tamarisk	Red Canyon	0.00	0.10	0.07	0.00	0.20	0.07	0.27
Verbascum thapsus	woolly mullein	No Thoroughfare Canyon[2]	0.11	0.12	0.14	0.13	0.18	0.15	0.13
Verbascum thapsus	woolly mullein	Red Canyon	0.10	0.03	0.012	0.28	0.34	0.17	0.22
Verbascum thapsus	woolly mullein	Ute Canyon	0.05	0.01	0.08	0.19	0.15	0.04	0.04
Tragopogon dubius	yellow salsify	Wedding Canyon	ND	ND	ND	0.00	0.00	ND	0.20
Tragopogon dubius	yellow salsify	No Thoroughfare Canyon[2]	ND	ND	ND	0.22	0.12	0.40	0.30
Tragopogon dubius	yellow salsify	Monument Canyon	ND	ND	ND	0.26	0.11	ND	0.24
Tragopogon dubius	yellow salsify	Red Canyon	ND	ND	ND	0.38	0.15	0.49	0.39
Tragopogon dubius	yellow salsify	Ute Canyon	ND	ND	ND	0.65	0.52	0.52	0.48
Cirsium vulgare	bull thistle	No Thoroughfare Canyon[2]	0.01	0.01	0.00	0.01	0.09	0.00	0.00
Cylindropyrum cylindricum	jointed goatgrass	Fruita Canyon	ND	0.00	0.00	0.00	0.00	ND	0.23
Cylindropyrum cylindricum	jointed goatgrass	No Thoroughfare Canyon[2]	0.00	0.00	0.00	0.00	0.00	0.01	0.05
Cylindropyrum cylindricum	jointed goatgrass	Wedding Canyon	0.00	0.00	0.00	0.00	0.00	ND	0.66

[1]ND = No data collected because this species was not on the priority list for that year.
[2]Includes Hydros 82, 85, and 95.

4 Discussion

4.1 Priority invasive exotic plant list

The NCPN will continue to work with Colorado NM staff and area IEP experts to review and update the list of priority species before each sampling period. In this report, presence and absence data for most priority species (and presence data for other species) should be reliable. However, absence data for non-priority species should be considered suspect, because not all observers consistently recorded non-priority species. Due to a miscommunication, yellow sweetclover was not included on the priority list in 2021, but it should have been. This species will return to the priority list for our next visit. Japanese chess (*Bromus japonicus*) was noted to be widespread by the field crew and could be considered as a transect species for future visits.

4.2 Possibilities for management control

The routes with the highest priority IEP densities in 2021 were Red Canyon, Monument Canyon, Hydro 82, and Wedding Canyon. The overall number of IEP patches has increased at Red Canyon, Wedding Canyon, and Fruita Canyon, driven in part by increases in jointed goatgrass, which went from 8 patches in 2019 to 42 in 2021. Many of the routes that remained relatively stable had 0–2 patches of goatgrass in 2021. This species has increased rapidly since the last monitoring visit and should be targeted for control.

Scotch thistle was found for the first time in our monitoring, in two patches in Monument Canyon. Broad-leaf pepperwort, Canada thistle, and bull thistle were recorded in 2021 for the first time since 2012, 2015, and 2015, respectively. All of these species are currently isolated and occurring in 10 patches or fewer. Controlling them soon could prevent widespread establishment.

The number, size, and maturity of tree patches indicate that control efforts of woody patches along monitored routes to date have been effective and should continue. Declines observed in these populations are likely the result of efforts by park staff and volunteers to control these species. However, there were increases in tamarisk patches in Red Canyon. It is important to control this species before it becomes widespread. Tree patches consisted largely of seedlings and saplings, which are easier to control than mature trees. From 2009 to 2021, seedlings and saplings accounted for 75–95% of patches. Continued control efforts should be made before more seedlings and saplings grow into mature trees.

Ripgut brome, added to the priority list in 2019, already represents one of the most common IEPs detected during monitoring. It also represented 73% of all patches larger than 40 m^2 and was found in 33% of transects. This species may be too widespread to be controlled. Cheatgrass remains widespread and is only recorded in transects. For all species except ripgut brome and broadleaf pepperwort, more than 75% of patches were smaller than 40 m^2 and will be easier to control than those two species.

It will be much easier for park staff to contain invasive species if eradication efforts continue. In just a few years, small patches could become large, and seedlings and saplings will become mature trees, requiring removal by chainsaw instead of loppers or pruning shears. Preventing additional exotic-species invasions should give native species a better chance to persist.

It should be noted that all observations of IEPs in this report are limited to the routes surveyed. Actual percent cover of IEPs across the entire park cannot be inferred with these methods. Because we have chosen to monitor areas most likely to be invaded by a broad suite of IEPs, it is plausible that the percent cover for most IEP species may be lower in the interior of the park than along the monitoring routes.

4.3 Future monitoring efforts

IEPs at Colorado NM will generally be monitored at the same time of year in alternating years. Consistency in timing of monitoring should ensure consistency in detection probabilities and cover estimates of most species. For many species, sampling

any time from May through September is not expected to drastically alter the chances of detecting invasive species larger than the minimum detection target size. In 2023, the NCPN plans to resurvey Colorado NM. Because detections from one year may be eradicated by park staff before the next sampling period, the monitoring quadrats are relocated each year. Long-term trend reporting will focus on (1) trends in species distribution and percent cover of individual species and (2) changes in IEP percent cover of priority species and cheatgrass by monitoring route. Extra-area surveys will also be considered at the request of park staff.

