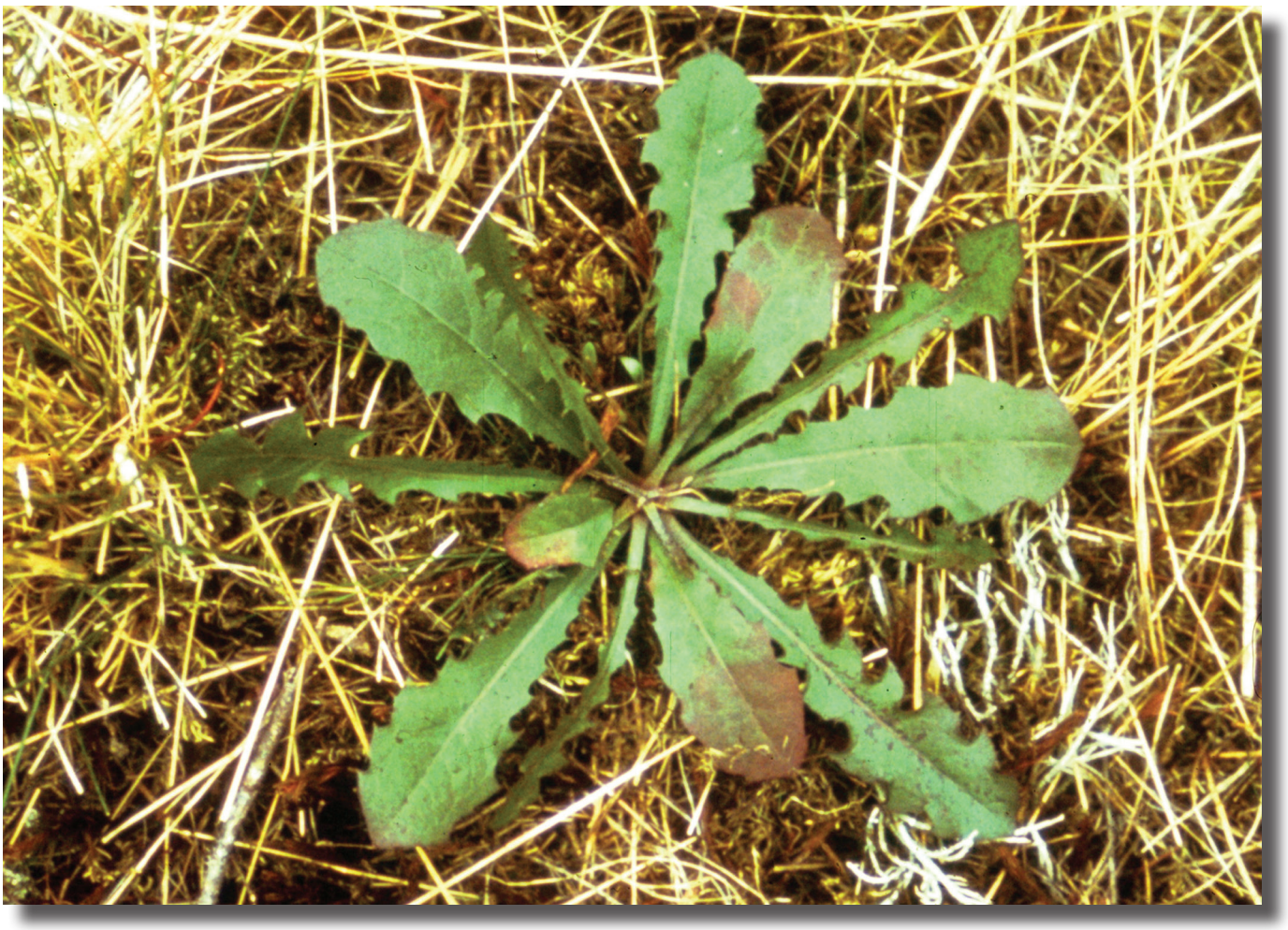
National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Invasive Exotic Plant Monitoring at Golden Spike National Historic Site

2014 Field Season

Natural Resource Report NPS/NCPN/NRR—2015/945



ON THE COVER

Rush skeletonweed (*Chondrilla juncea*). Utah State University Archive, Utah State University, Bugwood.org.

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Natural Resource Report NPS/NCPN/NRR—2015/945

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Fort Collins, Colorado

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Abstract

Invasive exotic plant (IEP) species are one of the biggest threats 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 during the 2014 field season at Golden Spike National Historic Site (NHS). On July 16–18, 2014, nine priority IEP species were detected on monitoring routes that covered all major roads, trails, and riparian areas at Golden Spike NHS. Three additional non-priority species were recorded only in quadrats. Exotic plant patches of priority species (that were on the list in all years) were more prevalent in 2014 than in any other year of monitoring, increasing from 6 in 2012 to 77 in 2014. The highest densities of plant patches were recorded along the Hydro 1 drainage, Last Cut drainage, Retired Service Road, Poulson Road, County Road, and Facility Road. Rush skeletonweed (*Chondrilla juncea*), Scotch thistle (*Onopordum acanthium*), and field bindweed (*Convolvulus arvensis*) were the most prevalent species, representing 82% of all invasions found. Eighty-two percent of the patches detected were present in small, localized invasions that have a good chance of being successfully controlled through management actions. Percent cover of more dominant species, such as cheatgrass (*Bromus tectorum*), crested wheatgrass (*Agropyron cristatum*), and tumble mustard (*Sisymbrium altissimum*) was lower than in previous years. The network will return to Golden Spike NHS for a fifth year of monitoring in 2016.

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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 target 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.

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.
2. To determine status and trends of selected invasive plant populations of management significance.

This report summarizes the 2014 field season and fourth complete monitoring visit at Golden Spike National Historic Site (NHS).

