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Invasive Non-native Plant Inventory for Montezuma Castle and Tuzigoot National Monuments

Natural Resource Technical Report NPS/SODN/NRTR—2009/268

ON THE COVER

Redstem storksbill (*Erodium cicutarium*). Photograph by Sheri Hagwood @ USDA-NRCS PLANTS Database.

Invasive Non-native Plant Inventory for Montezuma Castle and Tuzigoot National Monuments

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Authors
Theresa Mau-Crimmins
Melissa Mauzy
Sarah Studd
Sonoran Desert Network
7660 E. Broadway Blvd., Suite 303
Tucson, AZ 85710

Guy R. McPherson
School of Natural Resources and the Environment
Biological Sciences East
University of Arizona
Tucson, AZ 85721

Editing and Design
Alice Wondrak Biel
Sonoran Desert Network
7660 E. Broadway Blvd., Suite 303
Tucson, AZ 85710

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Executive Summary

Early detection and trend detection of invasive non-native plant species comprise two of the Sonoran Desert Network Inventory and Monitoring Program's vital signs. Baseline information on the presence, location, and abundance of invasive non-native plant species is necessary to accomplish two goals: (1) to identify which invasive non-native species are not yet present in the park (early detection monitoring); and (2) to map the spatial location, distribution, and abundance of those species that already occur in the park as the basis for future trend assessment.

The goals of this project were to: (1) Map the spatial location, distribution, and abundance of 50 non-native plants in Montezuma Castle (MOCA) and Tuzigoot (TUZI) national monuments, in central Arizona; (2) Map the spatial location, distribution, and abundance of 50 non-native plants in the proposed expansion lands adjacent to Tuzigoot National Monument; (3) Test the efficacy of roaming surveys for non-native plant mapping using a modified version of the "Beyond NAWMA" weed mapping standards suggested by the North American Weed Management Association in these park units (Stohlgren et al. no date); and (4) Implement an analytical prioritization technique, such as the Alien Plants Ranking System (Hiebert and Stubbendieck 1993), for management planning.

Through a 2003 Cooperative Ecosystems Studies Unit agreement between the SODN and the University of Arizona School of Natural Resources, the spatial location, distribution, and abundance of target non-native plant species were mapped at the two units of MOCA (Montezuma Castle and Montezuma Well), at TUZI, and (in 2004 only) on proposed expansion lands at TUZI. Fieldwork took place in 2003 and 2004. Roaming surveys were performed with the intent of comprehensively covering each park. Additional, randomly located, plot-based surveys were performed in order to assess any observer bias and the accuracy of the roaming surveys. The data collected from both field seasons were fed directly into an analytical prioritization system, to facilitate management planning relative to invasive non-natives. All of this information enhances efforts toward an exotic plant management plan for MOCA and TUZI.

Of the 50 target species for this project, 34 species were encountered during roaming surveys in at least one of the three main park units and mapped as points or polygons during 2003 (see Table 3-1). In 2004, 44 species were encountered during roaming surveys in at least one of the four park units and mapped as points or polygons (see Table 3-5). Redstem storksbill (*Erodium cicutarium*) and red brome (*Bromus madritensis* ssp. *rubens*) were found to be the most dominant species across the units.

Area affected is a measure of plant distribution calculated directly from mapped polygon boundaries; this measure does not reflect the intensity of invasion. For example, a 1.5-ha polygon estimated at 25–50% cover would represent 1.5 ha affected. Affected-area value varied substantially by species, with several species being widespread throughout the units. Red brome was the most widely distributed species across the park units. Redstem storksbill, barley (*Hordeum* spp.), and London rocket (*Sisymbrium irio*) also occurred widely in the three park units (see Tables 3-2 and 3-6).

Area infested was calculated using polygon data by multiplying the cover class midpoint by the polygon's area. For example, a polygon 1.5 ha in area, estimated at 25–50% cover, would represent 0.5625 ha (1.5 × .375 = 0.5625 ha) infested. Levels of infestation varied by species, with 36 species infesting less than 1% of the total park areas, 8 species infesting 1–5% of the total areas, and 5 species infesting 5–24% of the total areas in either 2003 or 2004 (see Tables 3-3 and 3-7). Bermuda grass (*Cynodon dactylon*) and johnsongrass (*Sorghum halepense*) were found to occupy 50–95% of small, concentrated patches in MOCA's Well unit in both 2003 and 2004 (see Table 3-8).

It is recommended that the Alien Plants Ranking System (Hiebert and Stubbendieck 1993) be used to identify species that are easy to control but have large impacts, and that management efforts should be concentrated on these plants first. No species fell within this quadrant of the graph for the units surveyed (see Figure 3-5). Several target species fall within the quadrant, "easy to control, lesser impact." Efforts could be placed on this group of species to minimize the overall impact of the weed communities at the parks. Alternatively, the most widespread species, red brome, redstem storksbill, barley, London

rocket, and cheatgrass (*Bromus tectorum*), are also the most difficult to control of the target species, and have the greatest impact. Ripgut brome (*Bromus rigidus*), red brome, cheatgrass, and barley also exhibit high potential to become pests. Careful consideration of these plants' potential for control, likelihood of spread, and current level of infestation should be weighed in planning for management efforts.

