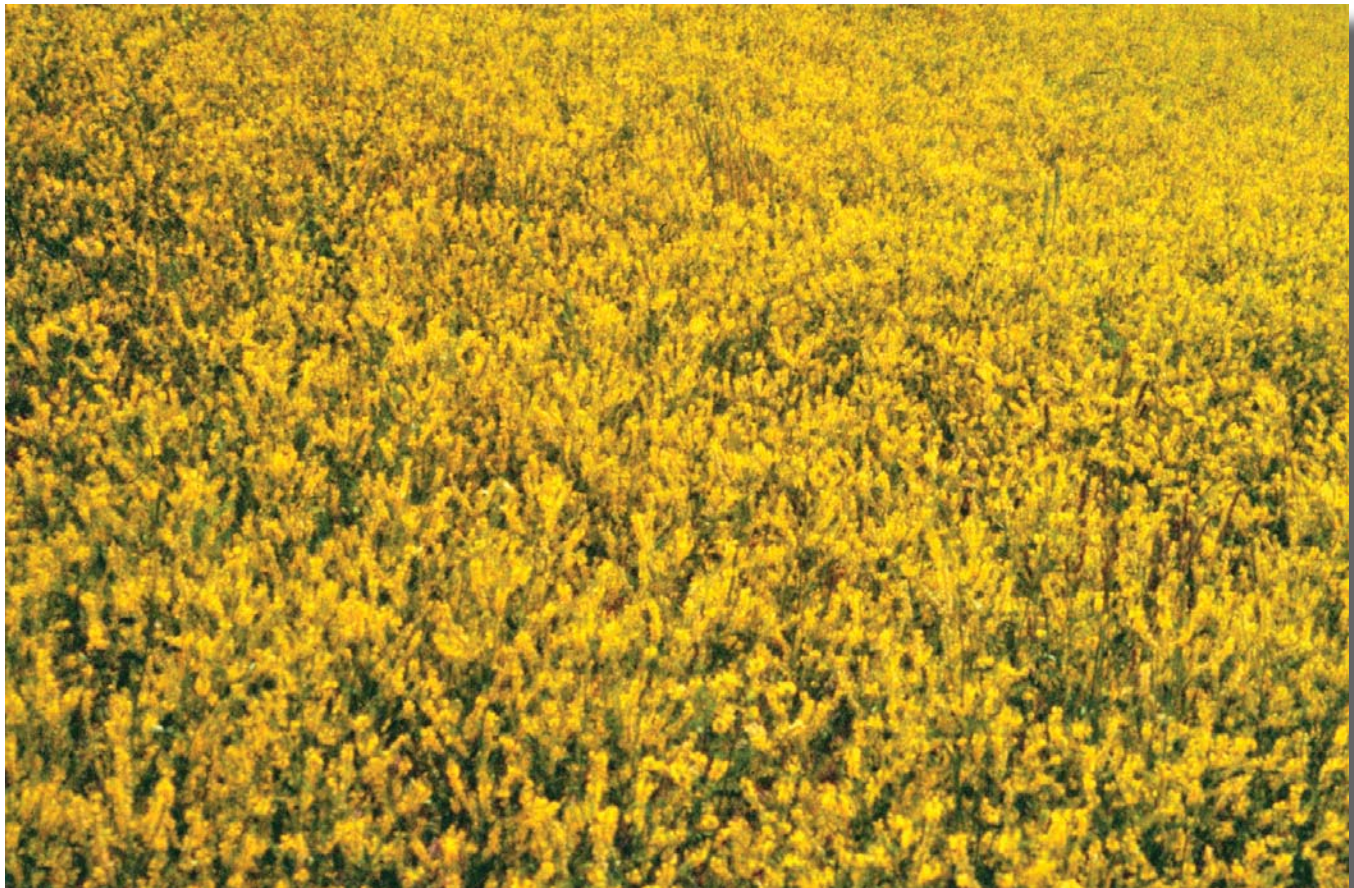




Invasive Exotic Plant Monitoring in Black Canyon of the Gunnison National Park and Curecanti National Recreation Area

2011 Field Season

Natural Resource Technical Report NPS/NCPN/NRTR—2012/575



ON THE COVER

Yellow sweetclover (*Melilotus officinale*). Photo by Steve Dewey, Utah State University, Bugwood.org.

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Contents

Figures..... v

Tables vii

Abstract..... ix

Acronyms xi

Acknowledgements xiii

1 Introduction..... 1

2 Methods..... 3

 2.1 Developing a park priority invasive exotic plant list..... 3

 2.2 Monitoring routes..... 3

 2.3 Monitoring transects..... 5

 2.4 Analyses 6

3 Results..... 13

 3.1 Priority invasive exotic plant list..... 13

 3.2 Monitoring routes..... 13

 3.3 Monitoring transects..... 14

 3.4 Results comparison: 2003–2004 and 2011..... 14

4 Discussion..... 27

5 Literature Cited 29

Appendices 31

 Appendix A. Exotic plant invasions detected on monitoring routes, Black Canyon of the Gunnison National Park and Curecanti National Recreation Area, July 5–August 21, 2011..... 31

 Appendix B. Invasive exotic plant percent cover detected by monitoring quadrats, Black Canyon of the Gunnison National Park and Curecanti National Recreation Area, July 5–August 21, 2011..... 31

Figures

Figure 2-1. The maximum effective detection distance (EDD) at BLCA/CURE ranged from 2.5 to 12.5 meters, making the effective detection swath width (EDSW) 5–25 meters. 4

Figure 2-2. Overview of invasive plant monitoring routes and extra areas surveyed at Black Canyon of the Gunnison NP, July 5–August 21, 2011. 7

Figure 2-3. Overview of invasive plant monitoring routes and extra areas surveyed at Curecanti NRA, July 5–August 21, 2011. 8

Figure 2-4. Monitoring quadrats established at Black Canyon of the Gunnison NP, July 5–August 21, 2011. 9

Figure 2-5. Monitoring quadrats established at Curecanti NRA, July 5–August 21, 2011. 10

Figure 2-6. Monitoring quadrats established at Curecanti NRA, July 5–August 21, 2011. 11

Figure 3-1. Invasive plant monitoring routes, Black Canyon of the Gunnison NP and Curecanti NRA, July 5–August 21, 2011. 17

Figure 3-2. Invasive plants detected on monitoring routes and quadrats in the vicinity of Beaver Creek, Curecanti NRA, July 5–August 21, 2011. 18

Figure 3-3. Invasive plants detected on monitoring routes and quadrats in the vicinity of the Iola Basin, Curecanti NRA, July 5–August 21, 2011. 19

Figure 3-4. Invasive plants detected on monitoring routes and quadrats in the vicinity of Dry Creek, Curecanti NRA, July 5–August 21, 2011. 20

Figure 3-5. Invasive plants detected on monitoring routes and quadrats in the vicinity of the Elk Creek Visitor Center, Curecanti NRA, July 5–August 21, 2011. 21

Figure 3-6. Invasive plants detected on monitoring routes and quadrats in the vicinity of Middle Bridge, Curecanti NRA, July 5–August 21, 2011. 22

Figure 3-7. Invasive plants detected on monitoring routes and quadrats along Soap Creek Arm, Curecanti NRA, July 5–August 21, 2011. 23

Figure 3-8. Invasive plants detected on monitoring routes and quadrats in the western portion of Curecanti NRA, July 5–August 21, 2011. 24

Figure 3-9. Invasive plants detected on monitoring routes along Deadhorse Trail, Black Canyon of the Gunnison NP, July 5–August 21, 2011. 25

Figure 3-10. Invasive plants detected on monitoring routes along South Rim Road, Black Canyon of the Gunnison NP, July 5–August 21, 2011. 26

Tables

Table 2-1. Priority invasive plant list, Black Canyon of the Gunnison NP and Curecanti NRA, 2011.....	3
Table 3-1. Invasive exotic plants detected, Black Canyon of the Gunnison NP and Curecanti NRA, July 5–August 21, 2011.	13
Table 3-2. Number of IEP infestations and infestations/100 m along monitoring routes, Black Canyon of the Gunnison NP and Curecanti NRA, July 5–August 21, 2011.	14
Table 3-3. Species observed and infestation size class detected along monitoring routes, Black Canyon of the Gunnison NP and Curecanti NRA, July 5 to August 21, 2011.....	15
Table 3-4. Number of monitoring transects where priority exotic plant species were detected, mean percent cover, and standard error, Black Canyon of the Gunnison NP and Curecanti NRA, July 5–August 21, 2011.	16

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. This report represents work completed at Black Canyon of the Gunnison National Park (BLCA) and Curecanti National Recreation Area (CURE) during 2011. Over 84 km were monitored along the shores of Blue Mesa Reservoir, along the South Rim Road, and along Deadhorse Trail from July 5 to August 21, 2011. Twenty-nine IEP species were detected on monitoring routes and transects. Of these, 15 were priority species, accounting for 704 separate infestations. Canada thistle (*Breca arvensis*), musk thistle (*Carduus nutans*), summer cypress (*Bassia sieversiana*), and Russian thistle (*Salsola australis*) were the most widespread species found along monitoring routes. Among priority species, summer cypress and Canada thistle had the highest percent cover found in transects along Blue Mesa Reservoir. Only one priority species, cheatgrass (*Anisantha tectorum*), was found in transects along the South Rim Road, while none were found along Deadhorse Trail. Network staff will return to BLCA and CURE in 2012 to complete the initial rotation of invasive monitoring routes.

Acronyms

BFP	Between Feature Position
BLCA	Black Canyon of the Gunnison National Park
CURE	Curecanti National Recreation Area
EDD	effective detection distance
EDSW	effective detection swath width
IEP	invasive exotic plant
MDTS	minimum detection target size
NCPN	Northern Colorado Plateau Network
NP	national park
NPS	National Park Service
NRA	national recreation area
PSR	patch separation resolution

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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 it may miss exotic plants dispersed to the interior areas of large parks by wind and/or animals. This report summarizes the 2011 field season at Black Canyon of the Gunnison National Park (BLCA) and Curecanti National Recreation Area (CURE).

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 (in review), 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).

The first step was to have BLCA, CURE, and NCPN staff review and update the list of priority invasive plants for the park (see below). Next, we established a series of co-located monitoring routes and quadrats along all roads, major drainages, and trails in the parks. The quadrats, which are 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, 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.

2.1 Developing a park priority invasive exotic plant list

NCPN, BLCA, and CURE staff reviewed the 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 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 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.

2.2 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 m² (0.01 acres or approximately 20 × 20 ft) for all IEPs. Use of the MDTS was necessary because field

Table 2-1. Priority invasive plant list, Black Canyon of the Gunnison NP and Curecanti NRA, 2011.

