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Natural Resource Stewardship and Science

Invasive Exotic Plant Monitoring in Cub Creek (2002–2003 to 2014), and Brief Surveys on the Green River (2014), Dinosaur National Monument

Natural Resource Report NPS/NCPN/NRR—2015/980



ON THE COVER

Musk thistle (*Carduus nutans*). Photo by Al Schneider, hosted by the USDA-NRCS PLANTS Database.

Invasive Exotic Plant Monitoring in Cub Creek (2002–2003 to 2014), and Brief Surveys on the Green River (2014), Dinosaur National Monument

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Abstract

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. During surveys conducted from July 2 to 9, 2014, NCPN staff detected 14 priority IEP species and two additional IEP species in a 132-hectare (326-acre) area in the Cub Creek vicinity. Russian knapweed (*Centaurea repens*), tamarisk (*Tamarix* sp.), perennial sowthistle (*Sonchus arvensis*), Canada thistle (*Cirsium arvense*), and yellow sweetclover (*Melilotus officinalis*) were widespread in Cub Creek. The number of hectares of invasive plants in 2014 (14.0 ha) was similar to that in 2010 (14.5 ha) (Edvarchuk et al. 2012), but substantially less than in 2002–2003 (46.8 ha) (Dewey et al. 2004). Russian knapweed, yellow sweetclover, Russian olive (*Eleaegnus angustifolia*), and tamarisk all declined from 2010 to 2014, while Canada thistle, bull thistle (*Cirsium vulgare*), common houndstoungue (*Cynoglossum officinale*), and perennial sowthistle all increased from 2010 to 2014. A brief survey was conducted along the northern portion of the Green River monitoring route on September 25, 2014. Thirty-six invasions of five species were detected along 856 m of river.

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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. Recognizing these challenges, Northern Colorado Plateau Network (NCPN) parks 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, this monitoring program detects early invasions, identifies existing invasions, and, to the extent possible, tracks changes in the abundance and distribution of priority 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 may miss exotic plants dispersed to the interior areas of large parks by wind and/or animals.

Specific objectives of NCPN invasive exotic plant monitoring are:

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

This report summarizes data collected in the Cub Creek area of Dinosaur National Monument (NM) in 2002 and 2003 by Dewey and others (2004), data from 2010 (Edvarchuk et al. 2012), and efforts from 2014. All of this monitoring targeted largely the same priority species list, covered the same area, and used almost the same methods. Results of a brief survey conducted along the northern portion of the Green River, on September 25, 2014, are also summarized.

2 Methods

Field work followed the invasive exotic plant monitoring protocol developed by Perkins and others (2013). 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 will capture the greatest amount of information (i.e., benefit) with the least amount of time and effort (i.e., cost).

We established a series of monitoring routes and transects for the park, as well as extra areas in the Cub Creek drainage. The transects, which are sampled in a quantitative manner, are used to make inference to the percent cover of IEPs located along the park's invasive pathways (i.e., the monitoring routes) and allow us to estimate trends in IEP percent cover over time. The monitoring routes, which are not quantitatively sampled, are used to increase the spatial coverage of mapping performed, with the goal of maximizing our opportunities for detecting IEPs in the park. Extra areas are used to cover sites of management concern that may be susceptible to exotic species invasions.

2.1 Developing a park priority invasive exotic plant list

Prior to beginning monitoring in 2011, network and park staff reviewed and updated the list of priority invasive plants originally developed for the park in 2010. This list was reviewed again prior to the 2014 field season. The 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 (Table 2-1) 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 plants, 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. Two species, halogeton (*Halogeton glomeratus*) and perennial sowthistle (*Sonchus arvensis*) were added to the priority list in 2014, to match earlier species lists used by Dewey and others (2004) in 2002 and 2003 and Edvarchuk and others (2012) in 2010 for the same Cub Creek areas.

2.2 Extra-area surveys and monitoring routes

2.2.1 Minimum detection target size

The minimum detection target size (MDTS) represented the patch size that was 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 weed 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*), are nearly impossible to detect in most field conditions.

2.2.2 Effective detection distance

The effective detection distance (EDD) was the maximum distance from which an observer could consistently detect (i.e., see and recognize) the MDTS of the least-visible priority species with at least 90% detection efficiency. Using fake plants of a targeted size, crew members were trained by walking away and determining the maximum distance from which they could consistently see and recognize the patch with complete confidence. The size of the EDD was then estimated in the field by crew members. The distance was measured either by pacing or using a laser rangefinder. The EDD for Dinosaur NM was between 1.5 and 8 meters, depending on vegetation.

Table 2-1. Priority invasive plant list for Dinosaur National Monument, 2014.

Scientific name (Utah)	Common name	Scientific name (Colorado)
[1]*Aegilops cylindrica*	jointed goatgrass	*Aegilops cylindrica*
Arctium minus	burdock	*Arctium minus*
[1]*Cardaria chalepensis*	orbicular whitetop	*Cardaria chalepensis*
Cardaria draba	hoary cress	*Cardaria draba*
[1]*Cardaria pubescens*	hairy whitetop	*Cardaria pubescens*
Carduus nutans	musk thistle	*Carduus nutans* var. *macrolepis*
Centaurea diffusa	diffuse knapweed	*Acosta diffusa*
Centaurea maculosa	spotted knapweed	*Acosta maculosa*
Centaurea repens	Russian knapweed	*Acroptilon repens*
[1]*Centaurea solstitialis*	yellow starthistle	*Centaurea solstitialis*
Cirsium arvense	Canada thistle	*Breea arvensis*
Cirsium vulgare	bull thistle	*Cirsium vulgare*
Cynoglossum officinale	common houndstoungue	*Cynoglossum officinale*
[1]*Dipsacus sylvestris*	teasel	*Dipsacus fullonum*
Elaeagnus angustifolia	Russian olive	*Elaeagnus angustifolia*
Euphorbia esula	leafy spurge	*Tithymalus esula*
[2]*Halogeton glomerat*us	halogeton	*Halogeton glomeratus*
Hyoscyamus niger	black henbane	*Hyoscyamus niger*
Lepidium latifolium	broadleaf pepperwort	*Cardaria latifolia*
Linaria dalmatica	Dalmatian toadflax	*Linaria genistifolia* ssp. *dalmatica*
[1]*Linaria vulgaris*	butter-and-eggs	*Linaria vulgaris*
Lythrum salicaria	purple loosestrife	*Lythrum salicaria*
Melilotus officinalis	yellow sweetclover	*Melilotus officinale*
Onopordum acanthium	Scotch thistle	*Onopordum acanthium*
[2]*Sonchus arvensis*	perennial sowthistle	*Sonchus arvensis*
Taeniatherum caput-medusae	Medusahead	*Taeniatherum caput-medusae*
Tamarix sp.	five-stamen tamarisk	*Tamarix* sp.
Tribulus terrestris	puncturevine	*Tribulus terrestris*

