National Park Service
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Natural Resource Stewardship and Science

Invasive Exotic Plant Monitoring in Colorado National Monument

2017 Field Season

Natural Resource Report NPS/NCPN/NRR—2019/1886



ON THE COVER

Quadrat and transect placed along Monument Canyon. Photo: NPS/Luke Gommermann.

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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 2017. During monitoring conducted June 1–7, a total of 20 IEP species were detected on monitoring routes and transects. Of these, 11 were priority species that accounted for 590 separate patches. IEPs were most prevalent along riparian areas. Yellow sweetclover (*Melilotis officinale*), yellow salsify (*Tragopogon dubius*), and woolly mullein (*Verbascum thapsus*) were the most commonly detected priority IEPs, representing 86% of all priority patches. Patches of less than 40 m^2 were typical of nearly all priority IEP species except yellow sweetclover. A patch management index (PMI) was created by combining patch size class and percent cover for each patch. A large majority (89%) of priority IEP patches were assigned a "Very Low" PMI, indicating small and/or sparse patches where control is generally still feasible. The number of patches of Russian olive (*Elaeagnus angustifolia*) and Siberian elm (*Ulmus pumila*) continued to decrease compared to those observed in the first year of NCPN monitoring (2009) and earlier (2003) survey efforts by Utah State University. Patches of tamarisk (*Tamarix* sp.) rose slightly in number from 2015. In addition, 92% of the tree patches were classified as seedlings or saplings, which require less effort to control than mature trees. Cheatgrass (*Anisantha tectorum*) had the highest average percent cover (1.1%) and highest frequency (64%) of all IEPs across all transects. When treated and untreated extra areas in the West Entrance area were compared, the treated area had more species per quadrat, higher overall percent cover, and nearly three times as many patches per hectare than the untreated area—but the patches were generally of a lower PMI, indicating they were likely newer and potentially easier to control. Park staff should consider adding revegetation efforts shortly after invasive plant control to prevent new establishment of invasive plants. Comparing segments of monitoring routes conducted between 2003 and 2017 or 2009 and 2017 indicated woolly mullein and yellow sweetclover were increasing, while tamarisk and Russian olive were decreasing. Network staff will return to re-sample all monitoring routes in 2019.

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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 is focusing 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. This report summarizes the 2017 field season at Colorado National Monument (NM).

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.

2 Methods

Field work followed the invasive exotic plant monitoring protocol developed by the NCPN (Perkins et al. 2013), adapted from Andersen and Dewey (2007). 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).

The first step was to have park and NCPN staff review and update the list of priority invasive exotic plants for the park. Next, we established a series of co-located monitoring routes and transects along all roads, major drainages, and trails in the park. 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 our opportunities for detecting IEPs in the park.

2.1 Developing a park priority invasive exotic plant list

Prior to the start of monitoring, NCPN and park staff reviewed the list of 28 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. Our 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. Tumblemustard (*Sisymbrium altissimum*), Russian thistle (*Salsola* sp.), and redstem filaree (*Erodium cicutarium*) were recorded in transect quadrats starting in 2017.

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
Arctium minus	burdock
Breea arvensis	Canada thistle
Cardaria sp.[1]	hoary cress
Cardaria latifolia[2]	broadleaf pepperwort
Carduus acanthoides	plumeless thistle
Carduus nutans	musk thistle
Chorispora tenella[3]	blue mustard
Cirsium vulgare	bull thistle
Convoluls arvensis	field bindweed
Cylindropyrum cylindricum	jointed goatgrass
Cynoglossum officinale[3]	common houndstongue
Descurainia sophia[3]	flixweed
Elaeagnus angustifolia	Russian olive
Isatis tentoria	Dyer's woad
Leucantha solstitialis	yellow starthistle
Linaria vulgaris	butter-and-eggs
Lythrum salicaria	purple loosestrife
Melilotus officinale[4]	yellow sweetclover
Onopordum acanthium	Scotch thistle
Tamarix spp.	tamarisk
Tithymalus esula	leafy spurge
Tragopogon dubius[3]	yellow salsify
Tribulus terrestris	puncturevine
Ulmus pumila	Siberian elm
Verbascum thapsus	woolly mullein

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

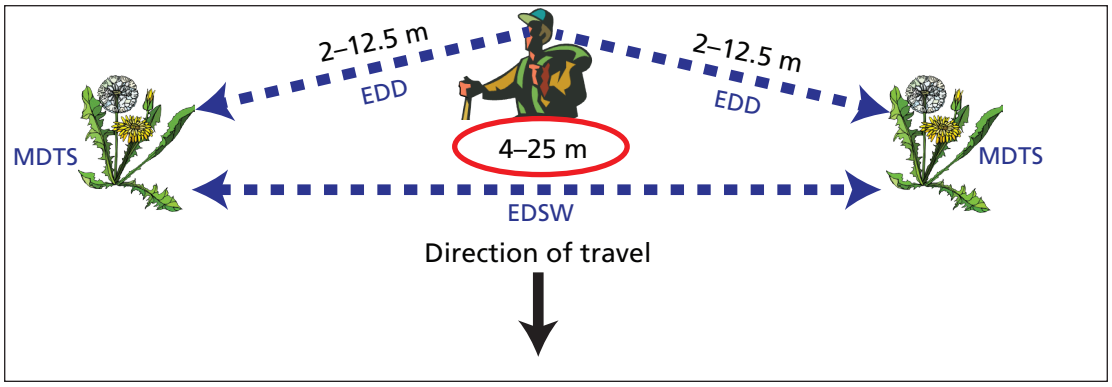


Figure 2-1. The maximum Effective Detection Distance (EDD) at Colorado National Monument was 2–12.5 meters, making the Effective Detection Swath Width (EDSW) 4–25 meters.

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 2017 was 2–12.5 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 2017 ranged from 4 to 25 meters (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 or patch. The PSR was set at 50 meters, based 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 Between feature position

Between feature positions allow electronic tracking of the user's route. The GPS unit was set to automatically generate positions every 20 meters.

2.2.6 Data collection methods

For Rim Rock Drive and 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 4–25 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 during 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, pole, 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

We established transects with three vegetation quadrats every 500 meters along monitoring routes. Our methods for sampling the quadrats were based on Stohlgren and others (2005). We centered vegetation quadrats at 0.5, 5, and 10 meters away from the edge of a road on the same side as the route being walked 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. 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. 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, the corners of the quadrat were

propped up to level it.

2.3.2 Data collection methods

In the monitoring quadrats, observers recorded all priority IEP species observed. In addition, cheatgrass have been recorded in transect quadrats since 2011. Tumblemustard, 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 Extra-area surveys and quadrats

Extra areas were completed at the park's request, due to planned and completed treatments at the park's West Entrance (Table 2-2, Figure 2-2). To increase sample size, we combined all treatment areas (some of which were overlapping) into one extra area. This extra area (Figure 2-3) included 12.44 hectares of areas that had been treated 1–3 times, plus an untreated area of 26.31 hectares. These same areas were monitored in 2015, after one cheatgrass treatment had been applied. This treatment occurred in March 2015 and covered most of the area we called treated area in 2017.

Extra-area quadrats (1 m^2) were randomly generated by the GIS technician prior to monitoring. Surveyors used GPS units to navigate to these quadrats in the field. Percent cover of each priority and non-priority IEP within each quadrat was recorded, along with dominant soil surface features, following the same methodology used for quadrats conducted along monitoring routes. There were 14 quadrats placed in treated areas and 16 in untreated areas (Figure 2-4).

Quadrats were also placed in the Gold Star area and near the East Entrance (Figures 2-5, 2-6) as a baseline for future treatments by the park. A small area near the East Entrance was treated in 2015, but it is not large enough to allow any meaningful comparisons between treated and untreated areas. In addition to priority species, the following species were recorded in extra areas: redstem filaree, Russian thistle, tumblemustard, desert madwort (*Alyssum desertorum*), and cheatgrass.

There were some notable changes in methods between 2015 and 2017. In 2015, only priority species and cheatgrass were mapped. Second, the extra areas were only mapped in 2015; no quadrats were observed. Therefore, only mapped cheatgrass in the West Entrance extra area can be compared across years. We compared the overall treatment area of 2017 with levels of cheatgrass in that same

Table 2-2. Treatments to remove IEPs from West Entrance extra areas by Colorado National Monument staff, 2015–2016.

Date	Treatment	Size (ha)	Species
March 2015	Herbicide	9.70	cheatgrass, redstem filaree, tumblemustard
July 17–29, 2015	Herbicide, hand-pulling	2.45	Russian thistle
October 14–15, 2015	Herbicide	0.27	cheatgrass, redstem filaree, tumblemustard
May 11–12, 2016	Hand-pulling	0.79	tumblemustard
July 6, 2016	Hand-pulling	0.24	Russian thistle
July 25–August 31, 2016	Herbicide	0.53	Russian thistle
August 25, 2016	Herbicide	0.04	Russian thistle
November 3–7, 2016	Herbicide	7.79	Cheatgrass, redstem filaree, tumblemustard

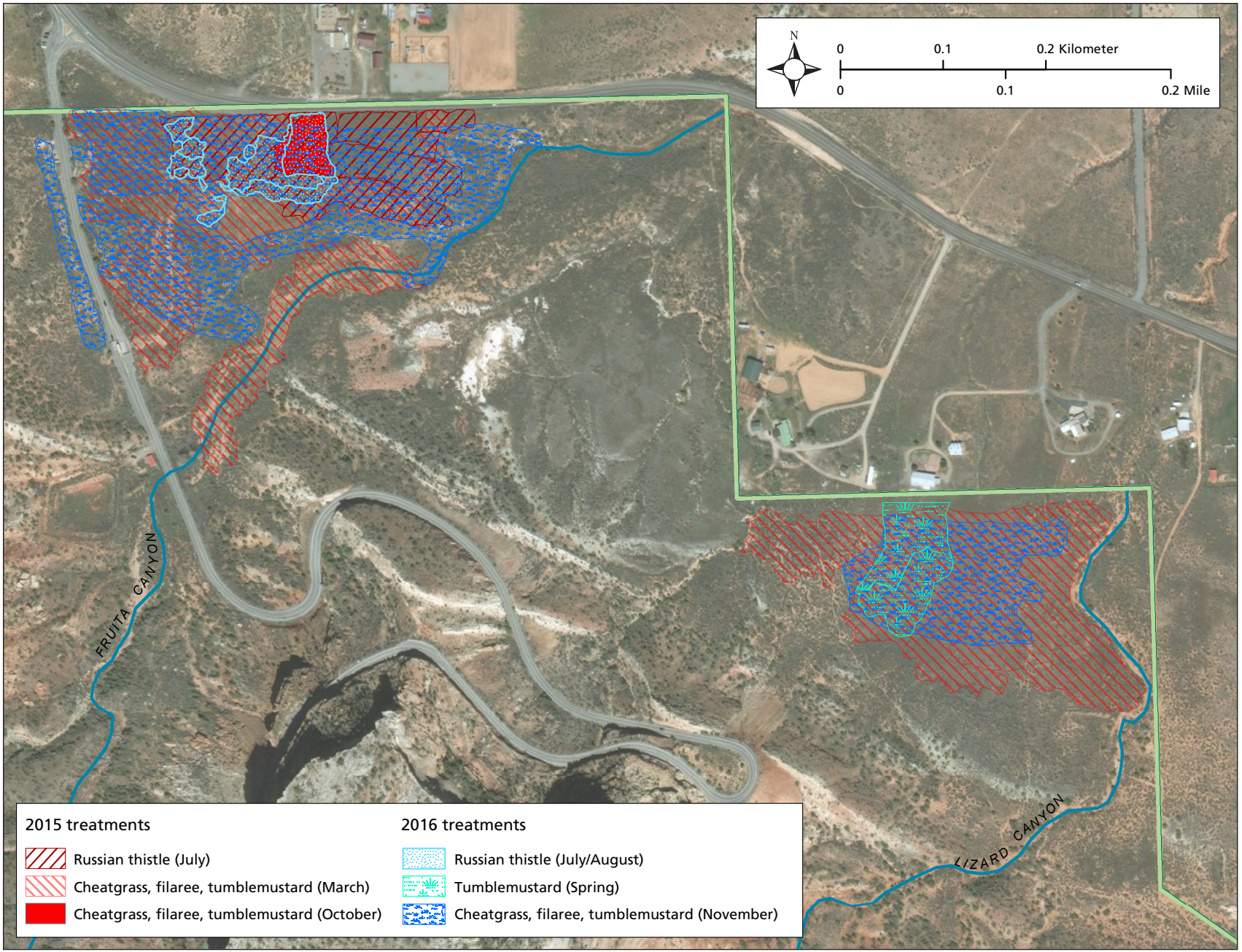


Figure 2-2. West Entrance treatment areas, Colorado National Monument, 2015 and 2016.

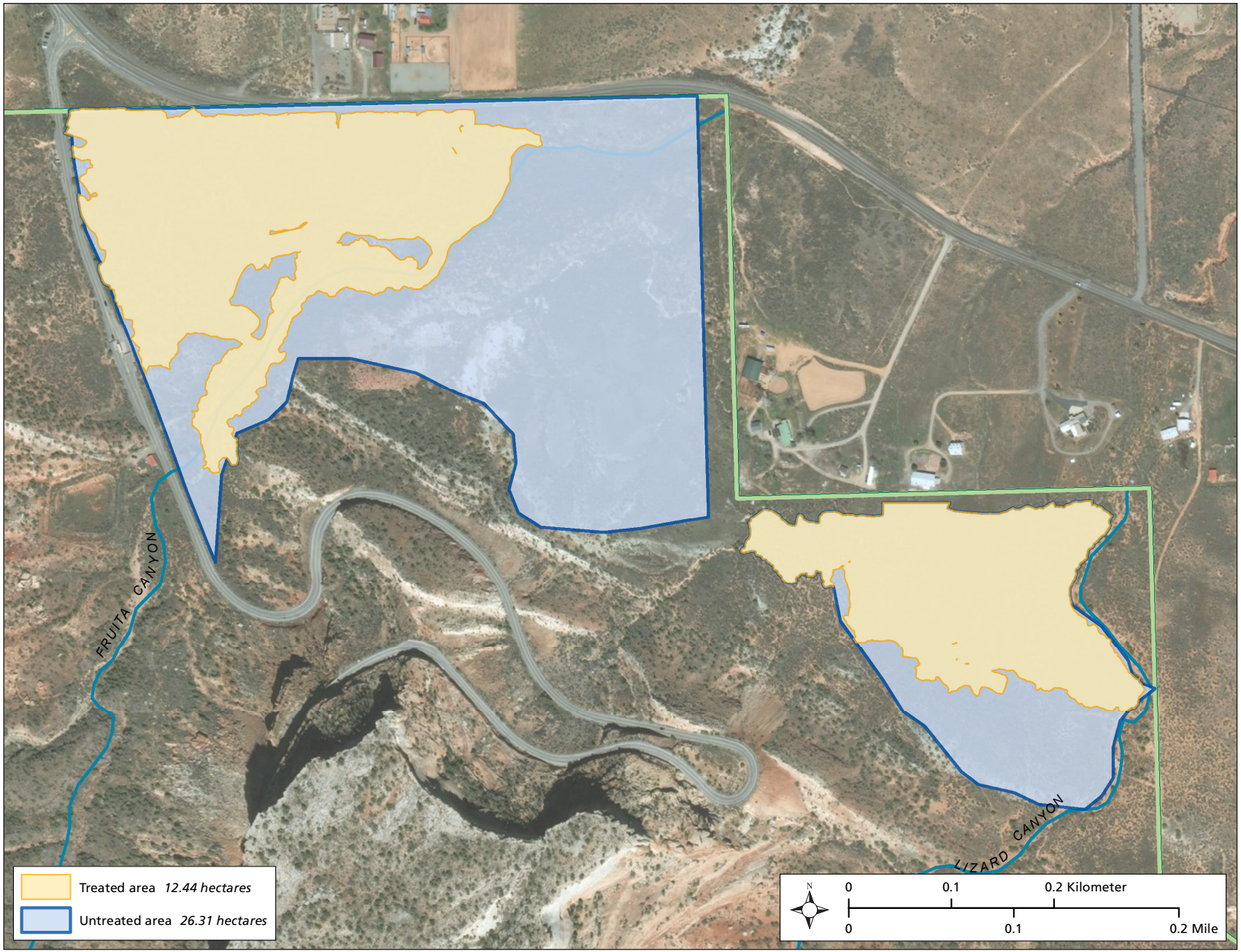


Figure 2-3. Extra area of treated and untreated areas near the West Entrance, Colorado National Monument.

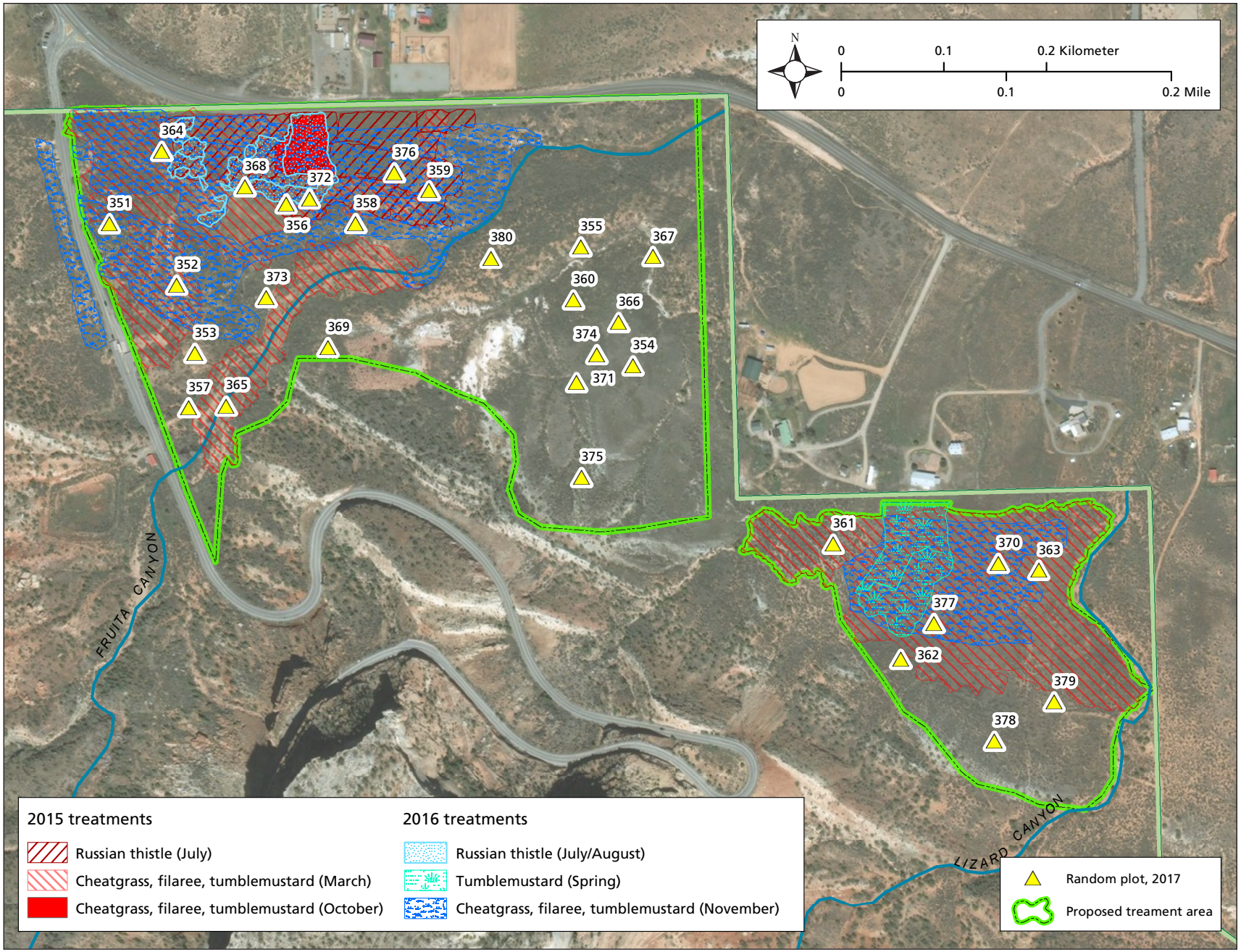


Figure 2-4. Location of quadrats in the West Entrance extra area, Colorado National Monument, 2017.

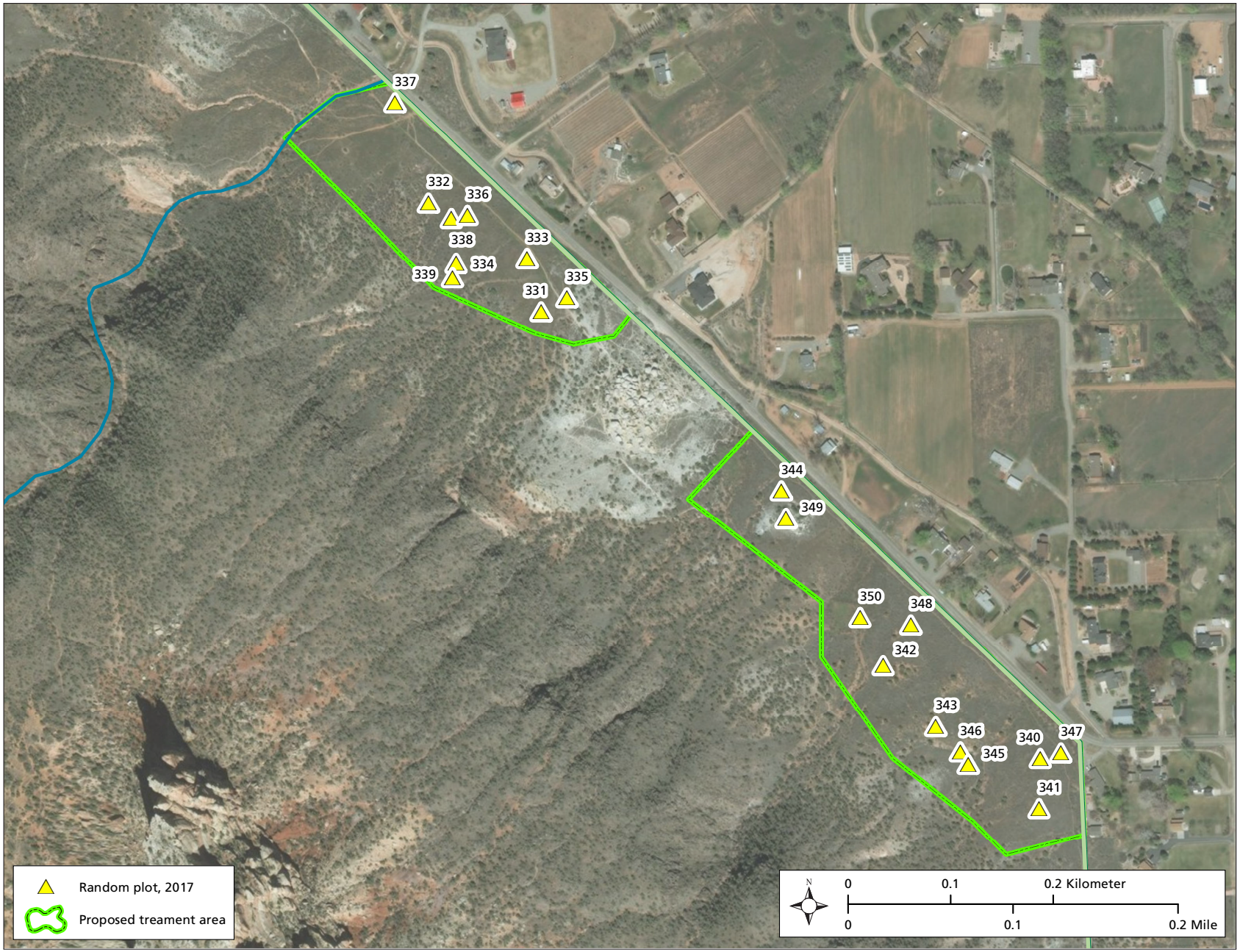


Figure 2-5. Location of quadrats in the Gold Star Canyon extra area, Colorado National Monument, June 1–7, 2017. Monitoring was conducted in the proposed treatment areas.