Scientific name	Common name
<i>Acosta diffusa</i>	diffuse knapweed
<i>Acosta maculosa</i>	spotted knapweed
<i>Acroptilon repens</i>	Russian knapweed
<i>Arctium minus</i>	burdock
<i>Artemisia absinthium</i>	absinthium
<i>Bassia sieversiana</i>	summer cypress
<i>Breia arvensis</i>	Canada thistle
<i>Cardaria draba</i>	hoary cress
<i>Cardaria latifolia</i>	broad-leaf pepperwort
<i>Carduus nutans</i> var. <i>macrolepis</i>	musk thistle
<i>Cirsium vulgare</i>	bull thistle
<i>Cynoglossum officinale</i>	common hound's-tongue
<i>Elaeagnus angustifolia</i>	Russian olive
<i>Hesperis matronalis</i>	Dame's rocket
<i>Hyoscyamus niger</i>	black henbane
<i>Iva xanthifolia</i>	marsh elder
<i>Leucanthemum vulgare</i>	ox-eye daisy
<i>Linaria genistifolia</i> ssp. <i>dalmatica</i>	Dalmatian toadflax
<i>Linaria vulgaris</i>	butter-and-eggs
<i>Matricaria perforata</i>	chamomile
<i>Onopordum acanthium</i>	Scotch thistle
<i>Phalaris arundinacea</i>	reed canarygrass
<i>Potentilla recta</i>	sulfur cinquefoil
<i>Rubus armeniacus</i>	Himalayan blackberry
<i>Salsola australis</i>	Russian thistle
<i>Tamarix ramosissima</i>	five-stamen tamarisk
<i>Tithymalus esula</i>	leafy spurge
<i>Ulmus pumila</i>	Siberian elm
<i>Verbascum thapsus</i>	woolly mullein

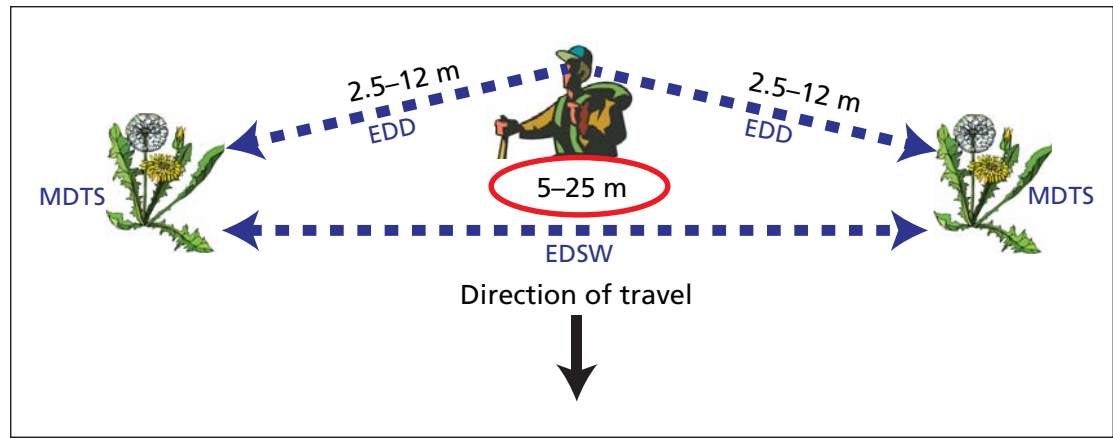


Figure 2-1. The maximum effective detection distance (EDD) at BLCA/CURE ranged from 2.5 to 12 meters, making the effective detection swath width (EDSW) 5–25 meters.

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 ramosissima*), 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 a searcher could consistently detect (i.e., see and recognize) the MDTs of the least-visible priority species with at least 90% detection 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 BLCA/CURE was between 2.5 and 12.5 m, depending on vegetation.

2.2.3 Effective Detection Swath Width

Effective detection swath width (EDSW) was 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 priority 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 5–25 m at BLCA/CURE.

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 infestations. 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 infestation. The PSR was 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 weed-control operations. If an infestation 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 infestation.

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 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

For the South Rim Road, we walked five meters out from one side of the road and then returned to the starting point by walking

back five meters from the road on the other side. In some cases, due to topography and property boundaries, it was not possible to walk five meters from the road. For single-track trails and reservoir shorelines, we walked the center of the trail or drainage in only one direction (Figures 2-2, 2-3).

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 5–25 m (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 species that were designated as priority were consistently recorded on monitoring routes. Survey crew members were given the latitude 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 point, 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.

Infestation 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) $40\text{--}400 \text{ m}^2$ (48–478 yd^2)
- 4) $400\text{--}1,000 \text{ m}^2$ (0.1–0.25 acre)
- 5) $1,000\text{--}2,000 \text{ m}^2$ (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 infestation: 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

Our methods for sampling monitoring transects and associated quadrats were based on Stohlgren and others (2005). We established transects with three vegetation quadrats every 500 m along monitoring routes (Figures 2-4, 2-5, 2-6). 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 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 road on the same side as the route that was being walked and on alternating sides for riparian areas, small roads or trails. If there was not enough space between the route and a topographic feature or property boundary, the three quadrats were evenly spaced between the route and the boundary. A 1-m^2 sampling frame was used to sample cover of vegetation and soil surface features by placing it on the right side of the transect line as the technician walks from the monitoring route. The sampling frame was leveled in some cases 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. 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 number of infestations per hectare 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.

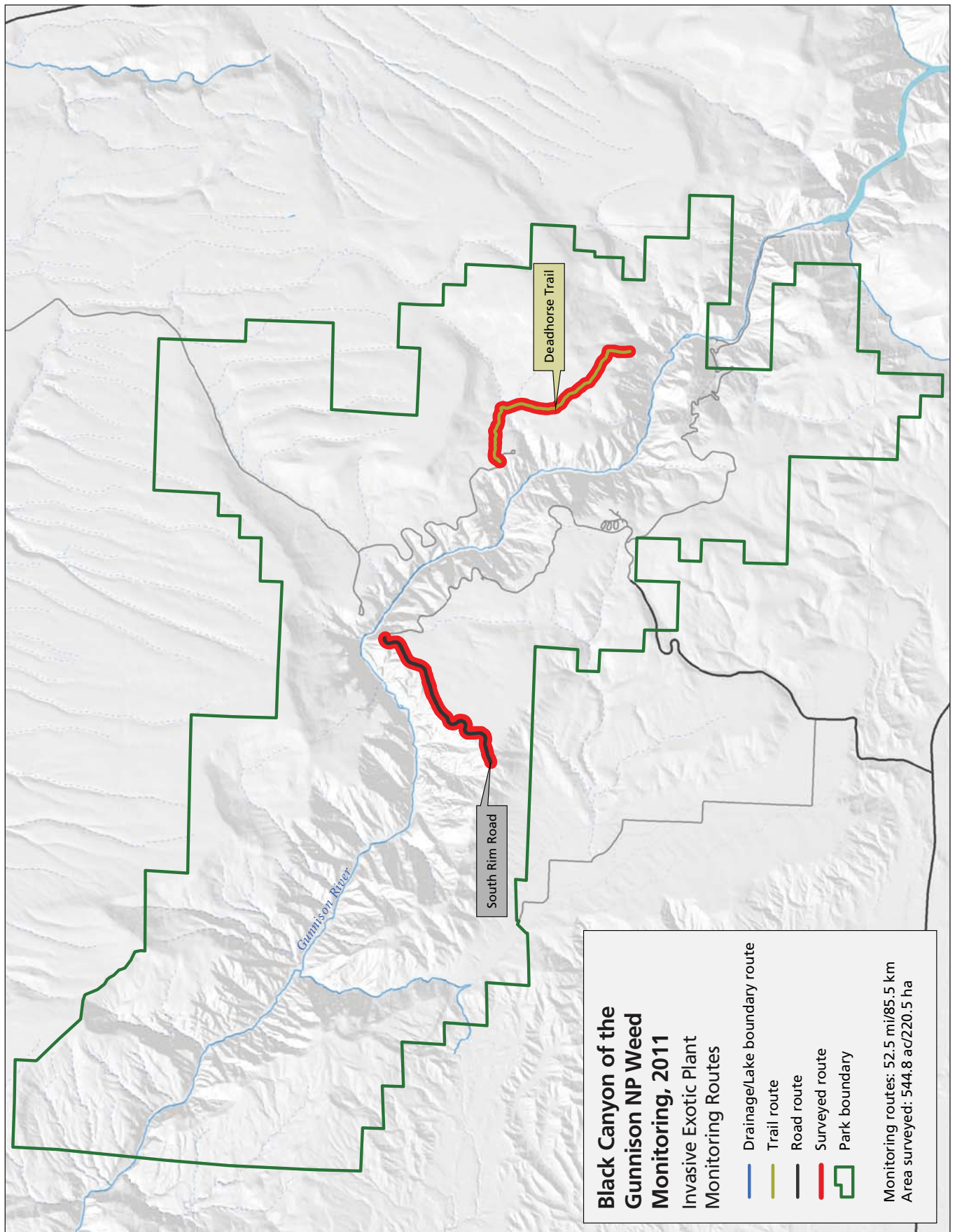


Figure 2-2. Overview of invasive plant monitoring routes and extra areas surveyed at Black Canyon of the Gunnison NP, July 5–August 21, 2011.