2 Methods

We followed the invasive plant monitoring protocol developed by the NCPN (Perkins et al. 2013), adapted from Andersen and Dewey (2007). The protocol emphasizes quick collection of IEP location and abundance data in order to maximize the amount of area searched, thus increasing our chances of finding a higher percentage of both new invasions and established IEPs. By focusing on roads, trails, and waterways, which are major vectors for invasive plants, we capture the greatest amount of information (i.e., benefit) with the least amount of time and effort (i.e., cost).

After park and NCPN staff reviewed the list of target invasive plants, we established a series of co-located monitoring routes and quadrats along all roads, major drainages, and trails in the park. The quadrats, 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.

All roads, trails, and riparian areas surveyed in 2014 were previously surveyed with monitoring routes and quadrats in 2008, 2010, and 2012 (Perkins and Weissinger 2009; Perkins 2011, 2013).

2.1 Developing a park target invasive exotic plant list

Prior to beginning monitoring in 2014, NCPN and park staff reviewed the list of high-priority target IEPs (Table 2-1) that was initially developed in 2008 and then reviewed in 2011 and 2013. Field bindweed (*Convolvulus arvensis*) was added in 2014. 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 high-priority target 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 target plants, instead of looking for every possible invasive plant species. The likelihood of eradicating these target species, or containing them within a park, is generally high. The list of priority species is reviewed before each field season.

2.2 Monitoring routes

2.2.1 Minimum detection target size

The minimum detection target size (MDTS) represents the patch size that was large enough to detect 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

Table 2-1. Priority invasive plant list, Golden Spike NHS, 2008–2014.

Scientific name	Common name
Cardaria chalepensis	lens-podded whitetop
Cardaria draba	hoary cress
Cardaria pubescens	whitetop
Carduus nutans	musk thistle
Centaurea diffusa	diffuse knapweed
Centaurea maculosa	spotted knapweed
Centaurea repens	Russian knapweed
Centaurea solstitialis	yellow starthistle
Centaurea squarrosa	squarrose knapweed
Chondrilla juncea	rush skeletonweed
Cirsium arvense	Canada thistle
*Convolvulus arvensis**	field bindweed
Crupina vulgaris	common crupina
Elymus repens	quackgrass
Euphorbia esula	leafy spurge
Hypericum perforatum	common St. John's wort
Isatis tinctoria	Dyer's woad
Lepidium latifolium	broad-leaf pepperwort
Linaria dalmatica	Dalmatian toadflax
Marrubium vulgare	horehound
Onopordum acanthium	Scotch thistle
Salvia aethiopsis	Mediterranean sage
Senecio jacobaea	tansy ragwort
Taeniatherum caput-medusae	Medusahead
Tribulus terrestris	puncturevine
Verbascum blattaria	moth mullein

*2008, 2014 only

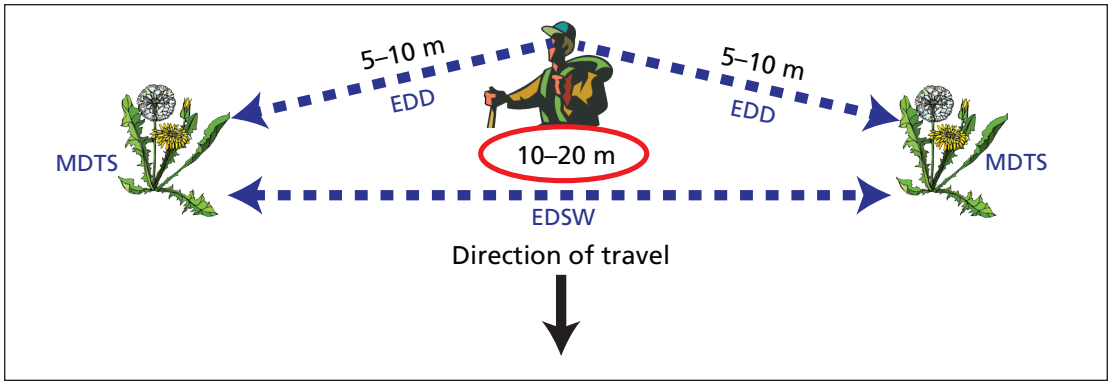


Figure 2-1. The maximum Effective Detection Distance (EDD) at Golden Spike NHS ranged from 5 to 10 meters, making the Effective Detection Swath Width (EDSW) 10–20 meters.

feasibly be eradicated if not found until the next scheduled monitoring visit. The NCPN has established an MDTS of 40 m^2 (0.01 acres, or approximately 20 × 20 ft) for all IEPs. Use of the MDTS is necessary because field technicians are not expected to find every single plant of every targeted weed species during route surveys. Although searching for single mature plants of some species, such as Russian olive (*Elaeagnus angustifolia*) and tamarisk (*Tamarix ramosissima*), is possible due to their large size, single plants of other species, such as field bindweed, 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 could consistently detect (i.e., see and recognize) the MDTS of the least-visible targeted species with at least 90% detection efficiency (Figure 2-1). Crew members are trained by using fake plants of a targeted size and 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 is then estimated in the field by crew members. The distance is measured either by pacing or using a laser rangefinder. The EDD for GOSP was between 5 and 10 m in 2014, depending on vegetation.

2.2.3 Effective detection swath width

Effective detection swath width (EDSW) is defined as the maximum width of a linear search swath (band transect) in which a walking observer is confident of visually detecting 90% of all target species of the MDTS (Figure 2-1). The effective detection swath width (EDSW) 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 ranged from 10 to 20 m at GOSP in 2014.