Acronyms

ft	feet
GPS	global positioning system
m	meters
MOCC	Montezuma Castle National Monument (Castle unit)
MOWE	Montezuma Castle National Monument (Well unit)
MOCA	Montezuma Castle National Monument
NAIPMS	North American Invasive Plant Mapping Standards
NAWMA	North American Weed Management Association
NM	national monument
NPS	National Park Service
SODN	Sonoran Desert Network
TUZI	Tuzigoot National Monument
USDA	U.S. Department of Agriculture
UTM	Universal Transverse Mercator

Acknowledgements

Thanks to Kathy Davis and the staff at Montezuma Castle and Tuzigoot national monuments for their support of this project. Much appreciation also goes to Melissa Mauzy and Meg Quinn for field data collection and plant identification. Kristen Beaupré performed invaluable data management and manipulation tasks, and Sarah Studd played a large role in final map production. Thanks also go to the Sonoran Desert Inventory and Monitoring Program for project support and facilities.

1 Introduction

The Sonoran Desert Inventory & Monitoring Network (SODN), whose purpose is to inventory and monitor natural resources in 11 national parks in southern Arizona and New Mexico, has identified invasive exotic plant species as a significant threat to park resources. The SODN is currently developing methods for both early detection and long-term monitoring of invasive non-native plant species in SODN park units.

The first step in invasive non-native plant monitoring is establishing baseline data on the presence, distribution, and abundance of target species in park units. Through the project documented in this report, the spatial location, distribution, and abundance of 50 key non-native plant species were mapped at Montezuma Castle and Tuzigoot national monuments, in central Arizona.

Non-native invasive species are a major threat to native species diversity and ecosystem function, causing economic impacts within the U.S. estimated at more than $100 billion annually (Pimentel et al. 1999). In addition to competing with and displacing native species, these introduced species can hybridize with natives and alter conditions to promote the establishment and spread of other non-native species. Invasive species have been called the "single most formidable threat of natural disaster of the twenty-first century" (Schnase et al. 2002).

The National Park Service (NPS) defines exotic species as those species that occupy or could occupy park lands directly or indirectly as the result of deliberate or accidental human activities (NPS 2006). Exotic species are also commonly referred to as non-native, alien, or invasive species. Because an exotic species did not evolve in concert with the species native to an area, the exotic species is not a natural component of the natural ecosystem at that location. According to the *NPS Management Policies* (NPS 2006), "(e)xotic species will not be allowed to displace native species if displacement can be prevented." In addition, these policies state that "high priority will be given to managing exotic species that have, or potentially could have, a substantial impact on park resources, and that can reasonably be expected to be successfully controllable."

The initial fieldwork for this project, made possible through a 2003 Cooperative Ecosystem Studies Unit agreement between the SODN and the University of Arizona School of Natural Resources, took place in late July and early August 2003.

Though many of the target species were mapped sufficiently in 2003, numerous dead target species individuals were observed, suggesting that sampling may have missed the peak in abundance of the target species and some may have been missed altogether. To supplement these data, a second field season was undertaken in 2004, occurring earlier in the growing season.

Also, after the 2003 field season, it was recommended that we implement an analytical prioritization technique, such as Hiebert and Stubbendieck (1993), to facilitate management planning relative to invasive non-natives. This system uses species location, distribution, and abundance information, in conjunction with phenological information, to determine which non-native species should receive first priority for control measures. The data collected through both field seasons were fed directly into such a system, resulting in a prioritization for management efforts. All of this information enhances efforts toward an exotic plant management plan for Montezuma Castle and Tuzigoot national monuments.

The information collected through this project will:

1. Increase the ability of resource managers to analyze and prioritize invasive plant management needs, enhancing the time- and cost-effectiveness of management actions;
2. Serve as a baseline for long-term monitoring and assist with the evaluation of changes in alien plant populations over time as well as detecting new infestations;
3. Serve as a critical tool for increasing public and political awareness and education on invasive plant issues; and
4. Implement the Alien Plants Ranking System (Hiebert and Stubbendieck 1993) to prioritize the target species for management efforts.

1.1 Project goals

The goals of this project (followed by the years to which they apply) were to:

1. Map the spatial location, distribution, and abundance of 50 non-native plants in

Montezuma Castle and Tuzigoot national monuments (2003, 2004);

2. Map the spatial location, distribution, and abundance of 50 non-native plants in the expansion lands adjacent to Tuzigoot National Monument (2004);

3. Test the efficacy of roaming surveys for non-native plant mapping using a modified version of the "Beyond NAWMA" (Stohlgren et al. no date) weed mapping standards suggested by the North American Weed Management Association (NAWMA) in these national parks (2003, 2004); and

4. Implement an analytical prioritization technique, such as Hiebert and Stubbendieck (1993), for management planning (2004).

1.2 Study area

Located midway between the cities of Flagstaff and Phoenix along Interstate Highway 17, Montezuma Castle National Monument (MOCA) occupies 671 hectares of the upper Verde Valley in central Arizona (Figure 1-1). MOCA comprises two comparably sized units located approximately seven kilometers apart: the Castle unit (MOCC), containing the primary structures and the park visitor center, and the Well unit (MOWE). Both are located along Beaver Creek. The Castle unit preserves a five-story, 20-room prehistoric cliff dwelling, built some 600 years ago by people of the Sinagua culture. The Well unit preserves a unique limestone sinkhole (or "well") located on a mesa overlooking Wet Beaver Creek, a perennial stream. The well is ringed with additional structures, likely because of the nearby perennial water source.

Tuzigoot National Monument (TUZI), located 35 kilometers west of Montezuma Castle NM (Figure 1-1), was established in 1939 to protect Tuzigoot Pueblo, a 110-room multistory structure also built by people of the Sinagua culture. Tavasci Marsh, an adjacent 130-hectare wetland, has been proposed for incorporation into park boundaries and was included in the surveys during 2004.