[1]Priority species searched for at Cub Creek in 2014 only. All other species (except those otherwise marked) were searched for at Cub Creek in 2014 and also during work completed there in 2002–2003 and 2010.
[2]Priority species for Cub Creek extra areas only.

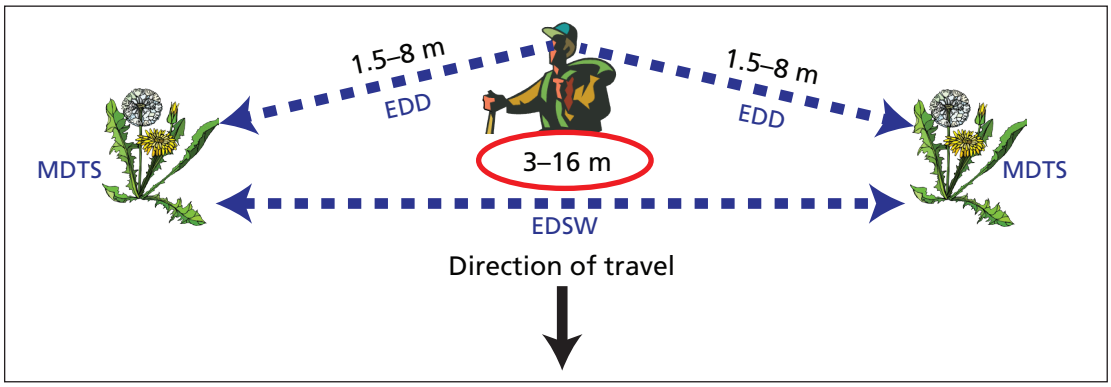


Figure 2-1. The maximum effective detection distance (EDD) at Dinosaur National Monument was 1.5–8 meters, making the effective detection swath width (EDSW) 3–16 meters.

2.2.3 Effective detection swath width

Effective detection swath width (EDSW) was the maximum width of a linear search swath (band transect) in which an observer was confident of visually detecting 90% of all priority species of the MDTS. The effective detection swath width is equal to two times the EDD, because the surveyor is able to effectively detect weeds for one EDD on either side of his/her search route. The EDSW for Dinosaur NM was 3–16 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 infestations, or patches. Individuals or clusters of a priority species separated by the PSR distance or more were recorded as separate patches. We considered plants separated by less than the PSR to be a single patch. The PSR was set at 50 meters, based on the assumption that most plants or groups of plants separated by less than 50 m are typically considered to be one patch during planning and implementation of weed-control operations. If a patch was continuous for more than 50 m, cover estimates were made every 50 m to aid in developing an effective management strategy for the entire patch.

2.2.5 Between feature position

Between feature positions (BFPs) allow electronic tracking of a user's route. A GPS unit was set to automatically generate these positions at a distance equal to the EDSW. Each time a surveyor walked the equivalent of one EDSW, the GPS unit created a point.

2.2.6 Data collection methods

2.2.6.1 Cub Creek extra areas

The Cub Creek extra areas were searched by having crew members walk side-by-side to monitor swaths. Distance between observers ranged from 1.5 to 8 m. The BFP feature was used to determine the location of the last swath. The surveyors then walked the transect, searching for IEPs on either side of their paths. When an IEP was found, the surveyor stood in the center of the patch to enter the necessary data. As the extra areas were traversed, locations of all priority species were documented using GPS units with at least five-meter accuracy.

2.2.6.2 Monitoring routes

Methods for monitoring routes were the same as for extra areas—except instead of covering an entire area, observers walked along a specific route. While walking along the route, we searched for 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 3–16 m (the length of one EDSW) and visually scanned the area.

2.2.6.3 Common methods

Only priority species were consistently recorded on extra areas and monitoring routes. Survey crew members were permitted to record additional species if they were noteworthy. Because the purpose of the monitoring is to detect invasives, rather than to control them, plants were generally not pulled unless they comprised an isolated population.

When a priority IEP was discovered, we recorded the following information: (1) the monitoring route/extra area, (2) the sequential number of the invasion per monitoring route, (3) patch size class (see below), (4) whether the plant was pulled, and (5) canopy cover class (see below). If several species were present with similar distributions at a single point, then we recorded a point for each individual species and assigned it its own sequential identification number. Invasions more than 50 m (55 yards) apart were considered separate invasions and recorded with separate points.

Patch size class was estimated as follows:

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

We recorded canopy 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. Canopy cover 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: descriptive notes (e.g., hillside, distance to road, wetland, stream), the growth stage of exotic trees (i.e., sapling, pole, mature tree), evidence of prior treatment, and evidence of disturbances (e.g., recent fire, flood, small mammal disturbance).

