



Invasive Exotic Plant Monitoring in Zion National Park

2013 Field Season

Natural Resource Technical Report NPS/NCPN/NRTR—2014/883



ON THE COVER

Estimating cover of invasive plants in monitoring quadrats along a transect. NPS photo.

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Prepared by

Dustin W. Perkins
Northern Colorado Plateau Network
National Park Service
P.O. Box 848
Moab, UT 84532

Editing and Design

Alice Wondrak Biel
Northern Colorado Plateau Network
National Park Service
P.O. Box 848
Moab, UT 84532

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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 10 monitoring protocols to be implemented as part of its long-term monitoring program. During surveys conducted on June 19–26, 2013, NCPN staff detected nine IEP species (6 of which were priority species) along 105.4 kilometers of monitoring routes and transects at Zion National Park. Bulbous bluegrass (*Poa bulbosa*), Siberian elm (*Ulmus pumila*), and Scotch thistle (*Onopordum acanthium*) were the most commonly detected priority invasive plants. The highest numbers of priority infestations were found at Watchman Campground and Visitor Center area (16.46 infestations/km), Hidden Canyon/Weeping Rock Trails (4.16/km), Watchman Housing Area (3.43/km), Upper Kolob Terrace Road (3.29/km), and South Campground and Nature Center (3.05/km). Roads generally had higher infestation densities than trails. Several trails were free of priority IEP infestations. IEPs were found on 111 transects (63%), with an average of 0.65 IEP species detected per plot. However, almost all of these detections were cheatgrass (*Bromus tectorum*). Cheatgrass was widespread—present in 62% of transects and with an estimated cover of 1.63% across all areas sampled. Cheatgrass cover was as high as 4.76% along the Sand Bench Trail.

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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 (Loope 1992). 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 it may miss exotic plants dispersed to the interior areas of large parks by wind and/or animals.

Specific objectives of NCPN invasive exotic plant monitoring are:

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

This report summarizes the 2013 field season at Zion National Park (NP).

2 Methods

We 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 will capture the greatest amount of information (i.e., benefit) with the least amount of time and effort (i.e., cost).

2.1 Developing a park target invasive exotic plant list

Prior to beginning monitoring in 2012, NCPN and Zion NP staff reviewed the park's list of priority IEPs (Table 2-1). 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 high-priority target IEP list includes existing IEPs and potential IEPs of high management concern. Because these methods are designed to be rapid, field crews are 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.

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 m² (0.01 acres or approximately 20 × 20 ft) for all IEPs. Use of the MDTS was necessary because field technicians are not expected to find every single plant of every

targeted IEP species during route surveys. Searching for single mature plants of some species, such as Siberian elm (*Ulmus pumila*), is possible due to their large size. Single plants of other species, such as Medusahead (*Taeniatherum caput-medusae*), 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). Using fake plants of a targeted size, crew members are trained by walking

Table 2-1. Priority invasive plant list, Zion NP, 2012–2013.

Scientific name	Common name
<i>Alhagi maurorum</i>	camelthorn
<i>Bassia scoparia</i> *	summer cypress
<i>Brassica tournefortii</i>	Sahara mustard
<i>Cardaria draba</i>	hoary cress
<i>Carduus nutans</i>	musk thistle
<i>Centaurea diffusa</i>	diffuse knapweed
<i>Centaurea melitensis</i>	Maltese starthistle
<i>Centaurea repens</i>	Russian knapweed
<i>Centaurea solstitialis</i>	yellow starthistle
<i>Centaurea squarrosa</i>	squarrose knapweed
<i>Cirsium arvense</i>	Canada thistle
<i>Conium maculatum</i>	poison hemlock
<i>Cynodon dactylon</i>	Bermuda grass
<i>Eragrostis cilianensis</i>	stinkgrass
<i>Euphorbia esula</i>	leafy spurge
<i>Hyoscyamus niger</i>	black henbane
<i>Hypericum perforatum</i>	St. Johnswort
<i>Isatis tinctoria</i>	Dyer's woad
<i>Lepidium latifolium</i>	broad-leaf pepperwort
<i>Leucanthemum vulgare</i>	ox-eye daisy
<i>Linaria dalmatica</i>	Dalmatian toadflax
<i>Linaria vulgaris</i>	butter-and-eggs
<i>Lythrum salicaria</i>	purple loosestrife
<i>Onopordum acanthium</i>	Scotch thistle
<i>Poa bulbosa</i>	bulbous bluegrass
<i>Potentilla recta</i>	sulfur cinquefoil
<i>Sorghum halepense</i>	Johnson grass
<i>Taeniatherum caput-medusae</i>	Medusahead
<i>Ulmus pumila</i>	Siberian elm

*Listed as *Kochia scoparia* (kochia) in the 2012 report.

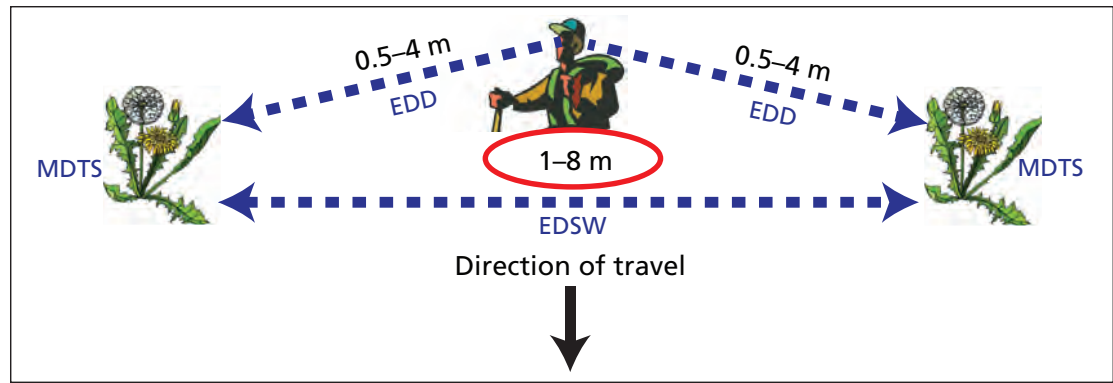


Figure 2-1. The maximum effective detection distance (EDD) at Zion National Park ranged from 0.5 to 4 meters, making the effective detection swath width (EDSW) 1–8 meters.

away and determining the maximum distance from which they can 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 Zion NP in 2013 ranged from 0.5 to 4 m.

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 IEPs for one EDD on either side of his/her search route. The EDSW ranged from 1 to 8 m at Zion NP in 2013.

2.2.4 Patch separation resolution

We define patch separation resolution as the minimum distance between plants that must be considered members of separate patches or infestations. 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 or infestation. 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 infestation during planning and implementation of IEP-control operations. If an infestation 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 infestation.

2.2.5 Between feature position

Between feature positions allow electronic tracking of a user's route. A GPS (global positioning system) unit is 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 established monitoring routes with advice from Zion NP staff (Figure 2-2). 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 8 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 GPS units with at least five-meter accuracy. Only priority species were consistently recorded during monitoring routes. Survey crew members were permitted to record additional species if they were noteworthy.

When a priority IEP was discovered, we recorded the following information: (1) the monitoring route, (2) the sequential number of the invasion per monitoring route, (3) infestation 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