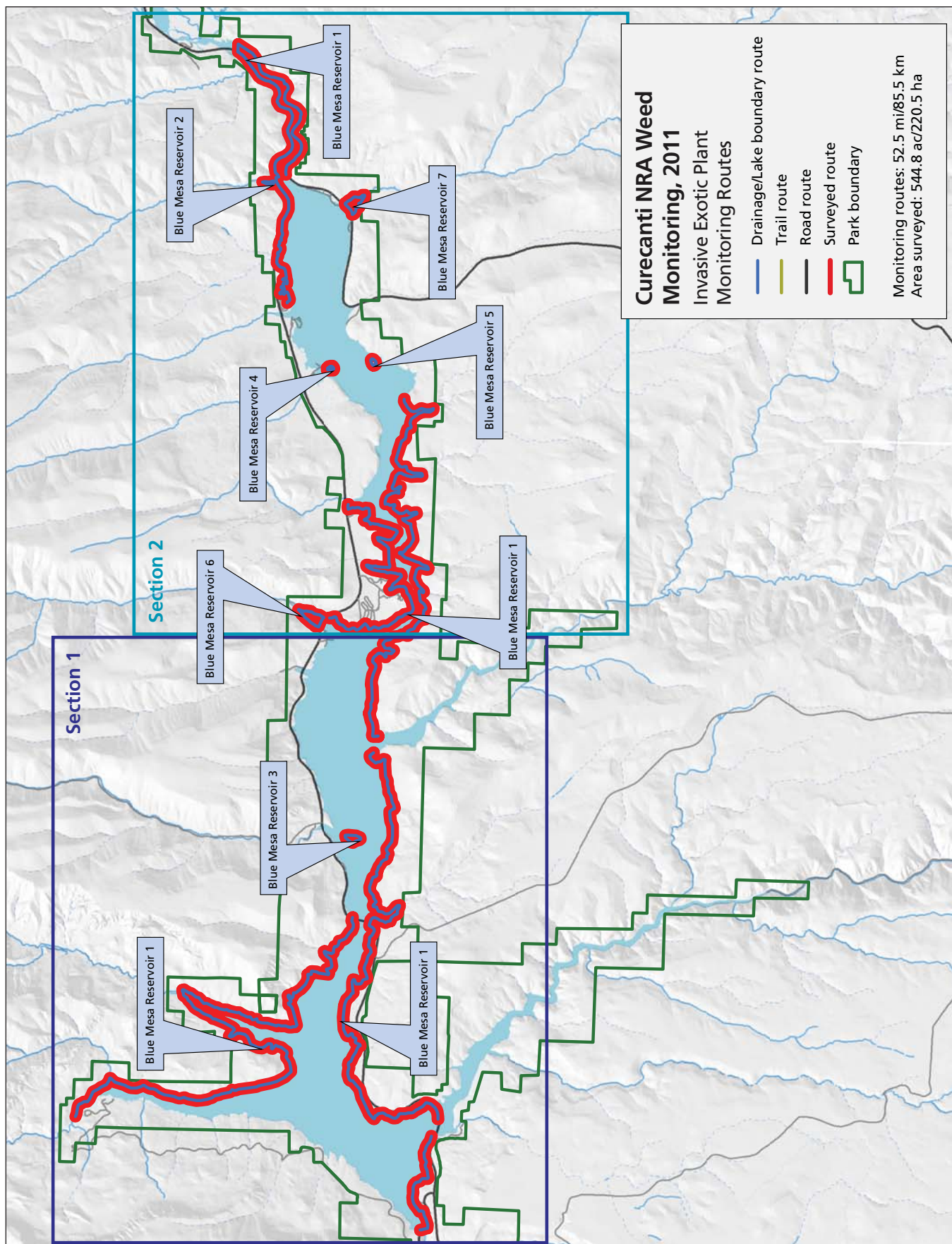


Figure 2-3. Overview of invasive plant monitoring routes and extra areas surveyed at Curecanti NRA, July 5–August 21, 2011.

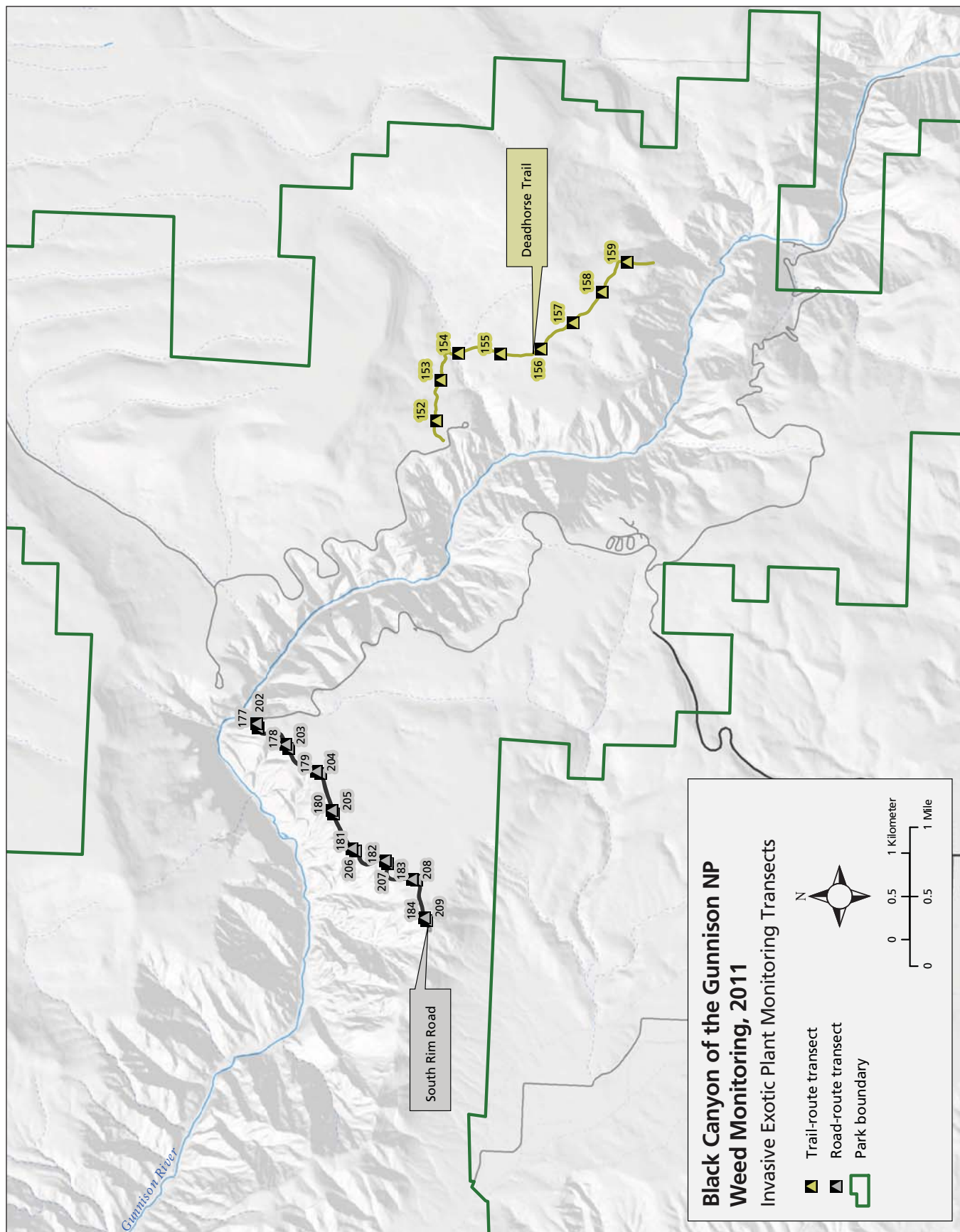


Figure 2-4. Monitoring quadrats established at Black Canyon of the Gunnison NP, July 5–August 21, 2011.

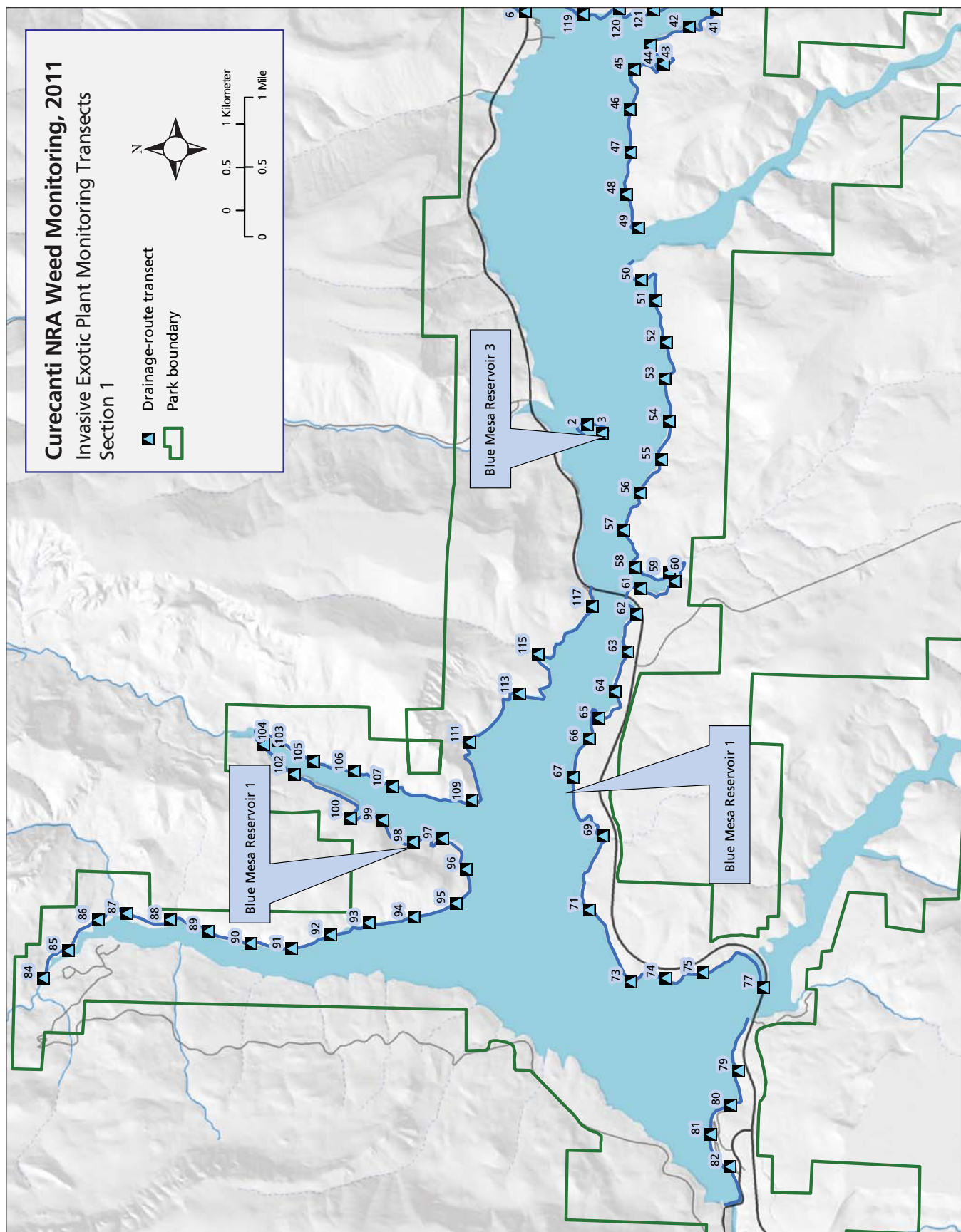


Figure 2-5. Monitoring quadrats established at Curecanti NRA, July 5–August 21, 2011.