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Appendix A. Exotic Plant Patch Data

Table A-1. Exotic plant patches detected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Species	Common Name	Pulled	Growth Stage	N Coord	E Coord	Cover Class	Size Class	Priority?
Columbus Canyon	Elaeagnus angustifolia	Russian-olive	FALSE	Seedling(s)	4323914	703326	5	1	Yes
Columbus Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4323226	702953.6	5	1	Yes
Columbus Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4323403	703025.1	2	2	Yes
Columbus Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4323272	702988.4	5	1	Yes
Columbus Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4323569	703240.7	5	1	Yes
Fruita Canyon	Convolvulus arvensis	Field bindweed	FALSE	–	4331404	695914	1	2	Yes
Fruita Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4331350	695840.6	4	1	Yes
Fruita Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4331704	695994	1	2	Yes
Fruita Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4331636	696004	1	2	Yes
Fruita Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4331888	696063.5	1	2	Yes
Fruita Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4331489	695976.5	1	2	Yes
Fruita Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4332041	696098.2	1	3	Yes
Fruita Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4332037	696108	5	1	Yes
Fruita Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4331372	695857.1	5	1	Yes
Gold Star Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329384	699675.8	2	2	Yes
Gold Star Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329431	699739.2	2	2	Yes
Gold Star Canyon	Cardaria latifolia	Broad-leaf pepperwort	FALSE	–	4328118	699618.8	2	2	Yes
Gold Star Canyon	Cardaria latifolia	Broad-leaf pepperwort	FALSE	–	4329113	699473.9	2	3	Yes
Gold Star Canyon	Chorispora tenella	Blue mustard	FALSE	–	4328093	699643.4	2	2	Yes
Gold Star Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4329417	699744.7	2	2	Yes
Gold Star Canyon	Descurainia sophia	Flixweed	FALSE	–	4328086	699637.8	2	2	Yes
Hydro 03	Elaeagnus angustifolia	Russian-olive	FALSE	Mature tree(s)	4332251	695415.9	5	1	Yes
Hydro 03	Tamarix sp.	Tamarisk	FALSE	Mature tree(s)	4332508	695471.5	5	1	Yes
Hydro 03	Tamarix sp.	Tamarisk	FALSE	Sapling(s)	4332554	695483.7	5	1	Yes
Hydro 03	Tamarix sp.	Tamarisk	FALSE	Sapling(s)	4332501	695477.2	2	1	Yes
Hydro 11	Agropyron cristatum	Crested wheatgrass	FALSE	–	4330010	696673.4	2	2	No
Hydro 11	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330395	696969.6	2	2	Yes
Hydro 11	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330232	696947.5	1	2	Yes
Hydro 11	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330285	696985.9	1	3	Yes
Hydro 11	Tragopogon dubius	Yellow salsify	TRUE	–	4330520	696955.6	5	1	Yes

Table A-1, cont. Exotic plant patches detected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Species	Common Name	Pulled	Growth Stage	N Coord	E Coord	Cover Class	Size Class	Priority?
Hydro 11	Tragopogon dubius	Yellow salsify	TRUE	–	4330147	696902.4	2	1	Yes
Hydro 82	Asparagus officinalis	Asparagus	TRUE	–	4322703	704469.5	5	1	No
Hydro 82	Asparagus officinalis	Asparagus	FALSE	–	4322599	704727.4	4	1	No
Hydro 82	Convolvulus arvensis	Field bindweed	FALSE	–	4322741	704265.3	5	1	Yes
Hydro 82	Convolvulus arvensis	Field bindweed	FALSE	–	4322643	703809.7	2	1	Yes
Hydro 82	Convolvulus arvensis	Field bindweed	FALSE	–	4322593	704710.3	2	2	Yes
Hydro 82	Cylindropyrum cylindricum	Jointed goatgrass	TRUE	–	4322741	704364.4	5	1	Yes
Hydro 82	Cylindropyrum cylindricum	Jointed goatgrass	TRUE	–	4322773	704140.1	2	2	Yes
Hydro 82	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4322729	704308.8	2	2	Yes
Hydro 82	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4322744	704233.9	4	2	Yes
Hydro 82	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4322626	704588.6	1	3	Yes
Hydro 82	Sonchus sp.	Sowthistle	TRUE	–	4322779	704104.2	5	1	No
Hydro 82	Tamarix sp.	Tamarisk	TRUE	Seedling(s)	4322693	704489.2	5	1	Yes
Hydro 82	Tamarix sp.	Tamarisk	TRUE	Seedling(s)	4322640	704554.5	5	1	Yes
Hydro 82	Tragopogon dubius	Yellow salsify	TRUE	–	4322770	704144.3	5	1	Yes
Hydro 82	Tragopogon dubius	Yellow salsify	FALSE	–	4322573	704687.7	1	1	Yes
Hydro 82	Tragopogon dubius	Yellow salsify	TRUE	–	4322772	704127.3	1	2	Yes
Hydro 82	Tragopogon dubius	Yellow salsify	TRUE	–	4322711	704452	1	3	Yes
Hydro 82	Tragopogon dubius	Yellow salsify	TRUE	–	4322605	704613.2	1	3	Yes
Hydro 82	Ulmus pumila	Siberian elm	TRUE	Seedling(s)	4322599	704746.1	1	1	Yes
Hydro 82	Ulmus pumila	Siberian elm	FALSE	Seedling(s)	4322745	704221.8	1	2	Yes
Hydro 85	Ulmus pumila	Siberian elm	FALSE	Seedling(s)	4321736	703380.7	5	1	Yes
Hydro 86	Cirsium vulgare	Bull thistle	TRUE	–	4321465	704584.5	5	1	Yes
Hydro 86	Elaeagnus angustifolia	Russian-olive	FALSE	Seedling(s)	4321410	704567.5	5	1	Yes
Hydro 86	Tragopogon dubius	Yellow salsify	TRUE	–	4321838	704542.4	5	1	Yes
Hydro 86	Tragopogon dubius	Yellow salsify	TRUE	–	4321596	704586.4	5	1	Yes
Hydro 86	Ulmus pumila	Siberian elm	TRUE	Seedling(s)	4321857	704554.5	5	1	Yes
Hydro 86	Ulmus pumila	Siberian elm	TRUE	Seedling(s)	4321135	704634.3	1	2	Yes
Hydro 86	Ulmus pumila	Siberian elm	TRUE	Seedling(s)	4321807	704567.2	5	1	Yes
Hydro 95	Arctium minus	Burdock	FALSE	–	4320345	702884.7	5	1	Yes
Hydro 95	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4320369	702894.9	5	1	Yes
Hydro 95	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4320732	703535.2	5	1	Yes