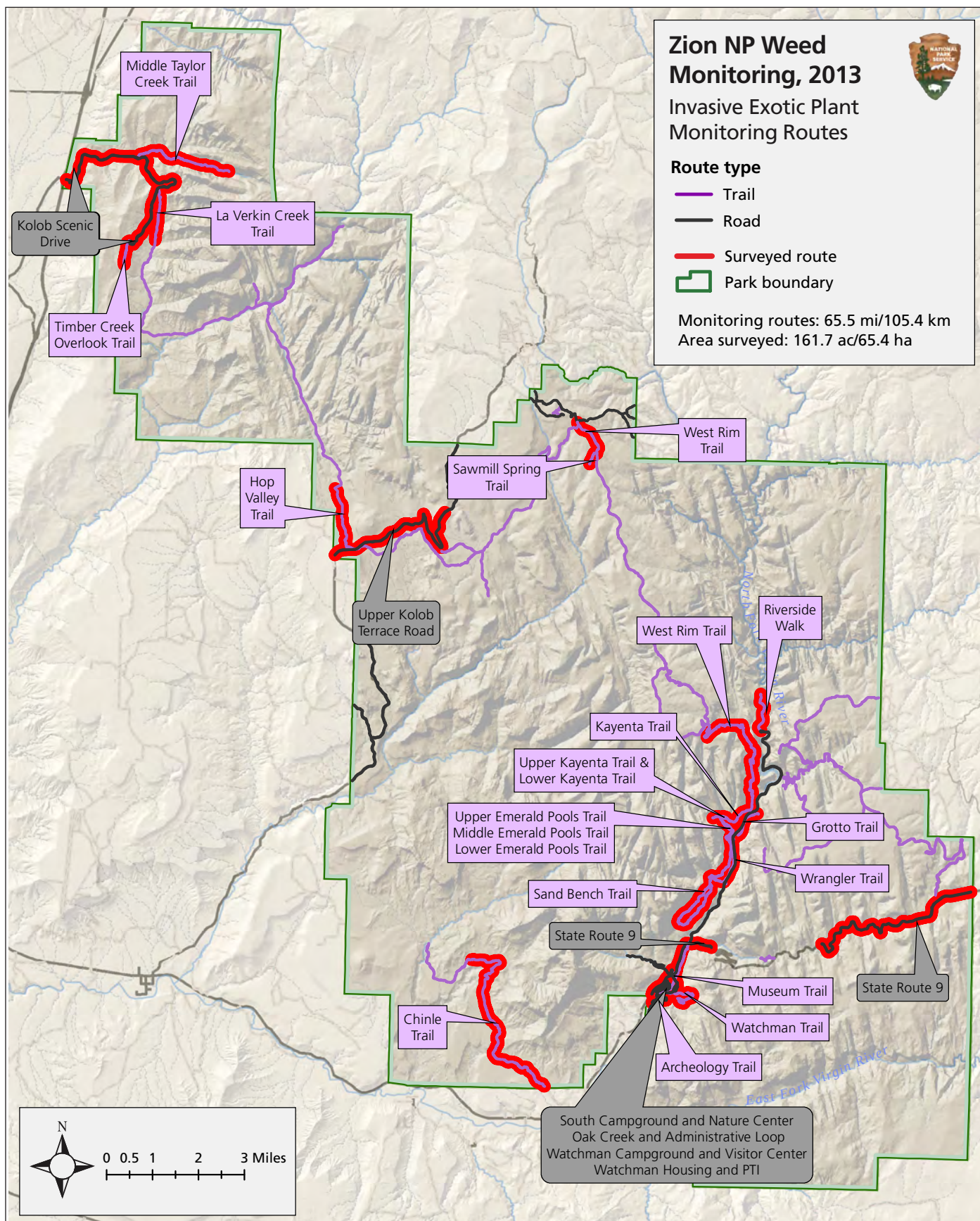


Figure 2-2. Overview of invasive plant monitoring routes surveyed at Zion NP, June 19–26, 2013.

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. Infestation size class was estimated as follows:

1. 1–a few plants (used for isolated single plants or very small patches ($\leq 2 \times 2$ m),
2. few plants–40 m² (48 yd²),
3. 40–400 m² (48–478 yd²),
4. 400–1,000 m² (0.1–0.25 acre), and
5. 1,000–2,000 m² (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 infestation: descriptive notes (e.g., hillside, distance to road, wetland, stream), the growth stage of exotic trees (e.g., sapling, pole, mature), evidence of prior treatment, and evidence of disturbances (e.g., recent fire, flood, small mammal disturbance).

2.3 Monitoring transects

We established transects with three vegetation quadrats every 500 m along monitoring routes (see Figures 2-3 to 2-6). Our methods for sampling the monitoring quadrats were based on Stohlgren and others (2005). If no invasives were detected for four consecutive transects (12 quadrats), then transects were established every 1,000 m. If invasive plants were found in categories greater than 1 for canopy cover class or infestation size class, then we reverted 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 road on the same side as the route being walked and on alternating sides for riparian areas, small roads, or trails. A 1-m² 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 priority IEP species observed were recorded, as well as cheatgrass (*Bromus tectorum*) and Russian thistle (*Salsola tragus*). 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 Analyses

We calculated the mean number of infestations per km 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. Due to differences in observers’ knowledge, only priority species should be used when comparing results from year to year.

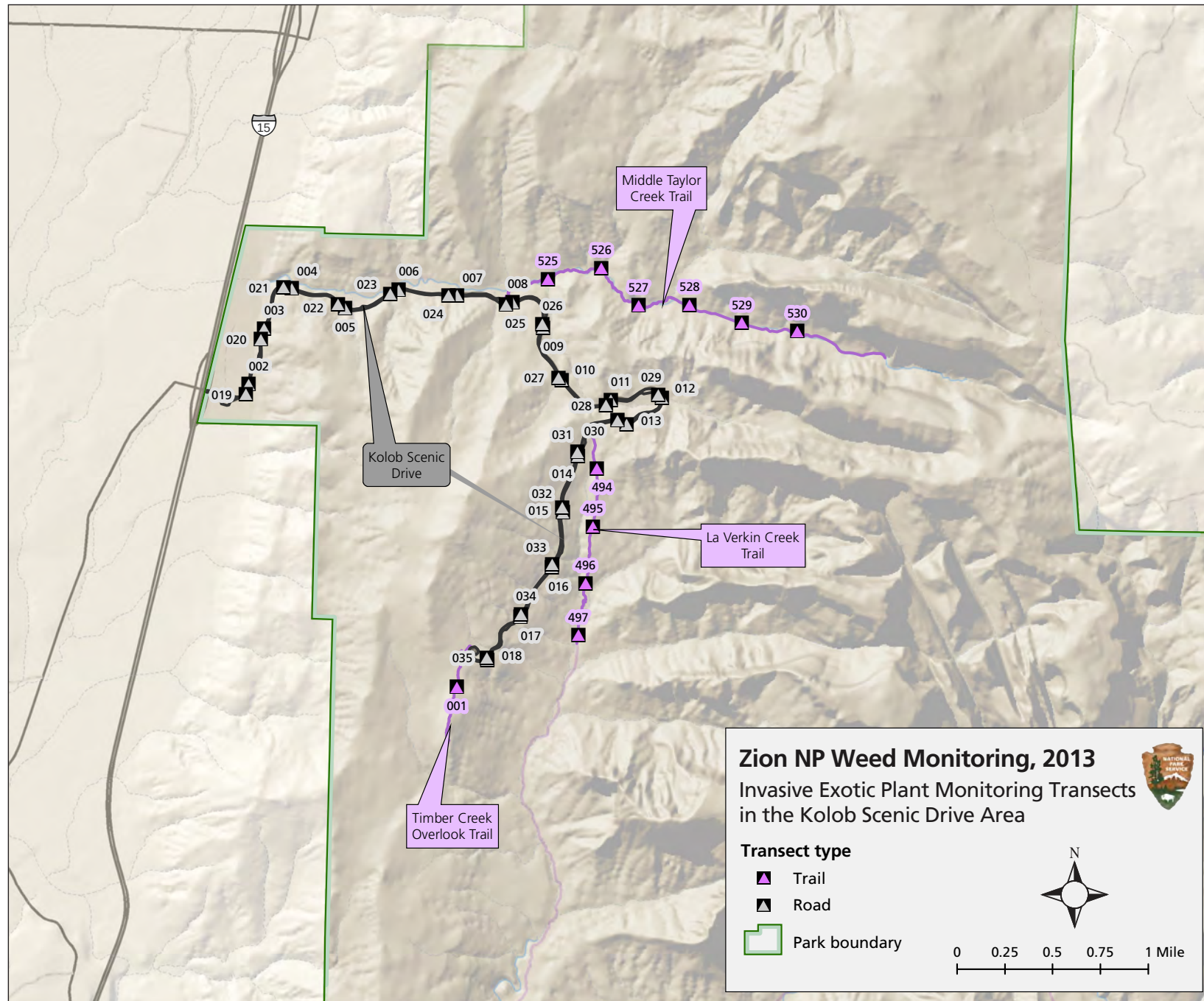


Figure 2-3. Monitoring routes and transects in the Kolob Scenic Drive area, Zion NP, June 19–26, 2013.