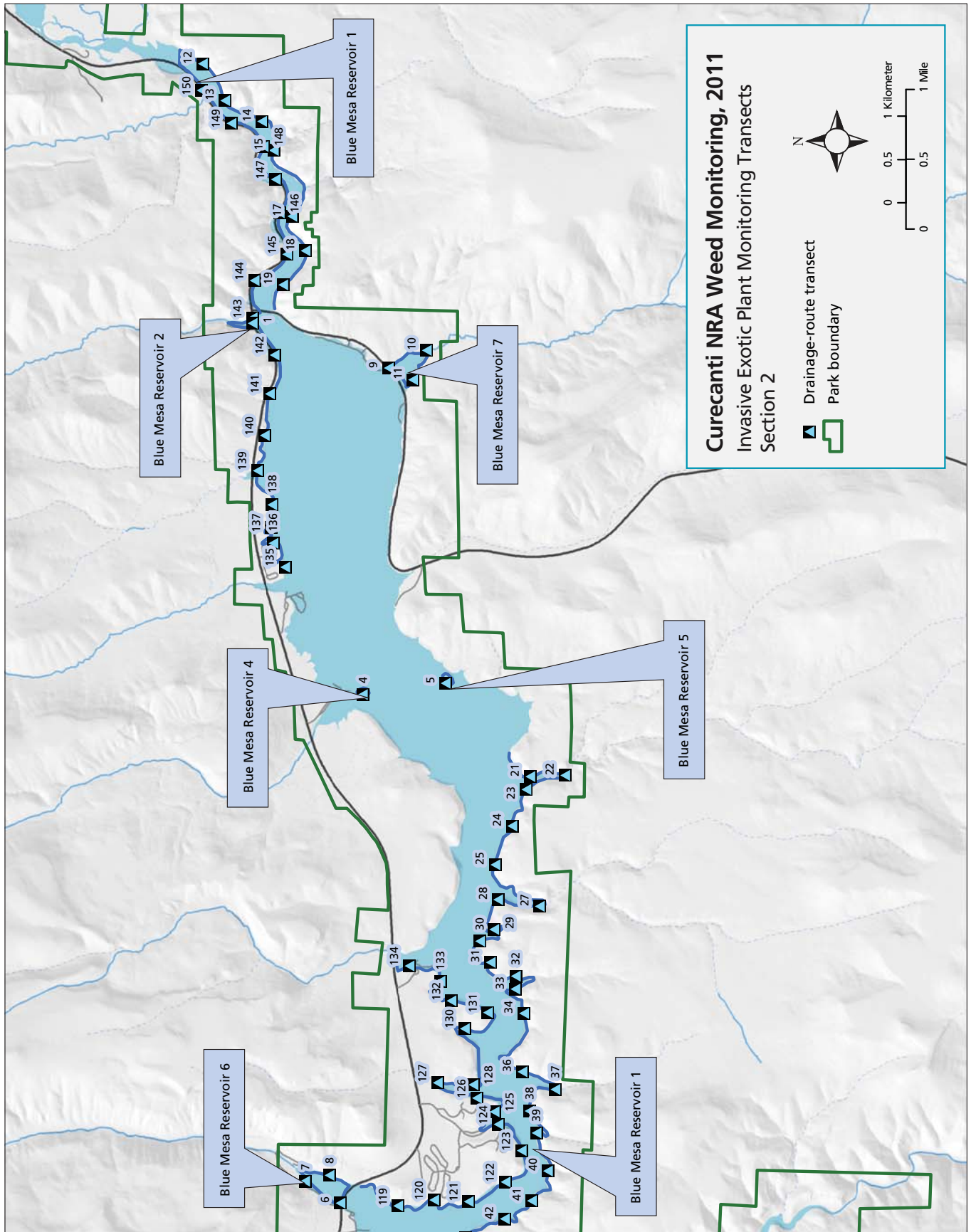


Figure 2-6. Monitoring quadrats established at Curecanti NRA, July 5–August 21, 2011.

3 Results

3.1 Priority invasive exotic plant list

Twenty-nine IEP species were identified as priority for BLCA/CURE (see Table 2-1). We also recorded cheatgrass in monitoring quadrats. A total of 24 IEP species were recorded on monitoring routes and quadrats in 2011, 15 of which were priority species. Seventeen IEP species were recorded on monitoring routes and 14 in monitoring quadrats. Of those 17 recorded species, 15 and 7 were priority species, respectively (Table 3-1). We covered 220 hectares (544 acres) along 84.5 km (53 miles) on monitoring routes in 2011.

3.2 Monitoring routes

A total of 727 infestations, 704 of which were priority species, were detected along nine monitoring routes (Tables 3-2 and 3-3, Figures 3-1, 3-2, 3-3, 3-4, 3-5, 3-6, 3-7, 3-8, 3-9, 3-10, and Electronic Appendix A).

Canada thistle (*Breea arvensis*), musk thistle (*Carduus nutans*), summer cypress (*Bassia sieversiana*), and Russian thistle (*Salsola australis*) were the most commonly detected priority IEPs (Table 3-3). Only priority species should be examined when comparing across areas, as these were the only species consistently recorded by all observers. Priority IEPs were found in high numbers (4.02/ha) surrounding Blue Mesa Reservoir, while relatively few were found along the South Rim Road (0.76). Of the 704 priority infestations, 55% were classified as infestations larger than size class 3 (>40 m²) (Table 3-3).

Only five tree infestations of three priority invasive tree species were detected: Russian olive, tamarisk, and Siberian elm (*Ulmus pumila*). Three of these infestations were saplings, while two were mature trees.

Table 3-1. Invasive exotic plants detected, Black Canyon of the Gunnison NP and Curecanti NRA, July 5–August 21, 2011.

Scientific name	Common name	Method detected		Priority?
		Routes	Transects	
<i>Acroptilon repens</i>	Russian knapweed	X		Yes
<i>Bassia sieversiana</i>	summer cypress	X	X	Yes
<i>Breea arvensis</i>	Canada thistle	X	X	Yes
<i>Cardaria latifolia</i>	broad-leaf pepperwort	X		Yes
<i>Cardaria</i> spp.	whiteweed	X		Yes
<i>Carduus nutans</i>	musk thistle	X	X	Yes
<i>Cirsium vulgare</i>	bull thistle	X		Yes
<i>Elaeagnus angustifolia</i>	Russian olive	X		Yes
<i>Leucanthemum vulgare</i>	ox-eye daisy	X	X	Yes
<i>Matricaria perforata</i>	scentless chamomile	X	X	Yes
<i>Phalaroides arundinacea</i>	reed canarygrass	X		Yes
<i>Salsola australis</i>	Russian thistle	X	X	Yes
<i>Tamarix ramosissima</i>	tamarisk	X		Yes
<i>Ulmus pumila</i>	Siberian elm	X		Yes
<i>Verbascum thapsus</i>	woolly mullein	X	X	Yes
<i>Agropyron cristatum</i>	crested wheatgrass		X	No
<i>Anisantha tectorum</i>	cheatgrass		X	No
<i>Bromus inermis</i>	smooth brome		X	No
<i>Convolvulus arvensis</i>	field bindweed	X		No
<i>Lycium barbarum</i>	matrimony vine	X		No
<i>Melilotus officinale</i>	yellow sweetclover		X	No
<i>Poa pratensis</i>	Kentucky bluegrass		X	No
<i>Rumex crispus</i>	curly dock		X	No
<i>Sisymbrium altissimum</i>	tumble mustard		X	No

3.3 Monitoring transects

A total of 153 transects were sampled in 2011 (Table 3-4, Electronic Appendix B). At Blue Mesa Reservoir, summer cypress and Canada thistle had the highest percent cover (0.14 and 0.11, respectively), while cheatgrass (10%) and Canada thistle (8%) had the highest frequency detected along transects (Table 3-4). While not a priority species, yellow sweetclover (*Melilotus officinale*) had even higher percent cover (0.97) and frequency (20%) than any priority species at Blue Mesa Reservoir. Only one priority species, cheatgrass, was found in one of 16 transects along the South Rim Road. However, smooth brome (*Bromus inermis*) was found in 19% of the transects, resulting in 6.94% cover along the South Rim Road. No IEP species were found on eight transects along Deadhorse Trail (Table 3-4).

3.4 Results comparison: 2003–2004 and 2011

BLCA was last intensively surveyed for IEPs in 2003 and 2004 (Dewey and Anderson 2005). Nineteen species were on the priority list of Dewey and Anderson (2005) and on our priority list. Of those 19, only three were found during the surveys. There was only one area common to the 2003–2004 and 2011 surveys: South Rim Road from Chasm View to High Point. Dewey and Anderson (2005) did not survey anywhere in CURE. Of species that were mapped in both 2003–2004 and 2011, Dewey and Anderson (2005) found one infestation of Canada thistle and two infestations of woolly mullein (*Verbascum thapsus*). In 2011, there was still one infestation of Canada thistle. Woolly mullein infestations had increased to four, and one infestation of musk thistle was found.

Table 3-2. Number of IEP infestations and infestations/100 m along monitoring routes, Black Canyon of the Gunnison NP and Curecanti NRA, July 5–August 21, 2011.

Route	Route type	Length	ha	Infestations		Infestations/ha	
				Total	Priority	Total	Priority
Blue Mesa 1	Reservoir	68,177.6	187.00	649	648	3.47	3.47
Blue Mesa 2	Reservoir	584.3	1.15	5	5	4.36	4.36
Blue Mesa 3	Reservoir	847.4	1.71	21	21	12.29	12.29
Blue Mesa 4	Reservoir	364.5	1.74	0	0	0.00	0.00
Blue Mesa 5	Reservoir	409.3	1.14	3	3	2.63	2.63
Blue Mesa 6	Reservoir	1,473.4	4.50	4	4	0.89	0.89
Blue Mesa 7	Reservoir	1,392.9	5.54	25	25	4.51	4.51
Reservoir total	Reservoir	73,249.4	202.77	707	706	4.02	4.02
Deadhorse Trail	Trail	4,103.9	9.82	13	12	1.32	1.22
South Rim Road	Road	7,185.1	7.86	7	6	0.89	0.76
Total		84,538.4	220.45	727	724	3.30	3.28

Table 3-3. Species observed and infestation size class detected along monitoring routes, Black Canyon of the Gunnison NP and Curecanti NRA, July 5 to August 21, 2011.

Scientific name	Common name	Total infestations	Infestation size class			
			1	2	3	4
<i>Acroptilon repens</i>	Russian knapweed	3	1	0	1	1
<i>Bassia sieversiana</i>	summer cypress	58	0	3	22	33
<i>Breea arvensis</i>	Canada thistle	240	23	59	117	41
<i>Cardaria latifolia</i>	broad-leaf pepperwort	4	1	2	1	0
<i>Cardaria</i> spp.	whitetop	12	1	7	4	0
<i>Carduus nutans</i>	musk thistle	182	66	49	67	0
<i>Cirsium vulgare</i>	bull thistle	17	10	6	1	0
<i>Elaeagnus angustifolia</i>	Russian olive	2	1	1	0	0
<i>Leucanthemum vulgare</i>	ox-eye daisy	5	0	2	3	0
<i>Matricaria perforata</i>	scentless chamomile	21	4	4	13	0
<i>Phalaroides arundinacea</i>	reed canarygrass	1	0	1	0	0
<i>Salsola australis</i>	Russian thistle	45	7	7	23	8
<i>Tamarix ramosissima</i>	tamarisk	1	1	0	0	0
<i>Ulmus pumila</i>	Siberian elm	2	1	0	1	0
<i>Verbascum thapsus</i>	woolly mullein	131	37	30	60	4
<i>Convolvulus arvensis</i> *	field bindweed	2	0	1	1	0
<i>Lycium barbarum</i> *	matrimony vine	1	0	1	0	0
Priority species		724	153	171	313	87
All species		727	153	173	314	87

*Not a priority species so may not have been recorded by all observers.