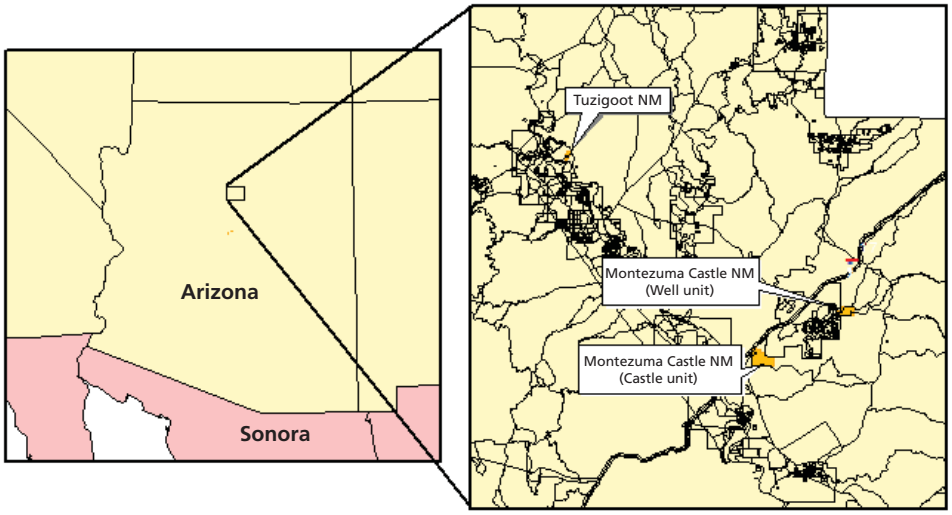

Figure 1-1. Location of Montezuma Castle and Tuzigoot national monuments, Arizona.

2 Methods

The location, abundance, and distribution of non-native species were mapped at Montezuma Castle and Tuzigoot national monuments following the North American Invasive Plant Mapping Standards (NAWMA 2002) and the "Beyond NAWMA" guidelines suggested by researchers at the U.S. Geological Survey and Colorado State University (Stohlgren et al. no date). Because the parks to be mapped were small (less than 500 ha), an intensive mapping method was undertaken. Using handheld computers and GPS units, field crews mapped individual target plants mapped as points, and mapped invaded regions as polygons. The methodology employed was the same for both seasons, to ensure comparability.

2.1 Roaming surveys

Fifty weed species identified by the National Park Service as problematic within Arizona were the targets for this mapping effort. Spatial location, distribution, and abundance of these plants were recorded as ArcView shapefiles (.shp) using pocket PCs equipped with HGIS software (www.starpal.com) attached to GPS units. Two University of Arizona researchers identified locations of target species via walking surveys. Target-species individuals were mapped as points; patches larger than three meters in diameter (spatial resolution of GPS units) were mapped as polygons. Up to five species were recorded for each polygon, in descending order of invasion by target species. Abundance of target species was recorded for polygons in the following cover classes: <1%, 1–5%, 6–25%, 26–50%, 51–75%, 76–95%, and 96–100%.

In 2003, data-collection surveys took place in July (21–25, 28) and August (11–15, 18–22) 2003. In 2004, data were collected in May (24–28) and June (2–6, 21–26). Data were collected following the North American Invasive Plant Mapping Standards (NAIPMS) (NAWMA 2002), including the following fields: collection date, examiner, plant name (genus, species), canopy cover, location (UTM coordinates).

Data files were manipulated in the office to incorporate several additional data fields suggested by the NAIPMS (NAWMA 2002), including:

- NPS region (Intermountain Region, abbreviated as IMR)
- NPS Inventory & Monitoring Network (Sonoran Desert Network, abbreviated as SODN)
- Park unit (MOCC, MOWE, or TUZI)
- State (AZ)
- County (Yavapai)
- Ownership (NPS)
- Type of survey (observed-mapped)
- Authority (following Kearney and Peebles 1951)
- Plant code (following the USDA Natural Resources Conservation Service's PLANTS database, http://plants.usda.gov/plants/index.html)
- Area of polygons

Data files were split and merged to generate individual ArcView shapefiles by species and park unit, with point and polygons appearing in separate files.

2.2 Circular-plot sampling

In the "Beyond NAWMA" guidelines, Stohlgren et al. (no date) recommend supplementing roaming surveys with randomly located circular-plot sampling to estimate spatial bias and accuracy. Approximately 10% of field resources were used to perform circular-plot sampling.

The circular plots were 7.32 m (24 ft) in diameter, encompassing three 1-m^2 quadrats (Figure 2-1). Percent cover of all species was recorded within the 1-m^2 quadrats to the nearest 1%. Percent cover of all ground variables (rock, leaf litter, dead wood, dung) was also recorded to the nearest 1%. All additional species observed within the entire circular plot were also recorded. A sample

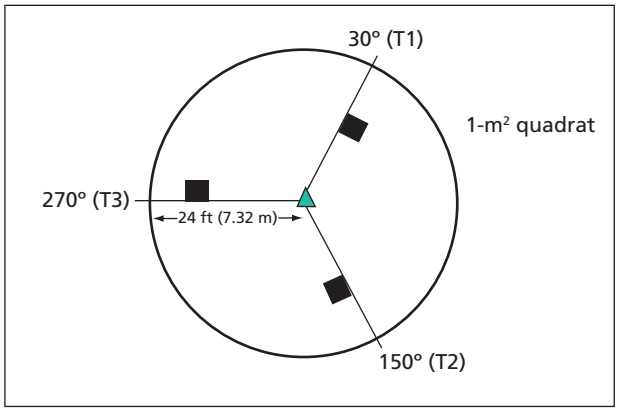

Figure 2-1. Circular-plot layout used for spatial bias and accuracy assessment.

data sheet is provided in Appendix A. Data from all circular plot data sheets were entered into an MS Access database.