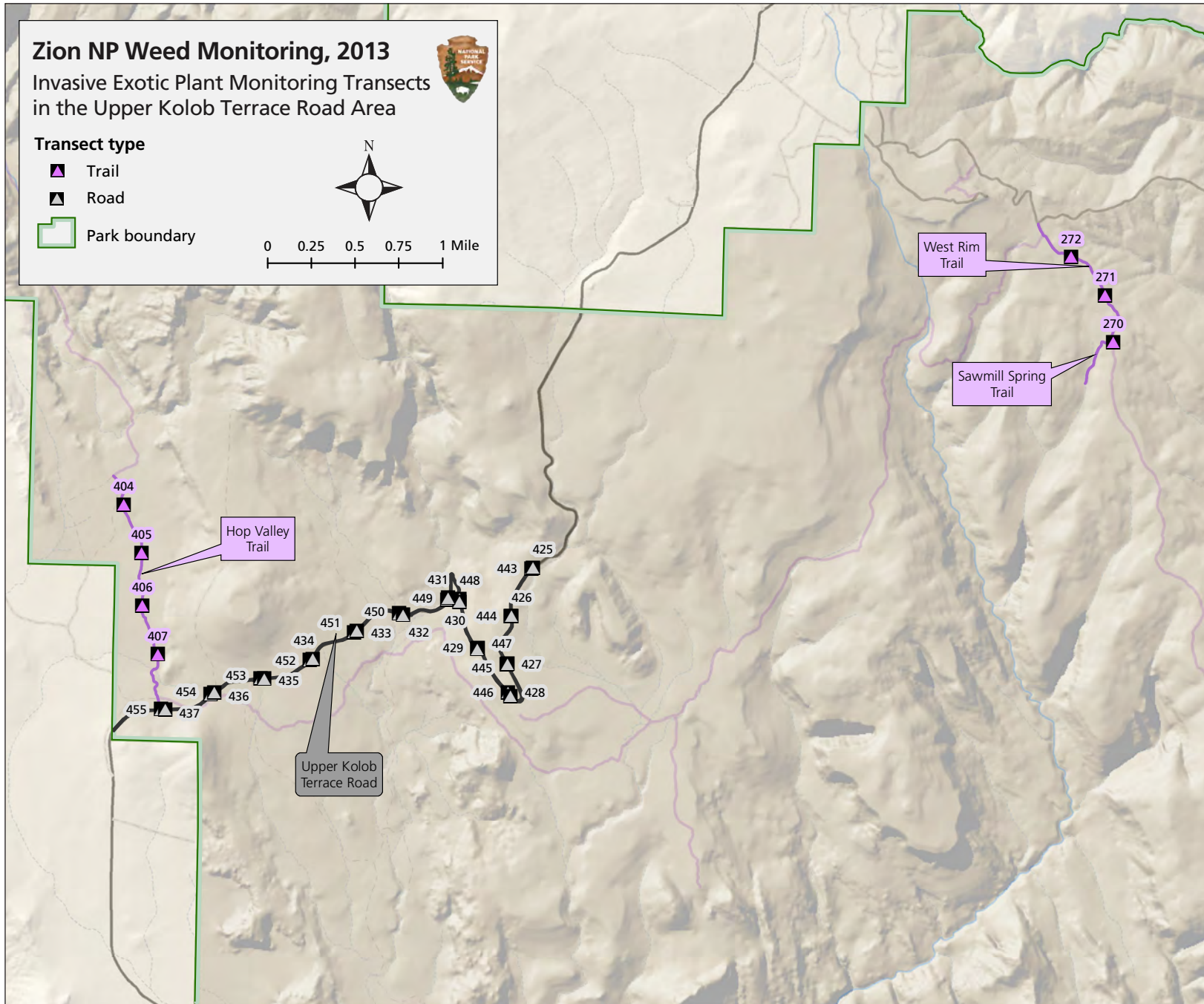


Figure 2-4. Monitoring routes and transects in the Upper Kolob Terrace Road area, Zion NP, June 19–26, 2013.

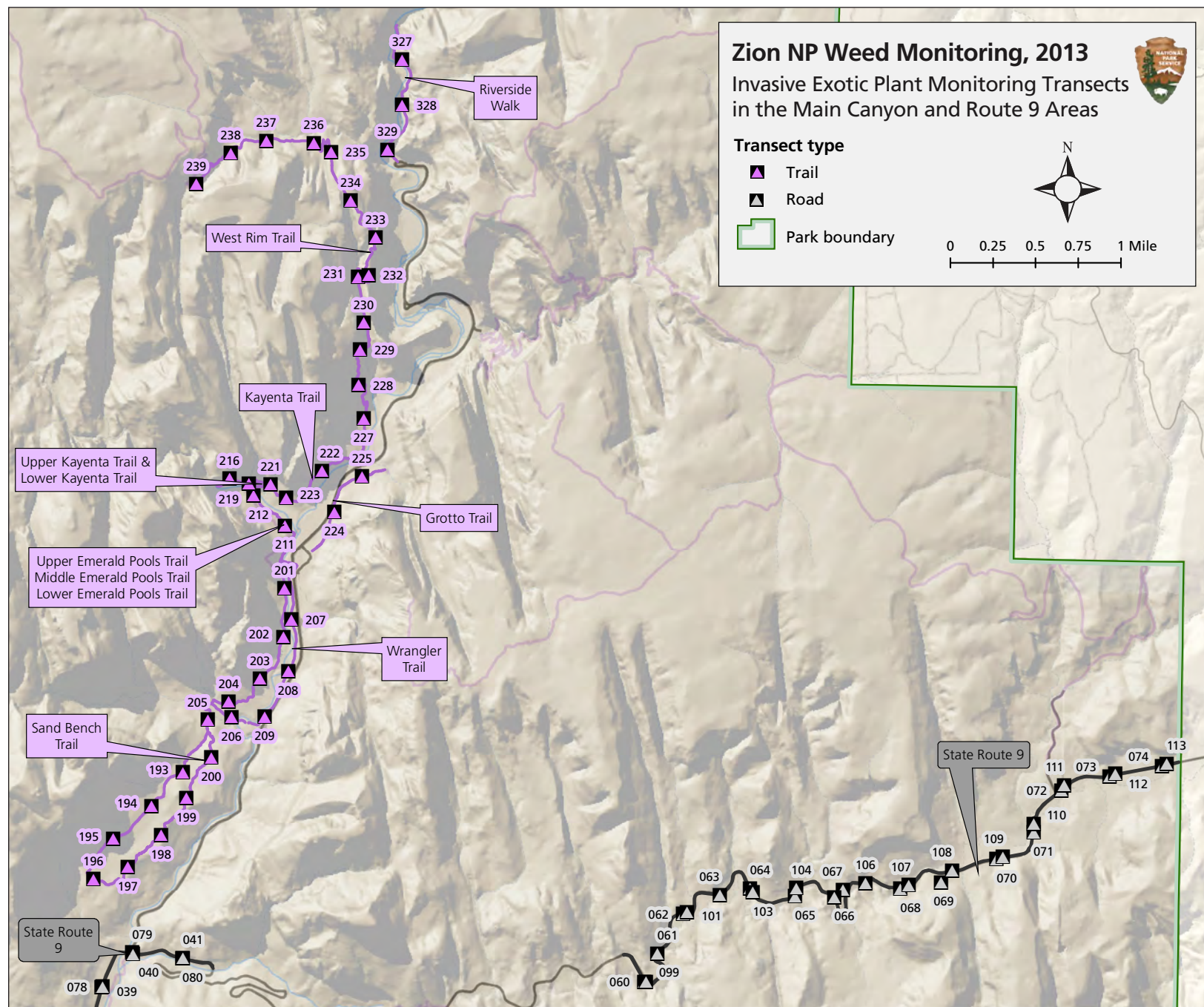


Figure 2-5. Monitoring routes and transects in the main canyon and Route 9 areas, Zion NP, June 19–26, 2013.