2.3 Monitoring transects

2.3.1 Quadrat establishment

We established one transect with three vegetation quadrats every 500 m along monitoring routes. We centered vegetation quadrats at 0.5, 5, and 10 m 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. A 1-m^2 sampling frame, used to sample vegetation cover and soil surface features, was placed on the right side of the transect line as the technician walked the monitoring route. In some cases, we leveled the sampling frame by propping up quadrat corners.

2.3.2 Data collection methods

In the monitoring quadrats, all IEP species known to the observer were recorded. At minimum, this included all priority species, as well as cheatgrass (*Bromus tectorum*). 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%. We also recorded percent cover, to the nearest 10%, 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).

2.4 Comparisons to earlier surveys (2002–2003 and 2010)

Dewey and others (2004) and Edvarchuk and others (2012) surveyed the same Cub Creek areas between 2002 and 2003 and again in 2010. Twenty-two species were priority species in all three surveys (2002–2003, 2010, and 2014). Six additional species were added for 2014 only (see Table 2-1). However, in the earlier surveys, crews mapped some patches with a combination of points, lines, and polygons, while the 2014 effort only used points. Due to these small differences in methodology, we only compared total number of hectares between the three sampling periods. We compared only areas in the Cub Creek drainage that had been monitored in all three sampling periods.

3 Results

3.1 Target invasive exotic plant list

In 2014, field crews searched on monitoring routes for 28 species identified as high-priority at Dinosaur NM (see Table 2-1). Observers were trained to recognize priority species but given the freedom to map additional species; therefore, presence and absence data for priority species are reliable for the areas searched, but absence data for other species are suspect.

3.2 Extra areas (Cub Creek)

We recorded a total of 932 patches of 14 priority IEP species and 2 additional species in the Cub Creek extra areas (Table 3-1, Figures 3-1, 3-2, 3-3, 3-4, 3-5). We covered 132 hectares (326 acres) in the Cub Creek area. Russian knapweed (*Centaurea repens*), tamarisk, perennial sowthistle, Canada thistle (*Cirsium arvense*), and yellow sweetclover (*Melilotus officinalis*) were widespread in Cub Creek. A high proportion (49%) of patches were larger than 400 m^2. Of the 173 tamarisk and Russian olive tree patches, 25 were in the seedling stage, 60 were in the sapling stage, 71 were mature trees, 1 was in old growth, and growth stage was not noted for 16 patches.

3.3 Monitoring routes

We surveyed 856 m of the northern portion of the Green River monitoring route in 2014 (see Figure 3-1, #3-6). A total of 36 patches of five different priority species were detected (see Table 3-1, Figure 3-6, Electronic Appendix A). Of the 13 tamarisk tree patches, 0 were in the seedling stage, 8 were in the sapling stage, 4 were mature trees, and growth stage was not noted for one patch.

3.4 Monitoring transects

A total of six and four transects were sampled in 2014 in the Cub Creek area and the northern portion of the Green River, respectively (Table 3-2; Electronic Appendix B). There was one short monitoring route in the Cub Creek area, and the transects along the Green River were part of the Green River monitoring route. Tamarisk, Canada thistle, and cheatgrass (*Bromus tectorum*) were detected. IEPs were found on 88% of transects.

3.5 Results comparison: Cub Creek in 2002–2003, 2010, and 2014

The number of hectares with invasives in Cub Creek declined from 46.8 hectares in 2002–2003 to 14.5 in 2010, and then remained approximately the same in 2014, with a total of 14.0 hectares.[1] Russian knapweed, yellow sweetclover, Russian olive, and tamarisk all declined from 2010 to 2014, while Canada thistle, bull thistle (*Cirsium vulgare*), common houndstoungue (*Cynoglossum officinale*), and perennial sowthistle all increased from 2010 to 2014. Most of the increases were relatively small per species. In 2014, perennial sowthistle was observed in the Cub Creek drainage for the first time during these three sample periods.

[1]Note that these acreages are slightly different than those reported by Dewey and others (2004) and Anderson and others (2012), as only areas that were common to all three monitoring periods were used in this report.)

Table 3-1. Priority IEP species observed and size of patches detected along Cub Creek area and the northern portion of the Green River monitoring route, Dinosaur National Monument, 2014.

Scientific name	Common name	Total patches	Parch size class				
			1	2	3	4	5
Cub Creek							
Arctium minus	burdock	27	16	7	4	0	0
Cardaria sp.	whitetop	6	0	4	2	0	0
Carduus nutans	musk thistle	6	2	3	1	0	0
Centaurea repens	Russian knapweed	222	5	67	90	55	5
Centaurea solstitialis	yellow starthistle	1	0	1	0	0	0
Cirsium arvense	Canada thistle	126	7	35	44	37	3
Cirsium vulgare	bull thistle	74	22	41	11	0	0
Cynoglossum officinale	common houndstongue	44	16	15	12	1	0
Elaeagnus angustifolia	Russian olive	28	22	5	1	0	0
Halogeton glomeratus	halogeton	1	0	1	0	0	0
Lepidium latifolium	broadleaf pepperwort	3	1	2	0	0	0
Melilotus officinalis	yellow sweetclover	119	6	32	30	50	1
**Saponaria officinalis*	bouncingbet	1	0	1	0	0	0
Sonchus arvensis	perennial sowthistle	130	18	45	51	16	0
Tamarix spp.	tamarisk	145	41	64	36	4	0
	Cub Creek total	**932**	**156**	**322**	**282**	**163**	**9**
Green River							
Carduus nutans	musk thistle	4	0	2	2	0	0
Centaurea repens	Russian knapweed	1	0	1	0	0	0
Cirsium arvense	Canada thistle	9	0	4	5	0	0
Lepidium latifolium	broadleaf pepperwort	9	0	3	6	0	0
Tamarix spp.	tamarisk	13	0	4	7	2	0
	Green River total	**36**	**0**	**14**	**20**	**2**	**0**