Infestation size classes: 1 = 1—a few plants (used for isolated single plants or very small patches (2 × 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 monitoring transects where priority exotic plant species were detected, mean percent cover, and standard error, Black Canyon of the Gunnison NP and Curecanti NRA, July 5–August 21, 2011.

		Deadhorse Trail (8)		South Rim Road (16)		Blue Mesa Reservoir (129)	
Scientific name	Common name	Transects detected	Percent cover (SE)	Transects detected	Percent cover (SE)	Transects detected	Percent cover (SE)
Priority species							
<i>Anisantha tectorum</i>	cheatgrass	0	0.00 (0.00)	1	0.19 (0.19)	13	0.07 (0.02)
<i>Bassia sieversiana</i>	summer cypress	0	0.00 (0.00)	0	0.00 (0.00)	5	0.14 (0.08)
<i>Breea arvensis</i>	Canada thistle	0	0.00 (0.00)	0	0.00 (0.00)	10	0.11 (0.06)
<i>Carduus nutans</i>	musk thistle	0	0.00 (0.00)	0	0.00 (0.00)	1	<0.01 (<0.01)
<i>Leucanthemum vulgare</i>	ox-eye daisy	0	0.00 (0.00)	0	0.00 (0.00)	1	<0.01 (<0.01)
<i>Matricaria perforata</i>	scentless chamomile	0	0.00 (0.00)	0	0.00 (0.00)	1	<0.01 (<0.01)
<i>Salsola australis</i>	Russian thistle	0	0.00 (0.00)	0	0.00 (0.00)	1	<0.01 (<0.01)
<i>Verbascum thapsus</i>	woolly mullein	0	0.00 (0.00)	0	0.00 (0.00)	3	0.02 (0.02)
Total priority species		0	0.00 (0.00)	1	0.19 (0.19)	31	0.37 (0.11)
Non-priority species*							
<i>Agropyron cristatum</i>	crested wheatgrass	0	0.00 (0.00)	1	0.06 (0.06)	1	<0.01 (<0.01)
<i>Bromus inermis</i>	smooth brome	0	0.00 (0.00)	3	6.94 (4.69)	0	0.00 (0.00)
<i>Melilotus officinale</i>	yellow sweetclover	0	0.00 (0.00)	0	0.00 (0.00)	26	0.97 (0.27)
<i>Poa pratensis</i>	Kentucky bluegrass	0	0.00 (0.00)	1	0.01 (0.01)	0	0.00 (0.00)
<i>Rumex crispus</i>	curly dock	0	0.00 (0.00)	0	0.00 (0.00)	4	0.04 (0.03)
<i>Sisymbrium altissimum</i>	tumble mustard	0	0.00 (0.00)	0	0.00 (0.00)	1	0.01 (0.01)

Total number of transects per route are listed in parentheses in the header row.

*Non-priority species may not have been recorded by all observers.

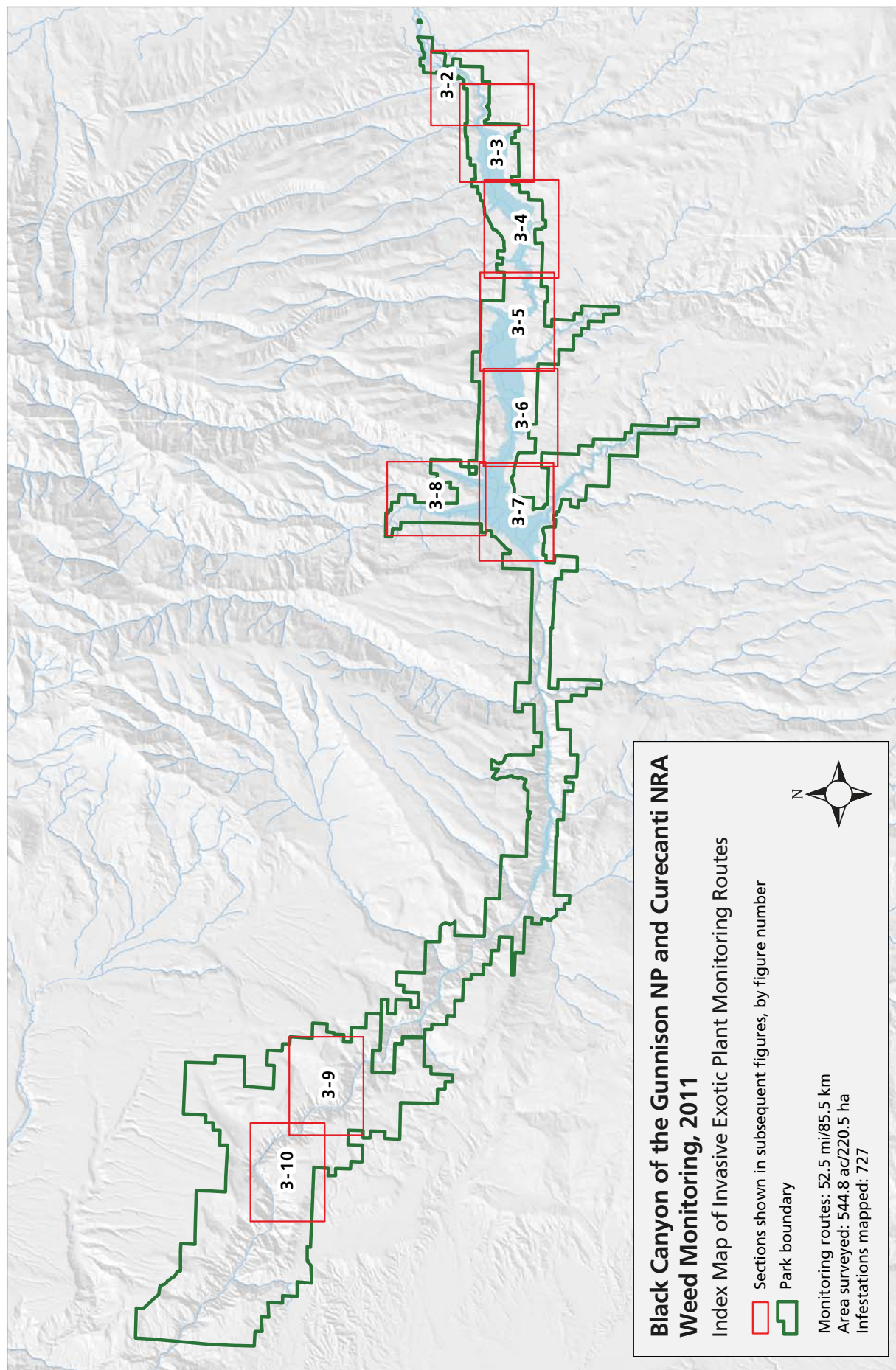


Figure 3-1. Index map of invasive plant monitoring routes, Black Canyon of the Gunnison NP and Curecanti NRA, July 5–August 21, 2011.

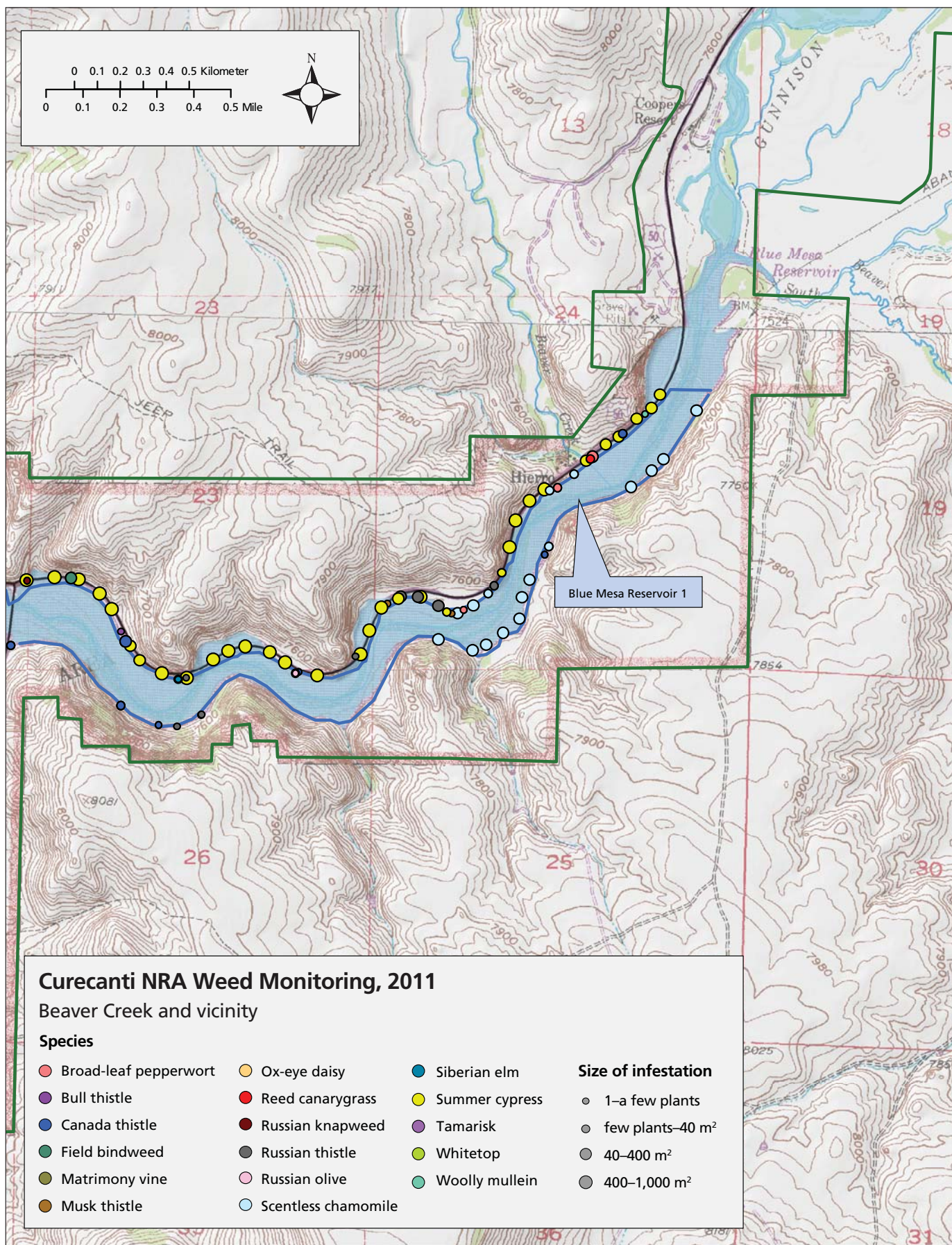


Figure 3-2. Invasive plants detected on monitoring routes and quadrats in the vicinity of Beaver Creek, Curecanti NRA, July 5–August 21, 2011.