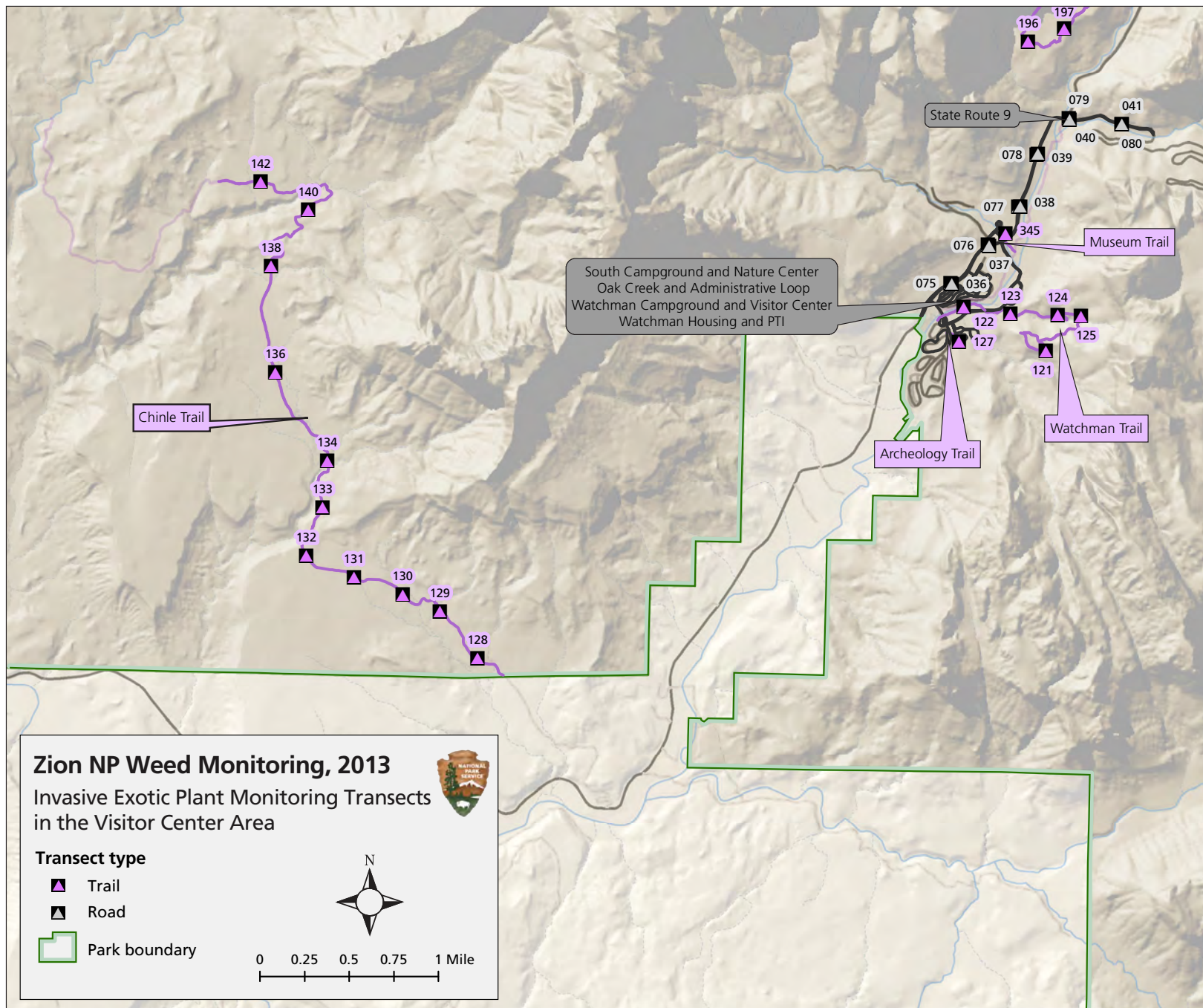


Figure 2-6. Monitoring routes and transects in the visitor center area, Zion NP, June 19–26, 2013.

3 Results

3.1 Target invasive exotic plant list

Thirty IEP species were identified as priority on the Zion NP target list for 2013, one more than in 2012 (see Table 2-1). Observers are 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 non-priority species are suspect. In addition, two species, cheatgrass (*Bromus tectorum*) and Russian thistle (*Salsola tragus*), were recorded consistently in all transects, but not mapped along routes, by all observers in 2013. This will continue in future years.

We recorded a total of seven priority IEP species on monitoring routes and one priority IEP on transects in 2013 (Table 3-1). One and two additional non-priority species were recorded on routes and transects, respectively. We covered 105.4 km (65.5 miles) of monitoring routes in 2013. Results from 2012 are displayed in Table 3-2 for reference but not discussed in this report, as they have been addressed in previous years (Perkins 2013).

3.2 Monitoring routes

A total of 132 priority infestations of seven different priority IEP species were detected along monitoring routes (Table 3-2; Figures 3-1 to 3-8; Electronic Appendix A) in 2013. The most common priority invasive species were bulbous bluegrass (*Poa bulbosa*), Siberian elm (*Ulmus pumila*), and Scotch thistle (*Onopordum acanthium*). These three species represented 87% of the priority infestations found.

Because some routes were completed over two years, Table 3-2 contains data collected over 2012 and 2013. The Watchman Campground and Visitor Center area had, by far, the highest number of priority infestations (16.46/km) of any route (see Table 3-2). The Hidden Canyon/Weeping Rock Trails (4.16/km) had the highest infestation density of any trail. The Watchman Housing Area, Upper Kolob Terrace Road, and South Campground and Nature Center had the next-highest IEP densities, at 3.43, 3.29, and 3.05

infestations/km, respectively. All other routes had fewer than three priority infestations per kilometer. Roads generally had higher infestation densities than trails. Several trails were free of priority IEP infestations.

Of the 132 priority infestations, 34% were larger than 40 m² (Table 3-3). Siberian elm was the only exotic tree species detected. Of the 28 tree infestations, 7 were seedlings, 2 were in the sapling stage, and 19 were mature trees (see Electronic Appendix A).

3.3 Monitoring transects

A total of 177 transects were sampled in 2013 (Table 3-4; see Figures 2-3 to 2-6, Electronic Appendix B). Only three IEP species were detected, only one of which was a priority species (bulbous bluegrass). IEPs were found on 111 transects (63%), with an average of 0.65 IEP species detected per plot. However, if only priority species were considered in comparison to 2012, then priority IEP species were only found in 2% of transects, with an average of 0.02 priority IEP species per transect. Cheatgrass had the highest percent cover, with 4.76%, 2.75%, 1.96%, and 1.38% along the Sand Bench Trail, Main Canyon Trails, State Route 9, and Central Canyon Trails, respectively. Cheatgrass was widespread, as it was present in 62% of the transects sampled in 2013. It was present in 93%, 85%, and 68%, of transects along the Sand Bench Trail, State Route 9, and Main Canyon Trails, respectively.

Table 3-1. Invasive exotic plants detected at Zion NP, June 19–26, 2013.

Scientific name	Common name	Method detected		Priority?
		Route	Transect	
<i>Bassia scoparia</i>	summer cypress	X		Yes
<i>Conium maculatum</i>	poison hemlock	X		Yes
<i>Cynodon dactylon</i>	Bermuda grass	X		Yes
<i>Onopordum acanthium</i>	Scotch thistle	X		Yes
<i>Poa bulbosa</i>	bulbous bluegrass	X	X	Yes
<i>Sorghum halepense</i>	Johnson grass	X		Yes
<i>Ulmus pumila</i>	Siberian elm	X		Yes
<i>Bromus tectorum</i>	cheatgrass		X	No
<i>Salsola tragus</i>	Russian thistle		X	No

Table 3-2. Number of IEP infestations and infestations/ha by route and route type, Zion NP, June 8–13, 2012, and June 19–26, 2013.

				Infestations		Infestations/km	
Route	Year	Length (m)	Area (ha)	Total	Priority only	Total	Priority only
Roads							
Kolob Scenic Drive	2013	17,412.1	5.23	18	18	1.03	1.03
Lava Point	2012	7,889.9	12.57	5	0	0.63	0.00
Lower Kolob Terrace	2012	13,082.7	13.49	12	8	0.92	0.61
Oak Creek & Administrative	2012–2013	4,193.9	5.04	3	1	0.72	0.48
S. Campground & Nature Ctr.	2013	3,606.4	3.31	12	11	3.33	3.05
Smith Mesa	2012	3,120.6	3.02	0	0	0.00	0.00
State Route 9	2013	21,405.3	5.83	7	6	0.33	0.33
Upper Kolob Terrace	2012–2013	18,852.8	11.52	74	62	3.93	3.29
Watchman CG and VC	2012–2013	4,860.3	7.70	80	80	16.46	16.46
Watchman Housing & PTI*	2013	4,373.6	2.42	15	15	3.43	3.43
Zion Scenic Drive	2012	20,513.0	20.41	51	45	2.49	2.19
	Roads, 2012	57,505.0	68.44	154	125	2.68	2.17
	Roads, 2013	61,805.7	22.08	123	121	1.99	1.96
Roads, 2012–2013		119,310.6	90.52	277	246	2.32	2.06
Trails							
Barney's	2012	418.4	0.62	0	0	0.00	0.00
Cable Mountain	2012	2,889.5	2.88	0	0	0.00	0.00
Central Trails¹	2012/2013	3,189.3	3.24	6	6	1.88	1.88
Chinle	2013	7,807.4	7.80	0	0	0.00	0.00
Connector	2012	6,024.7	23.92	1	0	0.17	0.00
Deertrap Mountain	2012	6,244.0	17.58	0	0	0.00	0.00
East Mesa/Observation Pt.	2012	7,637.7	12.36	2	0	0.26	0.00
East Rim/Stave Spring	2012	17,737.5	43.71	13	13	0.74	0.74
Emerald Pools Trails	2013	1,603.1	1.60	0	0	0.00	0.00
Hidden Canyon/Weeping Rock	2012	1,200.6	2.94	5	5	4.16	4.16
Hop Valley	2013	2,326.5	1.87	0	0	0.00	0.00
Kayenta Trails	2013	1,467.6	1.44	0	0	0.00	0.00
Northern Trails²	2013	6,823.6	6.38	0	0	0.00	0.00
Northgate Peaks/Wildcat	2012	11,125.7	24.88	20	17	1.80	1.53
Riverside Walk	2013	1,559.4	1.57	2	2	1.28	1.28
Sand Bench	2013	7,129.9	8.37	1	1	0.14	0.14
Sawmill Spring & West Rim	2013	8,369.6	6.54	0	0	0.00	0.00
Visitor Center Trails²	2012–2013	5,964.6	12.29	2	2	0.34	0.34
	Trails, 2012	55,881.7	136.62	41	35	0.73	0.63
	Trails, 2013	43,637.4	43.36	11	11	0.25	0.25
Trails, 2012–2013		99,519.1	179.98	52	46	0.52	0.46

¹Grotto, Wrangler, and Court of the Patriarch Trails

²La Verkin, Middle Taylor Creek, and Timber Creek Overlook Trails

³Archaeology, Museum, Parus, and Watchman Trails

*Shuttle staging area for Parks Transportation, Inc.