*Not a priority species

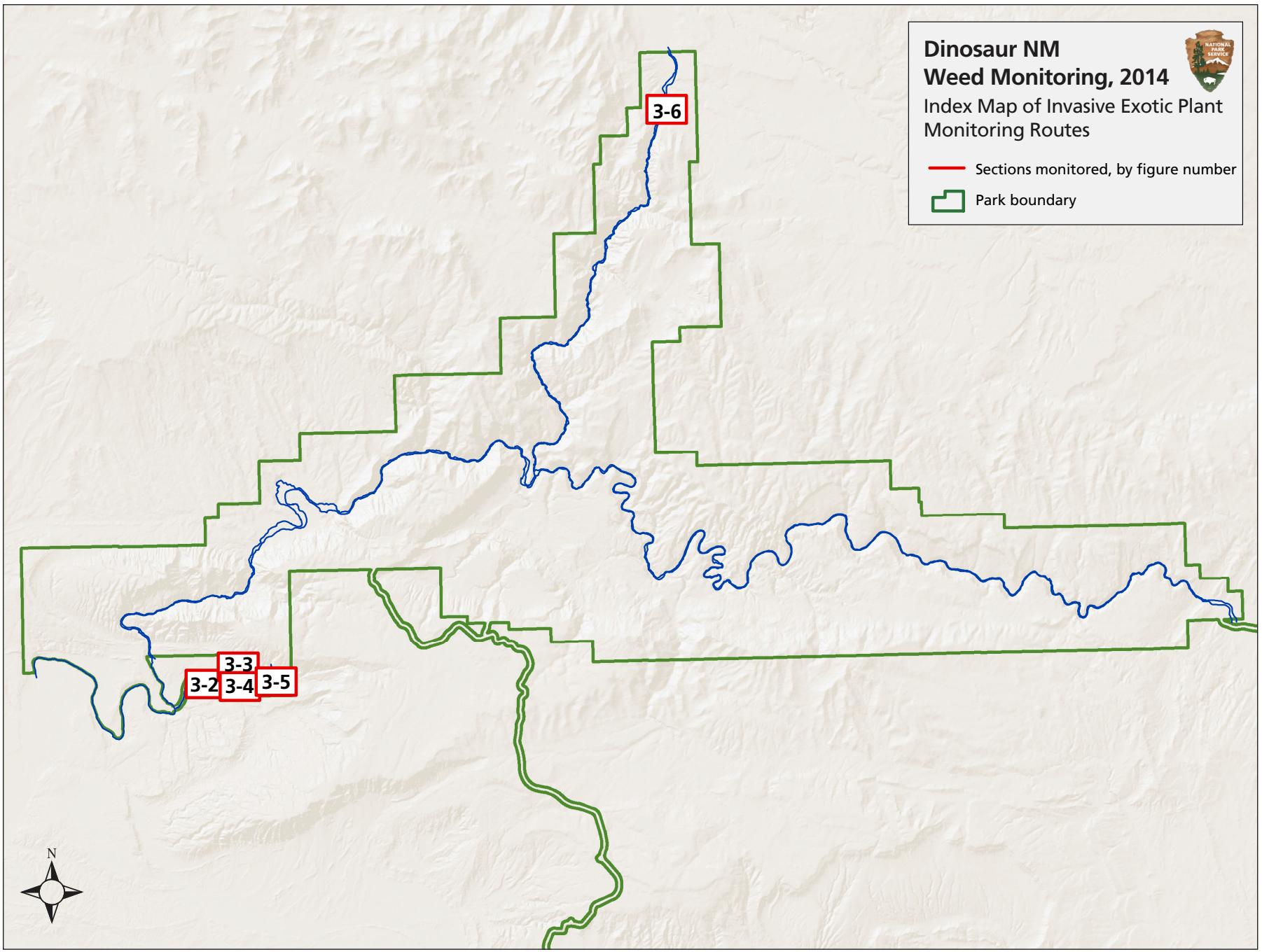


Figure 3-1. Index map for invasive exotic plant monitoring at Dinosaur National Monument by figure number, July 2–September 25, 2014.