2.2.4 Patch separation resolution

We define patch separation resolution (PSR) as the minimum distance between plants that must be considered members of separate patches. Individuals or clusters of a target species separated by the PSR distance or more are recorded as separate patches. We consider plants separated by less than the PSR to be a single patch. The PSR is set at 50 m, 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 is continuous for more than 50 m, cover estimates are 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 allow electronic tracking of a user's route. GPS units are set to automatically generate these positions at a distance equal to the EDSW. Each time a surveyor walks the equivalent of one EDSW, the GPS unit creates a point.

2.2.6 Data collection methods

We walked one EDD out from one side of a monitoring route and then returned to the starting point by walking back one EDD

from the route on the other side. While walking, 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 10–20 m (the length of one EDSW) and visually scanned the area in all directions. As monitoring routes were traversed, locations of all target species were documented using global positioning system (GPS) units with at least five-meter accuracy.

Only species designated as priority were consistently recorded on monitoring routes. When a priority IEP was discovered, we recorded the following information: (1) monitoring route, (2) 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 a separate point.

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), evidence of prior treatment, and evidence of disturbances (e.g., recent fire, flood, small-mammal disturbance).

2.3 Monitoring transects

From 2010 to 2014, we established transects with three vegetation quadrats every 500 m along monitoring routes.* If no invasives were detected for three consecutive transects (9 quadrats), then transects were established every 1,000 m. If invasive plants were found in categories greater than 1 for canopy cover class or patch size class, then we went back to establishing transects every 500 m.

2.3.1 Quadrat establishment

We centered vegetation quadrats at 0.5, 5, and 10 m away from the edge of a route on the same side as the route that was being walked and on alternating sides for riparian areas, small roads, or trails. A 1-m^2 sampling frame was used to sample vegetation cover and soil surface features.

Quadrat sampling methods used in 2010 and 2014 differed slightly from those used during the 2008 pilot field season. In 2008, all invasive species were recorded in monitoring quadrats, and quadrats were embedded in a larger (177-m^2) macroplot centered five meters from the monitoring route. Observers could make additional species observations, but non-priority species were not thoroughly mapped.

2.3.2 Data collection methods

In the monitoring quadrats, all priority IEP species observed were recorded. In all years except 2012, cheatgrass (*Bromus tectorum*) and crested wheatgrass (*Agropyron cristatum*) were also recorded in transects. In 2014, observers also recorded tumble mustard (*Sisymbrium altissimum*) in quadrats. For each quadrat, we recorded percent cover of each

*In 2008, methods differed slightly, as transects were placed every 400 m.

IEP using the following classes: <1, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11–25, 26–50, or >50%. 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 Analyses

We calculated the mean number of patches per kilometer for monitoring routes. Percent cover estimates were generated from the monitoring quadrat data. We calculated the mean and standard error of percent cover by species for monitoring quadrats. For classes represented by a range of percent cover values (11–25, 26–50, 51– 75, and >75% cover), midpoints (18, 38, 63, and 88%) were used when calculating the mean and standard error. Due to differences in observers' knowledge, only priority species should be used when comparing results from year to year.

3 Results

3.1 Monitoring routes

We covered 19.5 km (12.2 miles) along 12 monitoring routes in 2014 (Figure 3-1). We recorded a total of nine IEP species in 97 patches (Tables 3-1, 3-2, Figure 3-2, 3-3, Appendix A). Of the 97 patches, 31 were larger than 40 m^2 (Table 3-3). The highest densities of plant patches were recorded along the Hydro 1 drainage, Last Cut drainage, Retired Service Road, Poulson Road, County Road, and Facility Road. Rush skeletonweed (*Chondrilla juncea*), Scotch thistle (*Onopordum acanthium*), and field bindweed were the most prevalent species, representing 82% of all invasions found. Only priority species should be examined when comparing years and areas, as these were the only species recorded consistently by all observers and in both years.

3.2 Monitoring transects

We sampled a total of 40 transects in 2014 (Figure 3-4, Appendix B). No priority species were detected on any transect. However, three species consistently recorded in transects in 2008, 2010, and 2014 were detected in transects (Table 3-4). In 2014, 95% of transects were found to contain at least one of these species. Cheatgrass had the highest percent cover (11.6%) and was detected in 87.5% of transects.

3.3 Priority patches over time

The number of priority patches detected was the highest recorded in the four years sampled (Figure 3-5, Table 3-5). Rush skeletonweed, quackgrass (*Elymus repens*), broadleaf pepperwort (*Lepidium latifolium*), and Dalmatian toadflax (*Linaria dalmatica*) were all found in 2014; none was previously detected. The species with the most dramatic increases from 2012 to 2014 were rush skeletonweed (0 to 32 patches) and Scotch thistle (2 to 28 patches). Species that were on the priority list in all four sampling years also increased—from a total of six patches in 2012 to 77 patches in 2014. Percent cover for crested wheatgrass and tumble mustard appear to have declined since 2008. Cheatgrass shows a similar trend but still has standard errors that overlap, indicating that the trend may not be significant (Figure 3-6). Trend analyses will be completed after a few more years of sampling.

Table 3-1. Invasive exotic plants detected at Golden Spike NHS, July 16–18, 2014.

Scientific name	Common name	Method detected		Priority?
		Routes	Transects	
Chondrilla juncea	rush skeletonweed	X		Yes
Cirsium arvense	Canada thistle	X		Yes
Convolvulus arvensis	field bindweed	X		Yes
Elymus repens	quackgrass	X		Yes
Isatis tinctoria	Dyer's woad	X		Yes
Lepidium latifolium	broad-leaf pepperwort	X		Yes
Linaria dalmatica	Dalmatian toadflax	X		Yes
Onopordum acanthium	Scotch thistle	X		Yes
Verbascum blattaria	moth mullein	X		Yes
Agropyron cristatum	crested wheatgrass		X	No
Bromus tectorum	cheatgrass		X	No
Sisymbrium altissimum	tumble mustard		X	No

Table 3-2. Number of IEP patches per route surveyed, Golden Spike NHS, July 16–18, 2014.