Bolded entries were surveyed in 2013.

Table 3-3. Number of infestations by species and infestation size class detected along monitoring routes, Zion NP, June 19–26, 2013.

Scientific name	Common name	Total infestations	Infestation size class*				
			1	2	3	4	5
<i>Bassia scoparia</i>	summer cypress	2	0	1	1	0	0
<i>Conium maculatum</i>	poison hemlock	1	0	1	0	0	0
<i>Cynodon dactylon</i>	Bermudagrass	10	2	2	3	1	2
<i>Onopordum acanthium</i>	Scotch thistle	22	14	5	2	1	0
<i>Poa bulbosa</i>	bulbous bluegrass	65	6	30	28	1	0
<i>Sorghum halepense</i>	Johnson grass	4	3	1	0	0	0
<i>Ulmus pumila</i>	Siberian elm	28	12	10	5	1	0
Total priority species		132	37	50	39	4	2

*Infestation size classes: 1 = 1–a few plants ($\leq 2 \times 2$ m), 2 = few plants–40 m² (48 yd²), 3 = 40–400 m² (48–478 yd²), 4 = 400–1,000 m² (0.1–0.25 acre), 5 = 1,000–2,000 m² (0.25–0.5 acre).

Table 3-4. Number of transects where priority exotic plant species were detected/total transects monitored, mean percent cover, and standard error along monitoring routes at Zion NP, June 19–26, 2013.

Route	<i>Poa bulbosa</i> (bulbous bluegrass)		<i>Salsola tragus</i> * (Russian thistle)		<i>Bromus tectorum</i> * (cheatgrass)		All species	
	Detected/ Total	Percent cover (SE)	Detected/ Total	Percent cover (SE)	Detected/ Total	Percent cover (SE)	Detected/ Total	Percent cover (SE)
Main Canyon Trails ¹	1/22	0.01 (0.01)	1/22	0.01 (0.01)	15/22	2.73 (1.33)	15/22	2.75 (1.33)
Northern Trails ²	0/11	0.00 (0.00)	0/11	0.00 (0.00)	3/11	0.24 (0.18)	3/11	0.24 (0.18)
Central Trails ³	0/20	0.00 (0.00)	0/20	0.00 (0.00)	9/20	1.38 (0.70)	9/20	1.38 (0.70)
Sand Bench Trail	0/14	0.00 (0.00)	0/14	0.00 (0.00)	13/14	4.76 (2.28)	13/14	4.76 (2.28)
Chinle Trail	0/11	0.00 (0.00)	0/11	0.00 (0.00)	6/11	0.12 (0.04)	6/11	0.12 (0.04)
State Route 9	0/39	0.00 (0.00)	0/39	0.00 (0.00)	33/39	1.96 (0.40)	33/39	1.96 (0.40)
Kolob Scenic Drive	0/34	0.00 (0.00)	0/34	0.00 (0.00)	20/34	0.84 (0.32)	20/34	0.84 (0.32)
Upper Kolob Terrace Rd.	3/26	0.04 (0.02)	0/26	0.00 (0.00)	13/26	0.89 (0.30)	14/26	0.93 (0.30)
All transects	4/177	0.01 (<0.01)	1/177	<0.01 (<0.01)	110/177	1.62 (0.29)	111/177	1.63 (0.29)

*Not a priority species but was recorded consistently by all observers in 2013.

¹Archaeology, Watchman, Museum, Grotto, Wrangler, Lower Emerald Pools, Middle Emerald Pools, Upper Emerald Pools, Kayenta, Upper Kayenta, and Riverside Walk Trails

²La Verkin Creek, Middle Taylor Creek, and Timber Creek Overlook Trails

³Hop Valley and West Rim Trails

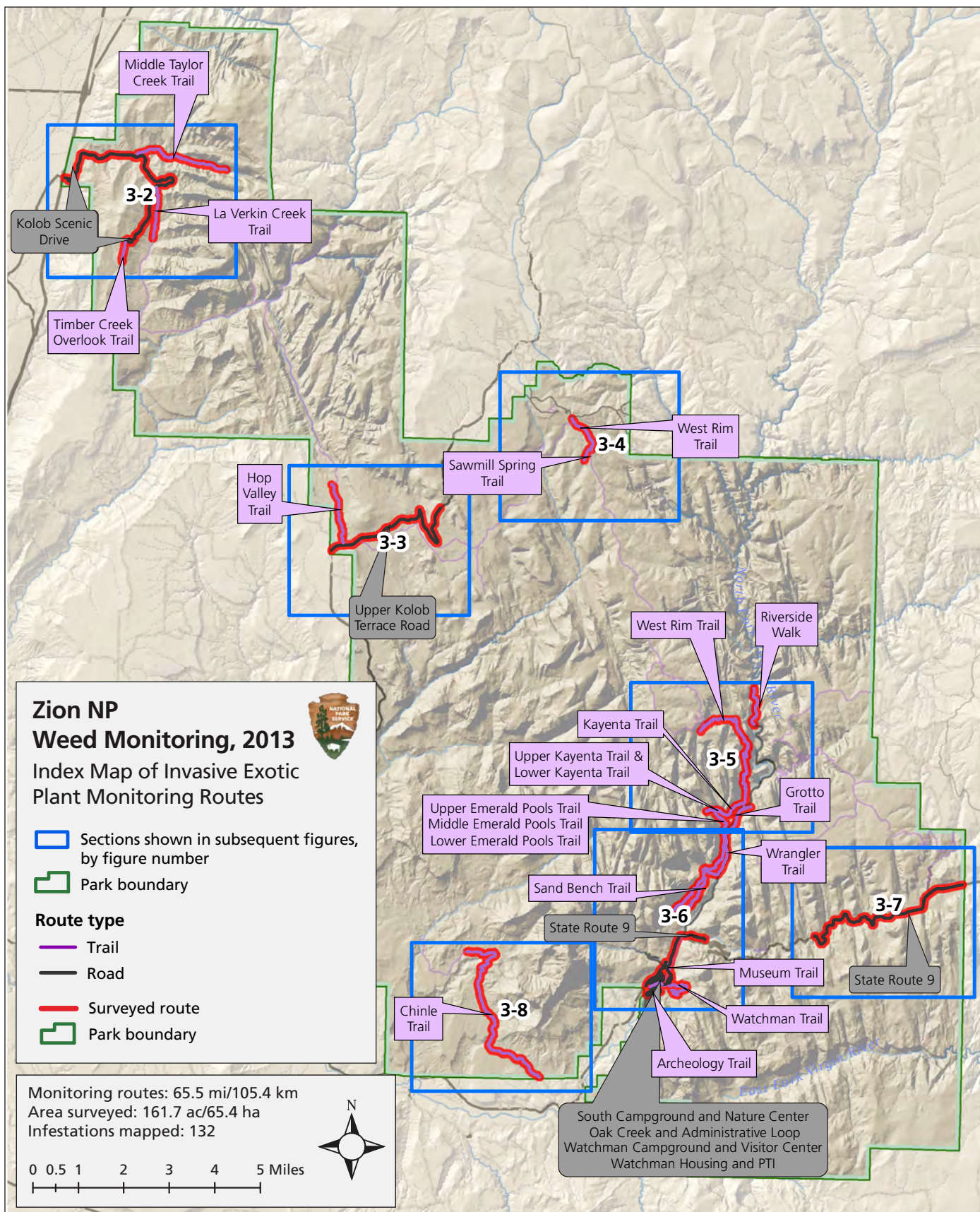


Figure 3-1. Index map of invasive plant monitoring routes by figure number, Zion National Park, June 19–26, 2013.