In 2003, 29 circular plots were sampled within Tuzigoot National Monument, providing excellent coverage of this small park, at 17.5 ha (Figure 2-2). Equal coverage was initially planned for each unit of Montezuma Castle National Monument; however, due to time constraints, 12 points were sampled in each unit (Figure 2-2).

To better align with the recommendation by Stohlgren and others (no date) that no more than 10% of field resources be allocated to the supplemental circular-plot method, only 10 circular plots were sampled within TUZI in 2004. Twelve plots were sampled in the Castle unit of MOCA that year, and 8 plots were sampled in the Well unit (Figure 2-3).

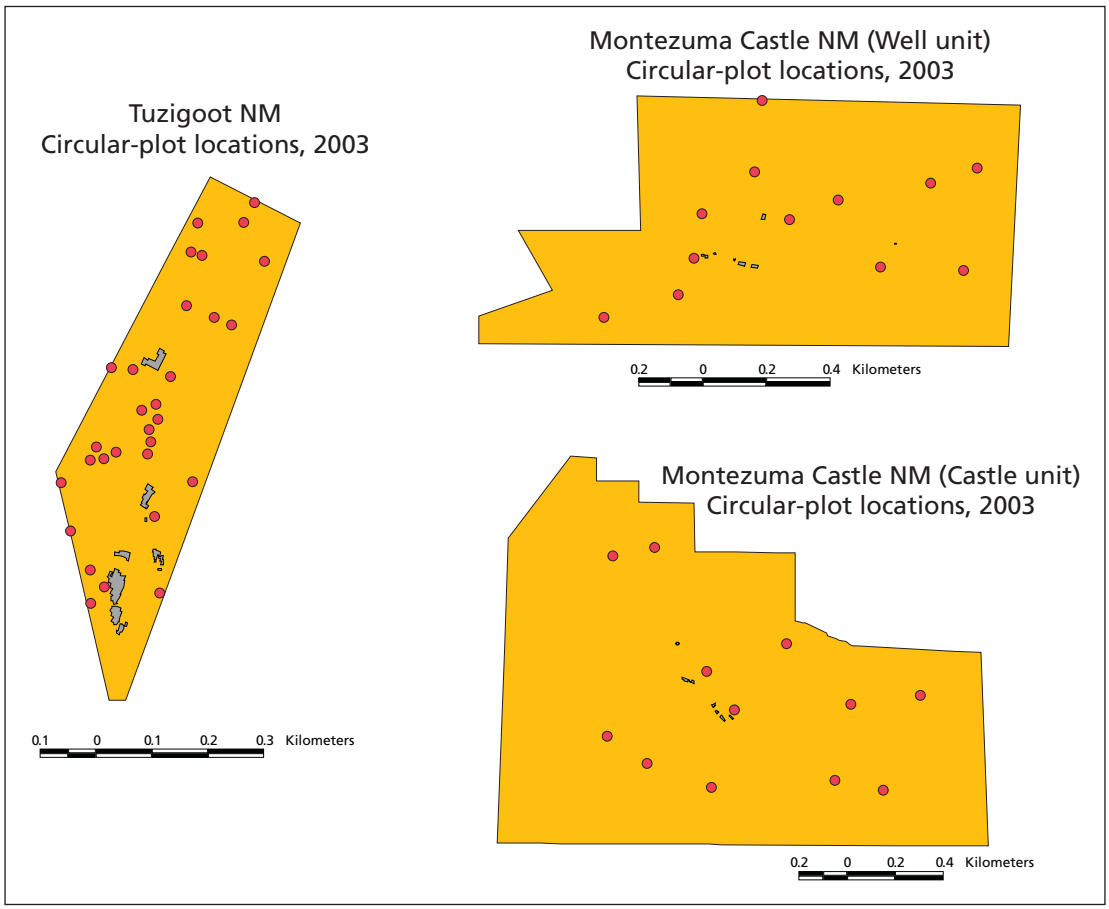

Figure 2-2. Location of circular plots in three park units, 2003.