Route	Type	Length (m)	Patches	Patches/km
Hydro 1	Riparian	295	5	16.9
Last Cut Drainage	Riparian	1,873	16	8.5
	All Riparian	***2,169***	***21***	***9.7***
Big Fill Section County R.	Road	5,150	13	2.5
County Road	Road	1,973	13	6.6
East Tour Road	Road	5,204	25	4.8
Facility Road	Road	657	4	6.1
Poulson's Road	Road	2,067	14	6.8
Residence Service Road	Road	163	0	0.0
Retired Service Road	Road	260	2	7.7
Water Tank Road	Road	447	1	2.2
Witkers Service Road	Road	464	1	2.2
	All Roads	***10,945***	***73***	***6.7***
Pacific Track Grade	Trail	997	3	3.0
Total		***19,485***	***97***	***5.0***

Table 3-3. Number of patches by species and size class detected along monitoring routes at Golden Spike NHS, July 16–18, 2014.

Scientific name	Common name	Total patches	Patch size class				
			1	2	3	4	5
Chondrilla juncea	rush skeletonweed	32	14	9	4	2	3
Onopordum acanthium	Scotch thistle	28	6	10	7	1	4
Convolvulus arvensis	field bindweed	20	0	17	2	1	0
Verbascum blattaria	moth mullein	6	3	2	1	0	0
Elymus repens	quackgrass	4	0	0	2	2	0
Isatis tinctoria	Dyer's woad	4	2	0	1	1	0
Cirsium arvense	Canada thistle	1	0	1	0	0	0
Lepidium latifolium	broad-leaf pepperwort	1	0	1	0	0	0
Linaria dalmatica	Dalmatian toadflax	1	1	0	0	0	0
Priority species		97	26	40	17	7	7

Patch size classes: 1 = 1–a few plants (≤2 × 2 m), 2 = few plants–40 m^2 (48 yd^2), 3 = 40–400 m^2 (48–478 yd^2), 4 = 400–1,000 m^2 (0.1–0.25 acre), 5 = 1,000–2,000 m^2 (0.25–0.5 acre).

Table 3-4. Number of monitoring transects where exotic plant species were detected/total transects monitored, mean percent cover, and standard error along monitoring routes at Golden Spike NHS, July 16–18, 2014.

Route	Crested wheatgrass*		Cheatgrass*		Tumble mustard*		All species	
	Detected/ Total	Percent cover (SE)	Detected/ Total	Percent cover (SE)	Detected/ Total	Percent cover (SE)	Detected/ Total	Percent cover (SE)
Big Fill Area	1/28	0.01 (0.01)	27/28	13.7 (3.2)	5/28	0.08 (0.04)	27/28	13.8 (3.6)
Administrative Area	9/12	12.2 (3.2)	8/12	6.9 (4.1)	1/12	0.03 (0.03)	11/12	19.1 (5.2)
All 2014	10/40	3.7 (1.3)	35/40	11.6 (2.6)	6/40	0.07 (0.03)	38/40	15.4 (2.9)

*Not a priority species but was recorded consistently by all observers in 2014.

Table 3-5. Priority species observed and size of patches detected at Golden Spike NHS, 2008–2014.

Scientific name	Common name	Year	Total patches	Patch size class				
				1	2	3	4	5
Chondrilla juncea	rush skeletonweed	2008	0	0	0	0	0	0
		2010	0	0	0	0	0	0
		2012	0	0	0	0	0	0
		2014	32	14	9	4	2	3
Isatis tinctoria	Dyer's woad	2008	28	20	4	3	1	0
		2010	25	12	5	5	1	2
		2012	0	0	0	0	0	0
		2014	4	2	0	1	1	0
Onopordum acanthium	Scotch thistle	2008	26	8	8	10	0	0
		2010	20	7	6	6	1	0
		2012	2	1	1	0	0	0
		2014	28	6	10	7	1	4
Verbascum blattaria	moth mullein	2008	0	0	0	0	0	0
		2010	1	0	0	1	0	0
		2012	4	0	2	2	0	0
		2014	6	3	2	1	1	0
All other priority species		2008	5	2	1	2	0	0
		2010	1	0	0	1	0	0
		2012	0	0	0	0	0	0
		2014	7	1	2	2	2	0
All priority species		2008	59	30	13	15	1	0
		2010	46	19	11	12	2	2
		2012	6	1	3	2	0	0
		2014	77	26	23	15	6	7

Dates of monitoring: July 12–13, 2008, July 21–23, 2010, August 6–7, 2012, and July 16–18, 2014.

"Priority species" represent species that were on the priority list in all four years.

Patch size classes: 1 = 1–a few plants (≤2 × 2 m), 2 = few plants–40 m^2 (48 yd^2), 3 = 40–400 m^2 (48–478 yd^2), 4 = 400–1,000 m^2 (0.1–0.25 acre), 5 = 1,000–2,000 m^2 (0.25–0.5 acre).