Table A-1, cont. Exotic plant patches detected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Species	Common Name	Pulled	Growth Stage	N Coord	E Coord	Cover Class	Size Class	Priority?
Hydro 95	Tragopogon dubius	Yellow salsify	FALSE	–	4320637	703398.9	2	2	Yes
Hydro 95	Tragopogon dubius	Yellow salsify	FALSE	–	4319665	702386.2	2	2	Yes
Hydro 95	Tragopogon dubius	Yellow salsify	FALSE	–	4319487	702366.6	2	2	Yes
Hydro 95	Tragopogon dubius	Yellow salsify	FALSE	–	4320451	702953.8	2	2	Yes
Hydro 95	Tragopogon dubius	Yellow salsify	FALSE	–	4320500	703210.4	2	2	Yes
Hydro 95	Tragopogon dubius	Yellow salsify	FALSE	–	4320299	702868.8	2	2	Yes
Hydro 95	Tragopogon dubius	Yellow salsify	FALSE	–	4319570	702370.2	2	2	Yes
Hydro 95	Tragopogon dubius	Yellow salsify	FALSE	–	4320451	702952.7	2	2	Yes
Hydro 95	Tragopogon dubius	Yellow salsify	FALSE	–	4320551	703306.3	2	2	Yes
Hydro 95	Verbascum thapsus	Woolly mullein	FALSE	–	4320788	703553.8	5	1	Yes
Hydro 95	Verbascum thapsus	Woolly mullein	FALSE	–	4320315	702880	2	2	Yes
Hydro 95	Verbascum thapsus	Woolly mullein	FALSE	–	4319541	702367	2	2	Yes
Hydro 95	Verbascum thapsus	Woolly mullein	FALSE	–	4319742	702444.7	2	2	Yes
Hydro 95	Verbascum thapsus	Woolly mullein	FALSE	–	4319929	702610.2	2	2	Yes
Hydro 95	Verbascum thapsus	Woolly mullein	FALSE	–	4319839	702514.6	2	2	Yes
Hydro 95	Verbascum thapsus	Woolly mullein	FALSE	–	4319678	702400.3	2	2	Yes
Hydro 95	Verbascum thapsus	Woolly mullein	FALSE	–	4320222	702782.7	2	2	Yes
Hydro 95	Verbascum thapsus	Woolly mullein	FALSE	–	4320480	702976.2	2	2	Yes
Hydro 95	Verbascum thapsus	Woolly mullein	FALSE	–	4319475	702366.8	2	2	Yes
Hydro 95	Verbascum thapsus	Woolly mullein	FALSE	–	4319388	702367.8	2	2	Yes
Hydro 95	Verbascum thapsus	Woolly mullein	FALSE	–	4320544	703301.9	2	2	Yes
Hydro 95	Verbascum thapsus	Woolly mullein	FALSE	–	4319619	702363.9	2	2	Yes
Hydro 95	Verbascum thapsus	Woolly mullein	FALSE	–	4320665	703396.5	2	3	Yes
Kodels Canyon	Ulmus pumila	Siberian elm	FALSE	Seedling(s)	4331750	694734.4	5	1	Yes
Lizard Canyon	Cardaria latifolia	Broad-leaf pepperwort	FALSE	–	4331875	696887.3	2	2	Yes
Lizard Canyon	Cylindropyrum cylindricum	Jointed goatgrass	TRUE	–	4332112	697089.1	5	1	Yes
Lizard Canyon	Cylindropyrum cylindricum	Jointed goatgrass	TRUE	–	4331714	696694.3	5	1	Yes
Lizard Canyon	Cylindropyrum cylindricum	Jointed goatgrass	TRUE	–	4331664	696624.4	5	1	Yes
Lizard Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4331603	696574.7	2	2	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330477	698566.2	1	2	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330120	697928.8	2	2	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330432	698801.5	2	2	Yes

Table A-1, cont. Exotic plant patches detected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Species	Common Name	Pulled	Growth Stage	N Coord	E Coord	Cover Class	Size Class	Priority?
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330111	697867.4	2	2	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328598	698232.9	2	2	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329500	697787.6	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328327	698196.3	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330211	698011.8	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328374	698234.6	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329572	697720.1	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328515	698178.7	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329138	697933.8	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328621	698227	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330443	698633.1	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4327947	697701.3	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330254	698108.9	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4327950	697862.4	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330242	698273.4	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328000	697888.7	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330243	698176.4	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330335	698413.5	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328071	698012.8	3	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329718	697726.3	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330030	697843.6	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330438	698475.3	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330430	698689.5	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330380	698451.9	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330424	698750.6	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328124	698109.1	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328677	698220.2	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329627	697696.6	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330287	698306.7	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328895	698163.9	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330311	698362.6	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329102	697984.9	2	3	Yes

Table A-1, cont. Exotic plant patches detected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Species	Common Name	Pulled	Growth Stage	N Coord	E Coord	Cover Class	Size Class	Priority?
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329053	698014.4	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328114	698161.4	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330079	697825.4	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330454	698571	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330243	698053.6	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330223	698224.1	3	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328216	698217.7	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328565	698208.4	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328973	698087.9	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329818	697744.7	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329464	697827	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329764	697758.5	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329373	697836.9	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328427	698246	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328026	697912.4	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329560	697776.7	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4327911	697656.2	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329276	697895.2	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329941	697763.5	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328771	698149.1	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329159	697984.1	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330473	698514.9	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4327999	697864.7	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328829	698147.4	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328715	698176.5	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4327982	697811.9	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329158	697879.7	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328462	698208.1	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329878	697731.5	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329206	697915.8	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328909	698101.7	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4330170	697970.3	3	3	Yes