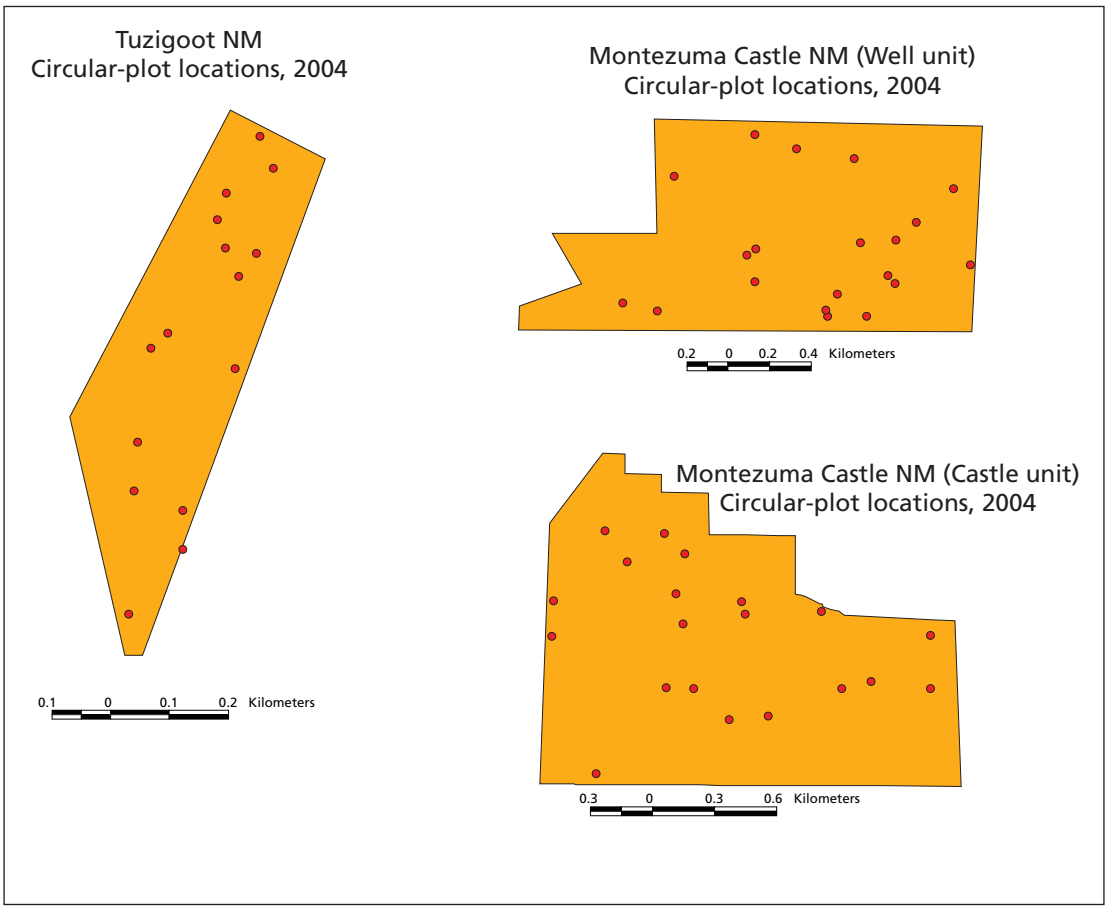

Figure 2-3. Location of circular plots in three park units, 2004.

3 Results

3.1 Roaming surveys

3.1.1 2003 surveys

Of the 50 target species for this project, 34 species were encountered during roaming surveys in at least one of the three park units and mapped as points or polygons during 2003 (Table 3-1; tables and figures begin on page 7). Maps of each species by park unit appear in Appendix B.

The area of land affected by each target species is provided in Table 3-2. These values represent all land area within park units invaded by these plants, measured through the roaming surveys. Therefore, these values represent distribution of non-native plant cover, but do not reflect the intensity of invasion. Points were estimated to represent 0.5 m^2. Figure 3-1 displays these data, highlighting red brome (*Bromus madritensis* ssp. *rubens*) as the most widely distributed species across the three park units. Redstem storksbill (*Erodium cicutarium*), cheatgrass (*Bromus tectorum*), common Mediterranean grass (*Schismus barbatus*), barley (*Hordeum* spp.), and wild oats (*Avena fatua*) also occur widely in MOCC and MOWE. London rocket (*Sisymbrium irio*) is rather widely distributed in MOWE and TUZI.

Figure 3-1 depicts species that are widely distributed, but gives no indication of the level of infestation. In contrast, Figure 3-2 displays actual land area occupied by target species. Land area infested was calculated using polygon data by multiplying the cover class midpoint by the polygon's area. For example, a polygon 1.5 ha in area, estimated at 25–50% cover, would represent 0.5625 ha (1.5 × .375 = 0.5625 ha) infested. Points were estimated to represent 0.5 m^2.

Figure 3-2 highlights redstem storksbill and red brome as the most dominant species across the three park units. These species are also the two most widely dispersed (Figure 3-1), as well as the most ubiquitous, infesting more than 50 hectares each across the three park units. As shown in Figure 3-2, cheatgrass, barley, and Mediterranean grass (*Schismus barbatus*) also infest sizeable land areas (<10 ha total), primarily in MOCC. These target plants are also widely distributed (Figure 3-1).

Species totals by park unit appear in Table 3-3. These values are much smaller than those in Table 3-2 because they represent total hectares completely infested by the target species.

In addition to recognizing species that are widely distributed across the park units, it is important to recognize target plants that occur in small but concentrated patches. These species may have the potential to become more widely dispersed across the study area in the future. The densest patches for these species are listed in Table 3-4, where johnsongrass (*Sorghum halepense*) and common Mediterranean grass are shown to have infested 50–75% of certain small-scale patches at MOCC and MOWE.

3.1.2 2004 surveys

Of the 50 target species for this project, 44 species were encountered during roaming surveys in at least one of the four park units surveyed and mapped as points or polygons in 2004 (Table 3-5). Maps of each species by park unit appear in Appendix C.

The area of land affected by each target species is provided in Table 3-6. These values represent all land area within park units invaded by these plants, measured through the roaming surveys. Therefore, these values represent distribution of non-native plant cover, but do not reflect the intensity of invasion. Points were estimated to represent 0.5 m^2. Figure 3-3 displays these data, highlighting red brome as the most widely distributed species across the park units. Redstem storksbill, barley, and London rocket also occur widely in the park units surveyed. Ripgut brome (*Bromus rigidus*) and cheatgrass are widespread in MOCC and MOWE, and Bermuda grass (*Cynodon dactylon*) and rabbitsfoot grass (*Polypogon monspeliensis*) are common on the TUZI expansion lands.

Figure 3-3 depicts species that are widely distributed, but gives no indication of the level of infestation. In contrast, Figure 3-4 displays actual land area occupied by target species. Land area infested was calculated using polygon data by multiplying the cover class midpoint by the polygon's area. For example, a polygon 1.5 ha in area estimated at 25–50% cover would represent 0.5625 ha (1.5 × .375 = 0.5625 ha) infested. Points were estimated to represent 0.5 m^2.