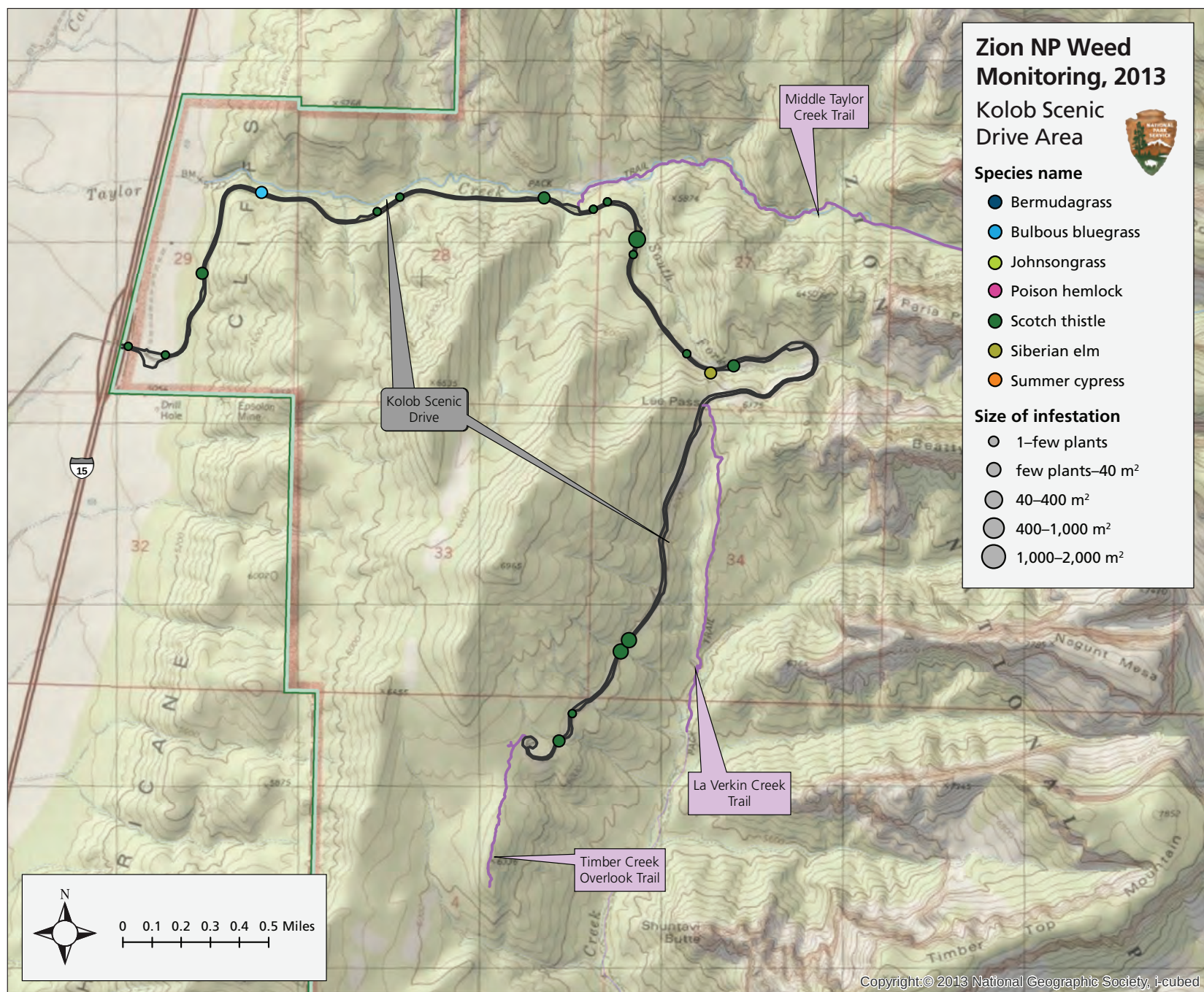


Figure 3-2. Invasive plants detected on monitoring routes in the Kolob Scenic Drive area, Zion National Park, June 19–26, 2013.



Figure 3-3. Invasive plants detected on monitoring routes in the Upper Kolob Terrace Road area, Zion National Park, June 19–26, 2013.

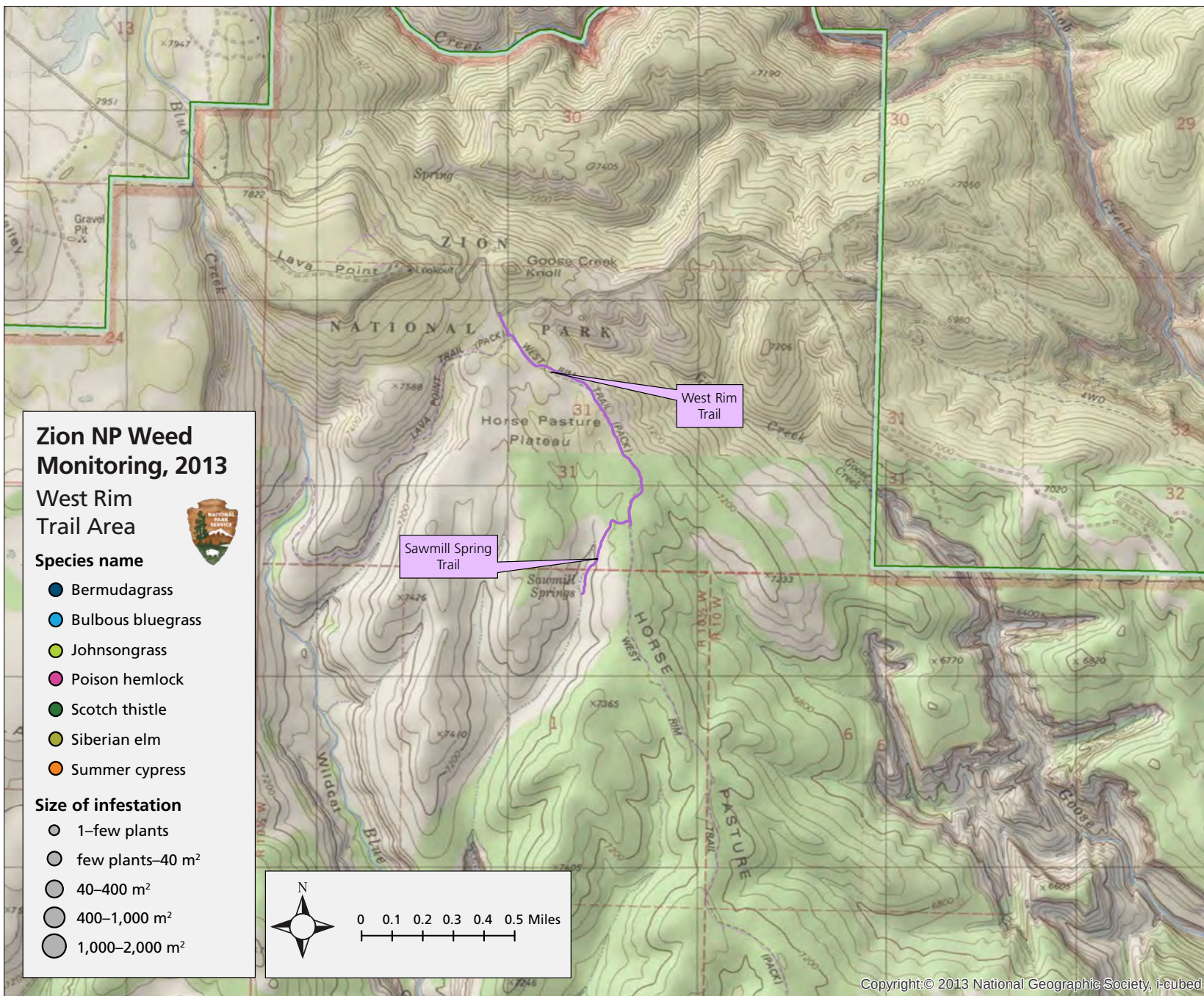


Figure 3-4. Invasive plants detected on monitoring routes in the West Rim Trail area, Zion National Park, June 19–26, 2013. (No IEPs were found on this route.)