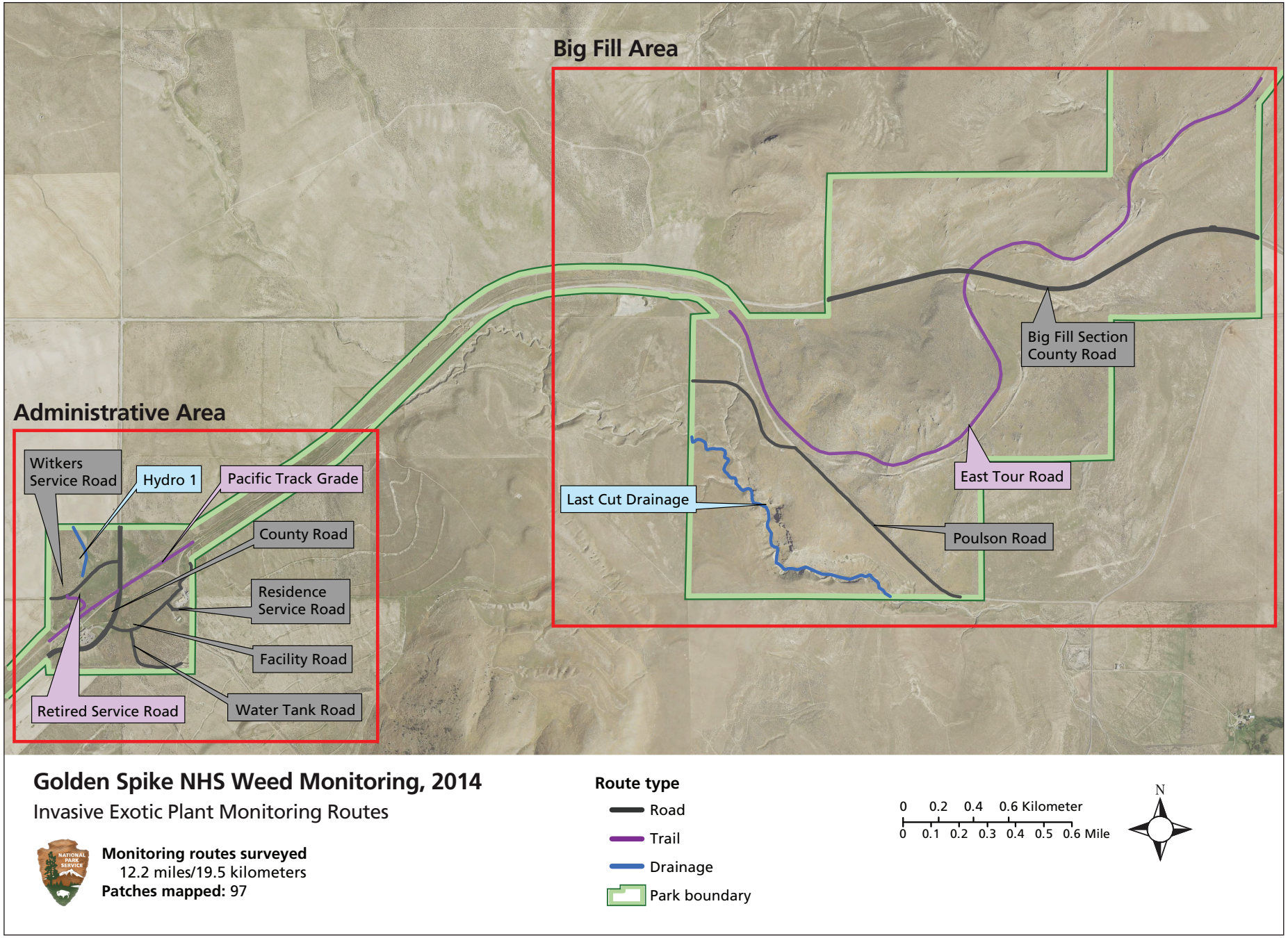


Figure 3-1. Invasive plant monitoring routes, Golden Spike NHS, August 16–18, 2014.