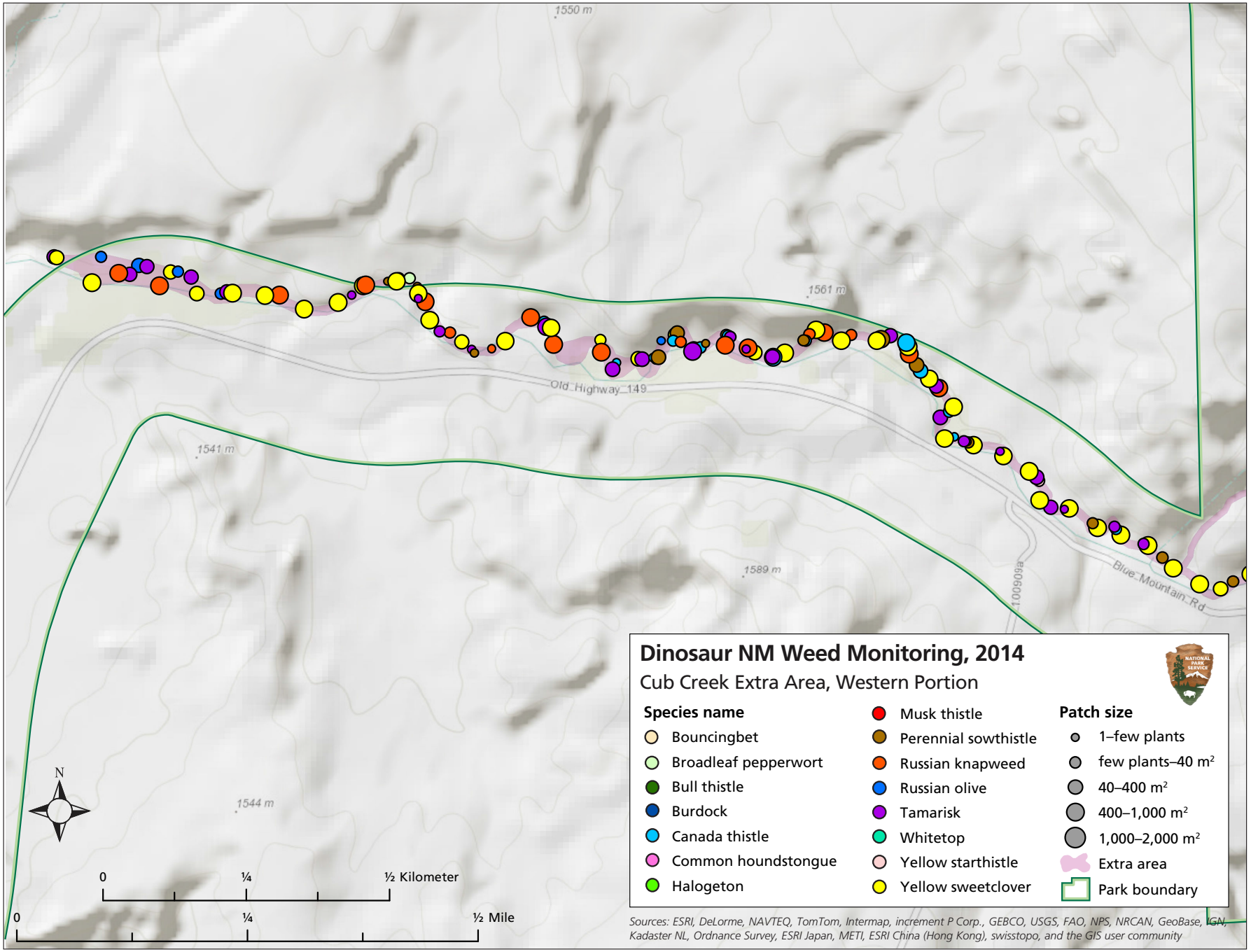


Figure 3-2. Invasive plant patches detected along the western portion of the Cub Creek extra areas, Dinosaur National Monument, July 2–9, 2014.

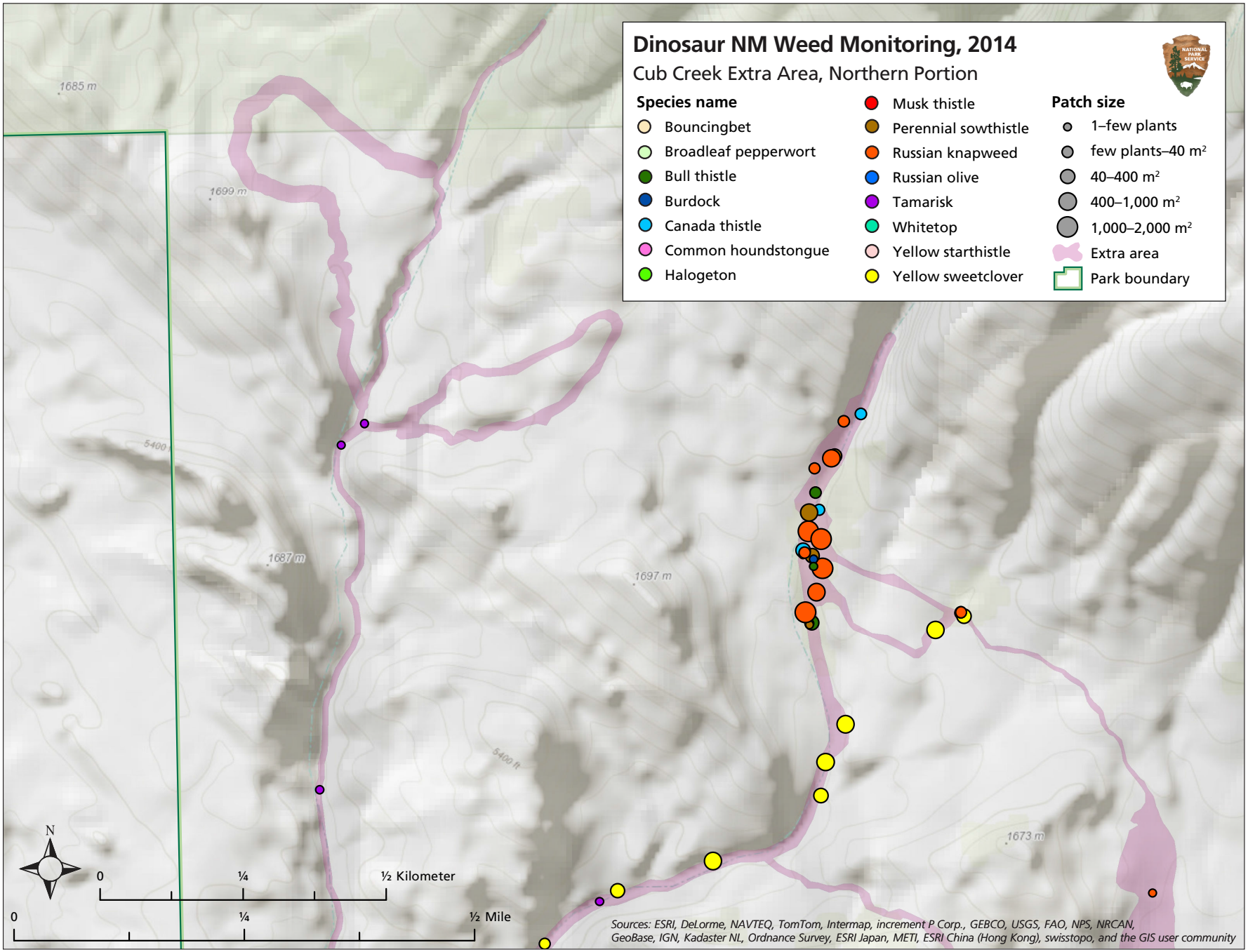


Figure 3-3. Invasive plant patches detected along the northern portion of the Cub Creek extra areas, Dinosaur National Monument, July 2–9, 2014.