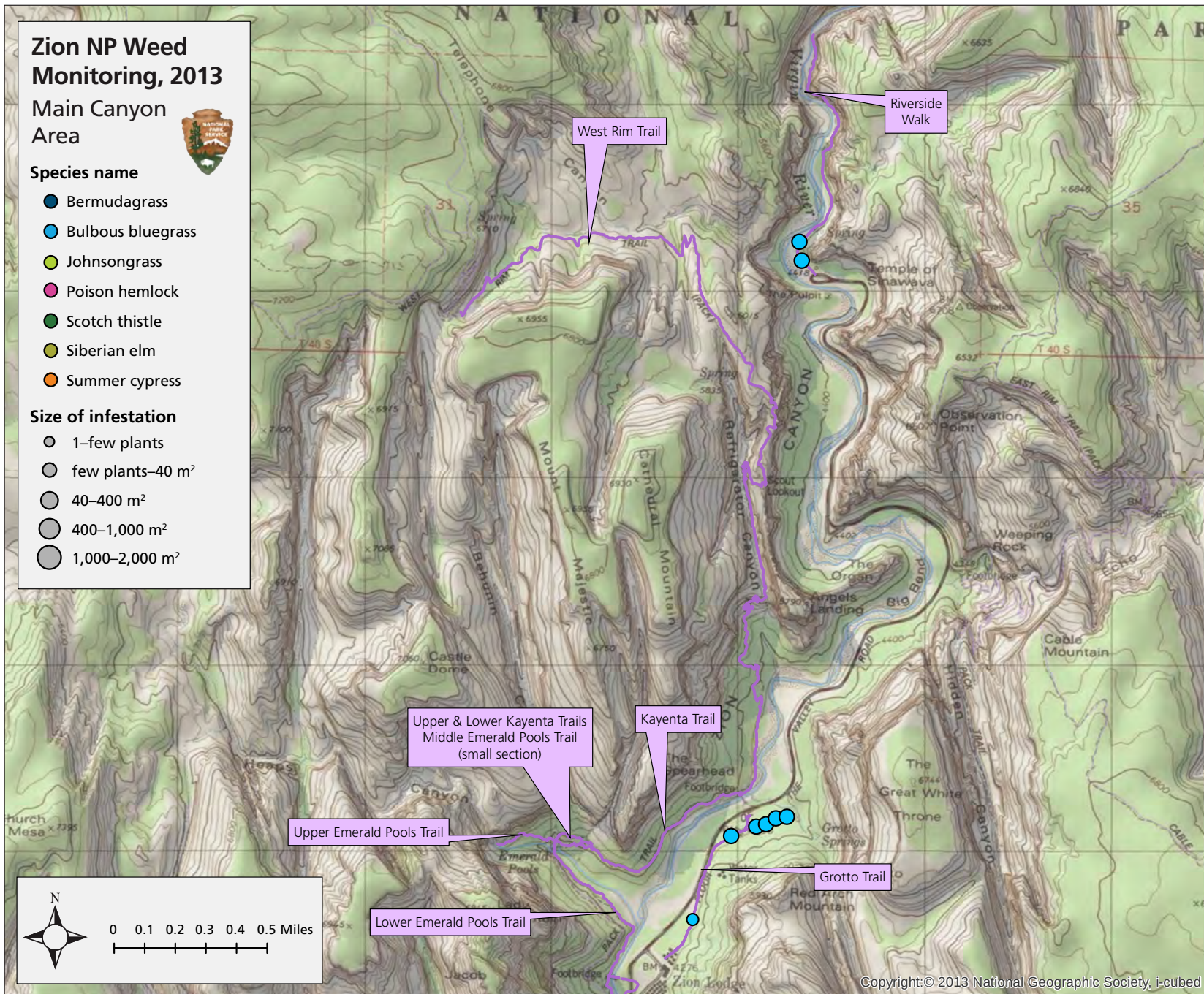


Figure 3-5. Invasive plants detected on monitoring routes in the main canyon area, Zion National Park, June 19–26, 2013.

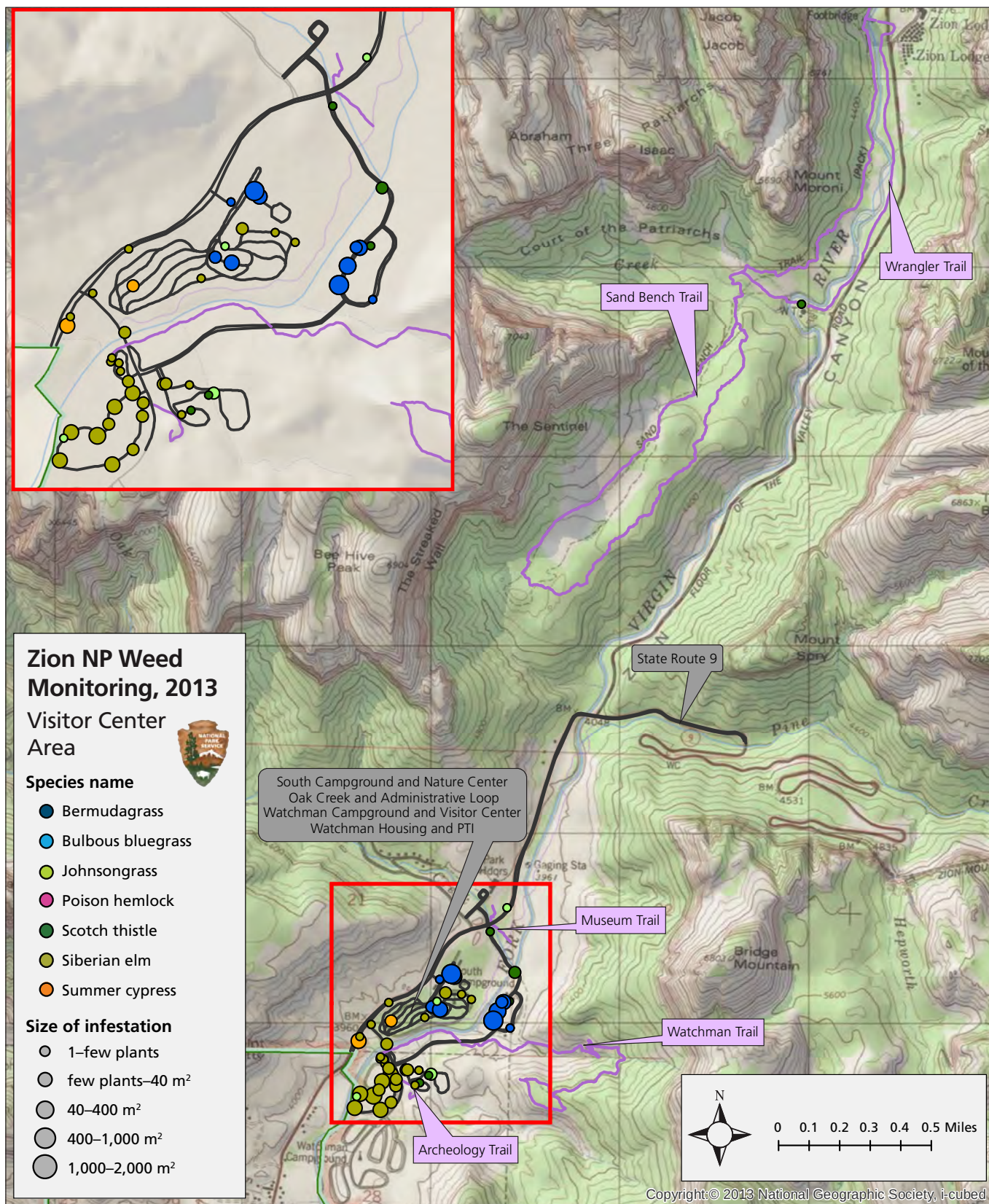


Figure 3-6. Invasive plants detected on monitoring routes in the visitor center area, Zion National Park, June 19–26, 2013.