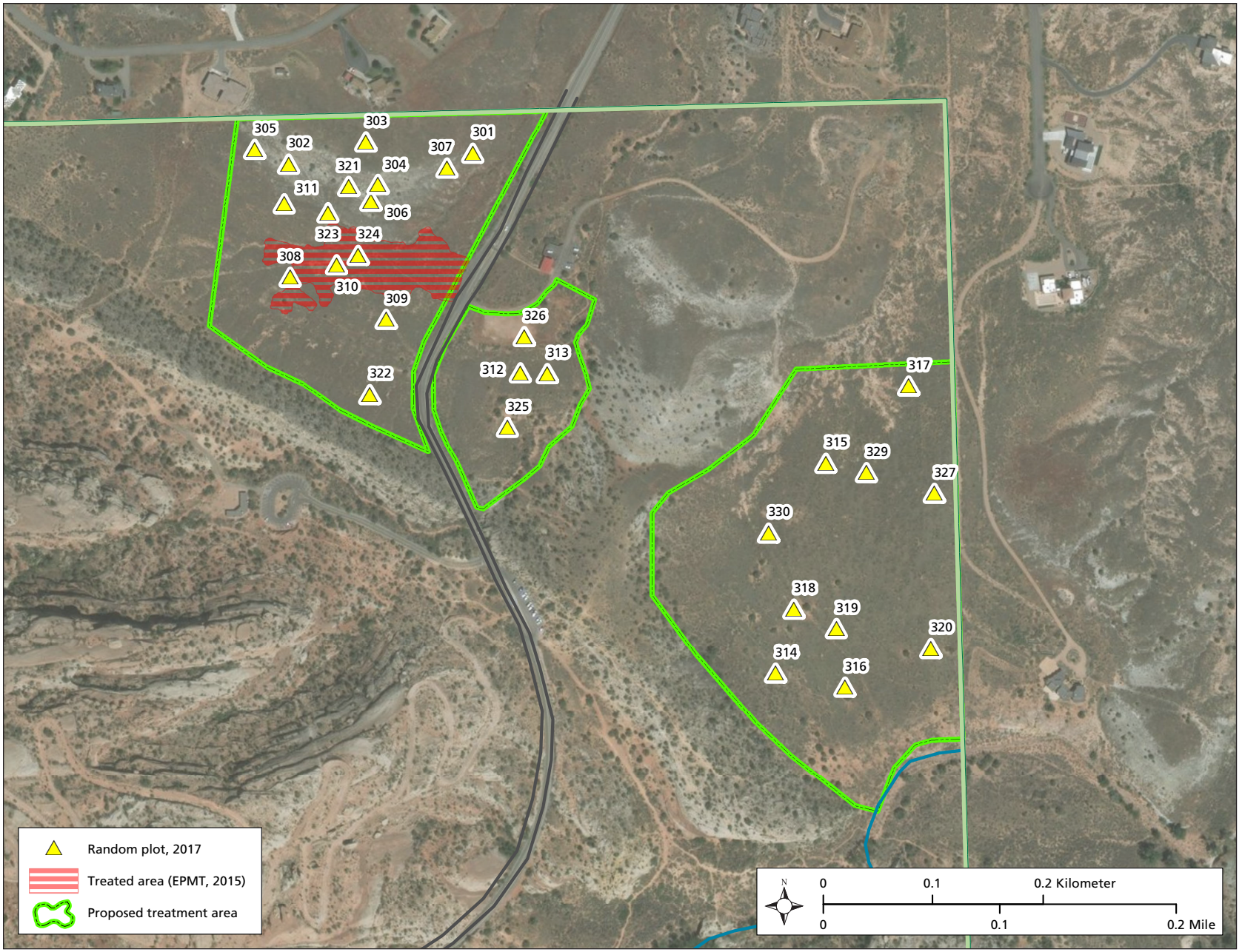


Figure 2-6. Location of quadrats in the East Entrance extra area, Colorado National Monument, June 1–7, 2017. Monitoring was conducted in both the proposed and the treated areas.

area in 2015. (However, we have no data on pre-treatment levels, as this first treatment of cheatgrass was done in March 2015, before any monitoring had been completed.)

Observers conducted extra-area surveys by searching for priority and non-priority IEPs along straight, parallel lines, one EDSW apart, that followed a UTM northing or easting. To conduct these searches, the observer walked to a starting position at the edge of the intended search area corresponding to a certain UTM value. From that position, the observer used a compass to set a bearing and a target horizon landmark, then walked along this line while searching for IEPs on either side of the line's center. When an IEP was found, the observer stood in the center of the patch to enter the necessary data. Patches were determined to be inside or outside the extra area according to the location of the observer when recording the patch.

2.5 Analyses

During data analysis, we developed a Patch Management Index (PMI) to quantify both the extent and the density of a patch into a single value that helps identify the scale of the problem. Park managers will be able to use this tool to help prioritize IEP treatment. PMI was determined using the following formula:

Patch size class (1–5) × Percent cover class (1–5) = Patch management index (1–25)

We then grouped PMI into five classes:

1. Very low (1–5)
2. Low (6–10)
3. Moderate (11–15)
4. High (16–20)
5. Very High (21–25).

Patches identified as Very Low or Low PMI will generally be easier to control or remove than patches with a High or Very High PMI. In many cases, directing resources toward controlling patches with Very Low or Low PMI can be a highly effective management strategy; the goal of early detection is to allow managers to eliminate patches before they can grow into bigger problems. Other times, a species with many inventoried patches that are mostly Very Low or Low in PMI may or may not be easier to treat (and possibly eradicate) than a different species that has few inventoried patches that are High or Very High in PMI. Therefore, park managers should consider PMI within the context of information on species and patch numbers.

In addition, we calculated the number of patches per kilometer 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 20 IEP species were recorded on monitoring routes, transects, and extra-area searches in 2017, eleven of which were priority species (Table 3-1). Nineteen IEP species were recorded on monitoring routes, nine species were recorded in monitoring transects, and six in extra areas. Of these, 11, 5, and 2 were priority species, respectively. We monitored 72.5 kilometers (45.1 mi) of monitoring routes and 26.2 hectares (64.7 ac) in extra areas in 2017.

3.2 Monitoring routes

A total of 590 patches of 11 priority IEP species were detected along 22 monitoring routes in 2017 (Table 3-2; Figures 3-1, 3-2, 3-3, 3-4, 3-5, 3-6, and 3-7; Appendix A). An additional 22 patches of six non-priority IEP species were detected along these same routes. No IEP species were detected along the Hydro 11 and Kodels Canyon monitoring routes. The Upper Ute Canyon route was conducted for the first time, per park request. Only a short segment of East Glade Park Road was monitored. The Liberty Cap, Monument Canyon, No Thoroughfare, and Old Gordon trails and Fenceline route were not monitored in 2017 due to time constraints and lower priority (the result of low IEP detections in past years).

Priority IEPs were most prevalent along riparian areas, averaging 0.99 patches/100 meters. They were found in highest numbers along the Ute Canyon (2.07 patches/100 m), No Thoroughfare Canyon (1.77 patches/100 m), Hydro 95 (1.56 patches/100 m), and Red Canyon (1.52 patches/100 m) routes (see Table 3-2). Roads (almost entirely consisting of detections along Rim Rock Drive) averaged 0.44 patches/100 meters. No priority IEPs were detected along the Kodels Canyon Route, which was the only trail monitored in 2017.

Yellow sweetclover, yellow salsify (*Tragopogon dubius*), and woolly mullein were the most commonly detected priority IEPs, representing 86% of all priority patches along

Table 3-1. Invasive exotic plants detected at Colorado National Monument, June 1–7, 2017.

Scientific name	Common name	Method detected			Priority?
		Route	Transect	Extra area	
Arctium minus	burdock	X	–	–	Yes
Chorispora tenella	blue mustard	X	–	–	Yes
Cirsium vulgare	bull thistle	X	X	–	Yes
Convolvulus arvensis	field bindweed	X	–	X	Yes
Descurainia sophia	flixweed	X	X	–	Yes
Elaeagnus angustifolia	Russian olive	X	–	–	Yes
Melilotus officinale	yellow sweetclover	X	X	–	Yes
Tamarix sp.	salt cedar	X	–	–	Yes
Tragopogon dubius	yellow salsify	X	X	X	Yes
Ulmus pumila	Siberian elm	X	–	–	Yes
Verbascum thapsus	woolly mullein	X	X	–	Yes
Anisantha diandra	ripgut brome	X	–	–	No
Anisantha tectorum	cheatgrass	X	X	X	No
Asparagus officinalis	asparagus	X	–	–	No
Bromus japonicus	Japanese chess	–	X	–	No
Erodium cicutarium	redstem filaree	X	X	X	No
Malcolmia africana	African mustard	X	–	–	No
Populus alba	white poplar	X	–	–	No
Salsola sp.	Russian thistle	X	–	X	No
Sisymbrium altissimum	tumblemustard	X	X	X	No

Table 3-2. Number of priority IEP patches per route, and number per 100 meters by route type, Colorado National Monument, June 1–7, 2017.*

Route	Route type	Length (m)	Ha	Patches detected		Patches/100 m	
				Total	Priority	Total	Priority
Columbus Canyon	Riparian	1,913.3	1.15	4	4	0.21	0.21
Fruita Canyon	Riparian	2,373.0	1.80	5	2	0.21	0.08
Gold Star Canyon	Riparian	1,866.8	1.87	3	2	0.16	0.11
Hydro 03	Riparian	421.4	0.34	4	4	0.95	0.95
Hydro 11	Riparian	1,298.9	0.65	0	0	0.00	0.00
Hydro 82	Riparian	1,356.0	0.72	16	16	1.18	1.18
Hydro 85	Riparian	402.3	0.24	3	3	0.75	0.75
Hydro 86	Riparian	891.4	0.54	2	2	0.22	0.22
Hydro 88	Riparian	710.6	0.57	2	2	0.28	0.28
Hydro 95	Riparian	2,821.3	2.26	44	44	1.56	1.56
Kodels Canyon	Riparian	1,061.2	0.85	6	2	0.57	0.19
Limekin Gulch	Riparian	503.2	0.50	3	3	0.60	0.60
Lizard Canyon	Riparian	1,263.0	0.79	6	3	0.48	0.24
Monument Canyon	Riparian	9,457.8	5.17	40	34	0.42	0.36
No Thoroughfare Canyon	Riparian	9,327.7	6.07	167	165	1.79	1.77
Red Canyon	Riparian	2,040.0	1.23	31	31	1.52	1.52
Ute Canyon	Riparian	7,766.0	6.38	161	161	2.07	2.07
Ute Canyon (Upper)	Riparian	1,705.9	0.68	12	12	0.70	0.70
Wedding Canyon	Riparian	2,298.7	1.15	3	2	0.13	0.09
Riparian Totals		49,478.4	33.00	512	492	1.03	0.99
East Glade Park Rd	Road	21.2	0.02	1	1	4.71	4.71
Rim Rock Dr (E Glade to Ute Canyon View Point)	Road	10,219.9	5.10	17	17	0.17	0.17
Rim Rock South	Road	12,125.0	6.47	82	80	0.68	0.66
Roads Totals		22,366.1	11.60	100	98	0.45	0.44
Kodels Canyon	Trail	660.1	0.52	0	0	0.00	0.00
Trails Totals		660.1	0.52	0	0	0.00	0.00
Route Totals		72,504.6	45.10	612	590	0.84	0.81

*Numbers are rounded.

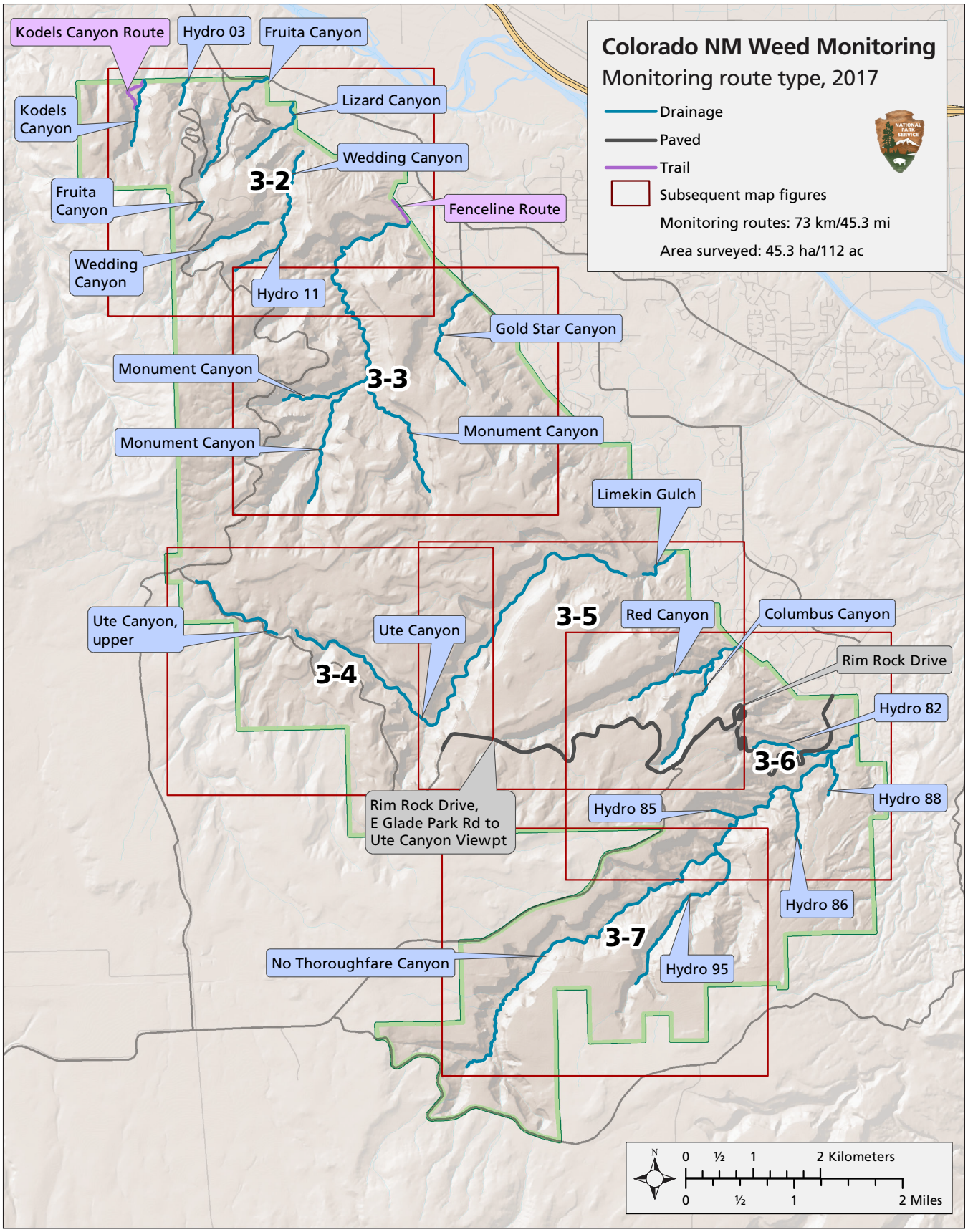


Figure 3-1. Invasive exotic plant monitoring routes, Colorado National Monument, June 1–7, 2017.

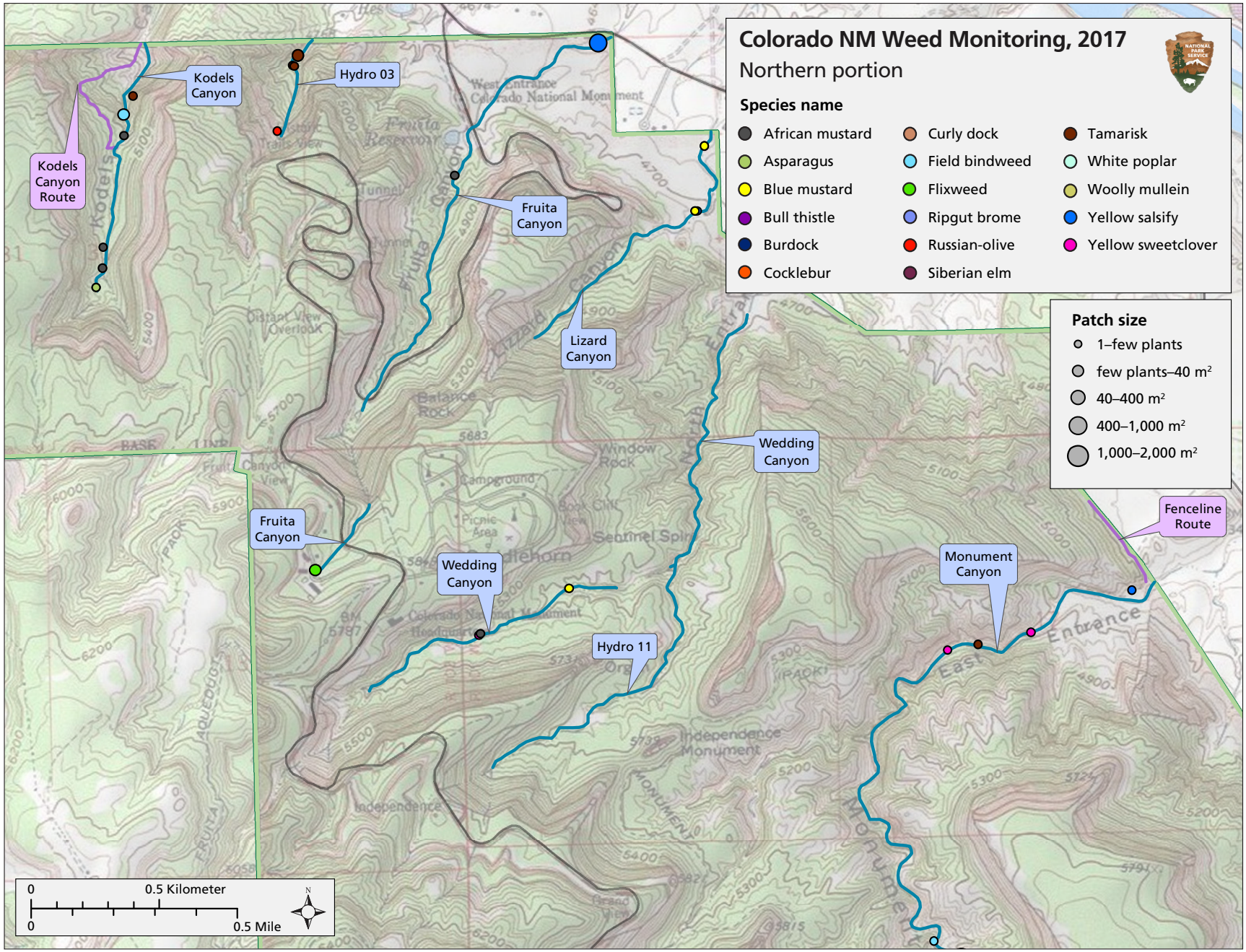


Figure 3-2. Invasive exotic plants detected on monitoring routes in the northern portion of Colorado National Monument, June 1–7, 2017.

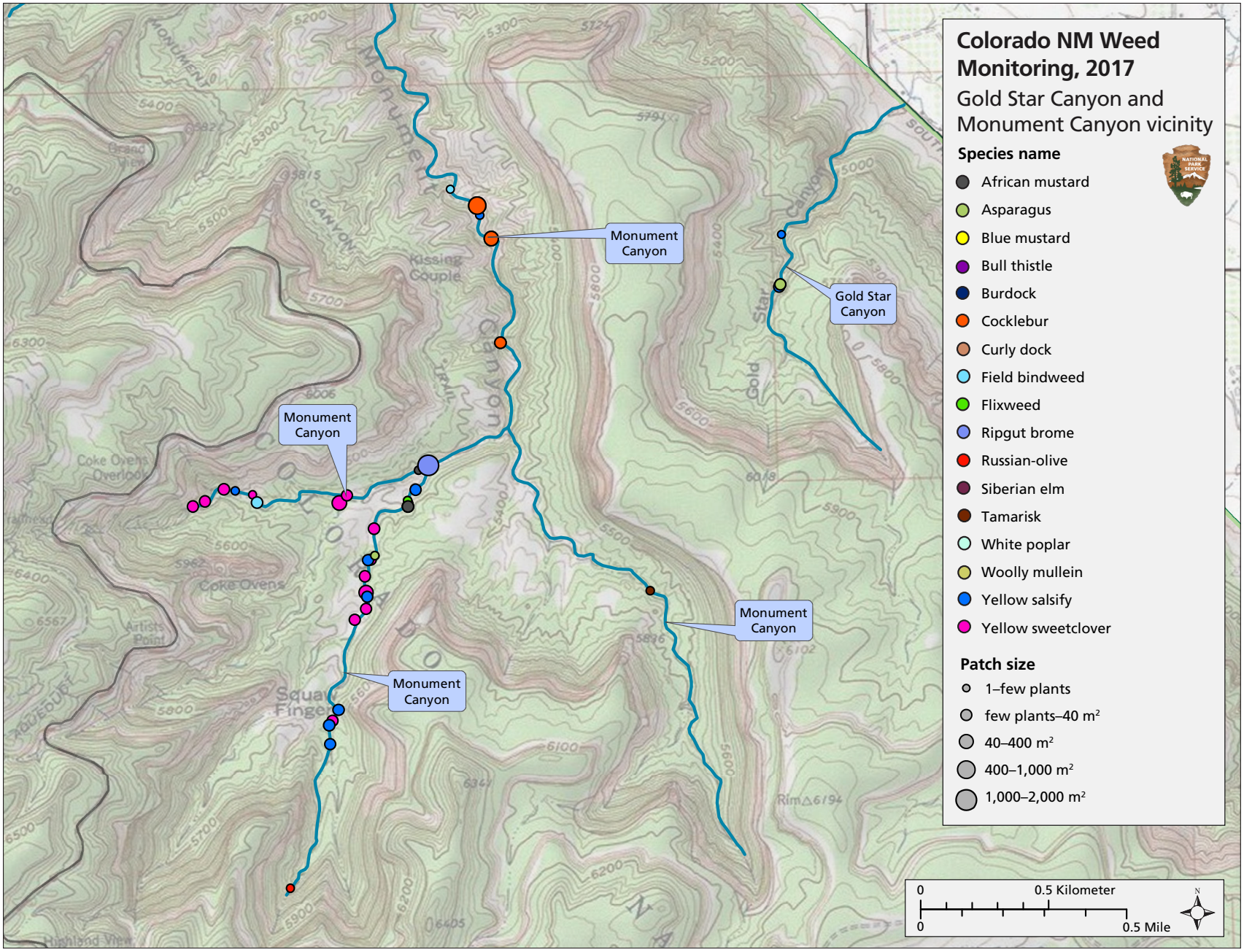


Figure 3-3. Invasive exotic plants detected on monitoring routes in the vicinity of Gold Star and Monument canyons, Colorado National Monument, June 1–7, 2017.

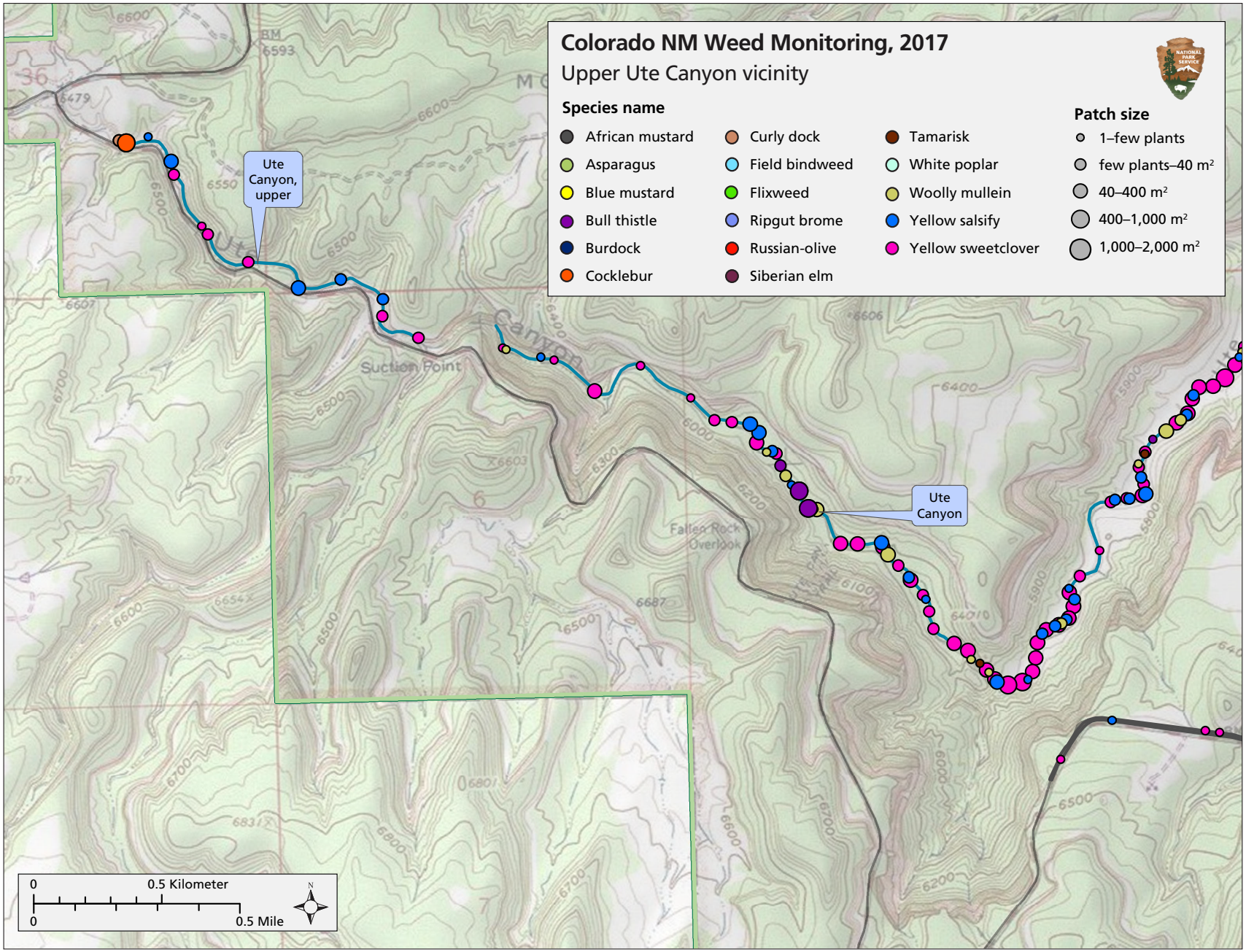


Figure 3-4. Invasive exotic plants detected on monitoring routes and monitoring plots in the vicinity of upper Ute Canyon, Colorado National Monument, June 1–7, 2017.