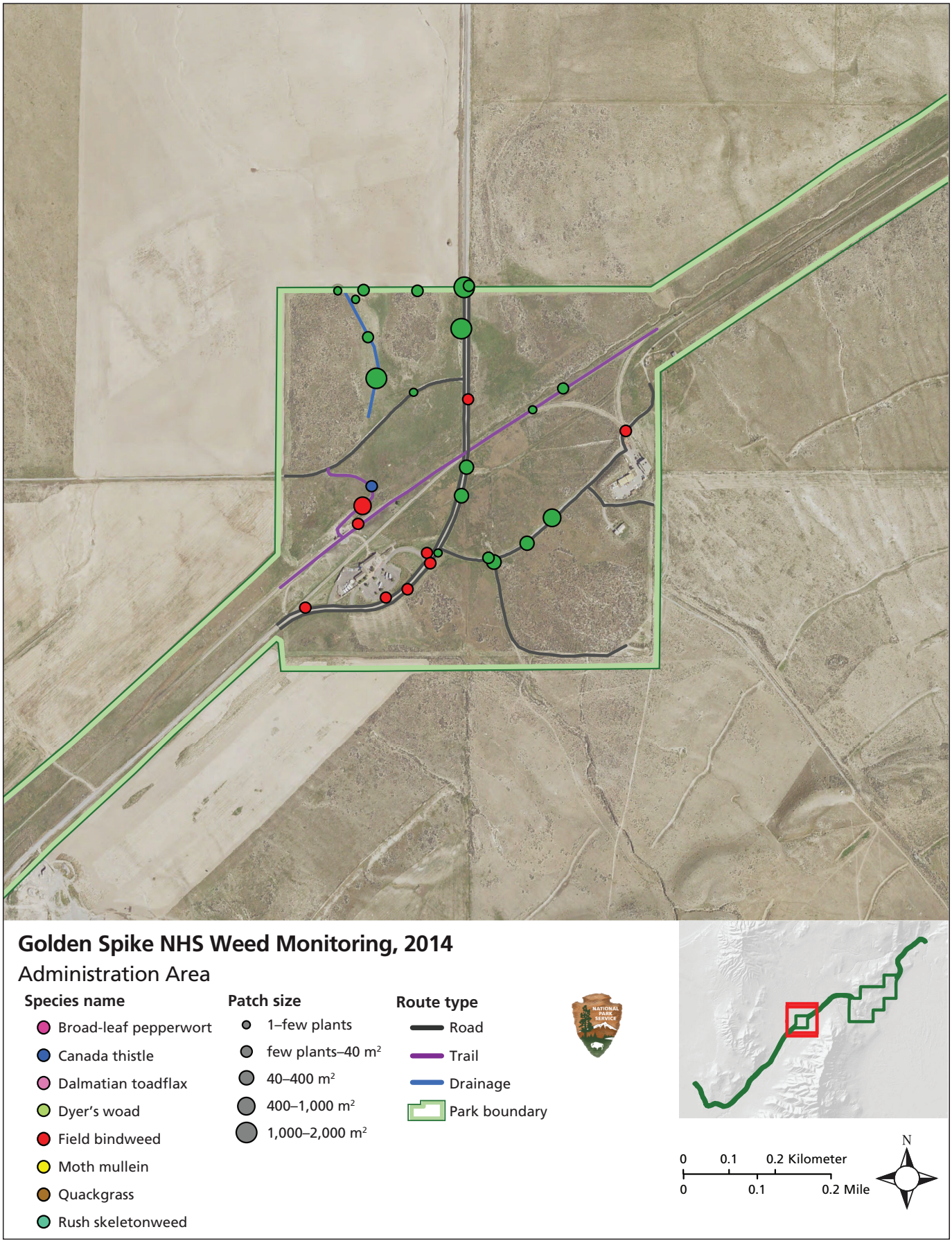


Figure 3-2. Invasive plant monitoring routes and invasive patches detected along monitoring routes, Administrative Area, Golden Spike NHS, August 16–18, 2014.

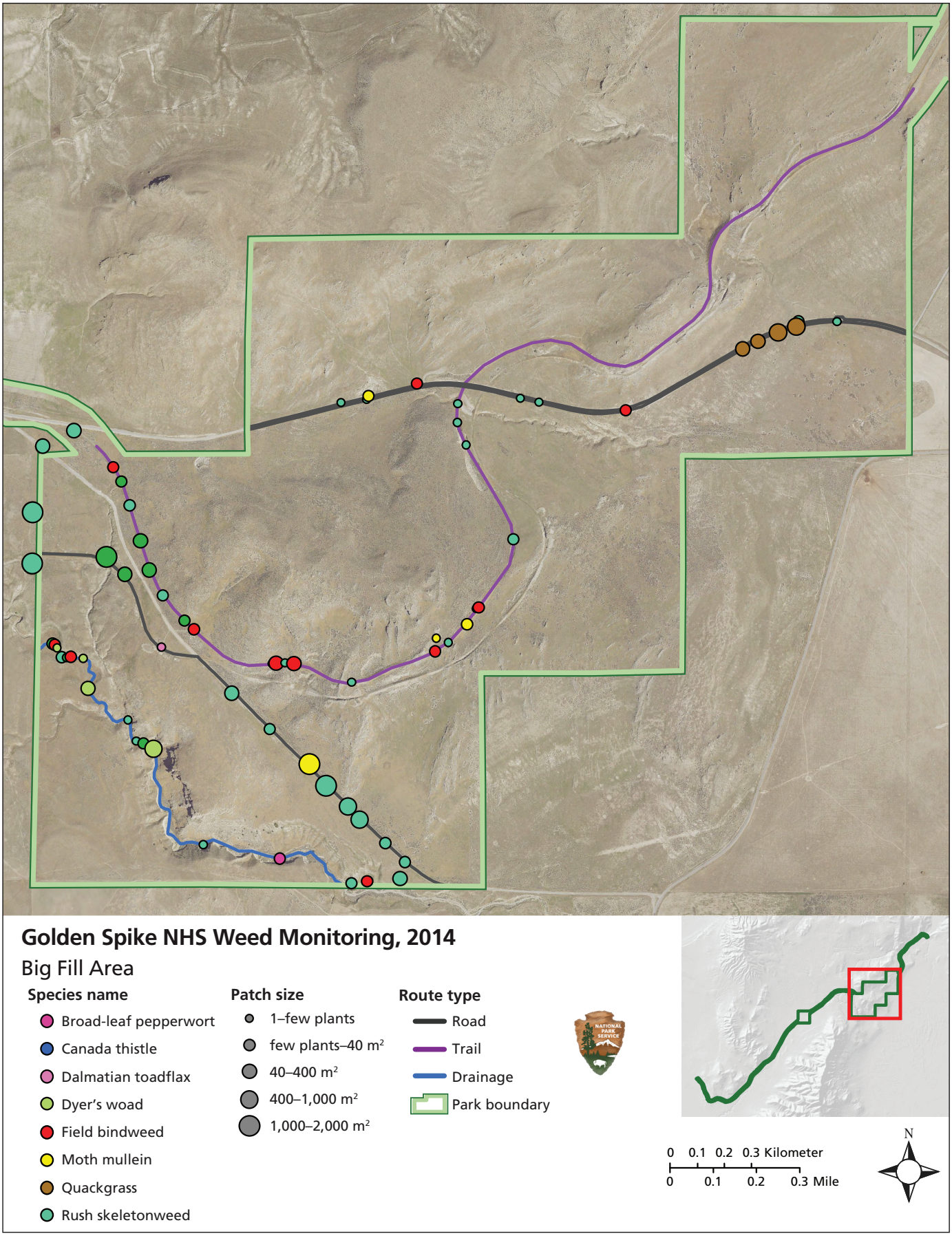


Figure 3-3. Invasive plant monitoring routes and invasive patches detected along monitoring routes, Big Fill Area, Golden Spike NHS, August 16–18, 2014.