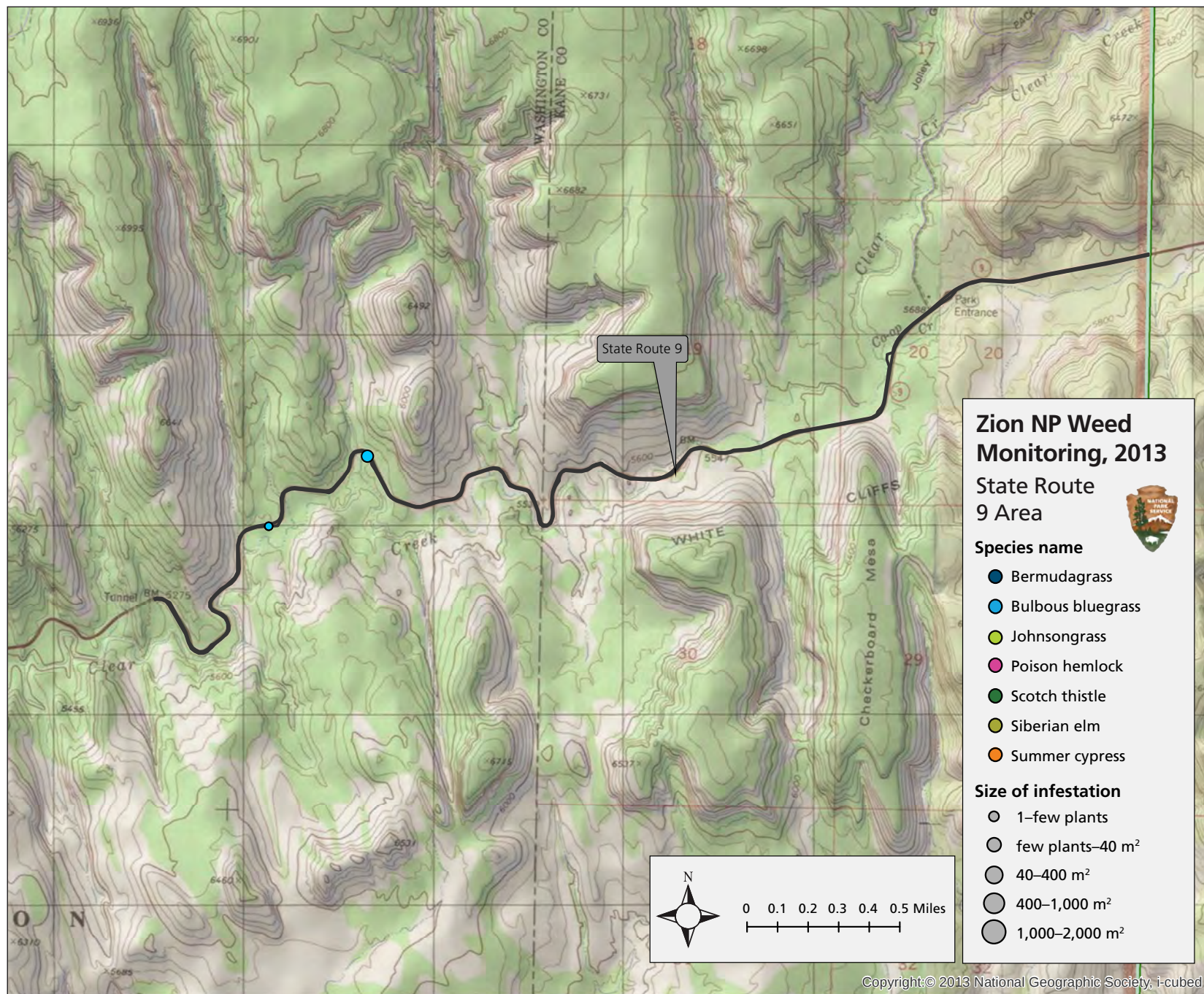


Figure 3-7. Invasive plants detected on monitoring routes in the State Route 9 area, Zion National Park, June 19–26, 2013.

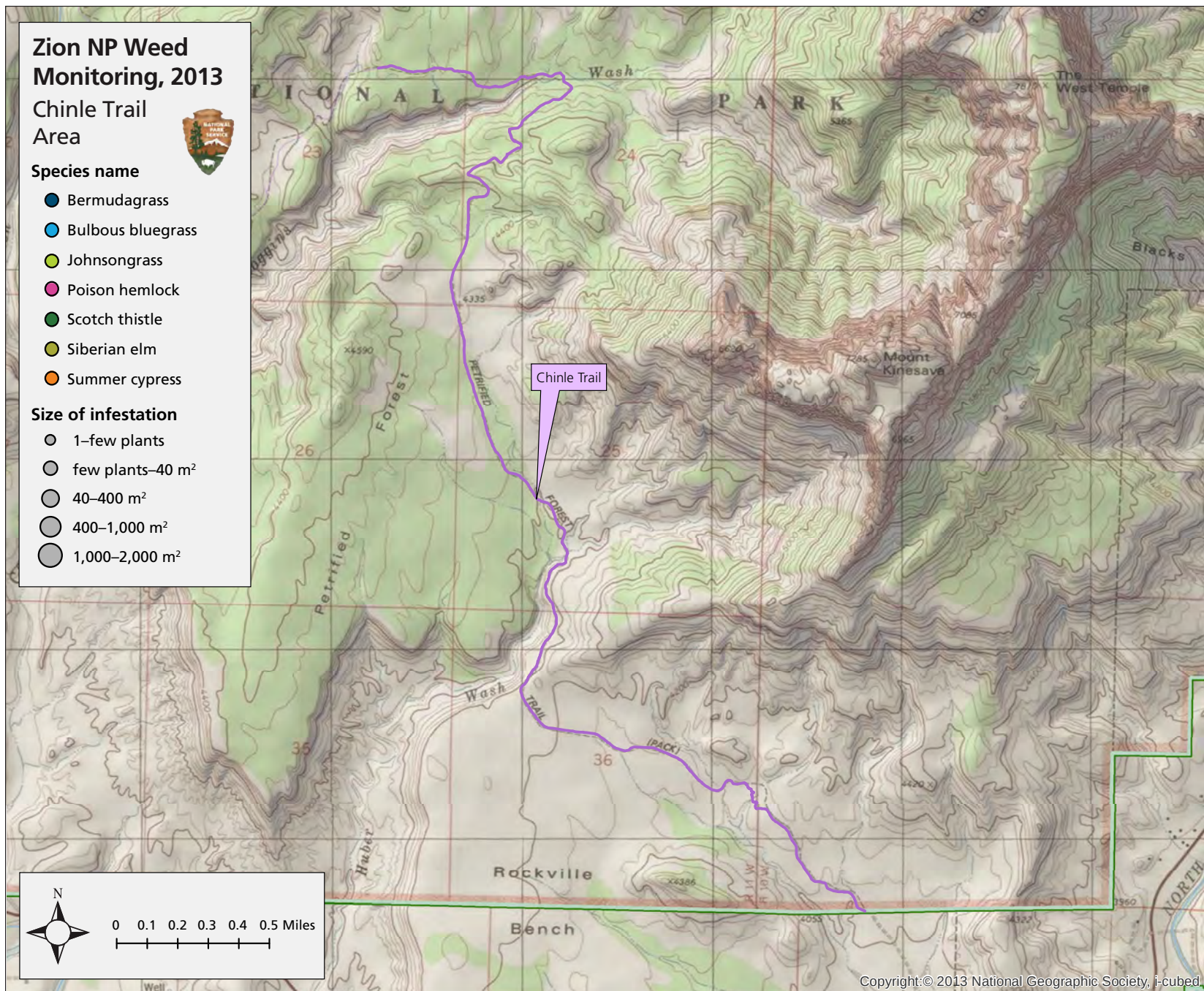


Figure 3-8. Invasive plants detected on monitoring routes in the Chinle Trail area, Zion National Park, June 19–26, 2013. (No IEPs were found on this route.)

4 Discussion

4.1 Priority IEP 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. Cheatgrass and Russian thistle were added to the species list for transects only in 2013, but these species were not mapped due to their widespread presence. 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.

4.2 Possibilities for management control

Bulbous bluegrass was the most widespread invasive plant (49% of priority infestations), but it is one that can be controlled with spring tilling, planting native grasses, or chemical control. Siberian elm, the second-most prevalent invasive species, can generally be controlled by cutting and girdling or hand-pulling seedlings. Scotch thistle, the third-most common priority invasive plant, is best controlled with manual methods, such as pulling, but careful use of herbicides can also be effective if done at the right time and growth stage.

Only 34% of priority infestations were larger than 40 m², indicating that control is still possible. Efforts should be made to control invasive plants in high-use visitor areas that tended to have the most invasive plants (Watchman Campground and Visitor Center, South Campground and Nature Center, Watchman Housing and PTI* area, Upper Kolob Terrace Road, Zion Scenic Drive, and Weeping Rock/Hidden Canyon Trails). Infestations were generally higher in areas that receive more visitation. Infestation densities were also generally higher along roads than trails.

It should also be noted that overall percent cover was very low and several monitoring routes had either few or no priority invasive plants (see Table 3-2). Efforts should be made to keep these areas IEP-free. Estimates of percent cover in this report (see Table 3-4) 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.

4.3 Future monitoring efforts

IEPs at Zion NP will generally be monitored at the same time each 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 through September is not expected to drastically alter the chances of detecting invasive species at a level larger than the minimum detection target size.

In 2014, the NCPN will expand monitoring efforts to new areas in the park (exact routes to be determined). We may also complete some extra-area surveys in locations yet to be determined. Because any previous detections could have been eradicated by park staff, the locations of monitoring quadrats are re-generated each year. 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. The NCPN invasive plant monitoring protocol completed the peer review process was approved in September 2013.

*Shuttle staging area for Parks Transportation, Inc.

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