Table A-1, cont. Exotic plant patches detected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Species	Common Name	Pulled	Growth Stage	N Coord	E Coord	Cover Class	Size Class	Priority?
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328049	698243.7	1	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329460	697887.6	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328047	697963.7	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329037	698075.7	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328155	698204.3	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4327953	697766.1	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328101	698220.3	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329688	697679.9	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328273	698211.7	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329981	697803.6	3	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329410	697877.3	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4328095	698062.4	2	3	Yes
Monument Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4329308	697839.9	2	3	Yes
Monument Canyon	Asparagus officinalis	Asparagus	FALSE	–	4326828	698980.6	5	1	No
Monument Canyon	Asparagus officinalis	Asparagus	FALSE	–	4326737	699022.6	5	1	No
Monument Canyon	Breea arvensis	Canada thistle	FALSE	–	4327887	697622	5	1	Yes
Monument Canyon	Breea arvensis	Canada thistle	FALSE	–	4328014	697884.6	2	2	Yes
Monument Canyon	Breea arvensis	Canada thistle	FALSE	–	4328038	697951.8	2	2	Yes
Monument Canyon	Bromus japonicus	Japanese chess	FALSE	–	4330442	698644.1	1	2	No
Monument Canyon	Bromus japonicus	Japanese chess	FALSE	–	4330472	698532.5	2	2	No
Monument Canyon	Chorispora tenella	Blue mustard	FALSE	–	4329558	697785.9	2	2	Yes
Monument Canyon	Convolvulus arvensis	Field bindweed	FALSE	–	4329089	697980.4	2	2	Yes
Monument Canyon	Convolvulus arvensis	Field bindweed	FALSE	–	4328901	698153.6	2	2	Yes
Monument Canyon	Convolvulus arvensis	Field bindweed	TRUE	–	4327547	698741.8	2	2	Yes
Monument Canyon	Convolvulus arvensis	Field bindweed	FALSE	–	4329406	697848.8	2	2	Yes
Monument Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330391	698455.3	1	2	Yes
Monument Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330330	698404.9	1	2	Yes
Monument Canyon	Elaeagnus angustifolia	Russian-olive	FALSE	Sapling(s)	4326363	697349	5	1	Yes
Monument Canyon	Lactuca serriola	Prickly lettuce	TRUE	–	4328116	698095.4	5	1	No
Monument Canyon	Lactuca serriola	Prickly lettuce	FALSE	–	4327920	697824.5	2	2	No
Monument Canyon	Onopordum acanthium	Scotch thistle	FALSE	–	4329307	697835.6	5	1	Yes
Monument Canyon	Onopordum acanthium	Scotch thistle	FALSE	–	4329559	697783.8	5	1	Yes

Table A-1, cont. Exotic plant patches detected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Species	Common Name	Pulled	Growth Stage	N Coord	E Coord	Cover Class	Size Class	Priority?
Monument Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4326372	697372.6	5	1	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4329296	697859.8	5	1	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4326795	699019	5	1	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4326860	698966.5	5	1	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4328840	698150.1	5	1	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4330181	697976.4	5	1	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4326924	698932.1	5	1	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4329843	697738.1	5	1	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4329465	697858.1	5	1	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4326348	697326.6	2	2	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4328091	698234.4	2	2	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4326729	699020.2	2	2	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4326953	697515	2	2	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4327738	698351.1	2	2	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4327657	697683.2	2	2	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4326382	697377.3	2	2	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4327527	697645.3	2	2	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4327248	697561.3	2	2	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4327921	697810	2	2	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4327071	698926.6	2	2	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4327962	697873.4	2	2	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4330307	698353.7	2	2	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4330445	698808.9	2	2	Yes
Monument Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4327906	698319	2	2	Yes
Monument Canyon	Ulmus pumila	Siberian elm	TRUE	–	4327945	698285.7	5	1	Yes
Monument Canyon	Ulmus pumila	Siberian elm	FALSE	Seedling(s)	4327676	697686	5	1	Yes
Monument Canyon	Ulmus pumila	Siberian elm	FALSE	Seedling(s)	4328898	698124.2	5	1	Yes
Monument Canyon	Ulmus pumila	Siberian elm	FALSE	Seedling(s)	4328811	698136.8	5	1	Yes
No Thoroughfare Canyon	Cardaria latifolia	Broad-leaf pepperwort	FALSE	–	4320071	701762.6	2	2	Yes
No Thoroughfare Canyon	Cardaria latifolia	Broad-leaf pepperwort	FALSE	–	4318935	700185.2	2	3	Yes
No Thoroughfare Canyon	Cardaria latifolia	Broad-leaf pepperwort	FALSE	–	4319270	700541	2	3	Yes
No Thoroughfare Canyon	Convolvulus arvensis	Field bindweed	TRUE	–	4321098	703343	2	2	Yes

Table A-1, cont. Exotic plant patches detected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Species	Common Name	Pulled	Growth Stage	N Coord	E Coord	Cover Class	Size Class	Priority?
No Thoroughfare Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4322371	704809.6	4	2	Yes
No Thoroughfare Canyon	Descurainia sophia	Flixweed	FALSE	–	4321537	703677.5	5	1	Yes
No Thoroughfare Canyon	Elaeagnus angustifolia	Russian-olive	FALSE	Sapling(s)	4321271	703463	5	1	Yes
No Thoroughfare Canyon	Elaeagnus angustifolia	Russian-olive	FALSE	Seedling(s)	4320892	702925.5	5	1	Yes
No Thoroughfare Canyon	Populus alba	White poplar	FALSE	Sapling(s)	4320964	703177.4	5	1	No
No Thoroughfare Canyon	Populus alba	White poplar	TRUE	Seedling(s)	4320728	702791.2	5	1	No
No Thoroughfare Canyon	Populus alba	White poplar	FALSE	Seedling(s)	4322639	705189.7	5	1	No
No Thoroughfare Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4321834	704157.5	5	1	Yes
No Thoroughfare Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4320671	702650.9	5	1	Yes
No Thoroughfare Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4321537	703580.9	5	1	Yes
No Thoroughfare Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4321963	704226.6	1	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4320347	702052.7	2	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4320981	702982.9	1	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4319315	700597.9	2	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4321009	703218	1	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4321663	703800	1	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4321572	703684.8	1	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4320650	702606.8	1	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4320051	701755.9	2	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4319104	700397.8	2	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4320495	702359.5	2	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4319883	701552.5	2	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4319893	701653.2	2	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4321253	703375.1	1	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4319967	701663.2	2	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4320741	702890	1	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4320124	701814	2	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4320222	701902.9	2	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4320873	702924.3	1	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4320256	701990.7	2	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4320959	703150.6	1	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4321148	703384.9	1	2	Yes