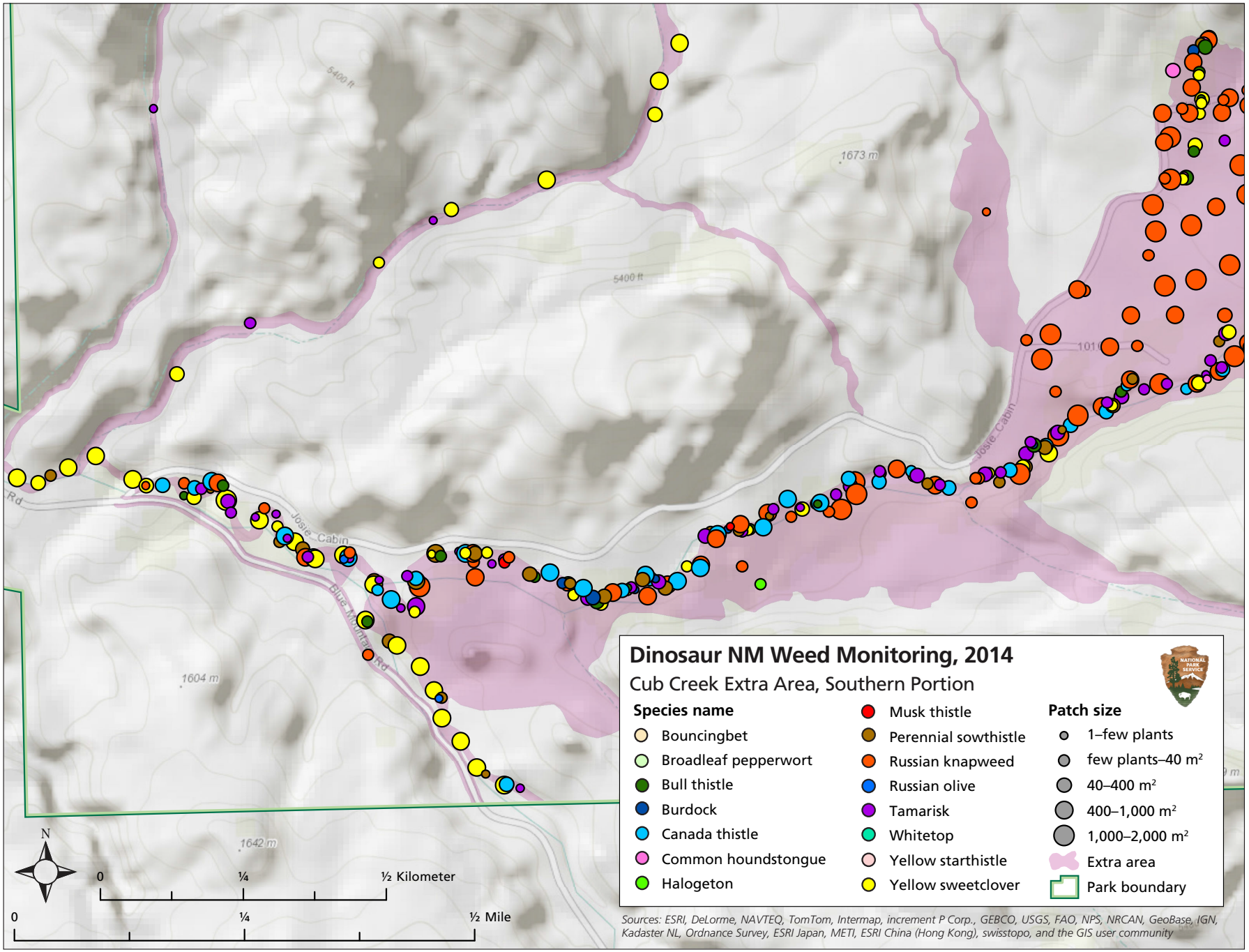


Figure 3-4. Invasive plant patches detected along the southern portion of the Cub Creek extra areas, Dinosaur National Monument, July 2–9, 2014.