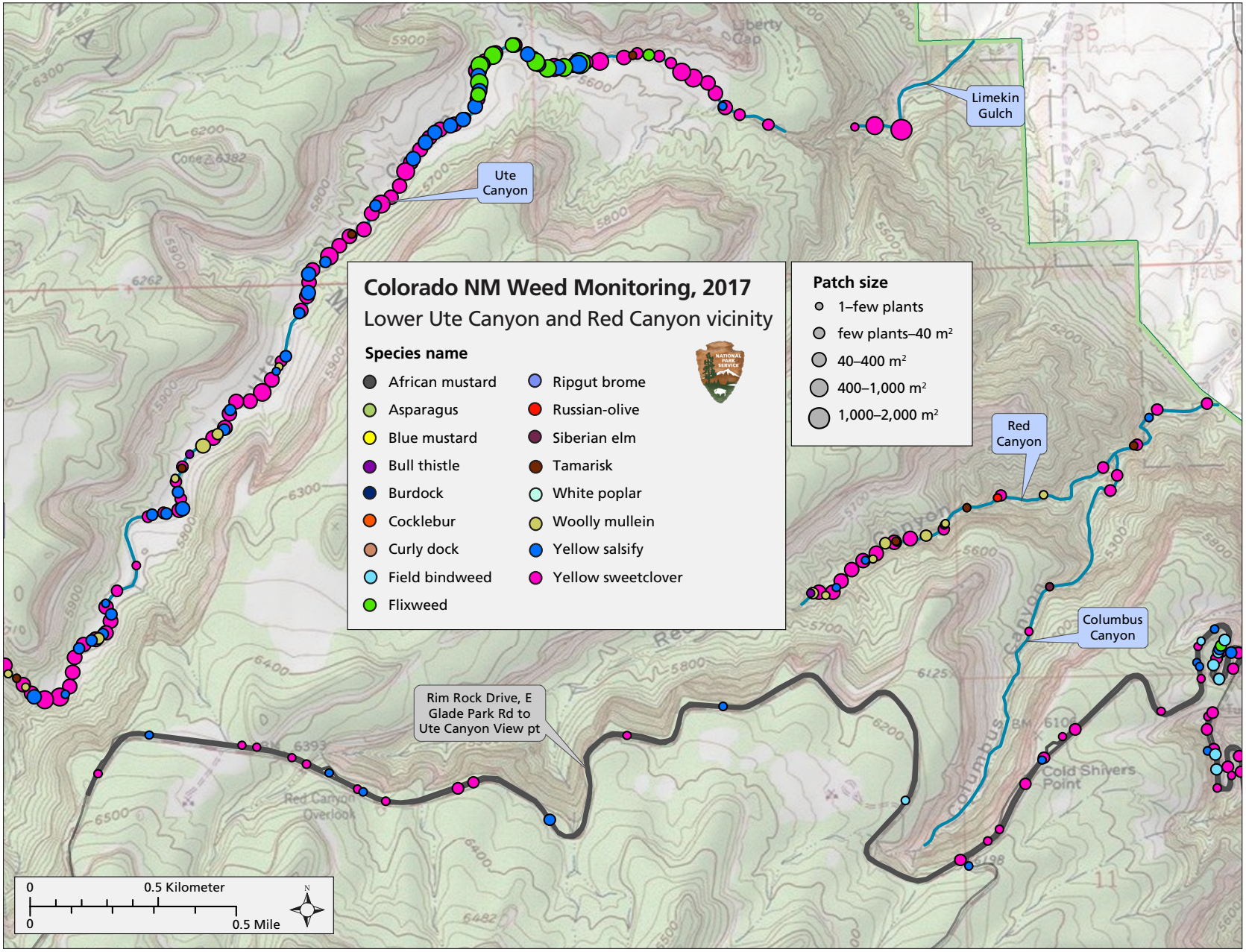


Figure 3-5. Invasive exotic plants detected on monitoring routes and monitoring plots in the vicinity of lower Ute Canyon and Red Canyon, Colorado National Monument, June 1–7, 2017.

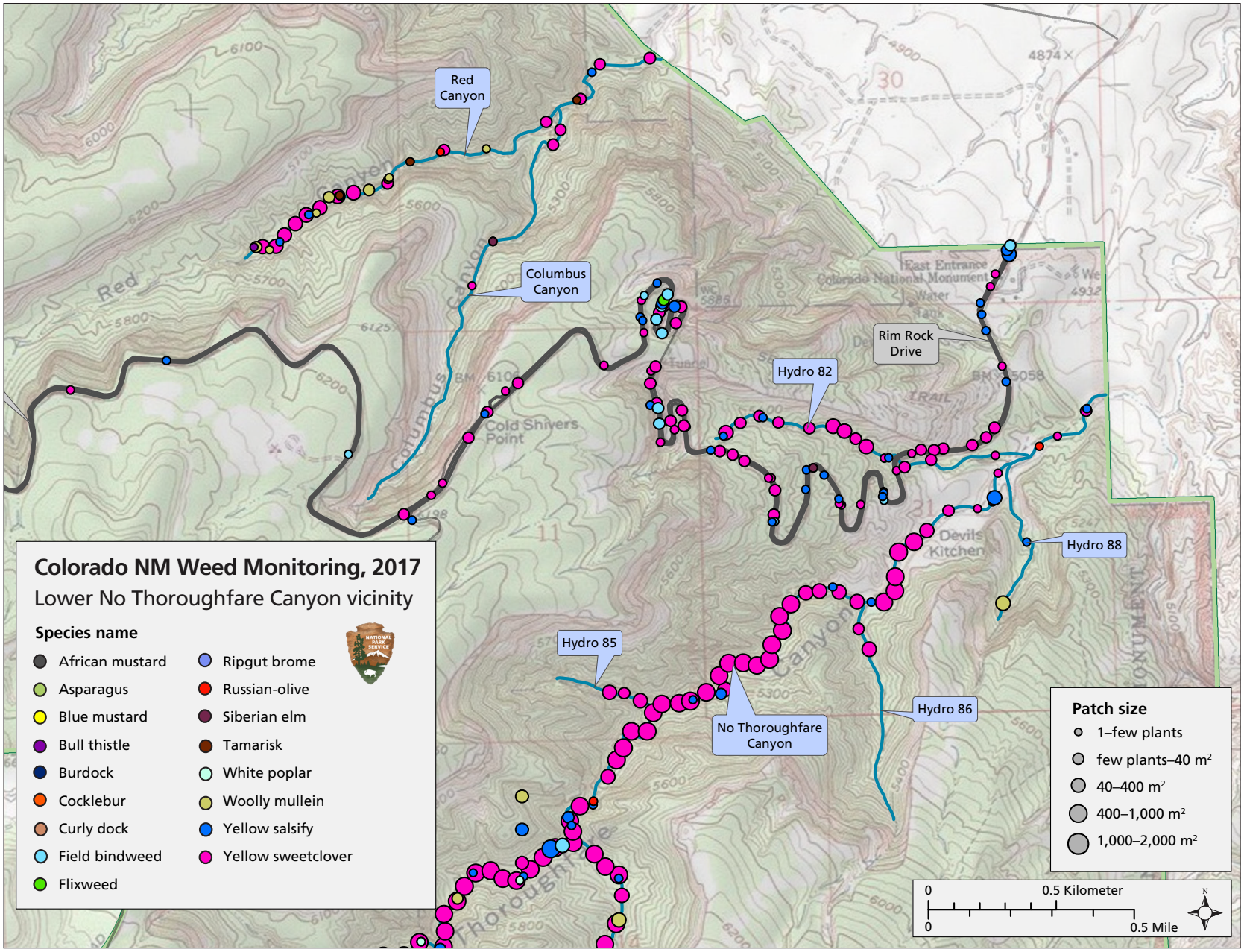


Figure 3-6. Invasive exotic plants detected on monitoring routes and monitoring plots in the vicinity of lower No Thoroughfare Canyon, Colorado National Monument, June 1–7, 2017.

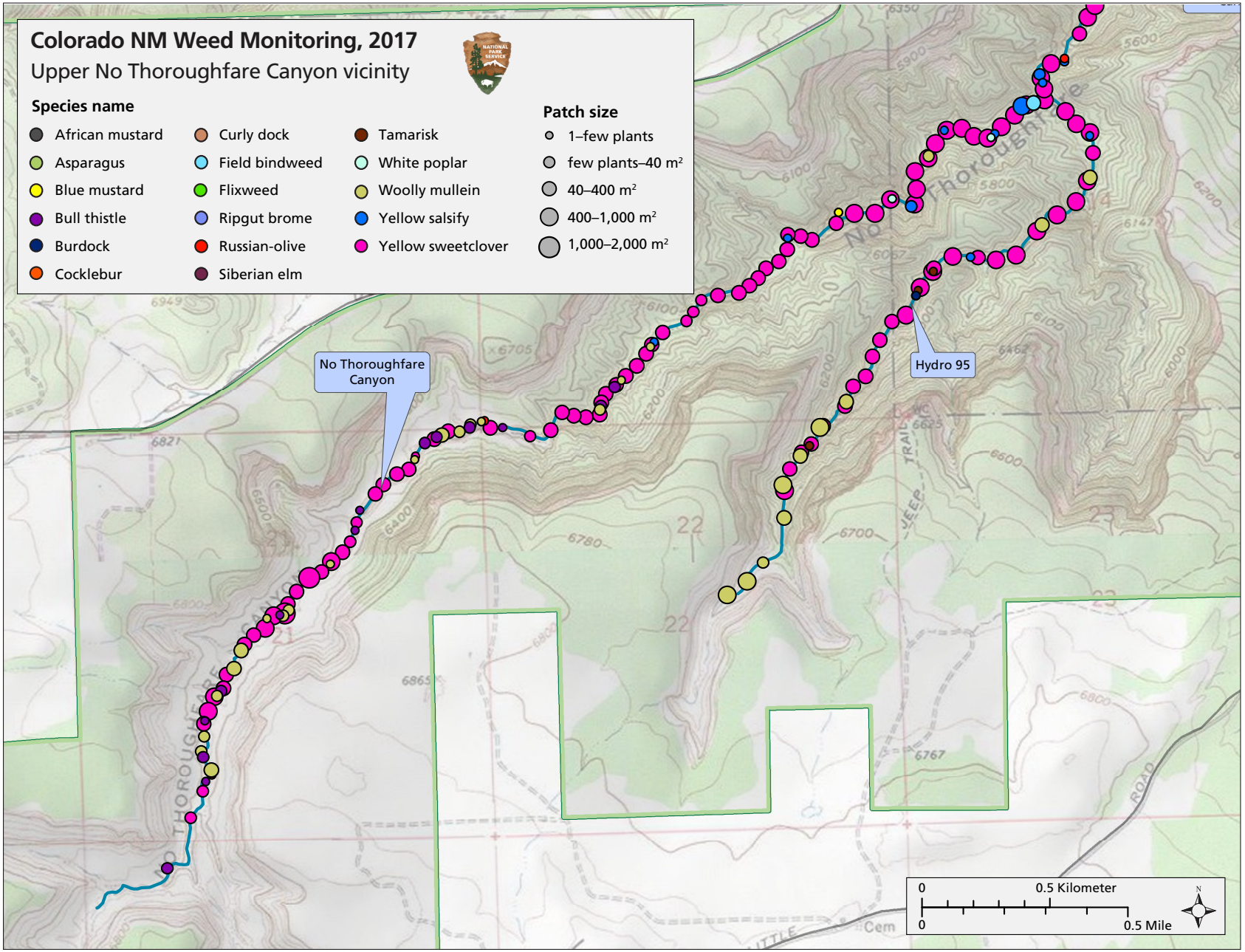


Figure 3-7. Invasive exotic plants detected on monitoring routes and monitoring plots in the vicinity of upper No Thoroughfare Canyon, Colorado National Monument, June 1–7, 2017.

Table 3-3. Number and species of priority and non-priority IEP patches detected along monitoring routes, and patch size class, Colorado National Monument, June 1–7, 2017.

Scientific name	Common name	Priority?	Total patches	Patch size class[1]					Patch management index[2]				
				1	2	3	4	5	Very Low	Low	Moderate	High	Very High
Arctium minus	burdock	Yes	1	1	0	0	0	0	1	0	0	0	0
Chorispora tenella	blue mustard	Yes	4	4	0	0	0	0	4	0	0	0	0
Cirsium vulgare	bull thistle	Yes	20	8	10	0	2	0	19	1	0	0	0
Convolvulus arvensis	field bindweed	Yes	16	6	9	1	0	0	15	1	0	0	0
Descurainia sophia	flixweed	Yes	13	1	3	2	6	1	11	2	0	0	0
Elaeagnus angustifolia	Russian olive	Yes	7	7	0	0	0	0	7	0	0	0	0
Melilotus officinale	yellow sweetclover	Yes	346	51	90	129	73	3	298	45	3	0	0
Tamarix sp.	tamarisk	Yes	18	17	1	0	0	0	18	0	0	0	0
Tragopogon dubius	yellow salsify	Yes	114	56	32	23	3	0	109	5	0	0	0
Ulmus pumila	Siberian elm	Yes	2	2	0	0	0	0	2	0	0	0	0
Verbascum thapsus	woolly mullein	Yes	49	16	16	13	4	0	41	7	0	0	0
Priority species total			590	169	161	168	88	4	525	61	3	0	0
Anisantha diandra	ripgut brome	No	1	0	0	0	0	1	**0**	**0**	**1**	**0**	**0**
Asparagus officinalis	asparagus	No	3	2	1	0	0	0	3	0	0	0	0
Erodium cicutarium	redstem filaree	No	3	2	1	0	0	0	3	0	0	0	0
Malcolmia africana	African mustard	No	7	6	1	0	0	0	7	0	0	0	0
Populus alb	white poplar	No	2	2	0	0	0	0	2	0	0	0	0
Sisymbrium altissimum	tumblemustard	No	6	3	1	0	2	0	4	2	0	0	0
Non-priority species total[3]			22	15	4	0	2	1	19	2	1	0	0
Total all species			612	184	165	168	90	5	544	63	4	0	0
Percentage all species			100%	30.1%	27.0%	27.5%	14.7%	0.8%	88.9%	10.3%	0.7%	0.0%	0.0%

[1]Patch size classes: 1 = 1–3 plants (≤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).

[2]PMI classes: Very Low (1–5), Low (6–10), Medium (11–15), High (16–20), Very High (21–25). PMI = Patch size class (1–5) × Patch percent cover (1–5).

[3]Non-priority species may not have been recorded by all observers.

monitoring routes (Table 3-3). Yellow sweetclover and yellow salsify represented 78% of all priority patches. Only priority species should be examined when comparing across areas, as these were the only species recorded consistently by all observers.

A total of 49 patches of woolly mullein were detected across all monitoring routes in 2017. This was one more patch than was detected in 2015, marking the highest number of woolly mullein patches detected in a single monitoring year to date. Concurrently, only seven patches of Russian olive and two patches of Siberian elm (*Ulmus pumila*) were detected across all routes monitored in 2017, marking the lowest number of patches detected of both species in a single monitoring year to date.

Of the 590 priority patches, 55.9% were assigned to size classes smaller than 40 m^2 (see Table 3-3). Smaller-sized patches were typical of nearly all priority IEP species except for yellow sweetclover, for which 59.2% of patches were found to be larger than 40 m^2.

Across all IEP species, the patch management index of the vast majority of patches were classified as Very Low (88.9%) or Low (10.3%) (see Table 3-3). Only three patches of yellow sweetclover, comprising <1% of patches of this species, were classified as Moderate PMI. The only other IEP species documented in 2017 with a Moderate PMI was the single patch of non-priority ripgut brome (*Anisantha diandra*) detected in the Monument Canyon drainage.

Three priority invasive tree species were detected: Russian olive, tamarisk, and Siberian elm. Of the 27 patches of trees detected, 48% were seedlings, 37% were saplings, 7% were mature trees, and growth stage was not noted for 7% of patches (Table 3-4).

3.3 Monitoring transects

Transect data from routes where at least 10 transects were conducted, and totals for drainages, roads, and trails, are summarized in Table 3-5 (see also Appendix B). A total of 146 transects were sampled in 2017. Yellow salsify, woolly mullein, and yellow sweetclover were the only priority IEP species present in more than one transect. Cheatgrass, redstem filaree, tumblemustard, and Japanese chess were the only non-priority IEP species present in more than one transect. Cheatgrass was widespread (found alive or dead in 64.4% of all transects), with an average percent cover of 1.07% of the total monitored area. Cheatgrass was present in over half of the transects along Monument Canyon, Rim Rock Drive South, and Ute Canyon. Yellow sweetclover was the second-most frequent IEP species detected (found in 11.6% of all transects), with an average percent cover of 0.1% of the total monitored area. Yellow sweetclover was most frequent (44.4% of transects) and had the highest percent cover (0.48%) in No Thoroughfare Canyon.

Riparian routes had the highest frequency of IEP species within transects (79.0%), with an average percent cover of 1.04%. IEPs were also prevalent along roads, with 44.4% of transects containing at least one IEP with an average percent cover of 0.77%. Across all routes, the frequency of IEP species within transects was 68.5% with an average percent cover of 0.55%.

Table 3-4. Total number of patches of trees by species and growth stage, Colorado National Monument, June 1–7, 2017.

Scientific name	Common name	Total patches	Growth stage			
			Mature tree	Sapling	Seedling	None listed
Elaeagnus angustifolia	Russian olive	7	1	2	3	1
Tamarix sp.	tamarisk	18	1	7	10	0
Ulmus pumila	Siberian elm	2	0	1	0	1
Total all species		27	2	10	13	2
Percentage all species		100%	7%	37%	48%	7%

Table 3-5. Percent cover of living and dead patches per monitoring route where at least 10 transects were conducted, and totals for drainages, roads, and trails, Colorado National Monument, June 1–7, 2017.

Route (total transects)	Type	Scientific name	Common name	Live/Dead	# of transects detected	Percent cover (SE)
Monument Canyon (20)	Riparian	*Anisantha tectorum*	cheatgrass	Live	13	0.48 (0.13)
		Anisantha tectorum	cheatgrass	Dead	10	0.18 (0.05)
		Erodium cicutarium	redstem filaree	Live	1	0.01 (0.01)
No Thoroughfare Canyon (19)	Riparian	*Anisantha tectorum*	cheatgrass	Live	8	0.40 (0.22)
		Anisantha tectorum	cheatgrass	Dead	4	0.04 (0.02)
		Bromus japonicus†	Japanese chess	Live	3	0.09 (0.05)
		Bromus japonicus†	Japanese chess	Dead	3	0.10 (0.07)
		Cirsium vulgare	bull thistle	Live	1	0.01 (0.01)
		Erodium cicutarium	redstem filaree	Live	1	0.01 (0.01)
		Melilotus officinale	yellow sweetclover	Live	8	0.48 (0.27)
		Sisymbrium altissimum	tumblemustard	Live	1	0.07 (0.07)
		Verbascum thapsus	woolly mullein	Live	1	0.01 (0.01)
Rim Rock, E Glade to Ute (20)	Road	*Anisantha tectorum*	cheatgrass	Live	2	0.02 (0.01)
Rim Rock South (24)	Road	*Anisantha tectorum*	cheatgrass	Live	18	0.70 (0.21)
		Anisantha tectorum	cheatgrass	Dead	8	0.22 (0.10)
		Erodium cicutarium	redstem filaree	Live	2	0.02 (0.02)
		Melilotus officinale	yellow sweetclover	Live	1	0.04 (0.04)
Ute Canyon (16)	Riparian	*Anisantha tectorum*	cheatgrass	Live	14	2.19 (0.73)
		Anisantha tectorum	cheatgrass	Dead	9	0.53 (0.17)
		Descurainia sophia	flixweed	Live	1	0.01 (0.01)
		Erodium cicutarium	redstem filaree	Live	6	0.26 (0.14)
		Melilotus officinale	yellow sweetclover	Live	6	0.19 (0.10)
		Sisymbrium altissimum	tumblemustard	Live	1	0.02 (0.02)
		Tragopogon dubius	yellow salsify	Live	1	0.01 (0.01)
		Verbascum thapsus	wooly mullein	Live	1	0.04 (0.04)
		Verbascum thapsus	wooly mullein	Dead	1	0.69 (0.69)
Riparian Total (100)‡					79	1.04 (0.37)
Road Total (45)					20	0.77 (0.8)
All Routes (146)‡					100	0.55 (0.27)

†Not a priority IEP

‡Includes routes with fewer than 10 transects.

3.4 Extra-area searches

At the request of park managers, extra-area quadrats were sampled near the East Entrance, mouth of Gold Star Canyon, and West Entrance (Table 3-6). The West Entrance was also surveyed with an extra-area search. In these three areas, invasive-plant control has either been completed or there are plans for treatment in the near future.

3.4.1 Gold Star Canyon and East Entrance extra areas

A total of 20 and 29 randomly-placed quadrats were conducted in the Gold Star Canyon and East Entrance extra areas, respectively (see Table 3-6). Cheatgrass, redstem filaree, and Russian thistle were found in both areas. Tumblemustard was also found in the Gold Star Canyon extra area. Cheatgrass was found in >94% of quadrats in both areas. Living cheatgrass was high at the mouth of Gold Star Canyon (2.65% cover) and the East Entrance (0.93% cover) (Table 3-7). The only other species found in more than half of quadrats in an extra area was tumblemustard, at the mouth of Gold Star Canyon (0.40% cover).

3.4.2 West Entrance extra areas

Both of the West Entrance extra areas were mapped. Cheatgrass, field bindweed, redstem filaree, tumblemustard, yellow salsify, and Russian thistle were found in both areas (Figure 3-8). The treated area area had nearly three times as many patches detected per hectare, slightly higher percent cover, and more species detected per plot than the untreated area (see Table 3-6). Invasive plant species were detected in 100% of quadrats in both areas. Percent cover of individual species was consistently higher in the treated area than the untreated area (see Table 3-7). Both West Entrance areas had consistently higher percent cover than the Gold Star Canyon and East Entrance extra areas.

The treated area generally had a larger proportion of Very Low PMI than the untreated area (Table 3-8). Overall, 73% of treated patches were classified as Very Low in 2017, compared to just 34% of untreated patches. In 2015, 62% of treated patches were classified as Very Low, compared to 25% of untreated patches. Although both the treated and untreated areas were mapped in 2015 and 2017, cheatgrass was the only species mapped in both years. More than 10 patches of cheatgrass were mapped. Numbers of patches of cheatgrass were higher in 2015 than in 2017 in both treated and untreated areas (Table 3-9), although the distribution appeared similar (Figures 3-8 and 3-9).

Table 3-6. Extra areas surveyed with hectares covered along the route, number of IEP patches, and number of patches/ha, Colorado National Monument, June 1–7, 2017.

Route	Ha	Patches detected	Patches/ha	Quadrats with IEPs/Total quadrats	Percent cover* (SE)	Total IEPs detected	IEPs/ Quadrat
West Entrance (Treated)	12.44	110	8.84	14/14	7.86 (2.01)	6	1.93
West Entrance (Untreated)	26.55	77	2.90	16/16	6.06 (1.36)	6	1.25
Gold Star Canyon	8.78	NA	NA	19/20	4.65 (0.57)	4	2.25
East Entrance	16.00	NA	NA	29/29	1.67 (0.26)	3	1.14

*Live and dead

Table 3-7. Frequency and percent cover of IEP species with >0.5% cover within sampled quadrats in extra areas, June 1–7, 2017.

Common name (Live or Dead)	Extra area	# of quadrats detected/total quadrats	Percent cover
Cheatgrass (Live)	East Entrance	28/29	0.93 (0.13)
	Gold Star Canyon	19/20	2.65 (0.44)
	West Entrance (Untreated)	17/17	4.19 (1.23)
	West Entrance (Treated)	14/14	4.21 (2.06)
Cheatgrass (Dead)	East Entrance	23/29	0.50 (0.06)
	Gold Star Canyon	16/20	0.97 (0.22)
	West Entrance (Untreated)	8/17	1.12 (0.45)
	West Entrance (Treated)	5/14	1.11 (0.74)
Russian thistle (Live)	East Entrance	1/29	0.02 (0.02)
	Gold Star Canyon	0/20	0.00 (0.00)
	West Entrance (Untreated)	0/17	0.00 (0.00)
	West Entrance (Treated)	6/14	1.93 (0.85)
Tumblemustard (Live)	East Entrance	0/29	0.00 (0.00)
	Gold Star Canyon	12/20	0.40 (0.10)
	West Entrance (Untreated)	1/17	0.63 (0.11)
	West Entrance (Treated)	2/14	0.21 (0.15)
All invasives (Live)	East Entrance	27/29	1.14 (0.25)
	Gold Star Canyon	19/20	3.05 (0.47)
	West Entrance (Untreated)	17/17	4.81 (1.26)
	West Entrance (Treated)	14/14	6.54 (2.05)
All invasives (Dead)	East Entrance	24/29	0.52 (0.06)
	Gold Star Canyon	19/20	1.60 (0.25)
	West Entrance (Untreated)	9/17	1.25 (0.44)
	West Entrance (Treated)	5/14	1.32 (0.76)

Table 3-8. Number and percentage of IEP patches detected in each patch management index category, West Entrance extra-area survey, Colorado National Monument, June 1–7, 2017.