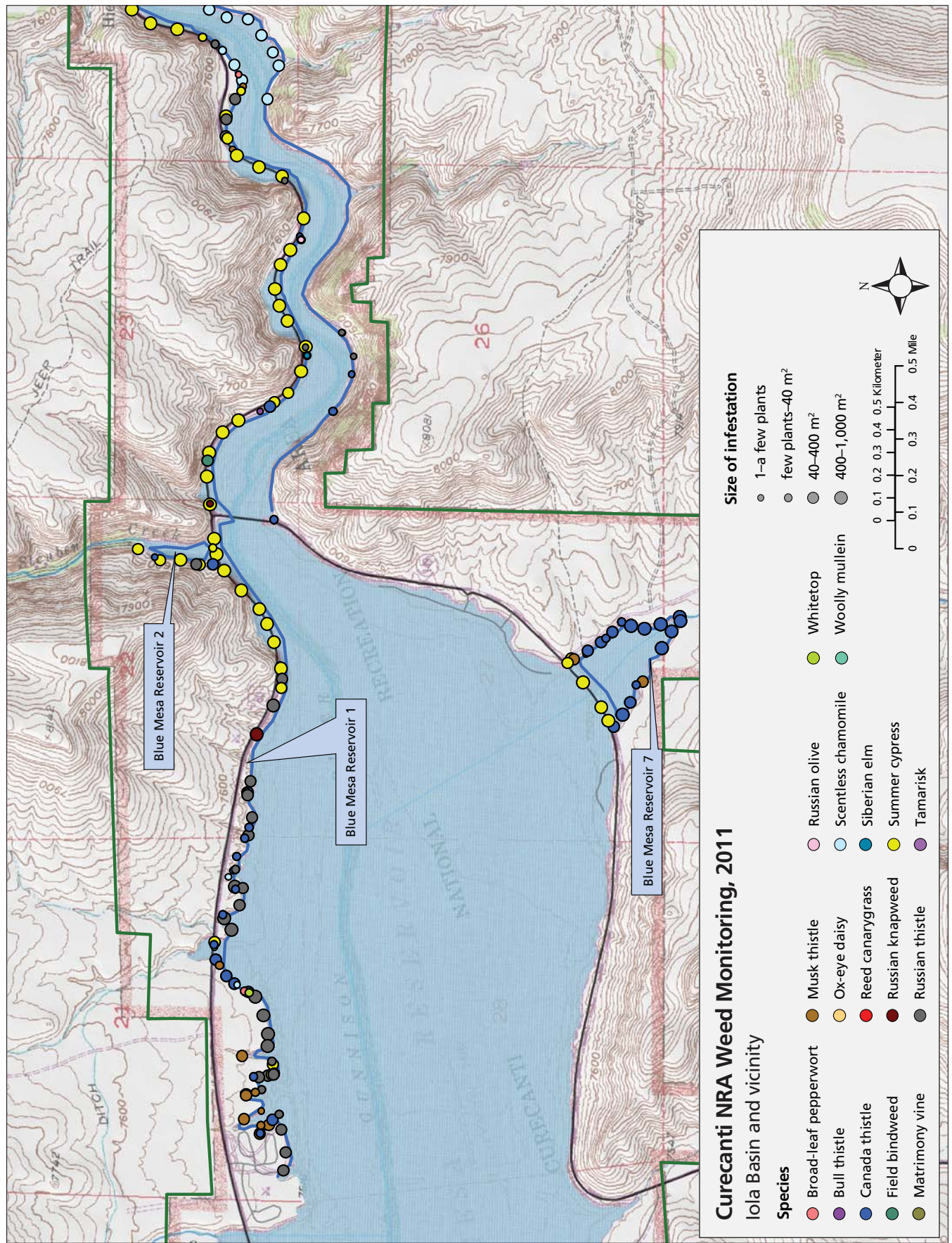


Figure 3-3. Invasive plants detected on monitoring routes and quadrats in the vicinity of the Iola Basin, Curecanti NRA, July 5-August 21, 2011.

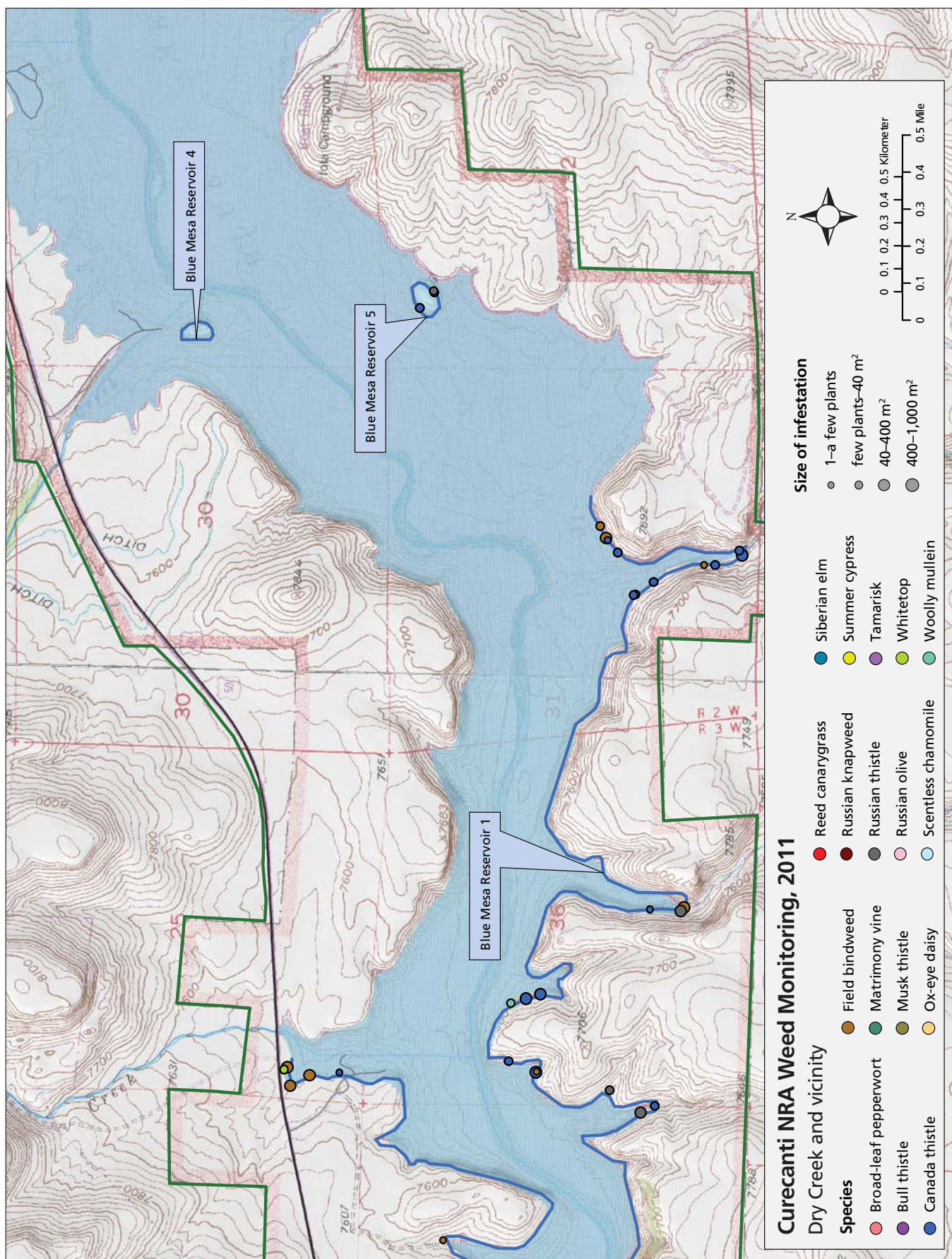


Figure 3-4. Invasive plants detected on monitoring routes and quadrats in the vicinity of Dry Creek, Curecanti NRA, July 5–August 21, 2011.

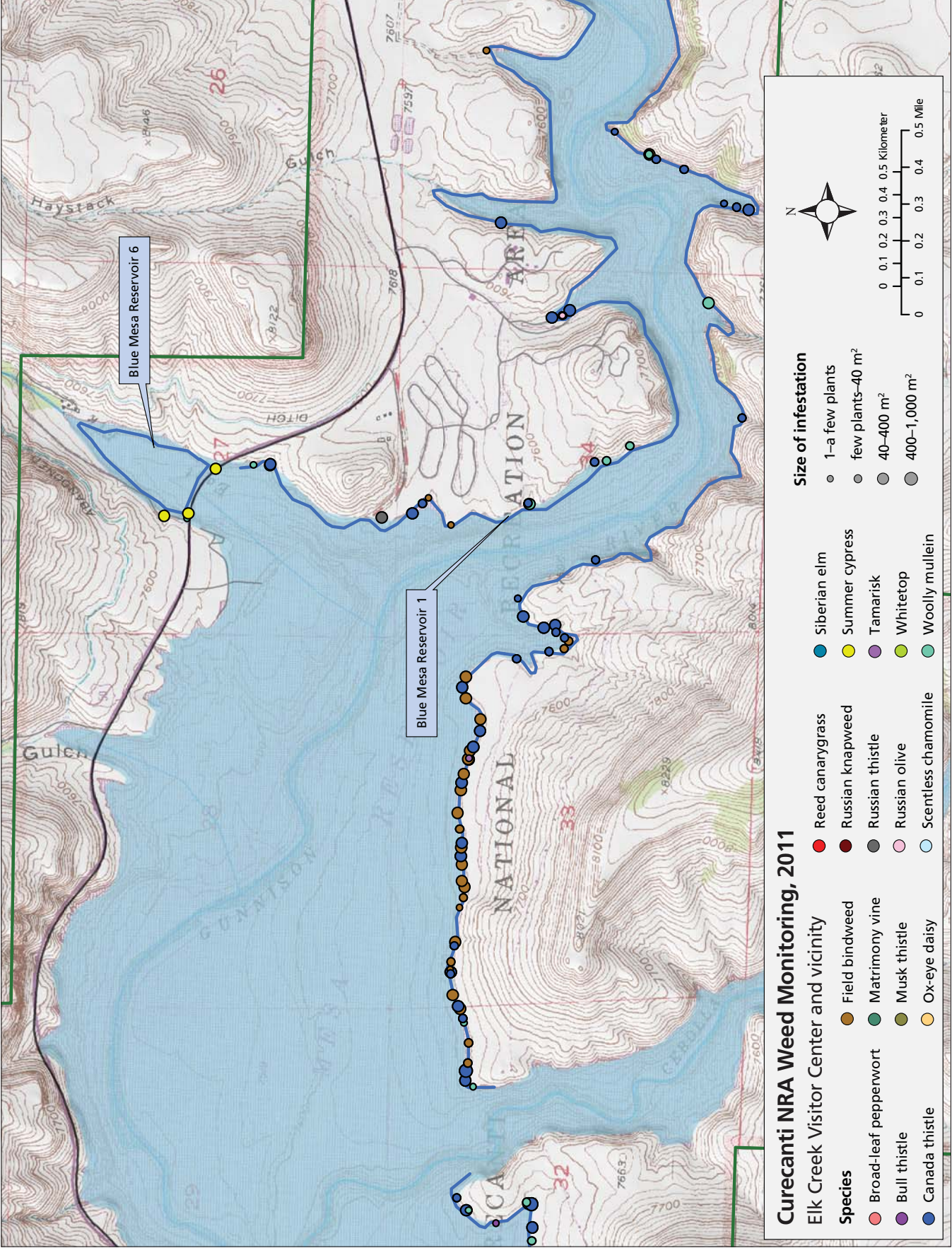


Figure 3-5. Invasive plants detected on monitoring routes and quadrats in the vicinity of the Elk Creek Visitor Center, Curecanti NRA, July 5–August 21, 2011.