Figure 3-4 highlights red brome and redstem storksbill as the most dominant species across the four park units. These species are the two most widely dispersed (Figure 3-3) as well as the most ubiquitous; red brome was measured to infest over 80 ha, and redstem storksbill was calculated at over 30 ha across the four park units (see Table 3-7). As shown in Figure 3-4, ripgut brome, barley, and cheatgrass also infest sizeable land areas (<10 ha total), primarily in MOCC; these four target plants are also widely distributed (Figure 3-3).

Species totals by park unit appear in Table 3-7. These values are much smaller than those in Table 3-6 because these represent total hectares completely infested by the target species.

In addition to recognizing species that are widely distributed across the park units, it is important to recognize target plants that are occurring in small but concentrated patches. These species may have the potential to become more widely dispersed across the study area in the future. The densest patches for these species appear in Table 3-8, where johnsongrass and common Mediterranean grass are shown to have infested 50–75% of certain small-scale patches at MOWE .

3.2 Circular plots

3.2.1 2003 surveys

Of the 50 target species, a total of 17 species were recorded within the circular plots in 2003: 10 of these in MOCC, 13 in MOWE, and 5 in TUZI (Table 3-9). Three 1-m^2 quadrats were located within each circular plot, in which percent cover of all species was recorded to the nearest 1%. Using these data, the relative abundance of the target species was calculated (Table 3-9).

3.2.2 2004 surveys

Of the 50 target species, 10 species were recorded within the circular plots in 2004: 6 of these in MOCC, 7 in MOWE, and 4 in TUZI (Table 3-10). Three 1-m^2 quadrats were located within each circular plot, in which percent cover of all species were recorded to the nearest 1%. Using these data, the relative abundance of the target species was calculated (Table 3-10).

3.3 Alien Plants Ranking System

Of the 40 species ranked using the APRS, all fell within the low- and medium-impact categories, and ranged from easy-to-control to difficult-to-control (Figure 3-5). On the 100-point scale, plants ranged from 33 to 79 (tamarisk) for significance of impact; from 7 to 51 (red brome) for innate ability to become a pest; and from 17 to 73 (red brome, ripgut brome) for difficulty to control or manage (Table 3-11). The species determined to be hardest to control, with the most serious impact, were red brome and barley.

Figure 3-6 displays the difficulty of control and ability to be a pest for the target species. The target species are rather evenly distributed along the y-axis, ability to become a pest. Several of the target species are very problematic; others appear to have less direct impact on the ecosystem they invade. The species determined to be hardest to control, with the greatest ability to become pests, were ripgut brome, red brome, and cheatgrass.

Note: Some species mapped were not ranked using the APRS because insufficient data was available on their life history strategies or ecological impacts. Also, some species ranked were only mapped during either the 2003 or 2004 season, but may have been observed during both seasons.

Table 3-1. Target species occurrences mapped by park unit during roaming surveys, summer 2003.

		MOCA				TUZI		Total	
		Castle unit		Well unit					
Species	**Common name**	**Points**	**Polygons**	**Points**	**Polygons**	**Points**	**Polygons**	**Points**	**Polygons**
Avena fatua	wild oats	9	7	0	2	0	0	9	9
Boerhavia coccinea	scarlet spiderling	1	0	10	6	0	0	11	6
Brassica tournefortii	Sahara mustard	1	0	0	1	0	0	1	1
Bromus madritensis ssp. *rubens*	red brome	52	49	46	18	387	29	485	96
Bromus rigidus	ripgut brome	65	36	52	14	0	0	117	50
Bromus tectorum	cheatgrass	72	23	4	12	0	0	76	35
Centaurea melitensis	Malta starthistle	3	3	0	3	0	0	3	6
Centaurea solstitialis	yellow starthistle	0	0	0	1	0	0	0	1
Conyza canadensis	Canadian horseweed	0	0	5	2	0	0	5	2
Cynodon dactylon	Bermuda grass	70	3	42	4	0	0	112	7
Cyperus esculentus	yellow nutsedge	3	0	3	0	0	0	6	0
Digitaria sanguinalis	hairy crabgrass	68	0	33	0	0	0	101	0
Echinochloa crus-galli	barnyard grass	6	0	4	0	0	0	10	0
Eragrostis curvula	weeping lovegrass	0	0	1	0	0	0	1	0
Erodium cicutarium	redstem storksbill	0	18	1	8	0	0	1	26
Helianthus annuus	common sunflower	2	0	5	1	0	0	7	1
Heterotheca subaxillaris	camphorweed	2	0	1	0	0	0	3	0
Hordeum ssp.	common barley	8	28	0	9	0	0	8	37
Lactuca serriola	prickly lettuce	17	0	26	2	0	0	43	2
Linaria dalmatica	Dalmatian toadflax	55	0	0	0	0	0	0	0
Marrubium vulgare	horehound	4	5	27	12	0	1	31	18
Melilotus albus	white sweetclover	81	0	28	0	0	0	109	0
Polygonum aviculare	prostrate knotweed	6	0	0	0	0	0	6	0
Polypogon monspeliensis	rabbitsfoot grass	116	5	22	0	0	0	138	5
Rumex crispus	curly dock	0	0	2	0	0	0	2	0
Salsola ssp.	Russian thistle	3	2	1	2	0	0	4	4
Schismus barbatus	common Mediterranean grass	2	13	0	4	0	0	2	17
Setaria viridus	green bristlegrass	4	0	4	0	0	0	8	0
Sisymbrium irio	London rocket	18	45	39	16	248	32	305	93
Sorghum halepense	johnsongrass	72	3	17	2	0	0	89	5
Tamarix ssp.	tamarisk	56	1	16	0	0	0	72	1
Tribulus terrestris	puncture vine	0	0	0	2	0	0	0	2
Verbascum thapsus	woolly mullein	0	0	1	0	0	0	1	0
Xanthium strumarium	rough cocklebur	0	3	35	0	0	0	35	3

Table 3-2. Area and percent affected by target species measured through roaming surveys, 2003.