Year (Treatment)	Scientific name	Common name	Total patches	Patch management index* (%)				
				Very Low	Low	Moderate	High	Very High
2017 (Treated)	*Anisantha tectorum*	cheatgrass	37	22 (59%)	15 (41%)	0	0	0
	Convolvulus arvensis	field bindweed	2	2 (100%)	0	0	0	0
	Erodium cicutarium	red stem filaree	24	18 (67%)	6 (33%)	0	0	0
	Salsola sp.	Russian thistle	20	12 (60%)	3 (15%)	5 (25%)	0	0
	Sisymbrium altissimum	tumblemustard	26	25 (97%)	1 (4%)	0	0	0
	Tragopogon dubius	yellow salsify	1	1 (100%)	0	0	0	0
		Total	110	80 (73%)	25 (23%)	5 (5%)	0	0
2017 (Untreated)	*Anisantha tectorum*	cheatgrass	44	14 (32%)	29 (66%)	1 (2%)	0	0
	Convolvulus arvensis	field bindweed	1	0	1 (100%)	0	0	0
	Erodium cicutarium	red stem filaree	9	8 (89%)	1 (11%)	0	0	0
	Salsola sp.	Russian thistle	3	3 (100%)	0	0	0	0
	Sisymbrium altissimum	tumblemustard	16	9 (56%)	7 (44%)	0	0	0
	Tragopogon dubius	yellow salsify	4	2 (50%)	2 (50%)	0	0	0
		Total	77	36 (34%)	40 (52%)	1 (1%)	0	0
2015 (Treated)	*Anisantha tectorum*	cheatgrass	110	62 (56%)	31 (28%)	17 (15%)	0	0
2015 (Untreated)	*Anisantha tectorum*	cheatgrass	113	25 (22%)	62 (55%)	26 (23%)	0	0

*PMI classes: Very Low (1–5), Low (6–10), Medium (11–15), High (16–20), Very High (21–25). PMI = Patch size class (1–5) × Patch percent cover (1–5).

Table 3-9. Cheatgrass in treated and untreated West Entrance extra areas, Colorado National Monument, 2015 and 2017.

Area	Year	Ha (ha)	Patches detected	Patches/ha	Quadrats with IEPs/ Total quadrats	Percent cover* (SE)
Treated	2015	12.44	110	8.84	NA	NA
	2017	12.44	37	2.97	14/14	5.32 (2.09)
Untreated	2015	26.55	113	4.26	NA	NA
	2017	26.55	44	1.66	16/16	5.31 (1.36)

*Live and dead

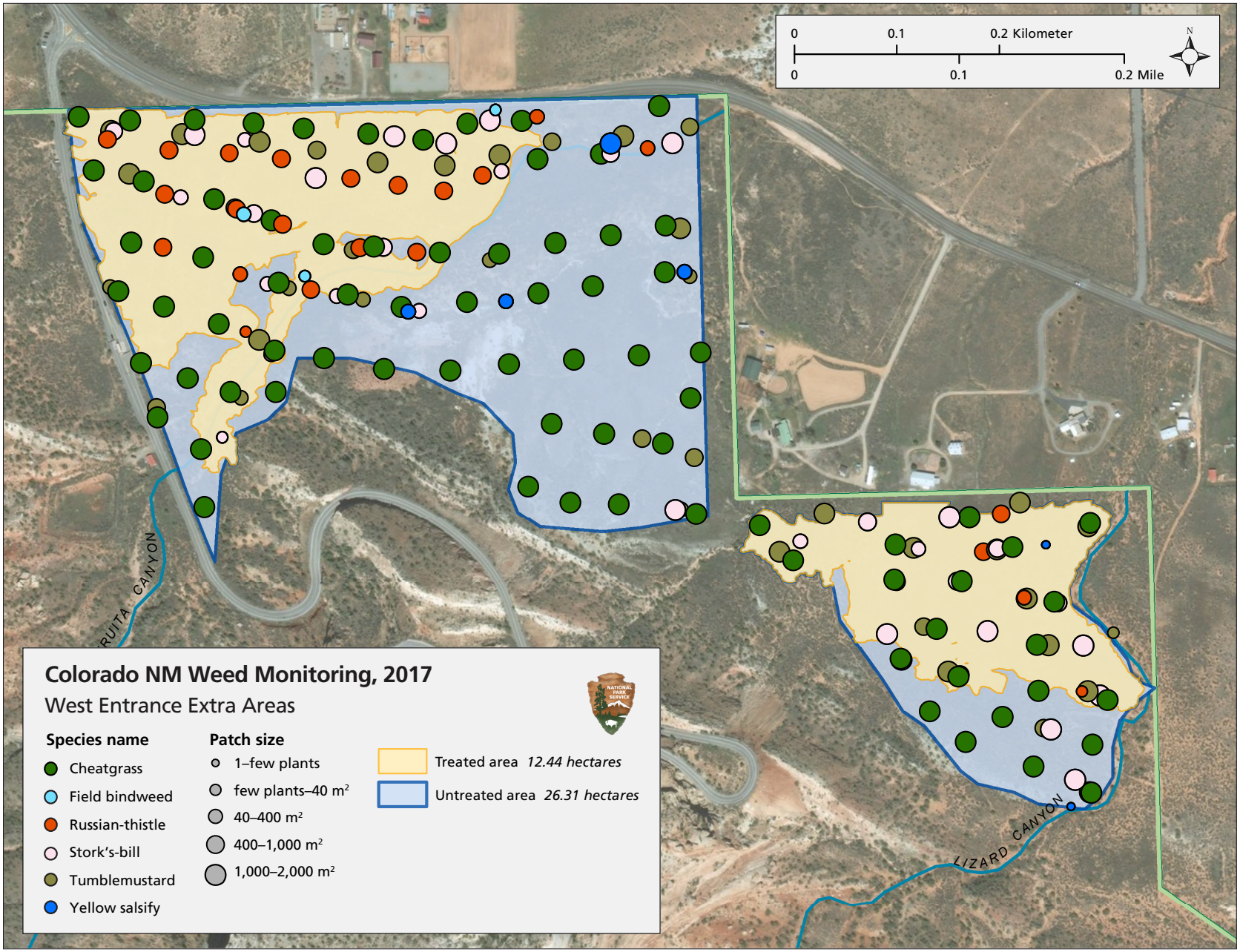


Figure 3-8. Invasive exotic plants detected on monitoring routes and monitoring plots in the West Entrance extra areas of Colorado National Monument, June 1–7, 2017. More species were on the search list in 2017 than in 2015.

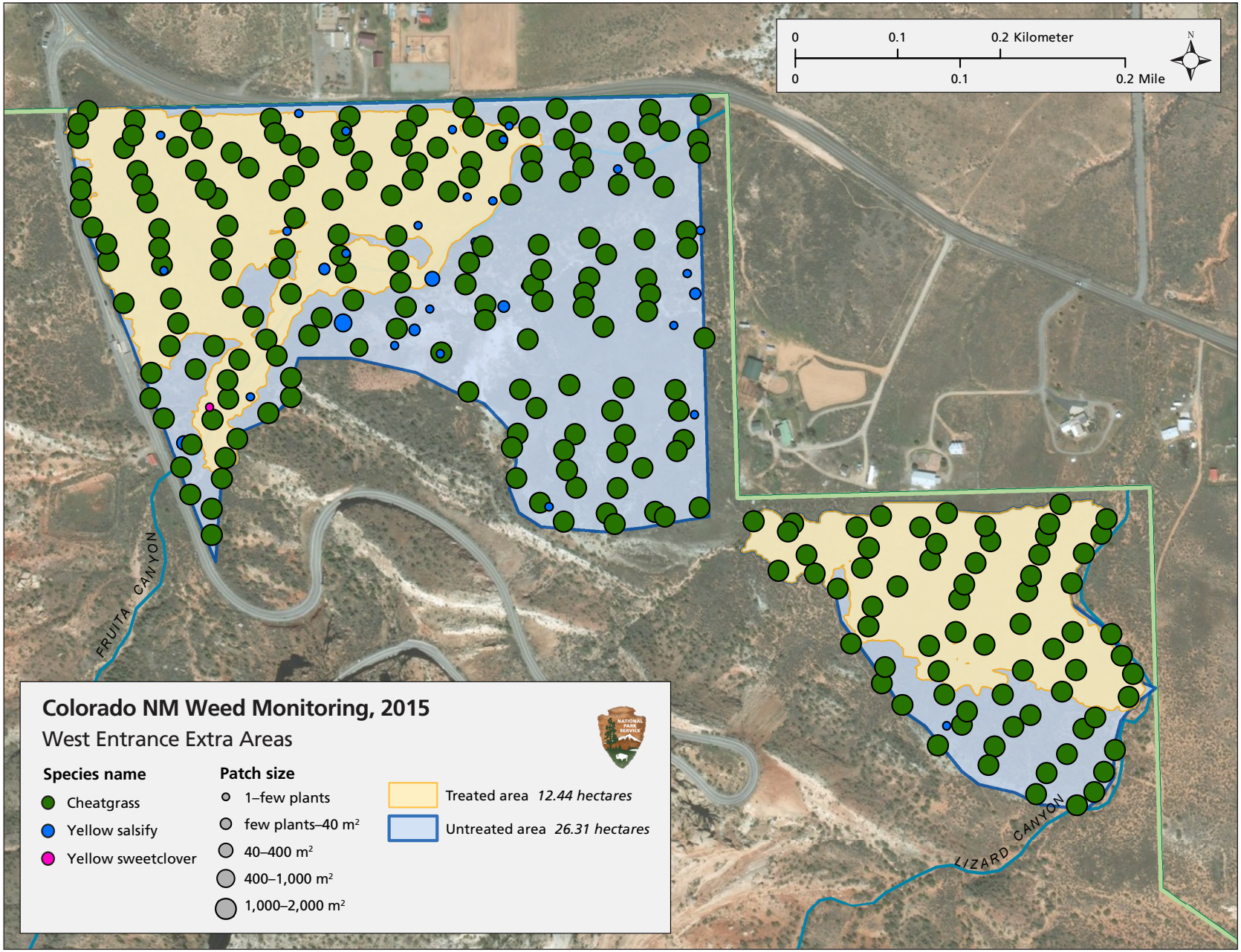


Figure 3-9. Invasive exotic plants detected on monitoring routes and monitoring plots in the West Entrance extra areas of Colorado National Monument, July 1–22, 2015.

3.5 Results comparison: 2003–2017

Colorado National Monument was previously surveyed for IEPs in 2003 (Dewey and Anderson 2005; 2009), 2009 (Perkins 2010), 2011 (Perkins 2012), 2013 (Perkins 2014), and 2015 (Perkins 2016). Table 3-10 lists monitoring routes where segments of each route and IEP species searched for were the same for two separate time periods (2003–2017 and 2009–2017). Figure 3-10 shows segments of routes commonly monitored between 2009 and 2017. Unless noted, only data from these commonly monitored routes were used for comparison between years.

The priority IEP species, bull thistle (*Cirsium vulgare*), field bindweed, Russian olive, tamarisk, Siberian elm, and woolly mullein, have been observed in every monitoring year since 2009. Yellow sweetclover and yellow salsify have been observed in every monitoring year since each was added to the priority list in 2011 and 2015, respectively.

In 2017, twenty-three patches of woolly mullein were observed along common segments of routes—the highest number of patches detected between 2003 and 2017. Also in 2017, the greatest number of yellow sweetclover patches (254) was observed since 2011, when this species was added to the priority list. Two patches of blue mustard (*Chorispora tenella*) and twelve patches of flixweed (*Descurania sophia*) were observed for the first time since these species were added to the priority list in 2015.

The following priority IEP species remain undetected since monitoring began in 2009: diffuse knapweed (*Acosta diffusa*), spotted knapweed (*Acosta maculosa*), Canada thistle (*Breea arvensis*), whitetop (*Cardaria* sp.[1]), plumeless thistle (*Carduus acanthoides*), musk thistle (*Carduus nutans*), yellow starthistle (*Leucantha solstitialis*), butter-and-eggs (*Linaria vulgaris*), purple loosestrife (*Lythrum salicaria*), and Scotch thistle *(Onopordum acanthium*). Russian knapweed (*Acroptilon repens*), jointed goatgrass (*Cylindropyrum cylindricum*), 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.

Table 3-11 highlights species detected at least 10 times along common routes monitored between 2003 and 2017.[2] The number of patches detected has decreased for most IEP species monitored, particularly among woody species. The number of tamarisk patches has generally decreased in Gold Star, Monument, and No Thoroughfare canyons since 2009. Russian olive patches have decreased in Monument, No Thoroughfare, and Ute canyons since 2011. The number of Siberian elm patches has decreased in Monument Canyon since 2013, and in No Thoroughfare and Ute canyons since 2015. However, the number of tamarisk patches increased in Ute Canyon in 2017. Woolly mullein has also shown recent increases in patch numbers in No Thoroughfare and Ute canyons.

Table 3-12 highlights species detected at least 10 times along common routes monitored between 2009 and 2017. In Columbus Canyon, the number of tamarisk patches has decreased, while the number of Siberian elm patches has slightly increased. In Red Canyon, the number of tamarisk, Russian olive, and woolly mullein patches has increased, while Siberian elm patches have decreased. In Wedding Canyon, tamarisk patches have decreased. Kodels Canyon, Kodels Canyon Route, and Limekin Gulch continue to have very low IEP occurrence, with seven or fewer IEP patches detected along these routes between 2009 and 2017.

[1] *Cardaria latifolia* was detected in 2009 and 2013 and continues to be monitored as a separate species from *Cardaria* sp.

[2] While entire routes are listed in Table 3-11, only segments of these routes shared between all years within a time period were considered for analysis.

Table 3-10. Common monitoring routes and IEP species, Colorado National Monument, 2003–2017 and 2009–2017.

Years	Common routes	Common IEPs
2003–2017	Gold Star Canyon Monument Canyon[1] No Thoroughfare Canyon Ute Canyon	field bindweed Russian knapweed Russian olive tamarisk woolly mullein
2009–2017	Columbus Canyon Gold Star Canyon Kodels Canyon Kodels Canyon Route Limekin Gulch Monument Canyon[2] No Thoroughfare Canyon Red Canyon Rim Rock Drive[3] Ute Canyon Wedding Canyon	broad-leaf pepperwort bull thistle burdock butter-and-eggs Canada thistle diffuse knapweed Dyer's woad field bindweed hoary cress jointed goatgrass leafy spurge musk thistle plumeless thistle puncture vine purple loosetrife Russian knapweed Russian olive Scotch thistle Siberian elm spotted knapweed tamarisk woolly mullein yellow starthistle

[1]Coverage of Monument Canyon and Independence Monument in 2003 was approximately equal to the coverage of Monument Canyon by NCPN from 2009 to 2017.

[2]Includes Hydro 88 monitoring route.

[3]Includes Rim Rock Drive from the East Entrance to the East Glade Park Road.

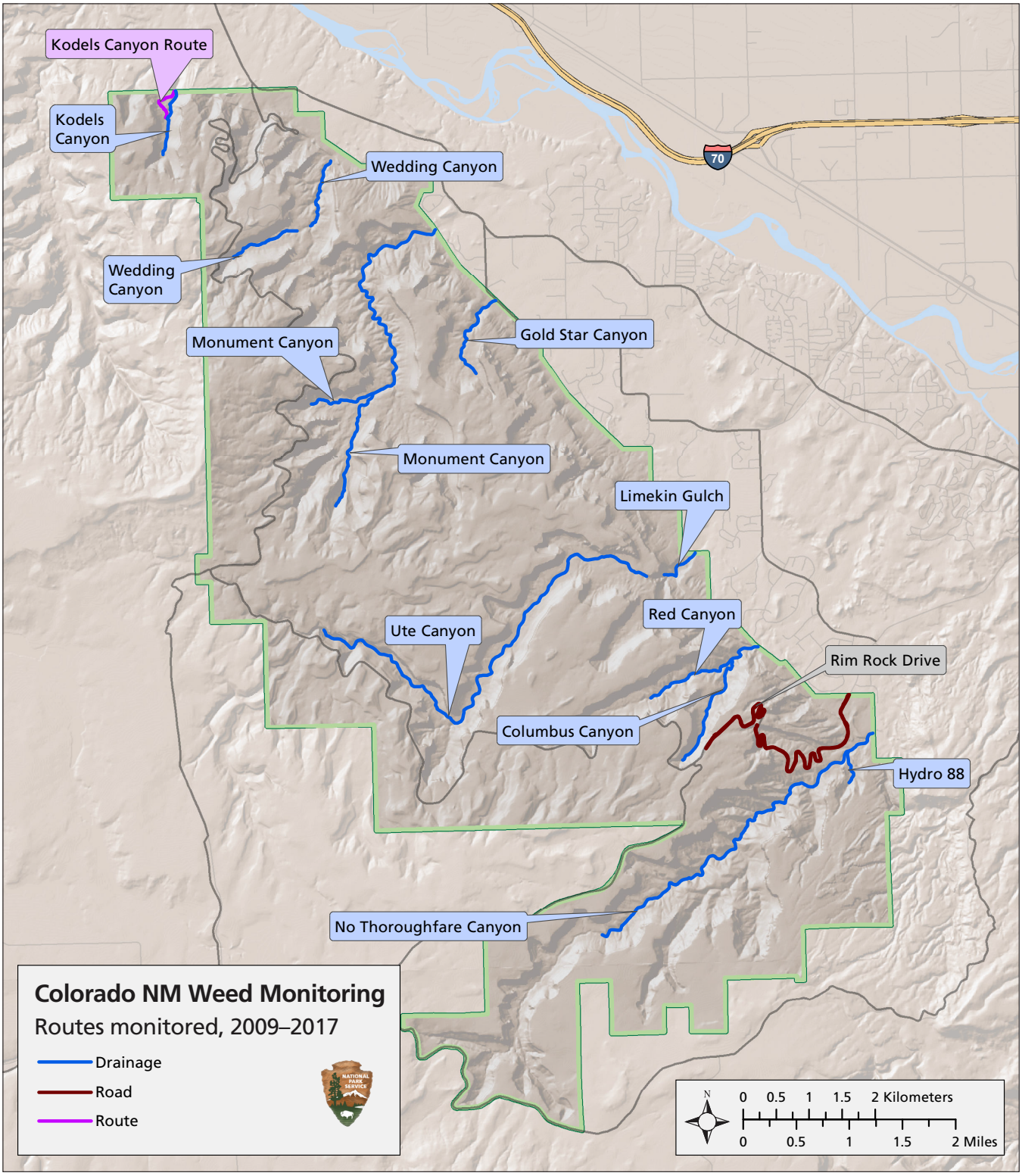


Figure 3-10. Monitoring routes consistently conducted during IEP monitoring, Colorado National Monument, 2009–2017.

Table 3-11. Number of IEP patches (minimum 10 detections) observed along routes consistently surveyed between 2003 and 2017, Colorado National Monument.

Scientific name	Common name	Route	2003	2009	2011	2013	2015	2017
Descurainia sophia	flixweed	Ute Canyon	ND	ND	ND	ND	0	10
Elaeagnus angustifolia	Russian olive	Monument Canyon	1	6	15	6	0	1
		No Thoroughfare Canyon	2	2	4	0	3	2
		Ute Canyon	6	4	4	0	0	0
Ulmus pumila	Siberian elm	No Thoroughfare Canyon	ND	2	8	3	5	0
Tamarix sp.	tamarisk	Gold Star Canyon	6	2	1	0	1	0
		Monument Canyon	33	8	7	2	1	1
		No Thoroughfare Canyon	17	2	5	0	4	0
		Ute Canyon	37	8	0	0	2	4
Verbascum thapsus	woolly mullein	Ute Canyon	5	4	1	4	14	12
Tragopogon dubius	yellow salsify	Monument Canyon	ND*	ND*	ND*	ND*	19	10
		No Thoroughfare Canyon	ND*	ND*	ND*	ND*	17	16
		Ute Canyon	ND*	ND*	ND*	ND*	55	43
Melilotus officinale	yellow sweetclover	Monument Canyon	ND*	ND*	48	28	24	18
		No Thoroughfare Canyon	ND*	ND*	66	47	54	83
		Ute Canyon	ND*	ND*	73	35	87	88

*ND=No data collected for this species.

Table 3-12. Number of patches of invasive exotic plants (minimum 10 detections) observed along routes consistently surveyed at Colorado National Monument between 2009 and 2017.

Scientific name	Common name	Route	2009	2011	2013	2015	2017
Convolvulus arvensis	field bindweed	Rim Rock Drive	14	25	12	16	11
Ulmus pumila	Siberian elm	Red Canyon	2	3	3	2	0
Tamarix sp.	tamarisk	Red Canyon	0	4	3	0	4
Verbascum thapsus	woolly mullein	Red Canyon	0	0	2	4	7
Tragopogon dubius	yellow salsify	Rim Rock Drive	ND*	ND*	ND*	24	21
Melilotus officinale	yellow sweetclover	Columbus Canyon	ND*	18	18	11	3
		Red Canyon	ND*	23	17	17	14
		Rim Rock Drive	ND*	57	22	31	44
		Wedding Canyon	ND*	13	1	2	1

*ND=No data collected for this species.

Changes in yellow sweetclover can be found across common sections of monitoring routes sampled since it was added to the priority list in 2011 (Figure 3-11). In general, the number of yellow sweetclover patches decreased across most routes between 2011 and 2013. While this decline has continued in Monument Canyon, Columbus Canyon, and Red Canyon, increases in yellow sweetclover patches have been observed since 2013 in Ute Canyon, No Thoroughfare Canyon, and Rim Rock Drive.

Transect data can also be compared across time among sections of routes consistently monitored since 2011—particularly for more common IEP species, such as cheatgrass and yellow sweetclover (Figure 3-12). Overall, the frequency of yellow sweetclover detections in transects (3 quadrats in a transect) has declined—from 35% in 2011 to 9% in 2017. Concurrently, the frequency of cheatgrass increased sharply, from 48% in 2011 to 85% in 2013, followed by a gradual decrease to 75% in 2017.

While the West Entrance extra area was surveyed in both 2015 and 2017, quantitative trends cannot be deduced due to different sampling densities across these two years (see Figures 3-8, 3-9). This was likely the result of three observers' conducting the survey in 2015, while only one observer conducted the survey in 2017. Such sampling bias should be avoided in the future through the continued implementation of randomized quadrats across these extra areas.

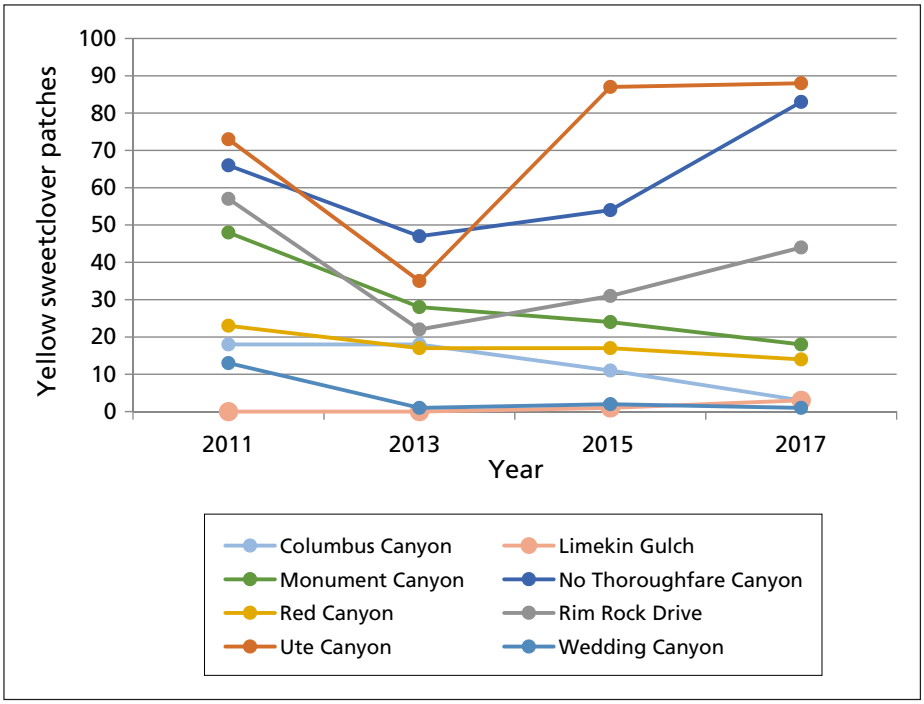


Figure 3-11. Number of yellow sweetclover patches along sections of routes consistently monitored between 2011 and 2017, Colorado National Monument.