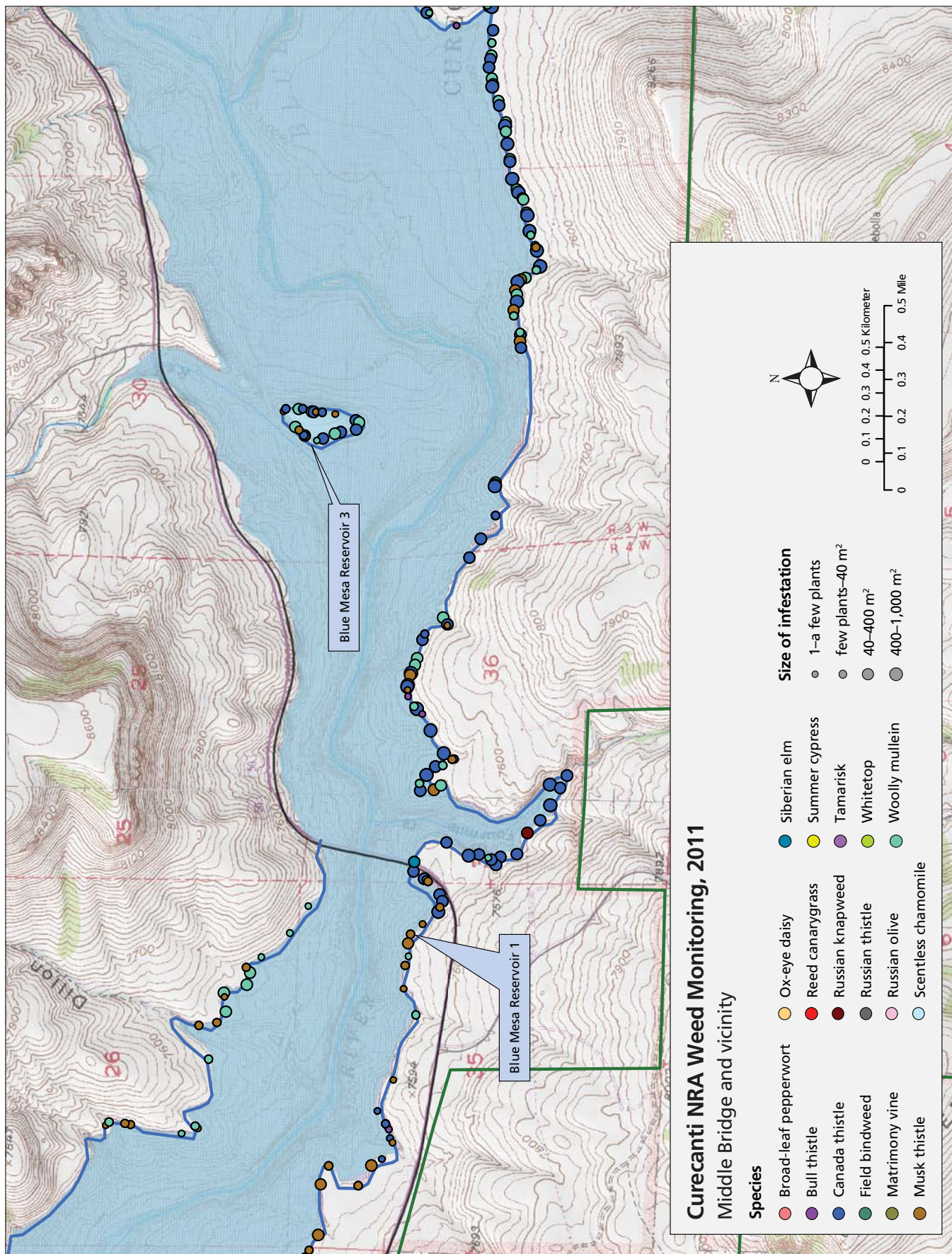


Figure 3-6. Invasive plants detected on monitoring routes and quadrats in the vicinity of Middle Bridge, Curecantí NRA, July 5–August 21, 2011.

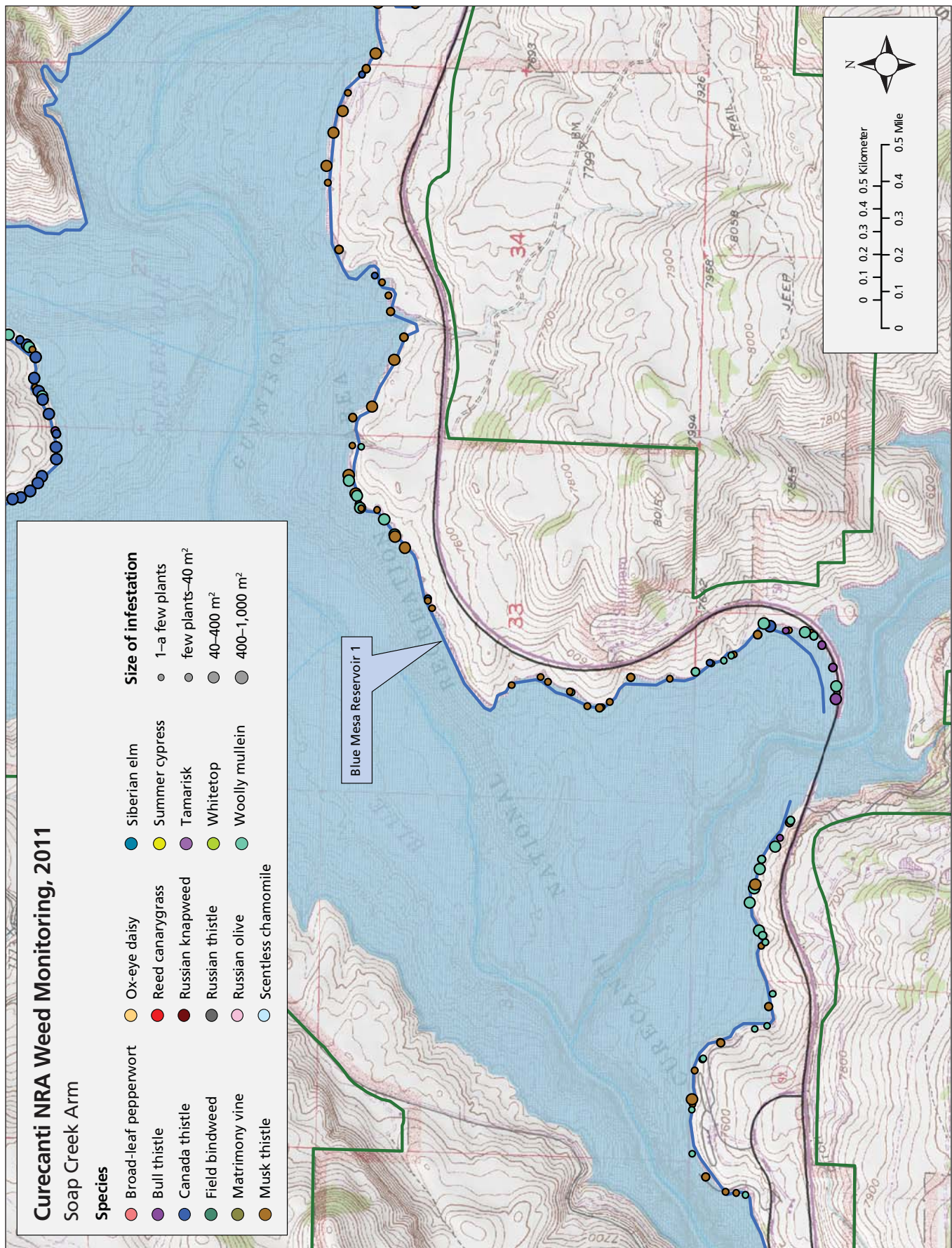


Figure 3-7. Invasive plants detected on monitoring routes and quadrats along the Soap Creek Arm, Curecanti NRA, July 5-August 21, 2011.

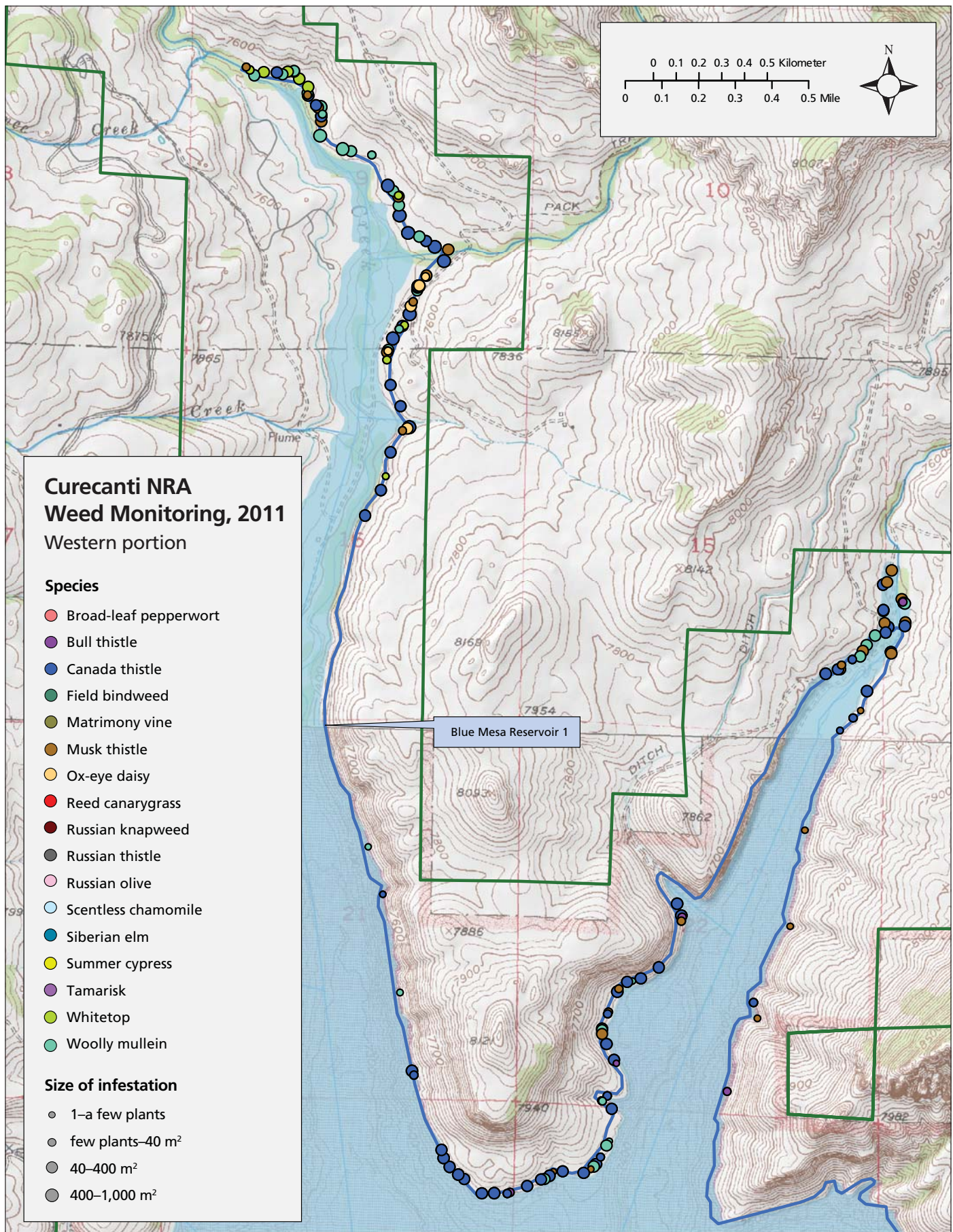


Figure 3-8. Invasive plants detected on monitoring routes and quadrats in the western portion of Curecanti NRA, July 5–August 21, 2011.