		MOCA				TUZI		
		Castle unit		Well unit				
Species	Common name	Ha affected	Percent affected	Ha affected	Percent affected	Ha affected	Percent affected	Total ha affected
Bromus madritensis ssp. *rubens*	red brome	221.79	95.8%	86.31	83.7%	2.33	13.3%	310.43
Erodium cicutarium	redstem storksbill	175.05	75.6%	64.04	62.1%	-	-	239.09
Bromus tectorum	cheatgrass	169.29	73.1%	54.42	52.8%	-	-	223.71
Schismus barbatus	common Mediterranean grass	109.47	47.3%	39.21	38.0%	-	-	148.68
Hordeum spp.	common barley	47.53	20.5%	43.50	42.2%	-	-	91.03
Sisymbrium irio	London rocket	T	T	45.32	44.0%	2.80	15.9%	48.12
Avena fatua	wild oats	21.71	9.4%	17.75	17.2%	-	-	39.46
Bromus rigidus	ripgut brome	T	T	31.22	30.3%	-	-	31.22
Marrubium vulgare	horehound	0.82	0.4%	17.81	17.3%	0.07	0.4%	18.70
Boerhavia coccinea	scarlet spiderling	T	T	11.01	10.7%	-	-	11.01
Conyza canadensis	Canadian horseweed	-	-	8.90	8.6%	-	-	8.90
Centaurea melitensis	Malta starthistle	0.34	0.1%	7.66	7.4%	-	-	8.00
Cynodon dactylon	Bermuda grass	0.25	0.1%	5.97	5.8%	-	-	6.22
Lactuca serriola	prickly lettuce	T	T	3.93	3.8%	-	-	3.93
Salsola spp.	Russian thistle	0.69	0.3%	2.85	2.8%	-	-	3.54
Helianthus annuus	common sunflower	T	T	2.23	2.2%	-	-	2.23
Sorghum halepense	johnsongrass	0.13	0.1%	2.03	2.0%	-	-	2.16
Brassica tournefortii	Sahara mustard	T	T	1.36	1.3%	-	-	1.36
Centaurea solstitialis	yellow starthistle	-	-	1.29	1.3%	-	-	1.29
Tribulus terrestris	puncture vine	-	-	0.92	0.9%	-	-	0.92
Xanthium strumarium	rough cocklebur	0.11	T	T	T	-	-	0.11
Tamarix spp.	tamarisk	0.07	T	T	T	-	-	0.07
Polypogon monspeliensis	rabbitsfoot grass	0.01	T	T	T	-	-	0.01
Cyperus esculentus	yellow nutsedge	T	T	T	T	-	-	T
Digitaria sanguinalis	hairy crabgrass	T	T	T	T	-	-	T
Echinochloa crus-galli	barnyard grass	T	T	T	T	-	-	T
Eragrostis curvula	weeping lovegrass	-	-	T	T	-	-	T
Heterotheca subaxillaris	camphorweed	T	T	T	T	-	-	T
Linaria dalmatica	Dalmatian toadflax	T	T	-	-	-	-	T
Melilotus albus	white sweetclover	T	T	T	T	-	-	T
Polygonum aviculare	prostrate knotweed	T	T	-	-	-	-	T
Rumex crispus	curly dock	-	-	T	T	-	-	T
Setaria viridus	green bristlegrass	T	T	T	T	-	-	T
Verbascum thapsus	woolly mullein	T	T	T	T	-	-	T

T denotes area <0.01 ha or percent <0.1%.
- denotes species not observed.