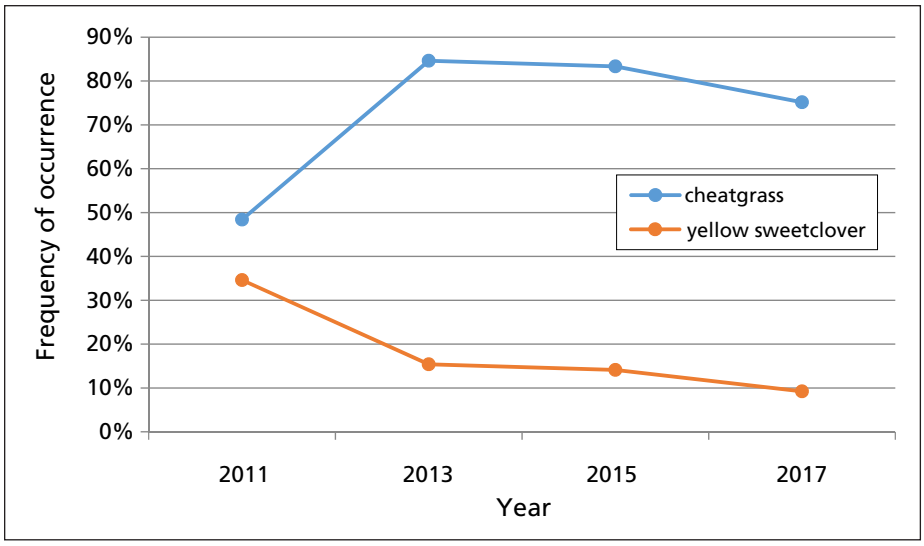


Figure 3-12. Frequency of cheatgrass and yellow sweetclover detected within transects along sections of routes consistently monitored between 2011 and 2017, Colorado National Monument.

4 Discussion

4.1 Priority invasive exotic plant list

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.

The NCPN will continue to work with Colorado NM staff and area IEP experts to review and update the list of priority species each year. At this time, the network recommends ripgut brome (*Anisantha diandra*) be considered for addition to the priority list. Only one patch of this species was recorded in 2017, in Monument Canyon—but as a non-priority species, it may be more widespread.

4.2 Possibilities for management control

The number of IEP patches remains low compared to 2009, when NCPN monitoring began, and 2003, when Utah State University conducted their surveys. These lower numbers are likely due to IEP control efforts by park staff. Because monitoring was conducted at approximately the same time each year, phenology differences between years should be minimal. Priority invasive exotic plants were most widespread along riparian and road areas. While patches have generally declined overall, the routes with the highest priority IEP densities are currently Ute, Red, and No Thoroughfare canyons, largely due to high quantities of yellow sweetclover. Eight of the eleven priority IEP species observed across the park were found to have 20 patches or fewer (see Table 3-3). These species should be targeted for control efforts for potential eradication along monitoring routes.

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. Tree patches consisted largely of seedlings and saplings, which are easier to control than mature trees. In 2009, 2011, 2013, 2015, and 2017, 92%, 75%, 83%, 79%, and 92% of patches, respectively, were seedlings and saplings. Continued control efforts should be made before more seedlings and saplings grow into mature trees.

Despite the increase in woolly mullein between 2013 and 2017, 65% of patches are currently less than 40 m^2 (see Table 3-3). Because this species can be treated with hand-pulling, future efforts by park staff and volunteers to control this species may be particularly effective. Keeping mullein at low numbers will require constant effort. Cheatgrass and yellow sweetclover are widespread across the park and sparsely dispersed within patches, making future control efforts difficult.

The NCPN has monitored treated areas at Colorado NM since 2015. While both treated and proposed (untreated) areas were monitored, no pre-treatment data were collected, preventing meaningful comparisons. However, the treated areas will provide information on the effectiveness of control over time. In addition to control efforts, park staff has been conducting seeding, planting, and caging of native plants in treatment areas and will install connectivity modifiers within one acre of the West Entrance extra area in summer 2018 to promote native revegetation.

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 aided by chainsaws instead of loppers or pruning shears. Preventing the invasion of additional species should give native species a better chance to persist.

While the patch management index was originally intended to elucidate trends in IEP populations over time, it can also be used to inform treatment decisions. A Very Low or Low classification indicates a patch that is either small in area, sparse in cover, or both small in area and sparse in cover. Therefore, from a management perspective, patches with Very Low or Low PMI should not be interpreted as insignificant. On the contrary—isolated and/or uncommon species with Very Low or Low PMI may be some of the most

important areas to treat, thereby preventing future spread and representing opportunities for eradication. For other, more widespread species, such as yellow sweetclover, the large number of patches with Very Low and Low PMI indicates that this species is sparsely scattered across a broad landscape. Therefore, while control of an individual patch will require minimal effort, control of the population will require traversing large areas. Conversely, while patches with higher PMI will be difficult to manage and treat due to their larger size and denser cover, these also represent opportunities for possible eradication if patch numbers for a given species are low. One example is the lone patch of the non-priority IEP species, ripgut brome, which was assigned Medium PMI. Ultimately, managers should consider both numbers of patches and PMI values when determining treatment priorities.

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 Extra areas

The extra areas were completed in an attempt to match management actions with monitoring. However, management actions often need to take place when funds and resources are available, and in some cases this occurs before pre-treatment data can be collected. In the West Entrance extra areas, the first herbicide application for cheatgrass on 9.7 hectares occurred in March 2015, before NCPN crews first monitored the area in July 2015. Therefore, it cannot be known how effective the treatment was on invasive plants. After the first treatment, seven additional herbicide and hand-pulling treatments occurred in the area between July 2015 and November 2016, ranging from 0.04 to 7.79 ha (average 1.73 ha). Any particular spot in the treated areas could have been treated 1–7 times from 2015 to 2017.

The mapping methods also appear to be somewhat problematic for species that are widespread in this area, such as cheatgrass. The 2017 data showed the number of cheatgrass patches had dropped by 75% in both the treated and untreated areas. However, spatial maps of the area indicate that the distribution remained the same. It is not clear if the drop in patches represents a true decrease or is simply the result of an observer's mapping nearly continuous cheatgrass differently. Cheatgrass can also vary widely in cover depending on precipitation. We think mapping is more effective for less-widespread species, while quadrats are more effective at determining abundance of widespread dominant species.

Although pre-treatment data are absent, some general comparisons between treated and untreated areas can be made with the above caveats in mind. Invasive species remain widespread in the treated area and actually appear to have higher cover and a higher number of invasive species per quadrat than in the untreated area. This may be because new invasives are filling in behind the controlled species faster than native species. Evidence of this can be seen in the larger percentage of smaller, lower cover class (indicated by Very Low PMI) in the treated area compared to the untreated area in both 2015 (after one treatment) and 2017 (after seven treatments). Park managers should consider rapidly re-seeding areas with a more comprehensive restoration plan after control of invasive plants is completed.

4.4 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 2019, the NCPN will resurvey all monitoring routes as staffing and time allows. 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 for inventories at the park's request.

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Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
Columbus Canyon	Melilotus officinale	Yellow sweet-clover	1	–	4323288.492	702990.494	5	1	5
Columbus Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323839.896	703307.821	1	2	2
Columbus Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323898.27	703336.041	1	2	2
Columbus Canyon	Ulmus pumila	Siberian elm	0	Sapling(s)	4323462.568	703072.148	5	1	5
East Glade Park Road	Tragopogon dubius	Yellow salsify	1	–	4322372.541	702756.322	5	1	5
Fruita Canyon	Descurainia sophia	Flixweed	0	–	4330538.905	695559.952	3	2	6
Fruita Canyon	Malcolmia africana	African mustard	0	–	4332080.337	696104.721	4	1	4
Fruita Canyon	Sisymbrium altissimum	Tumble mustard	0	–	4332223.25	696171.113	2	4	8
Fruita Canyon	Sisymbrium altissimum	Tumble mustard	0	–	4332162.478	696152.85	1	4	4
Fruita Canyon	Tragopogon dubius	Yellow salsify	0	–	4332598.293	696665.112	1	4	4
Gold Star Canyon	Asparagus officinalis	Asparagus	0	–	4328719.035	699266.246	2	2	4
Gold Star Canyon	Tragopogon dubius	Yellow salsify	1	–	4328709.657	699262.871	1	2	2
Gold Star Canyon	Tragopogon dubius	Yellow salsify	1	–	4328914.319	699271.852	5	1	5
Hydro 03	Elaeagnus angustifolia	Russian-olive	0	Mature Tree(s)	4332254.912	695412.744	5	1	5
Hydro 03	Tamarix sp.	tamarisk	0	Mature Tree(s)	4332510.65	695472.515	5	1	5
Hydro 03	Tamarix sp.	tamarisk	0	Sapling(s)	4332507.628	695477.636	5	1	5
Hydro 03	Tamarix sp.	tamarisk	0	Sapling(s)	4332549.918	695493.074	2	2	4
Hydro 82	Melilotus officinale	Yellow sweet-clover	0	–	4322731.884	704308.567	1	2	2
Hydro 82	Melilotus officinale	Yellow sweet-clover	0	–	4322614.032	704602.377	1	1	1
Hydro 82	Melilotus officinale	Yellow sweet-clover	0	–	4322659.095	704531.402	1	3	3
Hydro 82	Melilotus officinale	Yellow sweet-clover	0	–	4322751.681	704039.401	1	2	2
Hydro 82	Melilotus officinale	Yellow sweet-clover	0	–	4322739.973	704402.418	1	3	3
Hydro 82	Melilotus officinale	Yellow sweet-clover	0	–	4322624.622	705036.041	1	1	1
Hydro 82	Melilotus officinale	Yellow sweet-clover	0	–	4322719.853	704445.718	1	3	3
Hydro 82	Melilotus officinale	Yellow sweet-clover	0	–	4322778.373	704113.536	1	2	2
Hydro 82	Melilotus officinale	Yellow sweet-clover	0	–	4322579.277	704682.116	1	2	2
Hydro 82	Melilotus officinale	Yellow sweet-clover	0	–	4322713.99	703982.2	1	3	3
Hydro 82	Melilotus officinale	Yellow sweet-clover	0	–	4322691.223	704489.705	1	2	2
Hydro 82	Melilotus officinale	Yellow sweet-clover	0	–	4322752.468	704189.14	1	2	2
Hydro 82	Melilotus officinale	Yellow sweet-clover	0	–	4322606.736	704785.723	1	2	2

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
Hydro 82	Tragopogon dubius	Yellow salsify	1	–	4322615.403	704619.12	1	1	1
Hydro 82	Tragopogon dubius	Yellow salsify	1	–	4322772.609	704126.874	5	1	5
Hydro 82	Tragopogon dubius	Yellow salsify	0	–	4322699.119	703973.003	5	1	5
Hydro 85	Melilotus officinale	Yellow sweet-clover	0	–	4321666.882	703649.134	1	3	3
Hydro 85	Melilotus officinale	Yellow sweet-clover	0	–	4321694.591	703585.649	1	2	2
Hydro 85	Melilotus officinale	Yellow sweet-clover	1	–	4321698.218	703528.664	1	3	3
Hydro 86	Melilotus officinale	Yellow sweet-clover	0	–	4321867.08	704544.335	1	3	3
Hydro 86	Melilotus officinale	Yellow sweet-clover	0	–	4321946.496	704501.849	1	2	2
Hydro 88	Tragopogon dubius	Yellow salsify	1	–	4322287.205	705159.441	5	1	5
Hydro 88	Verbascum thapsus	Woolly mullein	1	–	4322047.134	705065.982	1	3	3
Hydro 95	Arctium minus	Burdock	0	–	4320346.922	702883.769	5	1	5
Hydro 95	Cirsium vulgare	Bull thistle	1	–	4319172.497	702142.683	2	2	4
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	Seedling(s)	4320453.216	702954.006	1	3	3
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4320903.836	703575.123	1	3	3
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4320379.293	702900.733	1	4	4
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4320598.41	703355.993	1	4	4
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4319584.361	702369.412	1	4	4
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	Seedling(s)	4320270.601	702844.792	1	4	4
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4320109.157	702714.334	1	3	3
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4320173.681	702743.906	1	3	3
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	Seedling(s)	4320499.428	703028.935	2	4	8
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4319733.503	702436.561	1	3	3
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4320439.836	702948.542	1	4	4
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4319990.918	702637.666	1	3	3
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4321066.153	703468.976	1	4	4
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4319669.089	702390.436	1	3	3
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4320244.393	702789.766	2	3	6
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4319916.086	702605.877	1	3	3
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4321016.753	703511.457	1	4	4
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4319766.536	702475.626	1	3	3
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4319837.214	702522.174	1	3	3
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4320031.814	702686.093	1	3	3

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4320661.604	703435.065	1	4	4
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4320505.303	703274.98	1	4	4
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4320794.782	703554.426	1	4	4
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4320485.913	703197.759	1	4	4
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4320984.396	703564.578	1	4	4
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4320713.38	703510.177	1	4	4
Hydro 95	Melilotus officinale	Yellow sweet-clover	0	–	4320495.161	703125.655	1	3	3
Hydro 95	Tamarix sp.	tamarisk	0	Seedling(s)	4320441.227	702952.463	2	1	2
Hydro 95	Tamarix sp.	tamarisk	0	Seedling(s)	4320366.547	702893.237	5	1	5
Hydro 95	Tamarix sp.	tamarisk	0	Seedling(s)	4319759.481	702467.91	5	1	5
Hydro 95	Tragopogon dubius	Yellow salsify	1	–	4320971.332	703563.637	5	1	5
Hydro 95	Tragopogon dubius	Yellow salsify	1	–	4320498.105	703096.566	5	1	5
Hydro 95	Verbascum thapsus	Woolly mullein	0	–	4319229.933	702223.748	1	4	4
Hydro 95	Verbascum thapsus	Woolly mullein	0	–	4319478.481	702368.494	1	3	3
Hydro 95	Verbascum thapsus	Woolly mullein	0	–	4320807.988	703564.603	1	3	3
Hydro 95	Verbascum thapsus	Woolly mullein	0	–	4319302.645	702285.958	1	2	2
Hydro 95	Verbascum thapsus	Woolly mullein	0	–	4319720.753	702432.388	1	3	3
Hydro 95	Verbascum thapsus	Woolly mullein	0	–	4319175.84	702145.777	1	4	4
Hydro 95	Verbascum thapsus	Woolly mullein	0	–	4319931.875	702611.451	1	3	3
Hydro 95	Verbascum thapsus	Woolly mullein	0	–	4319606.34	702364.266	1	4	4
Hydro 95	Verbascum thapsus	Woolly mullein	0	–	4320622.431	703376.989	1	3	3
Hydro 95	Verbascum thapsus	Woolly mullein	0	–	4319830.772	702508.01	1	4	4
Kodels Canyon	Asparagus officinalis	Asparagus	1	–	4331642.829	694705.499	5	1	5
Kodels Canyon	Convolvulus arvensis	Field bindweed	0	–	4332318.597	694811.862	2	2	4
Kodels Canyon	Malcolmia africana	African mustard	1	–	4332235.504	694812.824	5	1	5
Kodels Canyon	Malcolmia africana	African mustard	1	–	4331800.585	694732.6	5	1	5
Kodels Canyon	Malcolmia africana	African mustard	1	–	4331719.8	694730.432	5	1	5
Kodels Canyon	Tamarix sp.	tamarisk	1	Sapling(s)	4332391.429	694848.248	5	1	5
Limekin Gulch	Melilotus officinale	Yellow sweet-clover	0	–	4325258.187	702311.257	5	1	5
Limekin Gulch	Melilotus officinale	Yellow sweet-clover	0	–	4325247.117	702493.118	1	5	5
Limekin Gulch	Melilotus officinale	Yellow sweet-clover	0	–	4325264.745	702388.623	1	4	4
Lizard Canyon	Chorispora tenella	Blue mustard	1	–	4332195.966	697080.394	5	1	5

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
Lizard Canyon	Chorispora tenella	Blue mustard	1	–	4331942.462	697044.18	5	1	5
Lizard Canyon	Sisymbrium altissimum	Tumble mustard	0	–	4331843.57	696791.352	3	2	6
Lizard Canyon	Sisymbrium altissimum	Tumble mustard	0	–	4331720.162	696714.114	5	1	5
Lizard Canyon	Sisymbrium altissimum	Tumble mustard	0	–	4331533.764	696503.663	5	1	5
Lizard Canyon	Tragopogon dubius	Yellow salsify	0	–	4331941.538	697051.456	5	1	5
Monument Canyon	Anisantha diandra	Ripgut brome	0	–	4328012.471	697890.793	3	5	15
Monument Canyon	Asparagus officinalis	Asparagus	1	–	4327660.155	697681.312	5	1	5
Monument Canyon	Convolvulus arvensis	Field bindweed	0	–	4327866.6	697221.044	2	2	4
Monument Canyon	Convolvulus arvensis	Field bindweed	1	–	4329091.473	697976.712	4	1	4
Monument Canyon	Descurainia sophia	Flixweed	0	–	4327875.042	697809.566	2	1	2
Monument Canyon	Elaeagnus angustifolia	Russian-olive	0	Sapling(s)	4326359.196	697352.905	5	1	5
Monument Canyon	Erodium cicutarium	Stork's-bill	0	–	4329362.072	697967.192	4	1	4
Monument Canyon	Erodium cicutarium	Stork's-bill	0	–	4328027.192	697905.492	4	1	4
Monument Canyon	Malcolmia africana	African mustard	1	–	4327852.299	697811.377	1	2	2
Monument Canyon	Malcolmia africana	African mustard	0	–	4327993.479	697851.871	2	1	2
Monument Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4327450.883	697647.783	1	2	2
Monument Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4327894.5	697573.077	1	2	2
Monument Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4327515.54	697648.007	1	3	3
Monument Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4327765.159	697677.898	1	2	2
Monument Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4327871.566	697018.993	2	2	4
Monument Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4327407.788	697603.692	1	2	2
Monument Canyon	Melilotus officinale	Yellow sweet-clover	1	–	4330297.729	698354.392	5	1	5
Monument Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4327865.378	697543.285	3	3	9
Monument Canyon	Melilotus officinale	Yellow sweet-clover	1	–	4330226.834	698029.409	5	1	5
Monument Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4327919.704	697091.634	1	2	2
Monument Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4328011.148	697874.062	3	2	6
Monument Canyon	Melilotus officinale	Yellow sweet-clover	1	–	4327864.613	697814.16	1	1	1
Monument Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4327014.034	697516.531	1	2	2
Monument Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4327852.289	696971.832	2	2	4
Monument Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4327579.956	697643.222	2	2	4
Monument Canyon	Melilotus officinale	Yellow sweet-clover	1	–	4327872.768	697554.07	5	1	5
Monument Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4327643.844	697664.338	2	2	4

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
Monument Canyon	Melilotus officinale	Yellow sweet-clover	1	–	4327898.232	697204.281	5	1	5
Monument Canyon	Tamarix sp.	tamarisk	1	Sapling(s)	4330250.605	698149.195	5	1	5
Monument Canyon	Tamarix sp.	tamarisk	1	Sapling(s)	4327523.538	698757.543	5	1	5
Monument Canyon	Tragopogon dubius	Yellow salsify	0	–	4327499.041	697651.98	1	2	2
Monument Canyon	Tragopogon dubius	Yellow salsify	0	–	4327056.518	697539.356	1	2	2
Monument Canyon	Tragopogon dubius	Yellow salsify	0	–	4327917.283	697841.2	1	2	2
Monument Canyon	Tragopogon dubius	Yellow salsify	0	–	4326996.823	697503.394	1	2	2
Monument Canyon	Tragopogon dubius	Yellow salsify	0	–	4326921.844	697508.4	1	2	2
Monument Canyon	Tragopogon dubius	Yellow salsify	0	–	4327641.284	697655.533	1	2	2
Monument Canyon	Tragopogon dubius	Yellow salsify	1	–	4327913.499	697135.596	5	1	5
Monument Canyon	Tragopogon dubius	Yellow salsify	1	–	4330461.301	698749.599	5	1	5
Monument Canyon	Tragopogon dubius	Yellow salsify	0	–	4328988.693	698091.458	5	1	5
Monument Canyon	Tragopogon dubius	Yellow salsify	0	–	4327996.842	697881.862	1	2	2
Monument Canyon	Xanthium sp.	cocklebur	0	–	4328898.953	698137.489	2	3	6
Monument Canyon	Xanthium sp.	cocklebur	0	–	4328492.875	698172.984	2	2	4
Monument Canyon	Xanthium sp.	cocklebur	0	–	4329026.808	698082.218	3	4	12
No Thoroughfare Canyon	Chorispora tenella	Blue mustard	1	–	4320671.259	702581.966	5	1	5
No Thoroughfare Canyon	Cirsium vulgare	Bull thistle	0	–	4318683.46	700102.62	5	1	5
No Thoroughfare Canyon	Cirsium vulgare	Bull thistle	1	–	4319098.485	700397.299	5	1	5
No Thoroughfare Canyon	Cirsium vulgare	Bull thistle	0	–	4319988.67	701704.5	3	2	6
No Thoroughfare Canyon	Cirsium vulgare	Bull thistle	0	–	4319792.985	701009.894	2	2	4
No Thoroughfare Canyon	Cirsium vulgare	Bull thistle	1	–	4319428.897	700692.27	5	1	5
No Thoroughfare Canyon	Cirsium vulgare	Bull thistle	1	–	4319830.233	701268.112	5	1	5
No Thoroughfare Canyon	Cirsium vulgare	Bull thistle	0	–	4319771.281	700964.595	2	2	4
No Thoroughfare Canyon	Cirsium vulgare	Bull thistle	0	–	4319831.218	701139.911	1	2	2
No Thoroughfare Canyon	Cirsium vulgare	Bull thistle	0	–	4319915.738	701652.586	2	2	4
No Thoroughfare Canyon	Cirsium vulgare	Bull thistle	0	–	4318801.456	700167.666	2	2	4
No Thoroughfare Canyon	Cirsium vulgare	Bull thistle	0	–	4318542.346	700097.348	2	2	4
No Thoroughfare Canyon	Cirsium vulgare	Bull thistle	1	–	4319506.485	700710.008	5	1	5
No Thoroughfare Canyon	Cirsium vulgare	Bull thistle	0	–	4318447.349	700108.092	2	1	2
No Thoroughfare Canyon	Cirsium vulgare	Bull thistle	0	–	4318107.538	699957.531	2	2	4
No Thoroughfare Canyon	Convolvulus arvensis	Field bindweed	0	–	4321099.445	703344.32	1	3	3

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
No Thoroughfare Canyon	Elaeagnus angustifolia	Russian-olive	0	Seedling(s)	4321272.866	703464.439	5	1	5
No Thoroughfare Canyon	Elaeagnus angustifolia	Russian-olive	0	–	4322660.198	705208.264	5	1	5
No Thoroughfare Canyon	Elaeagnus angustifolia	Russian-olive	0	Sapling(s)	4319856.77	701198.036	5	1	5
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322330.362	704769.394	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321814.239	704051.916	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322408.696	704852.633	1	2	2
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321253.642	703412.776	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321665.547	703844.749	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322415.626	704966.944	1	1	1
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321197.079	703372.523	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321655.527	703799.099	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322052.576	704601.901	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321883.6	704162.729	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321155	703385	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321764.218	703957.16	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322554.696	705046.935	5	1	5
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322094.337	704348.417	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321697.755	703906.008	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321803.573	704104.197	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321812.175	703993.535	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322286.728	704718.785	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321995.267	704193.771	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	Seedling(s)	4321619.052	703699.215	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322053.494	704497.032	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322799.383	705391.736	1	2	2
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321827.777	704152.735	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321709.826	703978.954	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321939.886	704204.414	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	Seedling(s)	4321545.93	703674.651	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322087.753	704294.609	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4318982.871	700258.41	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4318811.966	700176.653	2	3	6

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320831.245	702881.143	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319877.991	701546.525	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320201.33	701893.554	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319460.041	700698.414	1	2	2
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320415.124	702267.263	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319796.406	701375.827	1	2	2
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319816.009	701055.758	3	3	9
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319018.729	700295.257	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320969.134	703110.874	2	4	8
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319571.198	700770.169	3	3	9
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319266.521	700560.415	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320993.156	703003.724	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321006.182	703217.446	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319190.291	700462.687	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322246.923	704658.569	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319095.31	700373.771	2	4	8
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319829.93	701221.162	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320384.901	702232.656	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4318777.631	700142.039	3	4	12
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321001.238	703063.697	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319928.53	701653.215	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	1	–	4320155.302	701852.276	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4318722.584	700116.313	2	4	8
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319962.455	701672.27	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320357.565	702191.256	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320328.19	702045.534	1	2	2
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320032.257	701749.342	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319667.536	700901.278	4	3	12
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319821.015	701457.52	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319306.968	700599.261	2	4	8
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319718.272	700928.253	2	1	2
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319889.579	701500.912	1	3	3

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320119.008	701828.553	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319607.943	700800.803	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319881.783	701646.904	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321091.51	703314.559	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4318672.957	700099.697	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320072.942	701792.624	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320763.417	702885.899	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320282.239	702013.791	1	2	2
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320479.634	702348.527	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319104.321	700416.621	3	5	15
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320248.372	701986.733	1	2	2
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4318865.212	700188.798	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320883.286	702932.964	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321109.998	703386.247	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319140.725	700428.85	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319385.585	700672.041	2	2	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320668.845	702723.841	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319242.434	700511.728	2	5	10
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320668.005	702642.936	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4318408.724	700096.184	2	2	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319870.39	701594.707	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320704.931	702878.764	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321052.91	703268.634	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319996.967	701712.458	3	3	9
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320962.45	703164.095	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319648.702	700855.441	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319785.58	701000.572	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320628.438	702572.35	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4318306.188	700047.859	1	2	2
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320453.114	702298.732	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319045.887	700339.743	2	4	8
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322094.39	704644.604	1	4	4