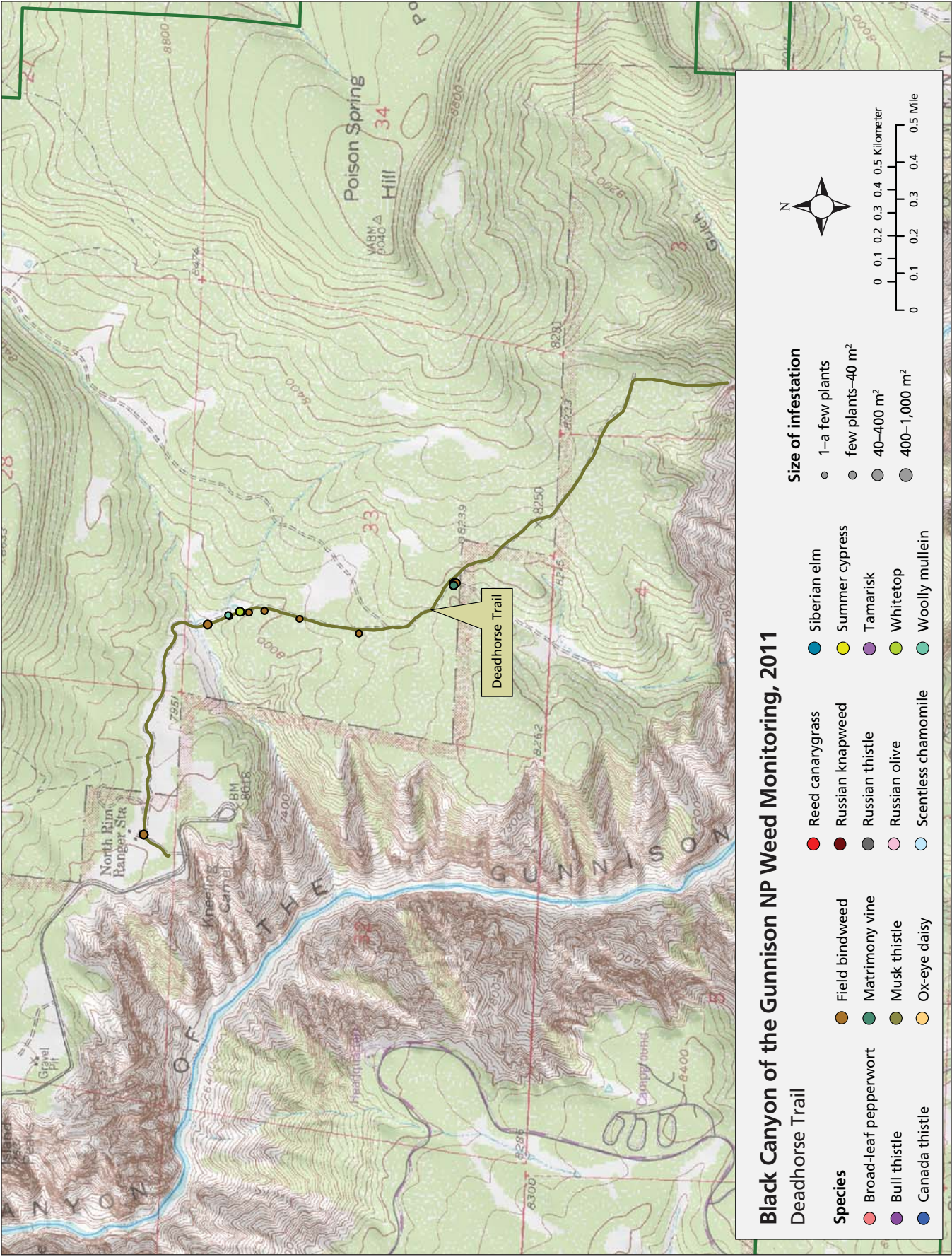


Figure 3-9. Invasive plants detected on monitoring routes along Deadhorse Trail, Black Canyon of the Gunnison NP, July 5–August 21, 2011.

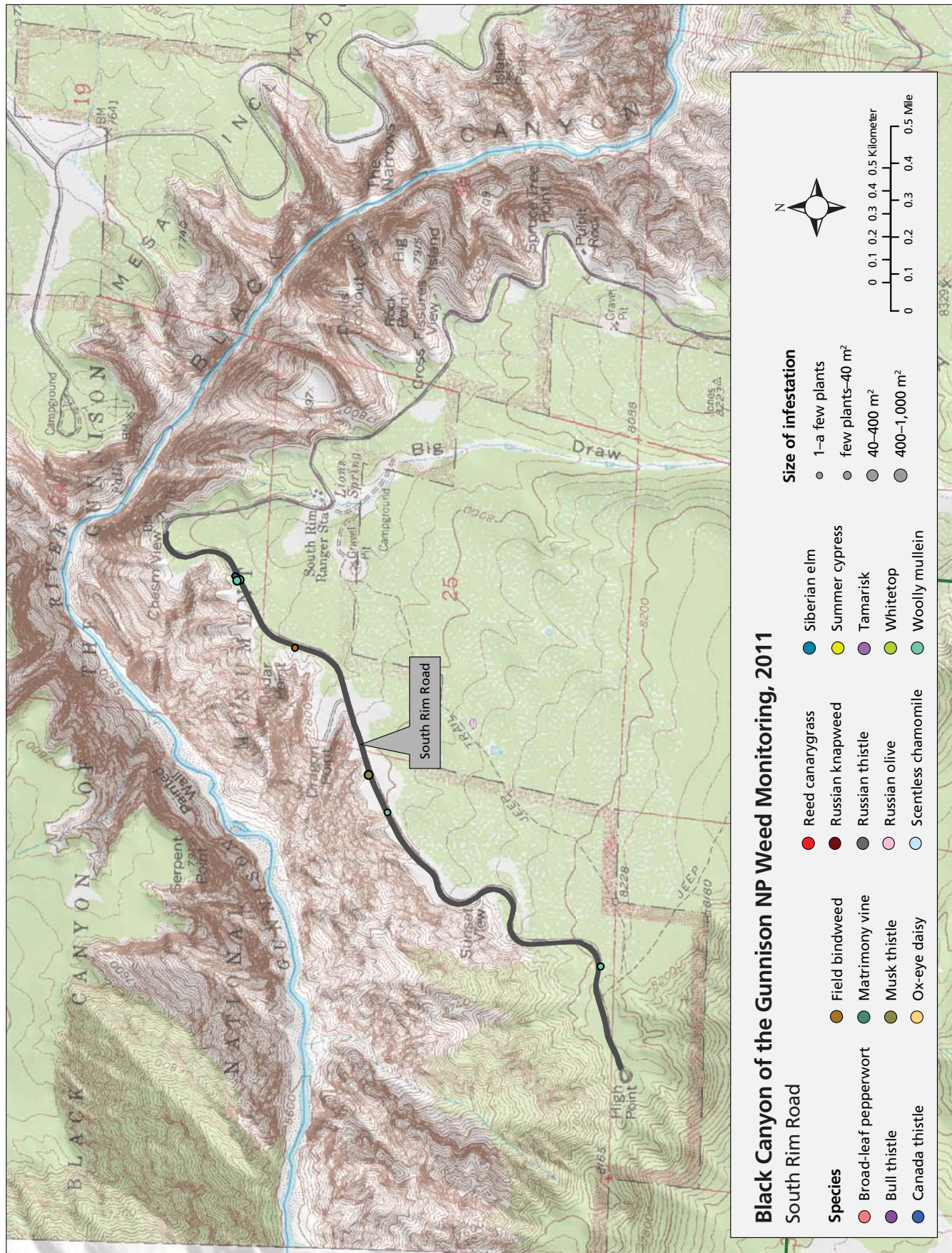


Figure 3-10. Invasive plants detected on monitoring routes along South Rim Road, Black Canyon of the Gunnison NP, July 5–August 21, 2011.

4 Discussion

The NCPN will continue to work with BLCA/CURE staff and area weed experts to review and update the list of priority species each year. Park staff may want to consider adding yellow sweetclover to the priority list for 2012. Alternatively, if it is too widespread, NCPN crews could begin monitoring it in transects but not along monitoring routes, as is done with cheatgrass. Presence and absence data for most priority species, and presence data for other species, should be reliable. However, absence data for non-priority species are suspect, because not all observers recorded all of these species.

Priority IEPs were most widespread along the shores of Blue Mesa Reservoir, followed by the South Rim Road, with relatively few along the Deadhorse Trail, as seen in both the monitoring routes and in the transects. Canada thistle, musk thistle, summer cypress, and Russian thistle were the most common IEPs, all of which can be controlled with sufficient resources.

It should be noted that 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.

IEPs at BLCA/CURE 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 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 2012, the NCPN will finish surveying the final routes of the first monitoring rotation. Because detections from one year may be eradicated by park staff before the next sampling period, the monitoring quadrats are re-located 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 and cheatgrass by monitoring route. Extra-area surveys will also be considered for inventories at the park's request. The NCPN invasive plant monitoring protocol was submitted for peer review in December 2010.

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Appendix A. Exotic plant invasions detected on monitoring routes, Black Canyon of the Gunnison National Park and Curecanti National Recreation Area, July 5–August 21, 2011.

See electronic appendix attached to this document.

Appendix B. Invasive exotic plant percent cover detected by monitoring quadrats, Black Canyon of the Gunnison National Park and Curecanti National Recreation Area, July 5–August 21, 2011.

See electronic appendix attached to this document.

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