Table A-1, cont. Exotic plant patches detected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Species	Common Name	Pulled	Growth Stage	N Coord	E Coord	Cover Class	Size Class	Priority?
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4320372	702206.3	2	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4321526	703652.5	1	2	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4320803	702860.6	1	3	Yes
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4320713	702823.8	1	3	Yes
No Thoroughfare Canyon	Ulmus pumila	Siberian elm	FALSE	Seedling(s)	4320661	702632.5	5	1	Yes
No Thoroughfare Canyon	Ulmus pumila	Siberian elm	FALSE	Seedling(s)	4322058	704251	5	1	Yes
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	FALSE	–	4318953	700237.7	2	2	Yes
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	FALSE	–	4320261	701999.5	2	2	Yes
No Thoroughfare Trail	Cardaria latifolia	Broad-leaf pepperwort	FALSE	–	4317979	699642	2	3	Yes
No Thoroughfare Trail	Cardaria latifolia	Broad-leaf pepperwort	FALSE	–	4318595	699994.4	2	3	Yes
No Thoroughfare Trail	Cardaria latifolia	Broad-leaf pepperwort	FALSE	–	4318081	699764.8	2	3	Yes
No Thoroughfare Trail	Elaeagnus angustifolia	Russian-olive	FALSE	Sapling(s)	4319005	700130.1	5	1	Yes
No Thoroughfare Trail	Tragopogon dubius	Yellow salsify	FALSE	–	4319703	700764.2	2	2	Yes
No Thoroughfare Trail	Tragopogon dubius	Yellow salsify	FALSE	–	4319868	701085.7	2	2	Yes
No Thoroughfare Trail	Tragopogon dubius	Yellow salsify	FALSE	–	4319792	700875.5	2	2	Yes
No Thoroughfare Trail	Tragopogon dubius	Yellow salsify	FALSE	–	4319913	701132.8	2	2	Yes
No Thoroughfare Trail	Tragopogon dubius	Yellow salsify	FALSE	–	4318090	699784.5	2	2	Yes
No Thoroughfare Trail	Tragopogon dubius	Yellow salsify	FALSE	–	4317764	699565.4	2	2	Yes
No Thoroughfare Trail	Tragopogon dubius	Yellow salsify	FALSE	–	4318576	700021.8	2	2	Yes
Red Canyon	Breea arvensis	Canada thistle	FALSE	–	4323151	701333.3	4	2	Yes
Red Canyon	Convolvulus arvensis	Field bindweed	FALSE	–	4323650	702504.4	3	2	Yes
Red Canyon	Convolvulus arvensis	Field bindweed	FALSE	–	4323240	701585.3	3	2	Yes
Red Canyon	Convolvulus arvensis	Field bindweed	FALSE	–	4323778	702737.5	2	2	Yes
Red Canyon	Convolvulus arvensis	Field bindweed	FALSE	–	4323178	701409.3	2	2	Yes
Red Canyon	Convolvulus arvensis	Field bindweed	FALSE	–	4323154	701342.9	4	2	Yes
Red Canyon	Convolvulus arvensis	Field bindweed	FALSE	–	4322990	701004.4	1	2	Yes
Red Canyon	Elaeagnus angustifolia	Russian-olive	FALSE	Seedling(s)	4323928	703279.8	5	1	Yes
Red Canyon	Elaeagnus angustifolia	Russian-olive	FALSE	Seedling(s)	4323076	701224.1	5	1	Yes
Red Canyon	Elaeagnus angustifolia	Russian-olive	FALSE	Seedling(s)	4324007	703344.3	1	2	Yes
Red Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4323651	702524.1	5	1	Yes
Red Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4323326	701863.5	5	1	Yes
Red Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4324111	703436.2	2	1	Yes

Table A-1, cont. Exotic plant patches detected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Species	Common Name	Pulled	Growth Stage	N Coord	E Coord	Cover Class	Size Class	Priority?
Red Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4323317	701782.4	5	1	Yes
Red Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4324159	703525.4	2	1	Yes
Red Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4323925	703270.1	5	1	Yes
Red Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4323659	702566.5	5	1	Yes
Red Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4323802	702984.8	1	2	Yes
Red Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4323674	702631.8	1	2	Yes
Red Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4323404	702014.9	1	3	Yes
Red Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4323579	702394.9	1	3	Yes
Red Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4323439	702163.5	5	1	Yes
Red Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323773	702735.3	5	1	Yes
Red Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4323430	702150.9	3	1	Yes
Red Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4324155	703560.3	5	1	Yes
Red Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4324102	703428	5	1	Yes
Red Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4323721	702674.6	5	1	Yes
Red Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4323668	702610.3	1	2	Yes
Red Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323083	701216.6	1	2	Yes
Red Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323221	701561.3	1	2	Yes
Red Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4323559	702319.7	1	2	Yes
Red Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323307	701759.4	1	2	Yes
Red Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323439	702219.7	1	2	Yes
Red Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4324155	703623.2	1	2	Yes
Red Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4323362	701940.1	1	2	Yes
Red Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323399	702017.8	1	2	Yes
Red Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4324163	703508.7	1	3	Yes
Red Canyon	Ulmus pumila	Siberian elm	FALSE	Mature tree(s)	4324180	703709.1	5	1	Yes
Red Canyon	Ulmus pumila	Siberian elm	FALSE	Seedling(s)	4323585	702398.1	5	1	Yes
Red Canyon	Ulmus pumila	Siberian elm	FALSE	Seedling(s)	4323804	702964.7	5	1	Yes
Red Canyon	Ulmus pumila	Siberian elm	FALSE	Seedling(s)	4324161	703494.3	5	1	Yes
Red Canyon	Ulmus pumila	Siberian elm	FALSE	Seedling(s)	4324180	703703.1	1	2	Yes
Red Canyon	Ulmus pumila	Siberian elm	TRUE	Seedling(s)	4324153	703610.1	1	2	Yes
Red Canyon	Ulmus pumila	Siberian elm	FALSE	Seedling(s)	4324014	703394.9	1	2	Yes
Red Canyon	Verbascum thapsus	Woolly mullein	TRUE	–	4323569	702379.5	5	1	Yes