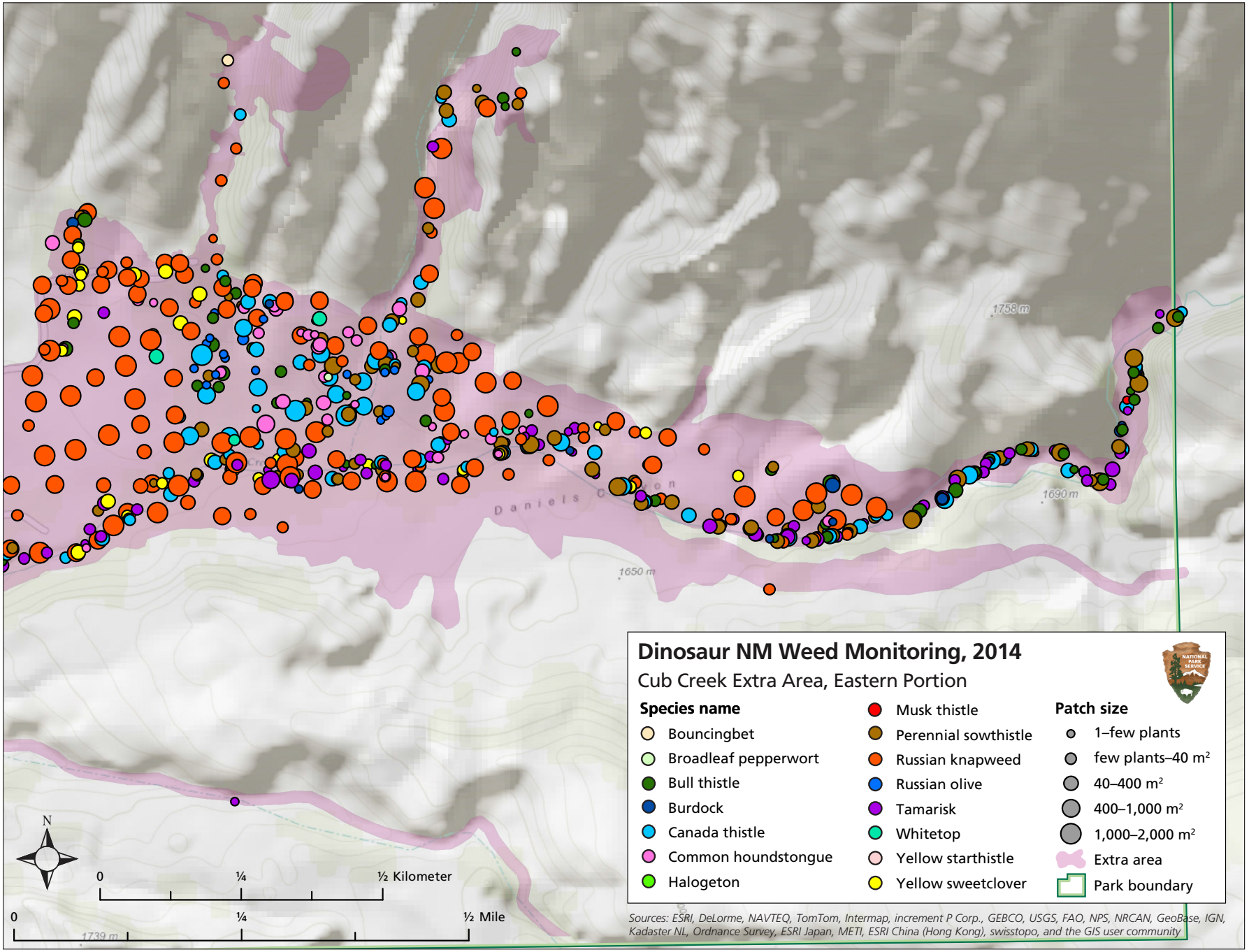


Figure 3-5. Invasive plant patches detected along the eastern portion of the Cub Creek extra areas, Dinosaur National Monument, July 2–9, 2014.

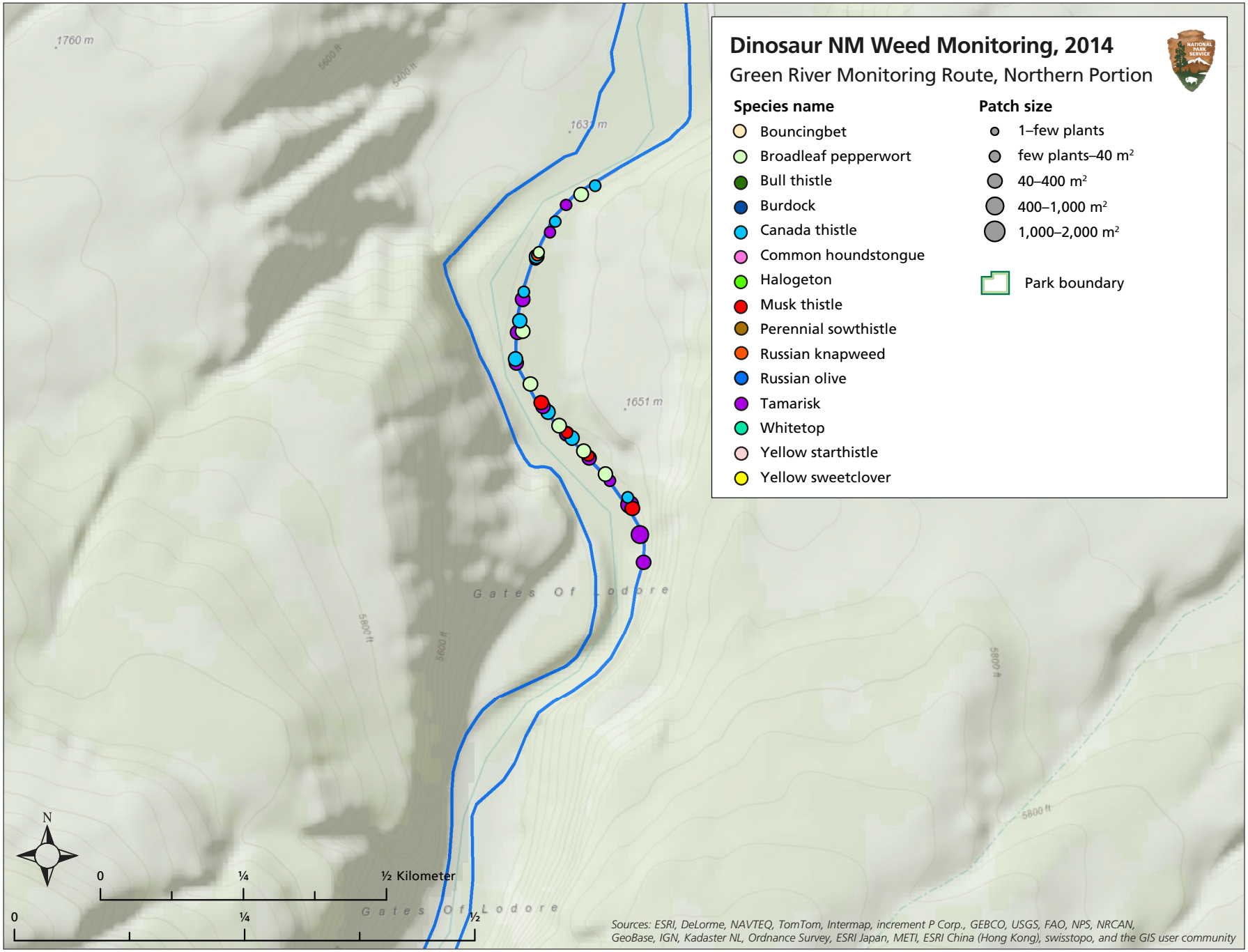


Figure 3-6. Invasive plant patches detected along the northern portion of the Green River monitoring route, Dinosaur National Monument, September 25, 2014.