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320526.984	702380.946	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4319343.891	700643.445	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320722.059	702784.313	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320346.35	702108.397	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320578.906	702433.081	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320584.087	702383.13	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	Seedling(s)	4321368.963	703522.911	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	Seedling(s)	4321545.439	703613.696	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322151.119	704645.354	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320565.096	702478.553	2	3	6
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	Seedling(s)	4321434.685	703556.14	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322443.669	705025.404	1	1	1
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322042.585	704236.907	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322090.174	704426.072	1	3	3
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	Seedling(s)	4321481.267	703582.505	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4321652.304	703732.106	1	4	4
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4322700.145	705279.393	5	1	5
No Thoroughfare Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4320940.771	702959.689	1	4	4
No Thoroughfare Canyon	Populus alba	White poplar	0	Seedling(s)	4320725.071	702790.198	3	1	3
No Thoroughfare Canyon	Populus alba	White poplar	0	Sapling(s)	4320964.104	703178.127	3	1	3
No Thoroughfare Canyon	Tamarix sp.	tamarisk	0	Sapling(s)	4318472.213	700130.999	3	1	3
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	0	–	4321086.863	703298.266	1	4	4
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	0	–	4321669.35	703854.732	5	1	5
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	1	–	4321692.569	703964.621	1	2	2
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	1	–	4321259.332	703463.448	5	1	5
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	1	–	4320993.267	702994.451	5	1	5
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	1	–	4320570.409	702382.65	5	1	5
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	1	–	4320979.506	703191.351	5	1	5
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	0	–	4321179	703379	5	1	5
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	1	–	4320695.561	702865.319	1	2	2
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	0	–	4322109.599	704399.896	5	1	5
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	1	–	4321210.82	703367.25	1	2	2

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	0	–	4322459.485	705032.836	1	3	3
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	0	–	4322051.796	704551.913	2	1	2
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	0	–	4322808.481	705393.811	5	1	5
No Thoroughfare Canyon	Tragopogon dubius	Yellow salsify	1	–	4320164.682	701860.523	2	1	2
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	0	–	4319801.087	701030.293	3	3	9
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	0	–	4319900.191	701648.109	2	2	4
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	0	–	4318565.647	700089.865	2	2	4
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	0	–	4318491.327	700129.322	2	3	6
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	0	–	4318888.661	700217.813	2	3	6
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	1	–	4320146.657	701845.229	5	1	5
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	1	–	4319296.561	700594.31	5	1	5
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	0	–	4318622.267	700101.706	2	2	4
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	0	–	4319814.753	701099.973	3	2	6
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	1	–	4319704.593	700924.998	5	1	5
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	0	–	4318959.618	700245.823	3	3	9
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	0	–	4320892.972	702933.926	1	2	2
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	1	–	4319853.819	701185.722	1	1	1
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	0	–	4319095.109	700409.907	2	2	4
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	0	–	4319116.208	700432.555	2	2	4
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	0	–	4319085.219	700347.4	3	1	3
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	1	–	4320016.405	701733.003	5	1	5
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	0	–	4319842.292	701142.86	3	2	6
No Thoroughfare Canyon	Verbascum thapsus	Woolly mullein	0	–	4318781.152	700151.345	2	2	4
Red Canyon	Cirsium vulgare	Bull thistle	0	–	4323438.312	702138.687	4	1	4
Red Canyon	Elaeagnus angustifolia	Russian-olive	1	Seedling(s)	4323638.561	702475.428	5	1	5
Red Canyon	Elaeagnus angustifolia	Russian-olive	1	Seedling(s)	4323810.368	702867.68	5	1	5
Red Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323530.478	702299.565	1	3	3
Red Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323441.722	702223.899	1	3	3
Red Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323928.535	703280.749	1	2	2
Red Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323593.526	702395.613	1	3	3
Red Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323652.145	702527.699	2	3	6
Red Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323565	702342.686	1	3	3

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
Red Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323637.044	702464.871	1	3	3
Red Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323688.913	702659.246	1	2	2
Red Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323818.979	702880.713	1	2	2
Red Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324178.513	703685.825	1	2	2
Red Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324154.51	703490.454	1	2	2
Red Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323441.082	702171.647	1	3	3
Red Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323485.973	702257.39	1	3	3
Red Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324018.044	703414.101	1	2	2
Red Canyon	Tamarix sp.	tamarisk	1	Seedling(s)	4323704.158	702660.688	5	1	5
Red Canyon	Tamarix sp.	tamarisk	1	Seedling(s)	4323641.182	702472.059	5	1	5
Red Canyon	Tamarix sp.	tamarisk	0	Sapling(s)	4324014.018	703400.286	5	1	5
Red Canyon	Tamarix sp.	tamarisk	0	Seedling(s)	4323772.417	702748.808	3	1	3
Red Canyon	Tragopogon dubius	Yellow salsify	1	–	4323565.881	702352.286	5	1	5
Red Canyon	Tragopogon dubius	Yellow salsify	1	–	4323459.883	702238.952	5	1	5
Red Canyon	Tragopogon dubius	Yellow salsify	0	–	4324124.06	703458.558	5	1	5
Red Canyon	Verbascum thapsus	Woolly mullein	0	–	4323662.368	702588.284	1	2	2
Red Canyon	Verbascum thapsus	Woolly mullein	1	–	4323428.59	702197.742	2	1	2
Red Canyon	Verbascum thapsus	Woolly mullein	0	–	4323710.026	702665.421	2	1	2
Red Canyon	Verbascum thapsus	Woolly mullein	1	–	4323571.237	702381.026	4	1	4
Red Canyon	Verbascum thapsus	Woolly mullein	0	–	4323633.604	702430.43	2	2	4
Red Canyon	Verbascum thapsus	Woolly mullein	0	–	4323439.065	702146.111	2	2	4
Red Canyon	Verbascum thapsus	Woolly mullein	0	–	4323822.416	703047.343	1	1	1
Rim Rock Drive	Convolvulus arvensis	Field bindweed	0	–	4322448.5	704601.363	2	1	2
Rim Rock Drive	Convolvulus arvensis	Field bindweed	0	–	4322748.837	703722.81	1	2	2
Rim Rock Drive	Convolvulus arvensis	Field bindweed	0	–	4323157.566	703711.015	2	2	4
Rim Rock Drive	Convolvulus arvensis	Field bindweed	0	–	4323254.975	703755.206	2	2	4
Rim Rock Drive	Convolvulus arvensis	Field bindweed	0	–	4323444.471	705095.402	2	2	4
Rim Rock Drive	Convolvulus arvensis	Field bindweed	0	–	4323208.354	703730.584	3	2	6
Rim Rock Drive	Convolvulus arvensis	Field bindweed	0	–	4322365.459	704173.794	4	1	4
Rim Rock Drive	Convolvulus arvensis	Field bindweed	0	–	4323102.323	703733.142	2	2	4
Rim Rock Drive	Convolvulus arvensis	Field bindweed	0	–	4323250.457	703664.027	2	1	2
Rim Rock Drive	Convolvulus arvensis	Field bindweed	0	–	4322809.167	703717.634	1	2	2

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
Rim Rock Drive	Convolvulus arvensis	Field bindweed	1	–	4322483.519	704599.549	5	1	5
Rim Rock Drive	Descurainia sophia	Flixweed	0	–	4323232.366	703741.019	2	2	4
Rim Rock Drive	Erodium cicutarium	Stork's-bill	0	–	4323254.288	705006.919	2	2	4
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4323142.467	703788.105	2	2	4
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322693.606	702977.182	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4323435.6	705090.608	5	1	5
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322436.35	704426.845	5	1	5
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322740.684	703818.456	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322800.803	703810.531	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	1	–	4322677.657	703726.104	5	1	5
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322645.937	704746.025	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322645.209	704796.275	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322650.964	704832.729	3	2	6
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322732.715	705032.403	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	1	–	4322516.37	702875.204	3	1	3
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322642.394	703958.389	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322664.465	704946.203	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322565.823	704650.339	5	1	5
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322695.62	705000.788	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322974.865	705063.307	5	1	5
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4323334.228	705036.52	3	1	3
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4323284.835	705018.252	4	1	4
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	1	–	4323104.546	703663.329	5	1	5
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322972.337	703708.059	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4323210.017	703741.361	4	2	8
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322536.987	704161.083	4	1	4
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322759.546	703766.494	3	2	6
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	1	–	4322470.16	702830.125	5	1	5
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322905.927	703686.744	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322433.611	704510.228	5	1	5
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322876.745	703121.548	3	1	3
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322392.834	704170.393	1	2	2

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4323182.923	703722.058	2	2	4
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322736.106	703827.36	4	1	4
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322794.918	703049.421	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322907.08	703170.382	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4323205.779	703808.087	2	2	4
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322632.139	704709.084	5	1	5
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	1	–	4322726.079	703781.538	5	1	5
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4323229.651	703651.632	5	1	5
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322829.221	703712.539	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322489.023	704174.545	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322823.298	703716.896	3	1	3
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322627.514	704010.009	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322601.523	704056.206	1	2	2
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322431.389	704435.181	5	1	5
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	1	–	4322977.18	703506.325	5	1	5
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	0	–	4322956.104	703689.597	3	1	3
Rim Rock Drive	Melilotus officinale	Yellow sweet-clover	1	–	4322536.747	704149.661	5	1	5
Rim Rock Drive	Sisymbrium altissimum	Tumble mustard	0	–	4323266.257	705011.564	5	1	5
Rim Rock Drive	Tragopogon dubius	Yellow salsify	0	–	4322363.892	704163.734	5	1	5
Rim Rock Drive	Tragopogon dubius	Yellow salsify	1	–	4323298.655	703714.44	5	1	5
Rim Rock Drive	Tragopogon dubius	Yellow salsify	1	–	4323207.152	703781.018	1	2	2
Rim Rock Drive	Tragopogon dubius	Yellow salsify	0	–	4323219.263	703734.286	1	2	2
Rim Rock Drive	Tragopogon dubius	Yellow salsify	0	–	4322822.295	703687.503	5	1	5
Rim Rock Drive	Tragopogon dubius	Yellow salsify	1	–	4322463.061	704596.211	2	1	2
Rim Rock Drive	Tragopogon dubius	Yellow salsify	1	–	4322479.465	704600.061	3	1	3
Rim Rock Drive	Tragopogon dubius	Yellow salsify	0	–	4323221.162	704977.381	5	1	5
Rim Rock Drive	Tragopogon dubius	Yellow salsify	0	–	4323426.075	705081.348	1	2	2
Rim Rock Drive	Tragopogon dubius	Yellow salsify	1	–	4322644.325	703923.112	5	1	5
Rim Rock Drive	Tragopogon dubius	Yellow salsify	0	–	4323112.674	704999.554	5	1	5
Rim Rock Drive	Tragopogon dubius	Yellow salsify	0	–	4323166.453	703647.025	5	1	5
Rim Rock Drive	Tragopogon dubius	Yellow salsify	0	–	4323175.899	704982.771	5	1	5
Rim Rock Drive	Tragopogon dubius	Yellow salsify	0	–	4322912.519	705079.38	5	1	5

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
Rim Rock Drive	Tragopogon dubius	Yellow salsify	1	–	4322454.45	704425.043	5	1	5
Rim Rock Drive	Tragopogon dubius	Yellow salsify	1	–	4323152.367	703657.769	5	1	5
Rim Rock Drive	Tragopogon dubius	Yellow salsify	1	–	4322568.598	704297.912	4	1	4
Rim Rock Drive	Tragopogon dubius	Yellow salsify	1	–	4322547.983	704366.159	5	1	5
Rim Rock Drive	Tragopogon dubius	Yellow salsify	1	–	4322491.949	704294.642	5	1	5
Rim Rock Drive	Tragopogon dubius	Yellow salsify	1	–	4322786.451	703041.147	5	1	5
Rim Rock Drive	Tragopogon dubius	Yellow salsify	0	–	4323411.574	705090.923	2	3	6
Rim Rock Drive	Ulmus pumila	Siberian elm	0	–	4322576.399	704324.714	5	1	5
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Convolvulus arvensis	Field bindweed	1	–	4322629.674	702507.683	5	1	5
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Melilotus officinale	Yellow sweet-clover	1	–	4322770.554	700170.572	5	1	5
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Melilotus officinale	Yellow sweet-clover	1	–	4322731.987	699355.426	5	1	5
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Melilotus officinale	Yellow sweet-clover	1	–	4322794.847	700113.407	5	1	5
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Melilotus officinale	Yellow sweet-clover	1	–	4322843.995	699919.153	5	1	5
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Melilotus officinale	Yellow sweet-clover	1	–	4322673.58	700369.115	5	1	5
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Melilotus officinale	Yellow sweet-clover	0	–	4322698.52	700822.376	2	2	4
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Melilotus officinale	Yellow sweet-clover	1	–	4322625.915	700480.008	5	1	5

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Melilotus officinale	Yellow sweet-clover	1	–	4322836.925	699975.676	4	1	4
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Melilotus officinale	Yellow sweet-clover	0	–	4322395.442	702723.131	1	2	2
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Melilotus officinale	Yellow sweet-clover	0	–	4322675.612	700761.136	1	2	2
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Melilotus officinale	Yellow sweet-clover	0	–	4322881.331	701421.124	1	1	1
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Tragopogon dubius	Yellow salsify	1	–	4322883.827	699555.654	5	1	5
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Tragopogon dubius	Yellow salsify	1	–	4322735.573	700258.644	5	1	5
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Tragopogon dubius	Yellow salsify	1	–	4322663.072	700390.695	5	1	5
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Tragopogon dubius	Yellow salsify	0	–	4322552.399	701119.169	1	2	2
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	Tragopogon dubius	Yellow salsify	1	–	4322995.592	701796.082	5	1	5
Ute Canyon	Cirsium vulgare	Bull thistle	0	–	4323780.643	698333.462	1	4	4
Ute Canyon	Cirsium vulgare	Bull thistle	0	–	4323879.248	698261.035	1	2	2
Ute Canyon	Cirsium vulgare	Bull thistle	0	–	4323980.597	699714.48	5	1	5
Ute Canyon	Cirsium vulgare	Bull thistle	0	–	4323711.873	698369.788	1	4	4
Ute Canyon	Descurainia sophia	Flixweed	0	–	4325512.374	701065.78	1	4	4
Ute Canyon	Descurainia sophia	Flixweed	0	–	4325577.542	700974.104	1	3	3
Ute Canyon	Descurainia sophia	Flixweed	0	–	4325487.474	701111.201	1	4	4

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
Ute Canyon	Descurainia sophia	Flixweed	0	–	4325492.066	701175.968	1	4	4
Ute Canyon	Descurainia sophia	Flixweed	0	–	4325498.534	700845.927	1	4	4
Ute Canyon	Descurainia sophia	Flixweed	0	–	4325384.26	700840.86	1	3	3
Ute Canyon	Descurainia sophia	Flixweed	0	–	4325540	701506.145	1	2	2
Ute Canyon	Descurainia sophia	Flixweed	0	–	4325539.037	700898.151	1	4	4
Ute Canyon	Descurainia sophia	Flixweed	0	–	4325432.263	700844.43	1	4	4
Ute Canyon	Descurainia sophia	Flixweed	0	–	4325508.126	701236.255	2	5	10
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324337.465	697175.025	1	1	1
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324055.889	698003.472	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324957.578	700461.611	2	4	8
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325545.808	701460.939	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323574.678	698495.416	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324795.082	700298.634	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325508.604	701593.641	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323074.715	699245.969	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323329.186	699404.224	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324290.195	697376.959	1	1	1
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324143.388	697910.258	1	1	1
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325514.265	701314.451	1	4	4
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325525.742	701054.365	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325368.08	700836.882	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324083.826	699850.801	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325529.496	701409.806	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324596.543	700171.764	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325577.723	700983.319	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323873.485	699660.481	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323045.996	699097.426	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325515.074	700866.586	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324700.728	700194.986	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323926.1	698244.194	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324047.773	698069.865	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324272.226	700034.688	1	3	3

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324541.504	700147.947	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324343.012	700071.454	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324169.934	697535.559	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323447.008	699430.053	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324188.148	699950.188	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323430.212	698768.277	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323236.93	699299.056	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323186.821	699264.104	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323022.589	699149.407	1	4	4
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324221.329	699997.252	1	4	4
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323383.156	699388.209	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325293.292	700789.222	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325430.92	701736.769	2	3	6
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324858.317	700394.52	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325535.879	701547.168	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324983.857	700500.423	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323283.513	699387.415	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324139.458	699869.187	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323488.208	698721.384	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324044.561	699806.04	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324920.693	700423.778	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323156.82	698992.164	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325415.96	700848.717	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323372.613	698817.575	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325500.59	701212.786	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323561.194	698660.238	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325249.535	700690.598	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325450.744	701679.779	1	4	4
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325334.447	701804.808	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325307.486	701861.807	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325267.97	701972.746	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323080.39	699065.45	1	3	3

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323308.666	698841.013	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323932.466	699685.028	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323241.965	698859.119	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323128.167	699257.62	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325085.129	700557.424	2	4	8
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324830.928	700337.108	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323572.926	698561.075	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323546.28	699505.863	1	1	1
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324650.871	700181.057	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324269.138	697713.591	1	1	1
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323761.192	699673.606	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325548.27	700908.424	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324185.966	699895.298	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323805.647	699678.935	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325269.455	700747.196	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323968.321	698167.483	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4324752.966	700259.164	1	4	4
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323736.842	699550.626	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325027.866	700533.47	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323033.242	699205.925	1	4	4
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325119.353	700577.287	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325477.867	700837.405	1	4	4
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323751.679	699612.573	1	2	2
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323257.955	699347.435	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325491.751	701136.949	1	4	4
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325511.311	701261.778	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325473.565	701634.45	1	4	4
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325217.492	700649.47	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4323183.365	698939.389	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325391.437	701767.646	1	3	3
Ute Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4325170.546	700614.054	1	3	3
Ute Canyon	Tamarix sp.	tamarisk	0	Seedling(s)	4325538.031	701443.8	5	1	5

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
Ute Canyon	Tamarix sp.	tamarisk	0	Seedling(s)	4323925.441	699683.208	1	1	1
Ute Canyon	Tamarix sp.	tamarisk	0	Seedling(s)	4324838.498	700346.037	5	1	5
Ute Canyon	Tamarix sp.	tamarisk	0	Seedling(s)	4323106.241	699039.683	5	1	5
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323222.562	699282.55	1	2	2
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323802.983	698304.217	5	1	5
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4324040.974	698142.649	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4324006.908	698177.752	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323833.127	699669.09	1	2	2
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323577.996	698655.128	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4325459.934	700840.158	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323355.839	699408.27	1	2	2
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323767.288	699687.314	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323935.307	698228.952	1	2	2
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323277.564	699376.487	1	2	2
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4324077.661	699847.896	1	2	2
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4325263.697	700731.722	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4325542.492	701033.537	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323749.769	699623.295	1	2	2
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4325504.08	701076.965	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4325505.692	701230.419	1	4	4
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4325491.417	701152.811	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4324531.313	700142.805	1	2	2
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4325134.856	700587.527	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4325287.57	700781.546	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323043.67	699227.297	5	1	5
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4324303.38	700051.893	2	1	2
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323744.904	699567.639	1	2	2
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323707.816	698389.976	5	1	5
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323253.136	699332.116	1	2	2
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323398.726	699387.001	1	1	1
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4324731.514	700245.325	1	2	2
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4324153.648	699872.979	1	2	2

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4325505.894	700858.102	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323356.922	698827.604	5	1	5
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4324684.237	700178.504	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4325237.167	700670.626	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4324362.932	700088.48	1	2	2
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323443.884	698762.237	1	2	2
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4324951.315	700439.092	1	2	2
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4323033.266	699107.16	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4325400.532	700845.051	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4324612.076	700177.198	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4325339.153	700828.987	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4325198.512	700635.496	1	3	3
Ute Canyon	Tragopogon dubius	Yellow salsify	1	–	4325339.921	701794.235	5	1	5
Ute Canyon	Tragopogon dubius	Yellow salsify	0	–	4324303.204	697325.473	4	1	4
Ute Canyon	Verbascum thapsus	Woolly mullein	0	–	4323931.499	698206.631	1	1	1
Ute Canyon	Verbascum thapsus	Woolly mullein	0	–	4324331.761	697189.946	4	1	4
Ute Canyon	Verbascum thapsus	Woolly mullein	0	–	4324321.93	700063.219	1	1	1
Ute Canyon	Verbascum thapsus	Woolly mullein	0	–	4323706.1	698402.524	1	3	3
Ute Canyon	Verbascum thapsus	Woolly mullein	0	–	4323839.926	698280.602	1	2	2
Ute Canyon	Verbascum thapsus	Woolly mullein	0	–	4323261.285	699357.033	2	2	4
Ute Canyon	Verbascum thapsus	Woolly mullein	0	–	4324057.997	699823.838	2	2	4
Ute Canyon	Verbascum thapsus	Woolly mullein	0	–	4323530.902	698680.536	1	3	3
Ute Canyon	Verbascum thapsus	Woolly mullein	0	–	4324013.401	699766.457	2	3	6
Ute Canyon	Verbascum thapsus	Woolly mullein	0	–	4323122.069	699005.02	5	1	5
Ute Canyon	Verbascum thapsus	Woolly mullein	0	–	4323071.58	699074.669	5	1	5
Ute Canyon	Verbascum thapsus	Woolly mullein	0	–	4323885.715	699658.085	1	1	1
Ute Canyon, upper	Melilotus officinale	Yellow sweet-clover	0	–	4324463.222	696706.59	3	2	6
Ute Canyon, upper	Melilotus officinale	Yellow sweet-clover	0	–	4324377.331	696846.885	2	2	4
Ute Canyon, upper	Melilotus officinale	Yellow sweet-clover	0	–	4324813.08	696001.029	4	1	4
Ute Canyon, upper	Melilotus officinale	Yellow sweet-clover	0	–	4324672.915	696181.228	2	2	4
Ute Canyon, upper	Melilotus officinale	Yellow sweet-clover	0	–	4325014.622	695891.925	3	2	6
Ute Canyon, upper	Melilotus officinale	Yellow sweet-clover	0	–	4324781.188	696024.254	3	2	6

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
Ute Canyon, upper	Rumex crispus	Curly dock	0	–	4325149.173	695678.089	3	2	6
Ute Canyon, upper	Tragopogon dubius	Yellow salsify	0	–	4324527.912	696708.519	3	2	6
Ute Canyon, upper	Tragopogon dubius	Yellow salsify	0	–	4324605.5	696543.241	3	2	6
Ute Canyon, upper	Tragopogon dubius	Yellow salsify	0	–	4325161.798	695791.874	2	1	2
Ute Canyon, upper	Tragopogon dubius	Yellow salsify	0	–	4324573.048	696378.385	3	3	9
Ute Canyon, upper	Tragopogon dubius	Yellow salsify	0	–	4325144.743	695684.173	3	1	3
Ute Canyon, upper	Tragopogon dubius	Yellow salsify	0	–	4325066.65	695881.018	2	3	6
Ute Canyon, upper	Xanthium sp.	cocklebur	0	–	4325140.222	695706.959	2	4	8
Wedding Canyon	Chorispora tenella	Blue mustard	1	–	4330467.764	696551.754	5	1	5
Wedding Canyon	Malcolmia africana	African mustard	1	–	4330290.751	696204.568	4	1	4
Wedding Canyon	Melilotus officinale	Yellow sweet-clover	0	–	4330284.45	696199.577	2	1	2
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332005.001	696948.525	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332368.579	696381.269	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332045.441	697086.649	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332115.269	696920.143	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332340.141	696680.151	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332181.939	696780.576	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332034.437	696913.757	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332218.522	697069.871	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332433.886	696462.117	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332429.386	696398.406	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332161.626	696944.926	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332551.572	696146.536	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332373.071	696502.805	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332194.696	696994.449	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332611.896	696196.365	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332141.321	697035.192	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332482.107	696435.736	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332163.024	696879.002	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332377.793	696566.365	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332514.321	696694.163	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332002.313	697072.315	2	5	10

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332513.669	696271.694	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4331980.987	697014.9	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332534.331	696215.66	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332614.459	696083.34	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332197.268	696880.215	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332452.939	696278.254	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332611.013	696133.51	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332314.964	696544.836	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332598.061	696366.093	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332253.729	696521.963	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332578.434	696592.909	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332608.448	696254.099	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332603.247	696302.832	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332573.453	696530.964	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332359.713	696189.65	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332610.659	696515.514	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332562.447	696098.124	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332226.976	696685.454	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332295.883	696653.403	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332305.513	696595.87	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332236.739	696610.4	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332607.971	696462.679	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332592.269	696419.514	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332625.074	696649.438	3	5	15
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332386.582	696274.484	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332490.446	696322.28	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332442.457	696532.008	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332429.721	696166.464	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332237.994	696563.065	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332224.162	696951.961	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332346.375	696231.412	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332477.402	696204.853	1	5	5