Table A-1, cont. Exotic plant patches detected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Species	Common Name	Pulled	Growth Stage	N Coord	E Coord	Cover Class	Size Class	Priority?
Red Canyon	Verbascum thapsus	Woolly mullein	TRUE	–	4323431	702198	5	1	Yes
Red Canyon	Verbascum thapsus	Woolly mullein	TRUE	–	4323404	702108.9	5	1	Yes
Red Canyon	Verbascum thapsus	Woolly mullein	TRUE	–	4323180	701412.2	5	1	Yes
Red Canyon	Verbascum thapsus	Woolly mullein	TRUE	–	4323897	703208.5	5	1	Yes
Red Canyon	Verbascum thapsus	Woolly mullein	TRUE	–	4323679	702644.2	5	1	Yes
Red Canyon	Verbascum thapsus	Woolly mullein	TRUE	–	4322814	700519.5	5	1	Yes
Red Canyon	Verbascum thapsus	Woolly mullein	FALSE	–	4323270	701714	2	2	Yes
Red Canyon	Verbascum thapsus	Woolly mullein	FALSE	–	4323161	701361.5	1	2	Yes
Ute Canyon	Agropyron cristatum	Crested wheatgrass	FALSE	–	4325506	701234.1	5	1	No
Ute Canyon	Agropyron cristatum	Crested wheatgrass	FALSE	–	4325473	700837.7	5	1	No
Ute Canyon	Agropyron cristatum	Crested wheatgrass	FALSE	–	4325536	701042.5	5	1	No
Ute Canyon	Agropyron cristatum	Crested wheatgrass	FALSE	–	4324929	700425.3	2	2	No
Ute Canyon	Agropyron cristatum	Crested wheatgrass	FALSE	–	4324272	700035.1	1	2	No
Ute Canyon	Agropyron cristatum	Crested wheatgrass	FALSE	–	4325218	700650.7	1	2	No
Ute Canyon	Agropyron cristatum	Crested wheatgrass	FALSE	–	4324987	700502.6	1	2	No
Ute Canyon	Agropyron cristatum	Crested wheatgrass	FALSE	–	4325257	700711.8	1	3	No
Ute Canyon	Agropyron cristatum	Crested wheatgrass	FALSE	–	4325326	700827.4	2	3	No
Ute Canyon	Agropyron cristatum	Crested wheatgrass	FALSE	–	4325250	702241.9	1	3	No
Ute Canyon	Agropyron cristatum	Crested wheatgrass	FALSE	–	4325282	700769.9	1	3	No
Ute Canyon	Cirsium vulgare	Bull thistle	FALSE	–	4323216	699270.5	5	1	Yes
Ute Canyon	Elaeagnus angustifolia	Russian-olive	FALSE	Seedling(s)	4325371	702478.3	5	1	Yes
Ute Canyon	Plantago major	Common plantain	FALSE	–	4324228	697617	2	3	No
Ute Canyon	Tamarix sp.	Tamarisk	FALSE	–	4324221	699998.3	5	1	Yes
Ute Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4324538	700150.1	5	1	Yes
Ute Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4325266	702421.4	5	1	Yes
Ute Canyon	Tamarix sp.	Tamarisk	FALSE	Seedling(s)	4325505	700844.9	5	1	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4325247	702238	5	1	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4325263	701995.6	1	1	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4325476	701626.2	5	1	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4325308	701853.8	5	1	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4324731	700247	2	1	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4325533	701396.4	5	1	Yes

Table A-1, cont. Exotic plant patches detected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Species	Common Name	Pulled	Growth Stage	N Coord	E Coord	Cover Class	Size Class	Priority?
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4325416	701755.1	5	1	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4324834	700346.5	5	1	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323144	698995.2	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4324057	698015.6	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4324172	699882.9	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323573	699500	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4324229	700002.3	1	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4324698	700185.4	1	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4325456	700840.7	1	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4325305	701916.5	1	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4324955	700449.4	1	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4325292	700791.5	1	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4324049	699810.6	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4325389	700844	1	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323214	699285.6	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4325337	700829.3	1	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323079	699071.1	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323741	699549.5	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4324184	697818.7	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323366	698824.6	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323314	698846.5	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323734	699621.8	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323325	699405.2	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4325263	700724.3	1	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4324187	699960.5	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323722	698344.6	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323674	698403	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323855	699662	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4323192	698935.4	2	2	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4325529	701049.9	1	3	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4325509	700863.7	1	3	Yes
Ute Canyon	Tragopogon dubius	Yellow salsify	FALSE	–	4325490	701170.9	1	3	Yes

Table A-1, cont. Exotic plant patches detected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Species	Common Name	Pulled	Growth Stage	N Coord	E Coord	Cover Class	Size Class	Priority?
Ute Canyon	Triticum aestivum	Wheat	FALSE	–	4324822	700330	4	1	No
Ute Canyon	Ulmus pumila	Siberian elm	FALSE	Sapling(s)	4325263	702445.7	5	1	Yes
Ute Canyon	Ulmus pumila	Siberian elm	FALSE	Sapling(s)	4325566	702776.7	3	2	Yes
Ute Canyon	Ulmus pumila	Siberian elm	FALSE	Seedling(s)	4325409	702489.2	5	1	Yes
Ute Canyon	Ulmus pumila	Siberian elm	FALSE	Seedling(s)	4325594	702792.1	1	3	Yes
Ute Canyon	Verbascum thapsus	Woolly mullein	TRUE	–	4325246	702234.9	5	1	Yes
Ute Canyon	Verbascum thapsus	Woolly mullein	TRUE	–	4325269	702306.1	5	1	Yes
Ute Canyon	Verbascum thapsus	Woolly mullein	FALSE	–	4323723	698363.4	2	2	Yes
Wedding Canyon	Anisantha diandra	Ripgut brome	TRUE	–	4330961	697042.8	4	2	Yes
Wedding Canyon	Anisantha diandra	Ripgut brome	FALSE	–	4331589	697256.3	1	2	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4331208	697127.5	1	2	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4331357	697129.3	2	2	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330462	696545.9	1	2	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4331101	697076.5	2	2	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330601	696971	1	2	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330256	696148.2	1	2	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330329	696309.6	1	2	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330393	696457.5	1	2	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330819	697064.5	1	2	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4331546	697240.4	2	2	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330533	696870.2	1	2	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4331467	697176.3	2	2	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330550	696937.1	1	2	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330765	697034.7	1	3	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330636	697017.8	1	3	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4331417	697149.8	1	3	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330981	697057.5	1	3	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4331046	697058.5	1	3	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330302	696259.8	1	3	Yes
Wedding Canyon	Cylindropyrum cylindricum	Jointed goatgrass	FALSE	–	4330474	696638.3	1	3	Yes
Wedding Canyon	Tamarix sp.	Tamarisk	TRUE	Seedling(s)	4331105	697066.4	3	1	Yes
Wedding Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4330663	697033.3	5	1	Yes