Table 3-2. Number of monitoring transects where exotic plant species were detected/total number of transects monitored, mean percent cover, and standard error by sampling area (management unit or monitoring route), Cub Creek area and the northern portion of the Green River monitoring route, Dinosaur National Monument, 2014.

Scientific name	Common name	Cub Creek		Green River	
		# detected (of 6)	% cover/SE	# detected (of 2)	% cover/SE
Bromus tectorum^	cheatgrass	5	4.06 (1.27)	1	20.00 (20.00)
Cirsium arvense	Canada thistle	0	0.00 (0.00)	1	0.50 (0.50)
Tamarisk chinensis	tamarisk	0	1.40 (0.00)	2	6.67 (3.33)

^Not on priority list, but a species that is consistently looked for and recorded, if present, in all transects.

Table 3-3. Hectares (acres) of invasive plant species that were target species in monitoring of the Cub Creek area in 2002–2003, 2010, and 2014.

Scientific name	Common name	2002–2003	2010	2014
Arctium minus	burdock	0.04 (0.10)	0.01 (0.03)	0.07 (0.17)
Cardaria sp.	whitetop	0.04 (0.10)	0.01 (0.04)	0.03 (0.08)
Carduus nutans	musk thistle	0.00 (0.00)	<0.01 (<0.01)	<0.01 (<0.01)
Centaurea repens	Russian knapweed	31.48 (77.79)	6.92 (17.10)	4.90 (12.12)
Cirsium arvense	Canada thistle	4.23 (10.46)	1.88 (4.64)	2.97 (7.35)
Cirsium vulgare	bull thistle	0.78 (1.92)	0.04 (0.10)	0.20 (0.48)
Cynoglossum officinale	common houndstongue	0.24 (0.60)	0.08 (0.20)	0.25 (0.62)
Elaeagnus angustifolia	Russian olive	<0.01 (0.01)	0.11 (0.27)	0.02 (0.05)
Halogeton glomeratus	halogeton	0.04 (0.10)	0.02 (0.04)	<0.01 (<0.01)
Lepidium latifolium	broadleaf pepperwort	0.00 (0.00)	<0.01 (0.01)	<0.01 (<0.01)
Melilotus officinalis	yellow sweetclover	1.76 (4.34)	3.60 (8.89)	3.08 (7.60)
Onopordum acanthium	Scotch thistle	<0.01 (<0.01)	0.00 (0.00)	0.00 (0.00)
Sonchus arvensis	perennial sowthistle	0.00 (0.00)	0.00 (0.00)	1.62 (4.01)
Tamarix sp.	tamarisk	7.13 (17.63)	1.81 (4.47)	0.80 (1.99)
Totals		**45.75 (113.05)**	**14.48 (35.78)**	**13.95 (34.47)**

4 Discussion

4.1 Priority invasive exotic plant list

The NCPN will continue to work with park staff and area IEP experts to review and update the list of priority species each year. Presence and absence data for most priority species, and presence data for other species, should be reliable for the area surveyed; however, absence data for non-priority species are suspect, because not all observers recorded all of these species in all years. One observer detected bouncingbet (*Saponaria officinalis*). After this species was identified, other field crew members said they had seen it in Hog Canyon. Bouncingbet is an invasive species that is on the noxious weed list for Colorado. This species was also found by Edvarchuk and others (2012). Dinosaur NM may want to consider adding it to the priority invasive species list for future surveys.

4.2 Possibilities for management control

In 2006, Dinosaur NM completed an Invasive Plant Management Plan and Environmental Assessment that established procedures and outlined areas for priority management. That plan identified the Cub Creek watershed as a priority site requiring immediate attention because of the presence of threatened species and the threat to several rare endemic plants and wetland habitats by severe infestations of Russian knapweed, Russian olive, tamarisk, and other invasive species. It is also a designated cultural landscape.

Edvarchuk and others (2012) noted a 51% reduction in invasive plant patches from 2002–2003 to 2010, from 61.3 hectares (151.5 acres) infested to 30 hectares (74 acres).

The number of hectares of invasive plants has declined by 4% since 2010. Russian olive, tamarisk, Russian knapweed, and yellow sweetclover declined by 82%, 56%, 29%, and 14%, respectively, since 2010, representing a decline of 3.6 hectares (8.9 acres) (see Table 3-3). Conversely, bull thistle, common houndstongue, and Canada thistle increased by 400%, 213%, and 58%, respectively, from 2010 to 2014. In addition, perennial sowthistle increased from 0 hectares to 1.6 hectares from 2010 to 2014. Together, these four species represent an increase of 3.0 hectares (7.4 acres) of IEPs from 2010 to 2014.

The widespread presence of perennial sowthistle in Cub Creek in 2014, when it had not been detected in 2010 or 2002–2003, was alarming. This either indicates that this species has spread extremely fast and has quickly grown into large patches (67 patches, 52% of perennial sowthistle infestations, were larger than 40 m^2) or the earlier efforts failed to identify this species.

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Appendix A. Exotic plant patches detected in Cub Creek extra areas and the northern portion of the Green River monitoring route at Dinosaur National Monument, July 2–September 25, 2014.

See attached electronic appendices.

Appendix B. Exotic plant transect data detected in Cub Creek extra areas and the northern portion of the Green River monitoring route at Dinosaur National Monument, July 2–September 25, 2014.

See attached electronic appendices.

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