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332449.33	696584.58	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332085.975	696885.253	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332491.634	696548.165	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332499.151	696602.397	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332441.31	696345.688	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332384.581	696690.308	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332456.948	696702.561	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332381.983	696629.735	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332508.365	696656.059	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332099.411	697017.834	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332216.246	696747.638	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332068.345	696941.331	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332321.565	696160.391	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332290.403	696202.489	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332492.183	696134.506	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332346.277	696275.773	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332379.339	696322.449	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332481.039	696493.567	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332054.694	697019.294	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332488.238	696371.324	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332367.253	696445.884	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332233.844	696206.214	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332374.503	696144.023	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332029.017	696984.399	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332444.616	696122.108	1	5	5
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332462.977	696655.286	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4331955.418	697071.279	2	5	10
West Entrance Extra Area	Anisantha tectorum	Cheatgrass	0	–	4332412.618	696220.249	1	5	5
West Entrance Extra Area	Convolvulus arvensis	Field bindweed	0	–	4332519.587	696244.559	1	3	3
West Entrance Extra Area	Convolvulus arvensis	Field bindweed	0	–	4332621.344	696489.983	3	2	6
West Entrance Extra Area	Convolvulus arvensis	Field bindweed	0	–	4332459.135	696303.849	2	2	4
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332536.314	696182.729	2	3	6

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332578.915	696602.14	1	4	4
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332451.561	696267.159	1	3	3
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332230.963	696665.275	1	5	5
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332382.796	696271.225	2	3	6
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332600.342	696117.822	1	4	4
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332595.393	696390.864	1	5	5
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332109.913	696871.626	2	5	10
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332520.227	696254.246	1	4	4
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332161.748	696940.294	1	4	4
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332193.238	696902.672	1	3	3
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332591.959	696245.547	1	3	3
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332589.22	696662.31	1	5	5
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332596.939	696196.68	1	5	5
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332611.24	696484.84	1	5	5
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332561.819	696495.615	1	3	3
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332554.619	696314.564	1	5	5
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332070.394	696942.902	1	4	4
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332140.15	697038.808	1	4	4
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332588.687	696442.216	1	5	5
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332487.352	696380.535	1	4	4
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4331967.75	697055.291	1	5	5
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332425.481	696415.38	2	3	6
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332439.945	696335.104	1	3	3
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332098.702	697063.325	1	5	5
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332301.954	696223.398	1	2	2
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332219.455	696852.747	1	4	4
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332050.132	697079.688	2	5	10
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332200.578	696787.241	2	3	6
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332017.037	697031.655	1	5	5
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332112.727	696969.861	1	5	5
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332224.089	696932.677	2	5	10
West Entrance Extra Area	Erodium cicutarium	Stork's-bill	0	–	4332193.199	696979.604	1	4	4

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332482.553	696412.931	1	5	5
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332226.981	696983.252	1	5	5
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332054.037	697062.089	2	2	4
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332461.236	696241.09	1	4	4
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332573.902	696281.092	3	5	15
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332548.042	696394.824	3	5	15
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332487.336	696165.568	1	5	5
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332579.021	696230.331	3	5	15
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332614.613	696530.305	1	4	4
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332582.356	696171.351	3	5	15
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332554.425	696348.878	3	5	15
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332145.596	697005.833	2	4	8
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332190.204	696965.77	1	5	5
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332487.069	696357.59	1	5	5
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332557.538	696477.557	1	5	5
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332524.818	696237.31	1	5	5
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332584.048	696638.248	1	4	4
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332404.663	696246.537	1	2	2
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332509.707	696282.347	1	5	5
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332592.503	696111.353	1	5	5
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332446.059	696310.068	1	5	5
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332542.258	696439.306	2	5	10
West Entrance Extra Area	Salsola sp.	Russian thistle	0	–	4332539.087	696167.182	2	5	10
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332582.202	696315.661	1	4	4
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332567.074	696440.504	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332111.274	697092.676	3	2	6
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332604.729	696679.475	1	4	4
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332570.099	696374.999	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332231.504	696671.32	2	3	6
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332597.793	696184.362	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332600.967	696115.027	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332340.55	696241.957	1	3	3

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332577.128	696493.987	2	5	10
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332474.831	696484.213	2	3	6
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332458.879	696679.581	2	3	6
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332330.922	696159.321	1	4	4
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332073.222	696931.35	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332505.849	696670.014	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332238.077	697001.703	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332099.345	697029.159	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332018.105	697024.789	2	4	8
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332194.107	696897.774	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332214.754	697068.075	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332484.907	696351.172	1	4	4
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332448.545	696114.126	1	3	3
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332291.246	696204.191	1	3	3
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332084.692	696885.994	2	5	10
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332595.909	696614.589	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332525.991	696235.604	1	4	4
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332558.931	696132.616	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332436.594	696360.737	1	3	3
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4331955.538	697069.52	2	5	10
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332161.273	696881.365	1	4	4
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332054.171	697067.834	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332117.016	696907.551	1	4	4
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332144.494	697007.865	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332282.309	696683.789	1	4	4
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332396.817	696259.52	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332227.444	696811.019	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332590.159	696545.075	1	4	4
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332190.181	696767.109	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332192.51	696979.244	1	5	5
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332300.447	696633.044	1	4	4
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332447.526	696288.533	1	3	3

Appendix A: Exotic Plant Patches Detected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Plot_ID	Species	Master_Common_Name	Pulled	Growth_Stage	N_Coord	E_Coord	Cover Class	Size Class	PMI
West Entrance Extra Area	Sisymbrium altissimum	Tumble mustard	0	–	4332590.028	696259.907	1	5	5
West Entrance Extra Area	Tragopogon dubius	Yellow salsify	0	–	4332424.722	696404.792	1	3	3
West Entrance Extra Area	Tragopogon dubius	Yellow salsify	0	–	4332588.77	696602.286	1	5	5
West Entrance Extra Area	Tragopogon dubius	Yellow salsify	0	–	4332196.901	697026.554	5	1	5
West Entrance Extra Area	Tragopogon dubius	Yellow salsify	0	–	4332463.32	696674.253	2	3	6
West Entrance Extra Area	Tragopogon dubius	Yellow salsify	0	–	4332434.67	696500.393	2	3	6

Appendix B. Exotic Plant Transect Data Collected along Monitoring Routes, Colorado National Monument, June 1–7, 2017.

Route	Transect	E_Coord	N_Coord	Species	Master_Common_Name	Alive?	AverageCover
Columbus Canyon	1	703247.764	4323826.202	Anisantha tectorum	Cheatgrass	Y	0.333
Columbus Canyon	2	703038.938	4323453.735	Anisantha tectorum	Cheatgrass	Y	4
Fruita Canyon	25	696298.354	4332439.342	Anisantha tectorum	Cheatgrass	Y	20
Fruita Canyon	26	696115.969	4332024.87	Anisantha tectorum	Cheatgrass	Y	0.5
Fruita Canyon	27	695985.558	4331578.785	Anisantha tectorum	Cheatgrass	N	0.167
Fruita Canyon	27	695985.558	4331578.785	Anisantha tectorum	Cheatgrass	Y	0.167
Fruita Canyon	28	695749.324	4331192.134	Anisantha tectorum	Cheatgrass	Y	0.167
Fruita Canyon	29	695711.499	4330729.412	Anisantha tectorum	Cheatgrass	N	0.5
Fruita Canyon	29	695711.499	4330729.412	Anisantha tectorum	Cheatgrass	Y	0.5
Gold Star Canyon	31	699472.437	4329092.267	Anisantha tectorum	Cheatgrass	N	0.5
Gold Star Canyon	31	699472.437	4329092.267	Anisantha tectorum	Cheatgrass	Y	0.667
Gold Star Canyon	32	699269.037	4328736.624	Anisantha tectorum	Cheatgrass	N	0.5
Gold Star Canyon	32	699269.037	4328736.624	Anisantha tectorum	Cheatgrass	Y	3.5
Gold Star Canyon	33	699423.914	4328353.584	Anisantha tectorum	Cheatgrass	N	0.667
Gold Star Canyon	33	699423.914	4328353.584	Anisantha tectorum	Cheatgrass	Y	0.167
Hydro 03	30	695479.891	4332492.408	Anisantha tectorum	Cheatgrass	N	0.167
Hydro 03	30	695479.891	4332492.408	Anisantha tectorum	Cheatgrass	Y	0.5
Hydro 11	34	696982.102	4330342.289	Anisantha tectorum	Cheatgrass	N	0.333
Hydro 11	34	696982.102	4330342.289	Anisantha tectorum	Cheatgrass	Y	0.5
Hydro 11	35	696687.907	4330022.295	Anisantha tectorum	Cheatgrass	N	0.5
Hydro 11	35	696687.907	4330022.295	Anisantha tectorum	Cheatgrass	Y	0.833
Hydro 11	36	696282.936	4329812.008	Anisantha tectorum	Cheatgrass	N	0.167
Hydro 11	36	696282.936	4329812.008	Anisantha tectorum	Cheatgrass	Y	0.333
Hydro 82	37	704392.851	4322738.335	Anisantha tectorum	Cheatgrass	N	0.667
Hydro 82	37	704392.851	4322738.335	Anisantha tectorum	Cheatgrass	Y	0.667
Hydro 82	39	704820.383	4322572.582	Anisantha tectorum	Cheatgrass	N	0.167
Hydro 82	39	704820.383	4322572.582	Anisantha tectorum	Cheatgrass	Y	0.167
Hydro 85	40	703555.072	4321689.963	Anisantha tectorum	Cheatgrass	N	2.167
Hydro 85	40	703555.072	4321689.963	Anisantha tectorum	Cheatgrass	Y	1.5
Hydro 88	44	705140.185	4322374.102	Anisantha tectorum	Cheatgrass	N	0.167

Appendix B. Exotic Plant Transect Data Collected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Route	Transect	E_Coord	N_Coord	Species	Master_Common_Name	Alive?	AverageCover
Hydro 95	45	703568.74	4320969.972	Anisantha tectorum	Cheatgrass	N	0.5
Hydro 95	45	703568.74	4320969.972	Anisantha tectorum	Cheatgrass	Y	0.667
Hydro 95	45	703568.74	4320969.972	Tragopogon dubius	Yellow salsify	Y	0.167
Hydro 95	46	703353.481	4320596.451	Anisantha tectorum	Cheatgrass	N	0.167
Hydro 95	46	703353.481	4320596.451	Anisantha tectorum	Cheatgrass	Y	0.167
Hydro 95	46	703353.481	4320596.451	Melilotus officinale	Yellow sweet-clover	Y	0.667
Hydro 95	47	702950.417	4320439.264	Anisantha tectorum	Cheatgrass	N	0.167
Hydro 95	47	702950.417	4320439.264	Anisantha tectorum	Cheatgrass	Y	0.5
Hydro 95	47	702950.417	4320439.264	Melilotus officinale	Yellow sweet-clover	Y	1.833
Hydro 95	48	702695.356	4320041.188	Anisantha tectorum	Cheatgrass	Y	0.5
Hydro 95	49	702387.821	4319653.173	Anisantha tectorum	Cheatgrass	N	0.167
Hydro 95	49	702387.821	4319653.173	Anisantha tectorum	Cheatgrass	Y	0.167
Kodels Canyon	52	694841.745	4332339.142	Anisantha tectorum	Cheatgrass	Y	0.167
Kodels Canyon	53	694733.976	4331718.486	Anisantha tectorum	Cheatgrass	N	0.333
Kodels Canyon	53	694733.976	4331718.486	Anisantha tectorum	Cheatgrass	Y	0.5
Kodels Canyon Route	51	694740.572	4332298.19	Anisantha tectorum	Cheatgrass	N	0.333
Kodels Canyon Route	51	694740.572	4332298.19	Anisantha tectorum	Cheatgrass	Y	3.833
Lizard Canyon	55	697121.757	4332046.463	Anisantha tectorum	Cheatgrass	N	0.333
Lizard Canyon	55	697121.757	4332046.463	Anisantha tectorum	Cheatgrass	Y	0.333
Lizard Canyon	56	696780.64	4331794.004	Anisantha tectorum	Cheatgrass	N	0.333
Lizard Canyon	56	696780.64	4331794.004	Anisantha tectorum	Cheatgrass	Y	0.667
Lizard Canyon	57	696431.4	4331460.287	Anisantha tectorum	Cheatgrass	N	0.333
Lizard Canyon	57	696431.4	4331460.287	Anisantha tectorum	Cheatgrass	Y	0.167
Monument Canyon	59	698409.16	4330323.342	Anisantha tectorum	Cheatgrass	N	0.167
Monument Canyon	59	698409.16	4330323.342	Anisantha tectorum	Cheatgrass	Y	0.167
Monument Canyon	60	697973.16	4330172.893	Anisantha tectorum	Cheatgrass	N	0.5
Monument Canyon	60	697973.16	4330172.893	Anisantha tectorum	Cheatgrass	Y	0.75
Monument Canyon	61	697730.571	4329885.073	Anisantha tectorum	Cheatgrass	Y	0.75
Monument Canyon	62	697789.361	4329499.169	Anisantha tectorum	Cheatgrass	N	0.333
Monument Canyon	62	697789.361	4329499.169	Anisantha tectorum	Cheatgrass	Y	0.833
Monument Canyon	65	698232.181	4328434.309	Anisantha tectorum	Cheatgrass	N	0.667
Monument Canyon	65	698232.181	4328434.309	Anisantha tectorum	Cheatgrass	Y	1

Appendix B. Exotic Plant Transect Data Collected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Route	Transect	E_Coord	N_Coord	Species	Master_Common_Name	Alive?	AverageCover
Monument Canyon	65	698232.181	4328434.309	Erodium cicutarium	Stork's-bill	Y	0.167
Monument Canyon	66	698222.648	4327977.975	Anisantha tectorum	Cheatgrass	Y	0.833
Monument Canyon	67	698499.215	4327659.946	Anisantha tectorum	Cheatgrass	N	0.333
Monument Canyon	67	698499.215	4327659.946	Anisantha tectorum	Cheatgrass	Y	0.667
Monument Canyon	68	698819.087	4327385.419	Anisantha tectorum	Cheatgrass	N	0.333
Monument Canyon	68	698819.087	4327385.419	Anisantha tectorum	Cheatgrass	Y	0.5
Monument Canyon	69	698916.419	4326956.962	Anisantha tectorum	Cheatgrass	N	0.167
Monument Canyon	69	698916.419	4326956.962	Anisantha tectorum	Cheatgrass	Y	0.333
Monument Canyon	71	698058.804	4328089.201	Anisantha tectorum	Cheatgrass	N	0.5
Monument Canyon	71	698058.804	4328089.201	Anisantha tectorum	Cheatgrass	Y	0.667
Monument Canyon	74	697813.112	4327860.707	Anisantha tectorum	Cheatgrass	N	0.333
Monument Canyon	74	697813.112	4327860.707	Anisantha tectorum	Cheatgrass	Y	2.5
Monument Canyon	76	697527.904	4327028.669	Anisantha tectorum	Cheatgrass	Y	0.167
Monument Canyon	77	697449.753	4326558.514	Anisantha tectorum	Cheatgrass	N	0.167
Monument Canyon	77	697449.753	4326558.514	Anisantha tectorum	Cheatgrass	Y	0.333
No Thoroughfare Canyon	95	705389.95	4322792.635	Anisantha tectorum	Cheatgrass	N	0.167
No Thoroughfare Canyon	95	705389.95	4322792.635	Bromus japonicus	Japanese chess	N	0.167
No Thoroughfare Canyon	95	705389.95	4322792.635	Bromus japonicus	Japanese chess	Y	0.167
No Thoroughfare Canyon	95	705389.95	4322792.635	Melilotus officinale	Yellow sweet-clover	Y	0.167
No Thoroughfare Canyon	96	705033.991	4322527.922	Bromus japonicus	Japanese chess	N	1.333
No Thoroughfare Canyon	96	705033.991	4322527.922	Bromus japonicus	Japanese chess	Y	0.833
No Thoroughfare Canyon	96	705033.991	4322527.922	Erodium cicutarium	Stork's-bill	Y	0.167
No Thoroughfare Canyon	97	704678.646	4322275.326	Bromus japonicus	Japanese chess	N	0.333
No Thoroughfare Canyon	97	704678.646	4322275.326	Bromus japonicus	Japanese chess	Y	0.667
No Thoroughfare Canyon	98	704377.005	4322101.664	Anisantha tectorum	Cheatgrass	N	0.25
No Thoroughfare Canyon	98	704377.005	4322101.664	Anisantha tectorum	Cheatgrass	Y	0.25
No Thoroughfare Canyon	99	704119.088	4321803.298	Anisantha tectorum	Cheatgrass	Y	0.167
No Thoroughfare Canyon	99	704119.088	4321803.298	Melilotus officinale	Yellow sweet-clover	Y	1.5
No Thoroughfare Canyon	101	703516.173	4321365.879	Melilotus officinale	Yellow sweet-clover	Y	0.333
No Thoroughfare Canyon	102	703243.092	4321031.068	Anisantha tectorum	Cheatgrass	N	0.167
No Thoroughfare Canyon	102	703243.092	4321031.068	Anisantha tectorum	Cheatgrass	Y	0.333
No Thoroughfare Canyon	104	702578.602	4320628.09	Melilotus officinale	Yellow sweet-clover	Y	0.25

Appendix B. Exotic Plant Transect Data Collected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Route	Transect	E_Coord	N_Coord	Species	Master_Common_Name	Alive?	AverageCover
No Thoroughfare Canyon	105	702226.499	4320380.493	Anisantha tectorum	Cheatgrass	Y	0.333
No Thoroughfare Canyon	105	702226.499	4320380.493	Melilotus officinale	Yellow sweet-clover	Y	1.333
No Thoroughfare Canyon	106	701828.154	4320132.262	Anisantha tectorum	Cheatgrass	N	0.167
No Thoroughfare Canyon	106	701828.154	4320132.262	Anisantha tectorum	Cheatgrass	Y	0.333
No Thoroughfare Canyon	106	701828.154	4320132.262	Melilotus officinale	Yellow sweet-clover	Y	0.333
No Thoroughfare Canyon	107	701479.886	4319880.054	Anisantha tectorum	Cheatgrass	Y	0.167
No Thoroughfare Canyon	108	701070.582	4319811.731	Anisantha tectorum	Cheatgrass	Y	3.5
No Thoroughfare Canyon	108	701070.582	4319811.731	Verbascum thapsus	Woolly mullein	Y	0.167
No Thoroughfare Canyon	109	700706.757	4319497.396	Anisantha tectorum	Cheatgrass	Y	2.5
No Thoroughfare Canyon	109	700706.757	4319497.396	Sisymbrium altissimum	Tumble mustard	Y	1.333
No Thoroughfare Canyon	110	700439.509	4319122.795	Melilotus officinale	Yellow sweet-clover	Y	5
No Thoroughfare Canyon	111	700166.273	4318796.019	Cirsium vulgare	Bull thistle	Y	0.167
No Thoroughfare Canyon	111	700166.273	4318796.019	Melilotus officinale	Yellow sweet-clover	Y	0.167
Red Canyon	134	703385.968	4324014.749	Anisantha tectorum	Cheatgrass	N	0.167
Red Canyon	134	703385.968	4324014.749	Anisantha tectorum	Cheatgrass	Y	0.333
Red Canyon	135	702991.779	4323798.714	Anisantha tectorum	Cheatgrass	Y	0.333
Red Canyon	137	702136.597	4323423.368	Anisantha tectorum	Cheatgrass	N	1
Red Canyon	137	702136.597	4323423.368	Anisantha tectorum	Cheatgrass	Y	2.667
Red Canyon	137	702136.597	4323423.368	Sisymbrium altissimum	Tumble mustard	Y	2
Rim Rock Drive	142	705051.951	4323360.956	Anisantha tectorum	Cheatgrass	Y	0.667
Rim Rock Drive	143	705051.571	4323329.387	Anisantha tectorum	Cheatgrass	N	2.333
Rim Rock Drive	143	705051.571	4323329.387	Anisantha tectorum	Cheatgrass	Y	4.333
Rim Rock Drive	144	703775.681	4323280.414	Anisantha tectorum	Cheatgrass	Y	0.333
Rim Rock Drive	145	703742.956	4323229.788	Anisantha tectorum	Cheatgrass	Y	3
Rim Rock Drive	146	703582.442	4322994.839	Anisantha tectorum	Cheatgrass	Y	0.5
Rim Rock Drive	147	703550.488	4322984.383	Anisantha tectorum	Cheatgrass	N	0.167
Rim Rock Drive	147	703550.488	4322984.383	Anisantha tectorum	Cheatgrass	Y	0.167
Rim Rock Drive	150	705082.17	4322899.977	Anisantha tectorum	Cheatgrass	Y	2
Rim Rock Drive	151	705093.054	4322871.832	Anisantha tectorum	Cheatgrass	N	0.5
Rim Rock Drive	151	705093.054	4322871.832	Anisantha tectorum	Cheatgrass	Y	1.333
Rim Rock Drive	152	703721.163	4322741.94	Anisantha tectorum	Cheatgrass	Y	0.667
Rim Rock Drive	153	703731.628	4322739.657	Anisantha tectorum	Cheatgrass	N	0.167

Appendix B. Exotic Plant Transect Data Collected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Route	Transect	E_Coord	N_Coord	Species	Master_Common_Name	Alive?	AverageCover
Rim Rock Drive	153	703731.628	4322739.657	Anisantha tectorum	Cheatgrass	Y	0.167
Rim Rock Drive	153	703731.628	4322739.657	Erodium cicutarium	Stork's-bill	Y	0.167
Rim Rock Drive	154	703862.748	4322645.368	Anisantha tectorum	Cheatgrass	Y	0.167
Rim Rock Drive	155	704741.146	4322644.218	Anisantha tectorum	Cheatgrass	Y	0.5
Rim Rock Drive	155	704741.146	4322644.218	Melilotus officinale	Yellow sweet-clover	Y	1
Rim Rock Drive	156	703845.162	4322636.882	Anisantha tectorum	Cheatgrass	Y	0.167
Rim Rock Drive	157	704726.424	4322635.356	Anisantha tectorum	Cheatgrass	Y	0.667
Rim Rock Drive	160	704342.394	4322572.164	Anisantha tectorum	Cheatgrass	N	0.833
Rim Rock Drive	160	704342.394	4322572.164	Anisantha tectorum	Cheatgrass	Y	0.5
Rim Rock Drive	161	704366.199	4322573.501	Anisantha tectorum	Cheatgrass	N	0.5
Rim Rock Drive	161	704366.199	4322573.501	Anisantha tectorum	Cheatgrass	Y	0.667
Rim Rock Drive	161	704366.199	4322573.501	Erodium cicutarium	Stork's-bill	Y	0.333
Rim Rock Drive	162	704526.315	4322549.914	Anisantha tectorum	Cheatgrass	N	0.5
Rim Rock Drive	162	704526.315	4322549.914	Anisantha tectorum	Cheatgrass	Y	0.5
Rim Rock Drive	163	704526.989	4322511.512	Anisantha tectorum	Cheatgrass	N	0.333
Rim Rock Drive	163	704526.989	4322511.512	Anisantha tectorum	Cheatgrass	Y	0.5
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	198	700396.534	4322658.786	Anisantha tectorum	Cheatgrass	Y	0.167
Rim Rock Drive, E Glade Park Rd to Ute Canyon View pt	202	702427.455	4322366.87	Anisantha tectorum	Cheatgrass	Y	0.167
Ute Canyon	166	701260.647	4325511.193	Anisantha tectorum	Cheatgrass	N	0.667
Ute Canyon	166	701260.647	4325511.193	Anisantha tectorum	Cheatgrass	Y	7.333
Ute Canyon	166	701260.647	4325511.193	Erodium cicutarium	Stork's-bill	Y	0.5
Ute Canyon	166	701260.647	4325511.193	Sisymbrium altissimum	Tumble mustard	Y	0.333
Ute Canyon	167	700841.941	4325466.184	Anisantha tectorum	Cheatgrass	N	0.833
Ute Canyon	167	700841.941	4325466.184	Anisantha tectorum	Cheatgrass	Y	1
Ute Canyon	167	700841.941	4325466.184	Melilotus officinale	Yellow sweet-clover	Y	0.333
Ute Canyon	168	701726.222	4325431.84	Anisantha tectorum	Cheatgrass	N	0.333
Ute Canyon	168	701726.222	4325431.84	Anisantha tectorum	Cheatgrass	Y	0.667
Ute Canyon	168	701726.222	4325431.84	Erodium cicutarium	Stork's-bill	Y	0.833
Ute Canyon	168	701726.222	4325431.84	Melilotus officinale	Yellow sweet-clover	Y	0.167
Ute Canyon	170	702318.026	4325254.914	Anisantha tectorum	Cheatgrass	N	1.5

Appendix B. Exotic Plant Transect Data Collected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Route	Transect	E_Coord	N_Coord	Species	Master_Common_Name	Alive?	AverageCover
Ute Canyon	170	702318.026	4325254.914	Anisantha tectorum	Cheatgrass	Y	2.667
Ute Canyon	170	702318.026	4325254.914	Erodium cicutarium	Stork's-bill	Y	2.167
Ute Canyon	171	700567.677	4325099.033	Anisantha tectorum	Cheatgrass	N	0.667
Ute Canyon	171	700567.677	4325099.033	Anisantha tectorum	Cheatgrass	Y	3.333
Ute Canyon	171	700567.677	4325099.033	Erodium cicutarium	Stork's-bill	Y	0.167
Ute Canyon	171	700567.677	4325099.033	Melilotus officinale	Yellow sweet-clover	Y	0.167
Ute Canyon	172	700253.681	4324738.468	Anisantha tectorum	Cheatgrass	Y	0.167
Ute Canyon	172	700253.681	4324738.468	Erodium cicutarium	Stork's-bill	Y	0.333
Ute Canyon	172	700253.681	4324738.468	Melilotus officinale	Yellow sweet-clover	Y	1.5
Ute Canyon	172	700253.681	4324738.468	Tragopogon dubius	Yellow salsify	Y	0.167
Ute Canyon	174	700053.867	4324304.838	Anisantha tectorum	Cheatgrass	N	0.5
Ute Canyon	174	700053.867	4324304.838	Anisantha tectorum	Cheatgrass	Y	0.833
Ute Canyon	175	697657.84	4324265.765	Anisantha tectorum	Cheatgrass	N	0.167
Ute Canyon	175	697657.84	4324265.765	Anisantha tectorum	Cheatgrass	Y	0.333
Ute Canyon	175	697657.84	4324265.765	Melilotus officinale	Yellow sweet-clover	Y	0.167
Ute Canyon	176	698085.48	4324045.556	Anisantha tectorum	Cheatgrass	N	2
Ute Canyon	176	698085.48	4324045.556	Anisantha tectorum	Cheatgrass	Y	10.167
Ute Canyon	176	698085.48	4324045.556	Descurainia sophia	Flixweed	Y	0.167
Ute Canyon	176	698085.48	4324045.556	Erodium cicutarium	Stork's-bill	Y	0.167
Ute Canyon	178	698394.831	4323715.49	Anisantha tectorum	Cheatgrass	Y	0.167
Ute Canyon	179	699458.703	4323669.741	Anisantha tectorum	Cheatgrass	Y	0.25
Ute Canyon	180	698754.034	4323460.535	Anisantha tectorum	Cheatgrass	Y	3.5
Ute Canyon	180	698754.034	4323460.535	Melilotus officinale	Yellow sweet-clover	Y	0.667
Ute Canyon	181	699357.78	4323262.724	Anisantha tectorum	Cheatgrass	N	1.833
Ute Canyon	181	699357.78	4323262.724	Anisantha tectorum	Cheatgrass	Y	0.667
Ute Canyon	181	699357.78	4323262.724	Verbascum thapsus	Woolly mullein	N	0.667
Ute Canyon	181	699357.78	4323262.724	Verbascum thapsus	Woolly mullein	Y	11
Ute Canyon	182	699037.863	4323107.522	Anisantha tectorum	Cheatgrass	Y	4
Wedding Canyon	203	697244.171	4331526.452	Anisantha tectorum	Cheatgrass	N	0.333
Wedding Canyon	203	697244.171	4331526.452	Anisantha tectorum	Cheatgrass	Y	1
Wedding Canyon	204	697077.224	4331103.612	Anisantha tectorum	Cheatgrass	N	0.5
Wedding Canyon	204	697077.224	4331103.612	Anisantha tectorum	Cheatgrass	Y	1.667

Appendix B. Exotic Plant Transect Data Collected along Monitoring Routes, Colorado National Monument, June 1–7, 2017, cont.