Table A-1, cont. Exotic plant patches detected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Species	Common Name	Pulled	Growth Stage	N Coord	E Coord	Cover Class	Size Class	Priority?
Wedding Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4330485	696591.6	5	1	Yes
Wedding Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4330482	696706.2	5	1	Yes
Wedding Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4330123	695841.2	5	1	Yes
Wedding Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4331630	697292.3	5	1	Yes
Wedding Canyon	Tragopogon dubius	Yellow salsify	TRUE	–	4330418	696480.5	5	1	Yes
Wedding Canyon	Ulmus pumila	Siberian elm	TRUE	Seedling(s)	4331215	697128.9	5	1	Yes
Wedding Canyon	Ulmus pumila	Siberian elm	TRUE	Seedling(s)	4330386	696452.1	5	1	Yes

Appendix B. Exotic Plant Transect Data

Table B-1. Exotic plant transect data collected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Transect	E Coord	N Coord	Species	Common Name	Alive?	Average Cover	Priority/ Transect?
Columbus Canyon	220	703248.3	4323576	Anisantha tectorum	Cheatgrass	Y	0.75	Yes
Columbus Canyon	221	702949.1	4323219	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Fruita Canyon	223	696318.2	4332463	Anisantha tectorum	Cheatgrass	Y	16	Yes
Fruita Canyon	224	696091.3	4332046	Anisantha tectorum	Cheatgrass	Y	0.333333	Yes
Fruita Canyon	225	695966.4	4331597	Anisantha tectorum	Cheatgrass	Y	0.5	Yes
Fruita Canyon	226	695757.4	4331220	Anisantha tectorum	Cheatgrass	Y	1.166667	Yes
Fruita Canyon	339	695703.6	4330686	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Fruita Canyon	226	695757.4	4331220	Erodium cicutarium	Stork's-bill	Y	0.5	Yes
Fruita Canyon	223	696318.2	4332463	Salsola sp.	Russian thistle	Y	0.333333	Yes
Gold Star Canyon	196	699478.5	4329121	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Gold Star Canyon	197	699269.4	4328766	Anisantha tectorum	Cheatgrass	Y	0.333333	Yes
Gold Star Canyon	229	699635.7	4328098	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Gold Star Canyon	196	699478.5	4329121	Cardaria latifolia	Broad-leaf pepperwort	Y	0.166667	Yes
Hydro 11	186	696909.6	4330156	Anisantha tectorum	Cheatgrass	Y	0.333333	Yes
Hydro 82	217	704137.1	4322773	Anisantha tectorum	Cheatgrass	Y	1.166667	Yes
Hydro 82	218	704592.6	4322622	Anisantha tectorum	Cheatgrass	Y	0.5	Yes
Hydro 82	217	704137.1	4322773	Erodium cicutarium	Stork's-bill	Y	0.333333	Yes
Hydro 85	338	703416.5	4321733	Anisantha tectorum	Cheatgrass	Y	0.666667	Yes
Hydro 95	210	703545.4	4320764	Anisantha tectorum	Cheatgrass	Y	7.166667	Yes
Hydro 95	211	703201.5	4320488	Anisantha tectorum	Cheatgrass	Y	0.333333	Yes
Hydro 95	213	702558.8	4319872	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Hydro 95	214	702369.1	4319448	Anisantha tectorum	Cheatgrass	Y	0.666667	Yes
Hydro 95	211	703201.5	4320488	Sisymbrium altissimum	Tumble mustard	Y	0.333333	Yes
Limekin Gulch	198	702496	4325276	Anisantha tectorum	Cheatgrass	Y	0.833333	Yes
Limekin Gulch	198	702496	4325276	Erodium cicutarium	Stork's-bill	Y	0.166667	Yes
Lizard Canyon	194	696996.3	4331900	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Lizard Canyon	195	696618.6	4331648	Anisantha tectorum	Cheatgrass	Y	7	Yes
Monument Canyon	179	698231.9	4328610	Anisantha diandra	Ripgut brome	Y	0.5	Yes
Monument Canyon	180	698089	4329029	Anisantha diandra	Ripgut brome	Y	0.666667	Yes
Monument Canyon	181	697849.6	4329301	Anisantha diandra	Ripgut brome	Y	1.833333	Yes

Table B-1, cont. Exotic plant transect data collected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Transect	E Coord	N Coord	Species	Common Name	Alive?	Average Cover	Priority/ Transect?
Monument Canyon	182	697690.5	4329638	Anisantha diandra	Ripgut brome	Y	0.166667	Yes
Monument Canyon	184	698165.8	4330247	Anisantha diandra	Ripgut brome	Y	2.5	Yes
Monument Canyon	185	698551.4	4330458	Anisantha diandra	Ripgut brome	Y	0.5	Yes
Monument Canyon	174	699008.8	4326709	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Monument Canyon	175	698914.5	4327143	Anisantha tectorum	Cheatgrass	Y	0.833333	Yes
Monument Canyon	176	698734.5	4327553	Anisantha tectorum	Cheatgrass	Y	0.333333	Yes
Monument Canyon	178	698211.2	4328172	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Monument Canyon	179	698231.9	4328610	Anisantha tectorum	Cheatgrass	Y	0.5	Yes
Monument Canyon	180	698089	4329029	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Monument Canyon	182	697690.5	4329638	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Monument Canyon	184	698165.8	4330247	Anisantha tectorum	Cheatgrass	Y	0.5	Yes
Monument Canyon	185	698551.4	4330458	Anisantha tectorum	Cheatgrass	Y	0.5	Yes
Monument Canyon	209	697687.6	4327685	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Monument Canyon	227	697360.4	4327878	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Monument Canyon	228	697797.3	4327969	Anisantha tectorum	Cheatgrass	Y	0.5	Yes
Monument Canyon	181	697849.6	4329301	Erodium cicutarium	Stork's-bill	Y	0.166667	Yes
Monument Canyon	182	697690.5	4329638	Erodium cicutarium	Stork's-bill	Y	0.166667	Yes
Monument Canyon	185	698551.4	4330458	Erodium cicutarium	Stork's-bill	Y	0.25	Yes
Monument Canyon	179	698231.9	4328610	Tragopogon dubius	Yellow salsify	Y	0.166667	Yes
Monument Canyon	174	699008.8	4326709	Lactuca serriola	Prickly lettuce	Y	0.333333	No
No Thoroughfare Canyon	248	700248.8	4318952	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
No Thoroughfare Canyon	249	700572.5	4319278	Anisantha tectorum	Cheatgrass	Y	0.5	Yes
No Thoroughfare Canyon	250	700861.2	4319652	Anisantha tectorum	Cheatgrass	Y	0.333333	Yes
No Thoroughfare Canyon	252	701650	4319922	Anisantha tectorum	Cheatgrass	Y	2.5	Yes
No Thoroughfare Canyon	253	702002.2	4320260	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
No Thoroughfare Canyon	255	702774.4	4320700	Anisantha tectorum	Cheatgrass	Y	1	Yes
No Thoroughfare Canyon	256	703010.9	4321004	Anisantha tectorum	Cheatgrass	Y	0.666667	Yes
No Thoroughfare Canyon	257	703382.8	4321167	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
No Thoroughfare Canyon	258	703585.7	4321540	Anisantha tectorum	Cheatgrass	Y	0.333333	Yes
No Thoroughfare Canyon	259	703972	4321707	Anisantha tectorum	Cheatgrass	Y	0.666667	Yes
No Thoroughfare Canyon	260	704217.8	4321973	Anisantha tectorum	Cheatgrass	Y	0.25	Yes
No Thoroughfare Canyon	261	704591.4	4322050	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes