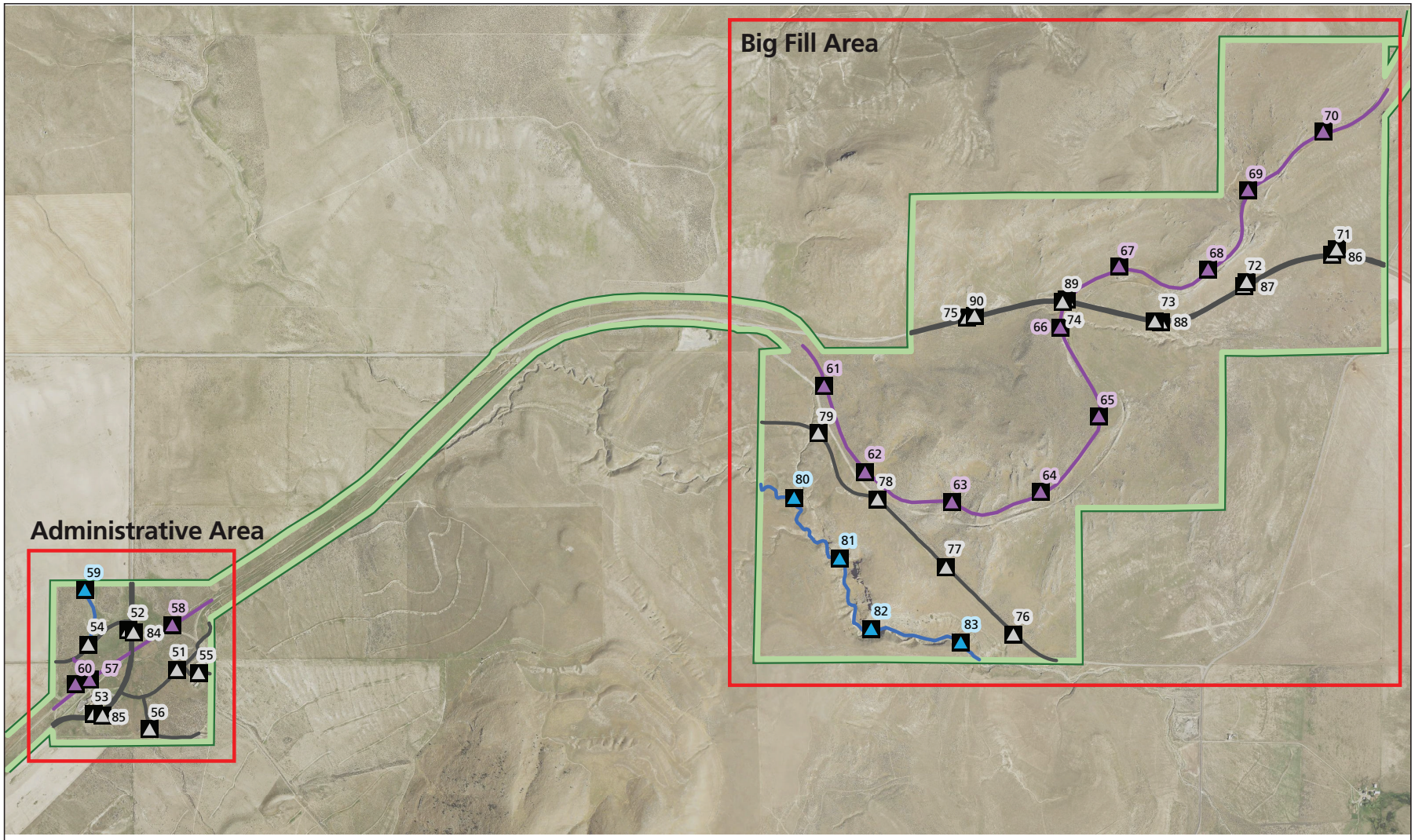


Figure 3-4. Invasive plant monitoring transects, Golden Spike NHS, July 16–18, 2014.