Route	Transect	E_Coord	N_Coord	Species	Master_Common_Name	Alive?	AverageCover
Wedding Canyon	205	697038.272	4330667.74	Anisantha tectorum	Cheatgrass	N	0.167
Wedding Canyon	205	697038.272	4330667.74	Anisantha tectorum	Cheatgrass	Y	0.333
Wedding Canyon	206	696638.18	4330472.917	Anisantha tectorum	Cheatgrass	N	0.5
Wedding Canyon	206	696638.18	4330472.917	Anisantha tectorum	Cheatgrass	Y	4.333
Wedding Canyon	207	696198.366	4330279.677	Anisantha tectorum	Cheatgrass	N	0.333
Wedding Canyon	207	696198.366	4330279.677	Anisantha tectorum	Cheatgrass	Y	3.667
Wedding Canyon	208	695780.317	4330087.5	Anisantha tectorum	Cheatgrass	N	0.167
Wedding Canyon	208	695780.317	4330087.5	Anisantha tectorum	Cheatgrass	Y	0.333

Appendix C. Invasive Exotic Plants Detected in Extra Areas

Extra Area	Plot #	E_Coord	N_Coord	Species Code	Species	Master Common Name	Alive?	Plot Cover	Treated/ Untreated	Comments
East Entrance	301	705021.155	4323407.676	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	301	705021.155	4323407.676	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
East Entrance	302	704853.195	4323397.768	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	302	704853.195	4323397.768	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
East Entrance	303	704923.553	4323418.042	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	303	704923.553	4323418.042	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
East Entrance	304	704934.71	4323379.474	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
East Entrance	305	704822.095	4323411.366	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	305	704822.095	4323411.366	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
East Entrance	306	704928.355	4323364.182	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	306	704928.355	4323364.182	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
East Entrance	307	704997.553	4323394.422	BROTEC	Anisantha tectorum	Cheatgrass	N	1	Untreated	–
East Entrance	307	704997.553	4323394.422	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
East Entrance	308	704854.51	4323294.626	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	308	704854.51	4323294.626	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
East Entrance	309	704942.237	4323256.429	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	309	704942.237	4323256.429	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
East Entrance	310	704896.8	4323305.896	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	310	704896.8	4323305.896	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
East Entrance	311	704849.383	4323361.438	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	311	704849.383	4323361.438	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
East Entrance	312	705064.451	4323207.589	BROTEC	Anisantha tectorum	Cheatgrass	N	1	Untreated	–
East Entrance	312	705064.451	4323207.589	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
East Entrance	313	705088.933	4323206.734	BROTEC	Anisantha tectorum	Cheatgrass	N	1	Untreated	–
East Entrance	313	705088.933	4323206.734	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
East Entrance	314	705297.059	4322933.584	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	314	705297.059	4322933.584	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
East Entrance	315	705343.01	4323125.196	BROTEC	Anisantha tectorum	Cheatgrass	N	1	Untreated	–
East Entrance	315	705343.01	4323125.196	BROTEC	Anisantha tectorum	Cheatgrass	Y	2	Untreated	–
East Entrance	317	705418.335	4323195.483	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
East Entrance	318	705313.86	4322992.186	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	318	705313.86	4322992.186	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–

Appendix C. Invasive Exotic Plants Detected in Extra Areas, Colorado National Monument, June 1–7, 2017, cont.

Extra Area	Plot #	E_Coord	N_Coord	Species Code	Species	Master Common Name	Alive?	Plot Cover	Treated/ Untreated	Comments
East Entrance	319	705352.427	4322974.133	BROTEC	Anisantha tectorum	Cheatgrass	N	1	Untreated	–
East Entrance	319	705352.427	4322974.133	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
East Entrance	320	705438.702	4322956.07	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
East Entrance	321	704907.974	4323377.398	BROTEC	Anisantha tectorum	Cheatgrass	N	1	Untreated	–
East Entrance	321	704907.974	4323377.398	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
East Entrance	322	704927.255	4323187.657	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	322	704927.255	4323187.657	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
East Entrance	323	704888.928	4323353.432	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	323	704888.928	4323353.432	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
East Entrance	324	704916.527	4323314.631	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	324	704916.527	4323314.631	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
East Entrance	325	705052.754	4323157.616	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
East Entrance	326	705067.808	4323240.507	BROTEC	Anisantha tectorum	Cheatgrass	Y	4	Untreated	–
East Entrance	327	705441.927	4323097.74	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	327	705441.927	4323097.74	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
East Entrance	329	705380.071	4323116.402	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	329	705380.071	4323116.402	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
East Entrance	330	705290.597	4323061.494	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
East Entrance	330	705290.597	4323061.494	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
East Entrance	311	704849.383	4323361.438	EROCIC	Erodium cicutarium	Stork's-bill	Y	0.5	Untreated	–
East Entrance	326	705067.808	4323240.507	EROCIC	Erodium cicutarium	Stork's-bill	Y	3	Untreated	–
East Entrance	327	705441.927	4323097.74	EROCIC	Erodium cicutarium	Stork's-bill	Y	1	Untreated	–
East Entrance	329	705380.071	4323116.402	EROCIC	Erodium cicutarium	Stork's-bill	Y	1	Untreated	–
East Entrance	326	705067.808	4323240.507	SALSOLA	Salsola sp.	Russian thistle	N	0.5	Untreated	–
East Entrance	326	705067.808	4323240.507	SALSOLA	Salsola sp.	Russian thistle	Y	0.5	Untreated	–
East Entrance	316	705360.246	4322920.852						Untreated	No species present on plot
Gold Star	331	699902.714	4329196.729	BROTEC	Anisantha tectorum	Cheatgrass	Y	4	Untreated	–
Gold Star	332	699792.622	4329302.945	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
Gold Star	332	699792.622	4329302.945	BROTEC	Anisantha tectorum	Cheatgrass	Y	4	Untreated	–
Gold Star	333	699888.881	4329248.677	BROTEC	Anisantha tectorum	Cheatgrass	N	1	Untreated	–

Appendix C. Invasive Exotic Plants Detected in Extra Areas, Colorado National Monument, June 1–7, 2017, cont.

Extra Area	Plot #	E_Coord	N_Coord	Species Code	Species	Master Common Name	Alive?	Plot Cover	Treated/ Untreated	Comments
Gold Star	333	699888.881	4329248.677	BROTEC	Anisantha tectorum	Cheatgrass	Y	3	Untreated	–
Gold Star	334	699819.423	4329243.722	BROTEC	Anisantha tectorum	Cheatgrass	Y	4	Untreated	–
Gold Star	335	699927.662	4329210.491	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
Gold Star	335	699927.662	4329210.491	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
Gold Star	336	699830.722	4329290.585	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
Gold Star	336	699830.722	4329290.585	BROTEC	Anisantha tectorum	Cheatgrass	Y	8	Untreated	–
Gold Star	337	699759.677	4329400.801	BROTEC	Anisantha tectorum	Cheatgrass	N	4	Untreated	–
Gold Star	337	699759.677	4329400.801	BROTEC	Anisantha tectorum	Cheatgrass	Y	3	Untreated	–
Gold Star	338	699814.952	4329287.78	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
Gold Star	338	699814.952	4329287.78	BROTEC	Anisantha tectorum	Cheatgrass	Y	2	Untreated	–
Gold Star	339	699816.132	4329230.307	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
Gold Star	339	699816.132	4329230.307	BROTEC	Anisantha tectorum	Cheatgrass	Y	2	Untreated	–
Gold Star	340	700389.832	4328760.882	BROTEC	Anisantha tectorum	Cheatgrass	N	2	Untreated	–
Gold Star	340	700389.832	4328760.882	BROTEC	Anisantha tectorum	Cheatgrass	Y	4	Untreated	–
Gold Star	341	700388.586	4328711.74	BROTEC	Anisantha tectorum	Cheatgrass	N	2	Untreated	–
Gold Star	341	700388.586	4328711.74	BROTEC	Anisantha tectorum	Cheatgrass	Y	3	Untreated	–
Gold Star	342	700236.429	4328851.287	BROTEC	Anisantha tectorum	Cheatgrass	N	1	Untreated	–
Gold Star	342	700236.429	4328851.287	BROTEC	Anisantha tectorum	Cheatgrass	Y	3	Untreated	–
Gold Star	343	700287.863	4328792.208	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
Gold Star	343	700287.863	4328792.208	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
Gold Star	344	700137.06	4329021.763	BROTEC	Anisantha tectorum	Cheatgrass	N	1	Untreated	–
Gold Star	344	700137.06	4329021.763	BROTEC	Anisantha tectorum	Cheatgrass	Y	2	Untreated	–
Gold Star	345	700319.203	4328754.949	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
Gold Star	345	700319.203	4328754.949	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
Gold Star	346	700311.633	4328767.448	BROTEC	Anisantha tectorum	Cheatgrass	N	2	Untreated	–
Gold Star	346	700311.633	4328767.448	BROTEC	Anisantha tectorum	Cheatgrass	Y	2	Untreated	–
Gold Star	347	700409.899	4328766.209	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
Gold Star	347	700409.899	4328766.209	BROTEC	Anisantha tectorum	Cheatgrass	Y	5	Untreated	–
Gold Star	348	700263.435	4328890.922	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
Gold Star	348	700263.435	4328890.922	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
Gold Star	350	700213.826	4328898.321	BROTEC	Anisantha tectorum	Cheatgrass	Y	2	Untreated	–
Gold Star	332	699792.622	4329302.945	EROCIC	Erodium cicutarium	Stork's-bill	N	0.5	Untreated	–

Appendix C. Invasive Exotic Plants Detected in Extra Areas, Colorado National Monument, June 1–7, 2017, cont.

Extra Area	Plot #	E_Coord	N_Coord	Species Code	Species	Master Common Name	Alive?	Plot Cover	Treated/ Untreated	Comments
Gold Star	334	699819.423	4329243.722	EROCIC	Erodium cicutarium	Stork's-bill	N	0.5	Untreated	–
Gold Star	336	699830.722	4329290.585	EROCIC	Erodium cicutarium	Stork's-bill	N	1	Untreated	–
Gold Star	337	699759.677	4329400.801	EROCIC	Erodium cicutarium	Stork's-bill	N	0.5	Untreated	–
Gold Star	338	699814.952	4329287.78	EROCIC	Erodium cicutarium	Stork's-bill	N	0.5	Untreated	–
Gold Star	342	700236.429	4328851.287	EROCIC	Erodium cicutarium	Stork's-bill	N	0.5	Untreated	–
Gold Star	346	700311.633	4328767.448	EROCIC	Erodium cicutarium	Stork's-bill	N	0.5	Untreated	–
Gold Star	348	700263.435	4328890.922	EROCIC	Erodium cicutarium	Stork's-bill	N	0.5	Untreated	–
Gold Star	350	700213.826	4328898.321	EROCIC	Erodium cicutarium	Stork's-bill	N	1	Untreated	–
Gold Star	335	699927.662	4329210.491	SALSOLA	Salsola sp.	Russian thistle	N	0.5	Untreated	–
Gold Star	342	700236.429	4328851.287	SALSOLA	Salsola sp.	Russian thistle	N	0.5	Untreated	–
Gold Star	331	699902.714	4329196.729	SISALT	Sisymbrium altissimum	Tumble mustard	N	0.5	Untreated	–
Gold Star	331	699902.714	4329196.729	SISALT	Sisymbrium altissimum	Tumble mustard	Y	0.5	Untreated	–
Gold Star	332	699792.622	4329302.945	SISALT	Sisymbrium altissimum	Tumble mustard	N	0.5	Untreated	–
Gold Star	332	699792.622	4329302.945	SISALT	Sisymbrium altissimum	Tumble mustard	Y	0.5	Untreated	–
Gold Star	333	699888.881	4329248.677	SISALT	Sisymbrium altissimum	Tumble mustard	N	0.5	Untreated	–
Gold Star	333	699888.881	4329248.677	SISALT	Sisymbrium altissimum	Tumble mustard	Y	0.5	Untreated	–
Gold Star	334	699819.423	4329243.722	SISALT	Sisymbrium altissimum	Tumble mustard	N	0.5	Untreated	–
Gold Star	334	699819.423	4329243.722	SISALT	Sisymbrium altissimum	Tumble mustard	Y	2	Untreated	–
Gold Star	335	699927.662	4329210.491	SISALT	Sisymbrium altissimum	Tumble mustard	N	0.5	Untreated	–
Gold Star	336	699830.722	4329290.585	SISALT	Sisymbrium altissimum	Tumble mustard	Y	0.5	Untreated	–
Gold Star	338	699814.952	4329287.78	SISALT	Sisymbrium altissimum	Tumble mustard	N	0.5	Untreated	–
Gold Star	338	699814.952	4329287.78	SISALT	Sisymbrium altissimum	Tumble mustard	Y	0.5	Untreated	–
Gold Star	339	699816.132	4329230.307	SISALT	Sisymbrium altissimum	Tumble mustard	Y	0.5	Untreated	–
Gold Star	341	700388.586	4328711.74	SISALT	Sisymbrium altissimum	Tumble mustard	N	0.5	Untreated	–
Gold Star	341	700388.586	4328711.74	SISALT	Sisymbrium altissimum	Tumble mustard	Y	0.5	Untreated	–
Gold Star	342	700236.429	4328851.287	SISALT	Sisymbrium altissimum	Tumble mustard	N	0.5	Untreated	–
Gold Star	343	700287.863	4328792.208	SISALT	Sisymbrium altissimum	Tumble mustard	N	0.5	Untreated	–
Gold Star	343	700287.863	4328792.208	SISALT	Sisymbrium altissimum	Tumble mustard	Y	0.5	Untreated	–
Gold Star	344	700137.06	4329021.763	SISALT	Sisymbrium altissimum	Tumble mustard	N	2	Untreated	–
Gold Star	344	700137.06	4329021.763	SISALT	Sisymbrium altissimum	Tumble mustard	Y	0.5	Untreated	–
Gold Star	346	700311.633	4328767.448	SISALT	Sisymbrium altissimum	Tumble mustard	N	0.5	Untreated	–
Gold Star	346	700311.633	4328767.448	SISALT	Sisymbrium altissimum	Tumble mustard	Y	1	Untreated	–

Appendix C. Invasive Exotic Plants Detected in Extra Areas, Colorado National Monument, June 1–7, 2017, cont.

Extra Area	Plot #	E_Coord	N_Coord	Species Code	Species	Master Common Name	Alive?	Plot Cover	Treated/ Untreated	Comments
Gold Star	347	700409.899	4328766.209	SISALT	Sisymbrium altissimum	Tumble mustard	N	0.5	Untreated	–
Gold Star	350	700213.826	4328898.321	SISALT	Sisymbrium altissimum	Tumble mustard	N	0.5	Untreated	–
Gold Star	350	700213.826	4328898.321	SISALT	Sisymbrium altissimum	Tumble mustard	Y	0.5	Untreated	–
Gold Star	349	700141.66	4328994.961						Untreated	No species present on plot
West Entrance	351	696112.728	4332510.59	BROTEC	Anisantha tectorum	Cheatgrass	Y	30	Treated	–
West Entrance	352	696178.24	4332450.718	BROTEC	Anisantha tectorum	Cheatgrass	Y	3	Treated	–
West Entrance	356	696285.417	4332530.083	BROTEC	Anisantha tectorum	Cheatgrass	Y	5	Treated	–
West Entrance	358	696352.826	4332511.056	BROTEC	Anisantha tectorum	Cheatgrass	Y	3	Treated	–
West Entrance	359	696424.712	4332542.838	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Treated	–
West Entrance	361	696818.938	4332198.318	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Treated	–
West Entrance	361	696818.938	4332198.318	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Treated	–
West Entrance	363	697019.376	4332172.534	BROTEC	Anisantha tectorum	Cheatgrass	N	4	Treated	–
West Entrance	363	697019.376	4332172.534	BROTEC	Anisantha tectorum	Cheatgrass	Y	5	Treated	–
West Entrance	364	696163.873	4332581.298	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Treated	–
West Entrance	365	696226.529	4332333.056	BROTEC	Anisantha tectorum	Cheatgrass	Y	7	Treated	–
West Entrance	368	696244.742	4332546.791	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Treated	–
West Entrance	370	696980.021	4332179.39	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Treated	–
West Entrance	370	696980.021	4332179.39	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Treated	–
West Entrance	372	696308.013	4332535.114	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Treated	–
West Entrance	376	696390.541	4332560.333	BROTEC	Anisantha tectorum	Cheatgrass	N	10	Treated	–
West Entrance	376	696390.541	4332560.333	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Treated	–
West Entrance	377	696916.904	4332120.899	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Treated	–
West Entrance	377	696916.904	4332120.899	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Treated	–
West Entrance	356	696285.417	4332530.083	EROCIC	Erodium cicutarium	Stork's-bill	Y	2	Treated	–
West Entrance	368	696244.742	4332546.791	EROCIC	Erodium cicutarium	Stork's-bill	Y	0.5	Treated	–
West Entrance	356	696285.417	4332530.083	SALSOLA	Salsola sp.	Russian thistle	Y	2	Treated	–
West Entrance	358	696352.826	4332511.056	SALSOLA	Salsola sp.	Russian thistle	Y	2	Treated	–
West Entrance	359	696424.712	4332542.838	SALSOLA	Salsola sp.	Russian thistle	Y	10	Treated	–
West Entrance	368	696244.742	4332546.791	SALSOLA	Salsola sp.	Russian thistle	Y	8	Treated	–
West Entrance	372	696308.013	4332535.114	SALSOLA	Salsola sp.	Russian thistle	Y	3	Treated	–

Appendix C. Invasive Exotic Plants Detected in Extra Areas, Colorado National Monument, June 1–7, 2017, cont.

Extra Area	Plot #	E_Coord	N_Coord	Species Code	Species	Master Common Name	Alive?	Plot Cover	Treated/ Untreated	Comments
West Entrance	376	696390.541	4332560.333	SALSOLA	Salsola sp.	Russian thistle	Y	2	Treated	–
West Entrance	356	696285.417	4332530.083	SISALT	Sisymbrium altissimum	Tumble mustard	Y	1	Treated	–
West Entrance	361	696818.938	4332198.318	SISALT	Sisymbrium altissimum	Tumble mustard	N	1	Treated	–
West Entrance	363	697019.376	4332172.534	SISALT	Sisymbrium altissimum	Tumble mustard	N	1	Treated	–
West Entrance	365	696226.529	4332333.056	SISALT	Sisymbrium altissimum	Tumble mustard	Y	2	Treated	–
West Entrance	370	696980.021	4332179.39	SISALT	Sisymbrium altissimum	Tumble mustard	N	1	Treated	–
West Entrance	353	696196.338	4332384.379	BROTEC	Anisantha tectorum	Cheatgrass	Y	4	Untreated	–
West Entrance	354	696623.511	4332372.077	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
West Entrance	354	696623.511	4332372.077	BROTEC	Anisantha tectorum	Cheatgrass	Y	3	Untreated	–
West Entrance	355	696572.453	4332488.142	BROTEC	Anisantha tectorum	Cheatgrass	Y	2	Untreated	–
West Entrance	357	696189.894	4332331.299	BROTEC	Anisantha tectorum	Cheatgrass	Y	5	Untreated	–
West Entrance	360	696565.448	4332436.599	BROTEC	Anisantha tectorum	Cheatgrass	N	4	Untreated	–
West Entrance	360	696565.448	4332436.599	BROTEC	Anisantha tectorum	Cheatgrass	Y	10	Untreated	–
West Entrance	362	696884.757	4332085.841	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	362 sampled twice, by Gommermann and Wood. Retained Gommermann data since he was crew leader.
West Entrance	366	696609.6	4332414.545	BROTEC	Anisantha tectorum	Cheatgrass	N	5	Untreated	–
West Entrance	366	696609.6	4332414.545	BROTEC	Anisantha tectorum	Cheatgrass	Y	6	Untreated	–
West Entrance	367	696643.011	4332478.678	BROTEC	Anisantha tectorum	Cheatgrass	Y	5	Untreated	–
West Entrance	369	696326.104	4332389.911	BROTEC	Anisantha tectorum	Cheatgrass	Y	20	Untreated	–
West Entrance	371	696568.388	4332355.763	BROTEC	Anisantha tectorum	Cheatgrass	N	2	Untreated	–
West Entrance	371	696568.388	4332355.763	BROTEC	Anisantha tectorum	Cheatgrass	Y	7	Untreated	–
West Entrance	373	696265.905	4332438.772	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
West Entrance	374	696588.223	4332383.084	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
West Entrance	374	696588.223	4332383.084	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
West Entrance	375	696573.342	4332263.381	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–
West Entrance	375	696573.342	4332263.381	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
West Entrance	378	696976.03	4332006.126	BROTEC	Anisantha tectorum	Cheatgrass	N	0.5	Untreated	–

Appendix C. Invasive Exotic Plants Detected in Extra Areas, Colorado National Monument, June 1–7, 2017, cont.

Extra Area	Plot #	E_Coord	N_Coord	Species Code	Species	Master Common Name	Alive?	Plot Cover	Treated/ Untreated	Comments
West Entrance	378	696976.03	4332006.126	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
West Entrance	379	697034.153	4332044.219	BROTEC	Anisantha tectorum	Cheatgrass	N	5	Untreated	–
West Entrance	379	697034.153	4332044.219	BROTEC	Anisantha tectorum	Cheatgrass	Y	1	Untreated	–
West Entrance	380	696485.217	4332477.23	BROTEC	Anisantha tectorum	Cheatgrass	Y	0.5	Untreated	–
West Entrance	354	696623.511	4332372.077	EROCIC	Erodium cicutarium	Stork's-bill	N	0.5	Untreated	–
West Entrance	362	696884.757	4332085.841	EROCIC	Erodium cicutarium	Stork's-bill	N	0.5	Untreated	362 sampled twice, by Gommermann and Wood. Retained Gommermann data since he was crew leader.
West Entrance	354	696623.511	4332372.077	SISALT	Sisymbrium altissimum	Tumble mustard	N	0.5	Untreated	
West Entrance	362	696884.757	4332085.841	SISALT	Sisymbrium altissimum	Tumble mustard	N	0.5	Untreated	362 sampled twice, by Gommermann and Wood. Retained Gommermann data since he was crew leader.
West Entrance	362	696884.757	4332085.841	SISALT	Sisymbrium altissimum	Tumble mustard	Y	10	Untreated	362 sampled twice, by Gommermann and Wood. Retained Gommermann data since he was crew leader.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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