Table B-1, cont. Exotic plant transect data collected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Transect	E Coord	N Coord	Species	Common Name	Alive?	Average Cover	Priority/ Transect?
No Thoroughfare Canyon	262	704853.5	4322411	Anisantha tectorum	Cheatgrass	Y	1	Yes
No Thoroughfare Canyon	263	705201.1	4322654	Anisantha tectorum	Cheatgrass	Y	1.166667	Yes
No Thoroughfare Canyon	249	700572.5	4319278	Cardaria latifolia	Broad-leaf pepperwort	Y	0.333333	Yes
No Thoroughfare Canyon	255	702774.4	4320700	Erodium cicutarium	Stork's-bill	Y	0.166667	Yes
No Thoroughfare Canyon	262	704853.5	4322411	Erodium cicutarium	Stork's-bill	Y	0.166667	Yes
No Thoroughfare Canyon	255	702774.4	4320700	Salsola sp.	Russian thistle	Y	0.166667	Yes
No Thoroughfare Canyon	248	700248.8	4318952	Verbascum thapsus	Woolly mullein	Y	0.666667	Yes
Red Canyon	199	703402.1	4324016	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Red Canyon	200	703011	4323803	Anisantha tectorum	Cheatgrass	Y	0.5	Yes
Red Canyon	201	702571.1	4323661	Anisantha tectorum	Cheatgrass	Y	1	Yes
Red Canyon	202	702158	4323439	Anisantha tectorum	Cheatgrass	Y	1.666667	Yes
Red Canyon	203	701719.2	4323275	Anisantha tectorum	Cheatgrass	Y	1	Yes
Red Canyon	204	701272.4	4323093	Anisantha tectorum	Cheatgrass	Y	1.666667	Yes
Red Canyon	205	700871.5	4322960	Anisantha tectorum	Cheatgrass	Y	7.5	Yes
Red Canyon	206	700408	4322829	Anisantha tectorum	Cheatgrass	Y	1.5	Yes
Ute Canyon	230	697457	4324239	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Ute Canyon	231	697826.6	4324181	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Ute Canyon	232	698214.3	4323939	Anisantha tectorum	Cheatgrass	Y	0.5	Yes
Ute Canyon	233	698516	4323570	Anisantha tectorum	Cheatgrass	Y	0.333333	Yes
Ute Canyon	234	698837.2	4323288	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Ute Canyon	235	699216.9	4323033	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Ute Canyon	236	699416.5	4323434	Anisantha tectorum	Cheatgrass	Y	0.333333	Yes
Ute Canyon	237	699628.2	4323750	Anisantha tectorum	Cheatgrass	Y	0.5	Yes
Ute Canyon	238	699861.3	4324116	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Ute Canyon	239	700108.1	4324497	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes
Ute Canyon	240	700401.8	4324870	Anisantha tectorum	Cheatgrass	Y	0.666667	Yes
Ute Canyon	241	700696.3	4325251	Anisantha tectorum	Cheatgrass	Y	1.5	Yes
Ute Canyon	242	700994.6	4325569	Anisantha tectorum	Cheatgrass	Y	4	Yes
Ute Canyon	243	701458.1	4325545	Anisantha tectorum	Cheatgrass	Y	0.333333	Yes
Ute Canyon	244	701861.4	4325305	Anisantha tectorum	Cheatgrass	Y	3.666667	Yes
Ute Canyon	243	701458.1	4325545	Erodium cicutarium	Stork's-bill	Y	0.333333	Yes
Ute Canyon	244	701861.4	4325305	Erodium cicutarium	Stork's-bill	Y	0.166667	Yes

Table B-1, cont. Exotic plant transect data collected along monitoring routes, Colorado National Monument, June 9–15, 2021.

Route	Transect	E Coord	N Coord	Species	Common Name	Alive?	Average Cover	Priority/ Transect?
Ute Canyon	236	699416.5	4323434	Agropyron cristatum	Crested wheatgrass	Y	0.5	No
Ute Canyon	234	698837.2	4323288	Lactuca serriola	Prickly lettuce	Y	0.166667	No
Wedding Canyon	188	697132.1	4331349	Anisantha tectorum	Cheatgrass	Y	0.5	Yes
Wedding Canyon	190	696889.9	4330537	Anisantha tectorum	Cheatgrass	Y	0.333333	Yes
Wedding Canyon	191	696445.6	4330380	Anisantha tectorum	Cheatgrass	Y	1.666667	Yes
Wedding Canyon	192	695989.9	4330241	Anisantha tectorum	Cheatgrass	Y	0.166667	Yes

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