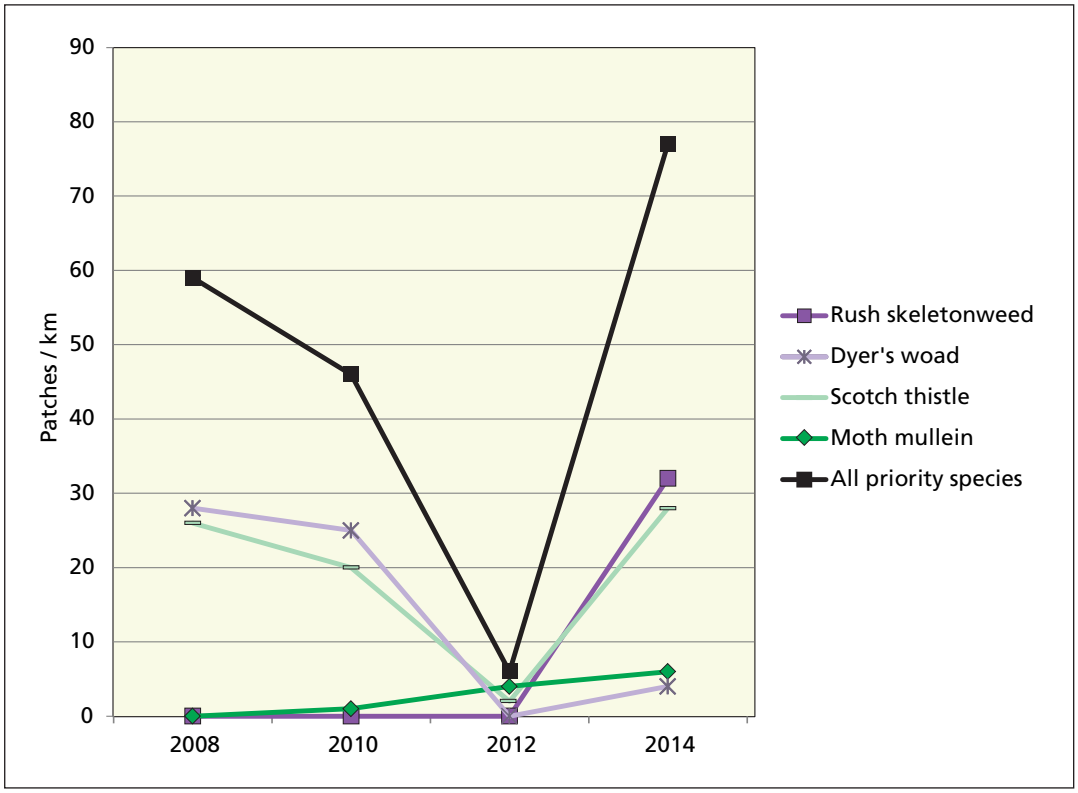


Figure 3-5. Patches per kilometer of the highest density priority invasive species that were consistently recorded on monitoring routes in all years and for all priority species found at Golden Spike NHS, 2008–2014.

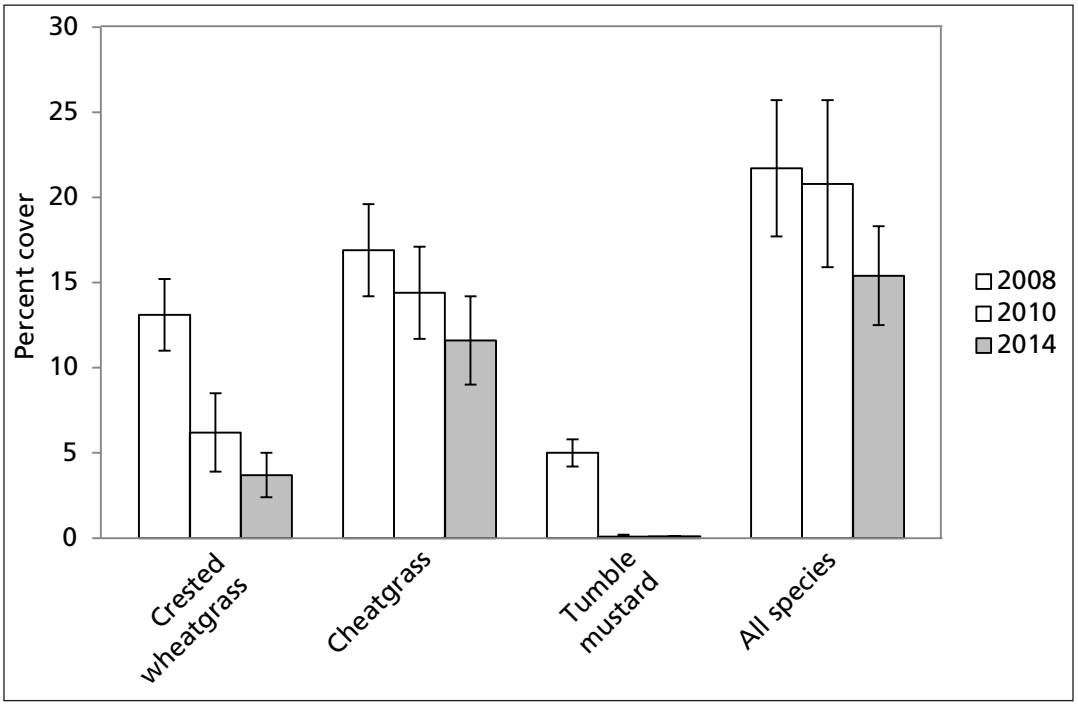


Figure 3-6. Percent cover and standard error of invasive species that were consistently recorded in transects in all years and percent cover of total invasive species found at Golden Spike NHS, 2008, 2010, and 2014. (In 2012, these species were not looked for in transects due to a miscommunication.)

4 Discussion

The NCPN will continue to work with Golden Spike NHS staff and area weed experts to review and update the list of priority species each year. Presence and absence data for most priority species should be reliable for the areas searched. However, absence data for other species are suspect, as they are not consistently recorded from year to year. The NCPN does not have any species to recommend adding to the list for 2016, but we are open to suggestions from park staff or the Northern Rockies Exotic Plant Management Team. The network will continue to collect data on tumble mustard, cheatgrass, and crested wheatgrass in transects only.

Priority IEPs increased substantially from 2012, and were present in their highest levels detected during any monitoring from 2008 to 2014. It is unclear why IEPs increased substantially, but precipitation in 2012 tended to be below average, while precipitation in 2014 was above average. Unfortunately, the closest weather stations to Golden Spike NHS are 47 km NE (Cutler Dam) and 57 km NW (Plymouth) away. These weather stations were also missing key months of data during the sampling period from 2008 to 2014.

Percent cover of the three species that have been consistently monitored (crested wheatgrass, cheatgrass, and tumble mustard) were at their lowest levels during monitoring. Estimates of percent cover 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 along areas most likely to be invaded by a broad suite of IEPs, it is plausible that the percent cover for most IEP species is lower in the interior of the park than along the monitoring routes.

IEPs at Golden Spike NHS will generally be monitored at the same time of year, every other year. Consistency in timing of monitoring should ensure consistency in detection probabilities and cover estimates of most species. For many species, sampling at any time from May to September is not expected to drastically alter the chances of detecting invasive species patches larger than the minimum detection target size. A complete fifth sample of monitoring routes will occur in 2016. Long-term trend reporting will focus on trends in species distributions, trends in percent cover of individual species, and changes in IEP percent cover of priority species 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 on monitoring routes at Golden Spike NHS, July 16–18, 2014

See electronic appendices.

Appendix B. Exotic plant transect data detected at Golden Spike NHS, July 16–18, 2014

See electronic appendices.

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