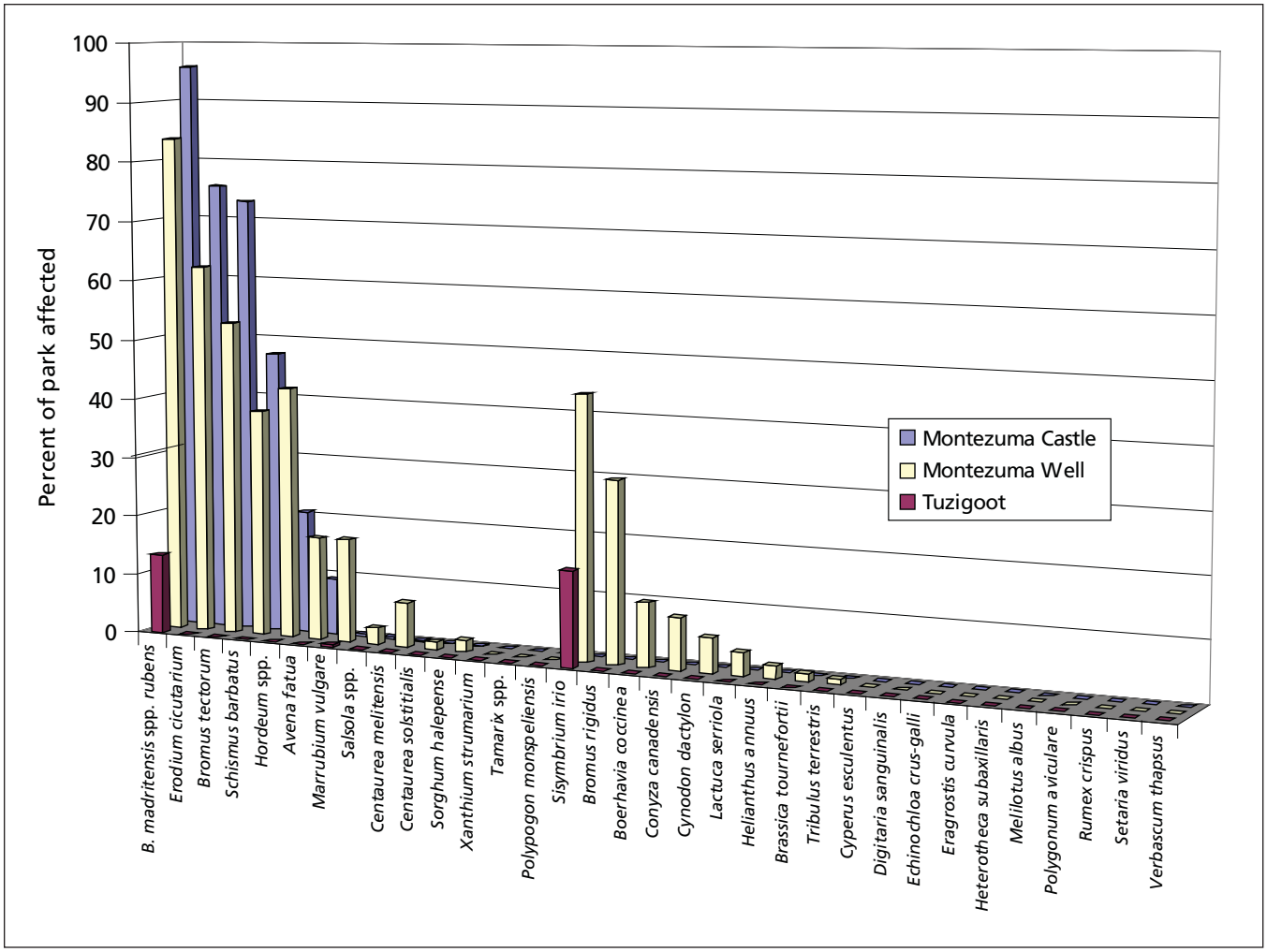

Figure 3-1. Percent land area affected by non-native species, calculated from roaming surveys, 2003.

Table 3-3. Area and percent infested by target species measured by roaming surveys, 2003.

		MOCA				TUZI		
		Castle unit		Well unit				
Species	Common name	Ha infested	Percent infested	Ha infested	Percent infested	Ha infested	Percent infested	Total ha infested
Erodium cicutarium	redstem storksbill	49.49	21.4%	18.13	16.9%	-	-	67.62
Bromus madritensis ssp. *rubens*	red brome	35.24	15.2%	20.23	18.9%	0.68	3.9%	56.15
Bromus tectorum	cheatgrass	10.55	4.6%	1.16	1.1%	-	-	11.71
Hordeum spp.	common barley	9.97	4.3%	0.93	0.9%	-	-	10.90
Schismus barbatus	common Mediterranean grass	7.88	3.4%	0.52	0.5%	-	-	8.40
Tamarix spp.	tamarisk	7.20	3.1%	T	T	-	-	7.20
Bromus rigidus	ripgut brome	0.01	0.0%	5.07	4.7%	-	-	5.08
Sisymbrium irio	London rocket	0.85	0.4%	0.77	0.7%	0.86	4.9%	2.48
Marrubium vulgare	horehound	T	T	0.94	0.9%	T	T	0.94
Conyza canadensis	Canadian horseweed	-	-	0.37	0.3%	-	-	0.37
Cynodon dactylon	Bermuda grass	0.12	0.1%	0.24	0.2%	-	-	0.36
Sorghum halepense	johnsongrass	0.01	0.0%	0.32	0.3%	-	-	0.33
Avena fatua	wild oats	0.13	0.1%	0.09	0.1%	-	-	0.22
Centaurea solstitialis	yellow starthistle	-	-	0.16	0.1%	-	-	0.16
Boerhavia coccinea	scarlet spiderling	T	T	0.13	0.1%	-	-	0.13
Lactuca serriola	prickly lettuce	T	T	0.12	0.1%	-	-	0.12
Salsola spp.	Russian thistle	0.01	0.0%	0.09	0.1%	-	-	0.10
Digitaria sanguinalis	hairy crabgrass	0.01	0.0%	T	-	-	-	0.01
Helianthus annuus	common sunflower	T	T	0.01	0.0%	-	-	0.01
Melilotus albus	white sweetclover	0.01	0.0%	T	T	-	-	0.01
Polypogon monspeliensis	rabbitsfoot grass	0.01	0.0%	T	T	-	-	0.01
Brassica tournefortii	Sahara mustard	T	T	-	-	-	-	T
Centaurea melitensis	Malta starthistle	T	T	-	-	-	-	T
Cyperus esculentus	yellow nutsedge	T	T	T	T	-	-	T
Echinochloa crus-galli	barnyard grass	T	T	T	T	-	-	T
Eragrostis curvula	weeping lovegrass	-	-	T	T	-	-	T
Heterotheca subaxillaris	camphorweed	T	T	T	T	-	-	T
Linaria dalmatica	Dalmatian toadflax	T	T	-	-	-	-	T
Polygonum aviculare	prostrate knotweed	T	T	-	-	-	-	T
Rumex crispus	curly dock	-	-	T	T	-	-	T
Setaria viridus	green bristlegrass	T	T	T	T	-	-	T
Tribulus terrestris	puncture vine	-	-	-	-	-	-	T
Verbascum thapsus	woolly mullein	T	T	T	T	-	-	T
Xanthium strumarium	rough cocklebur	-	-	T	T	-	-	T

T denotes area <0.01 ha.
- denotes species not observed.

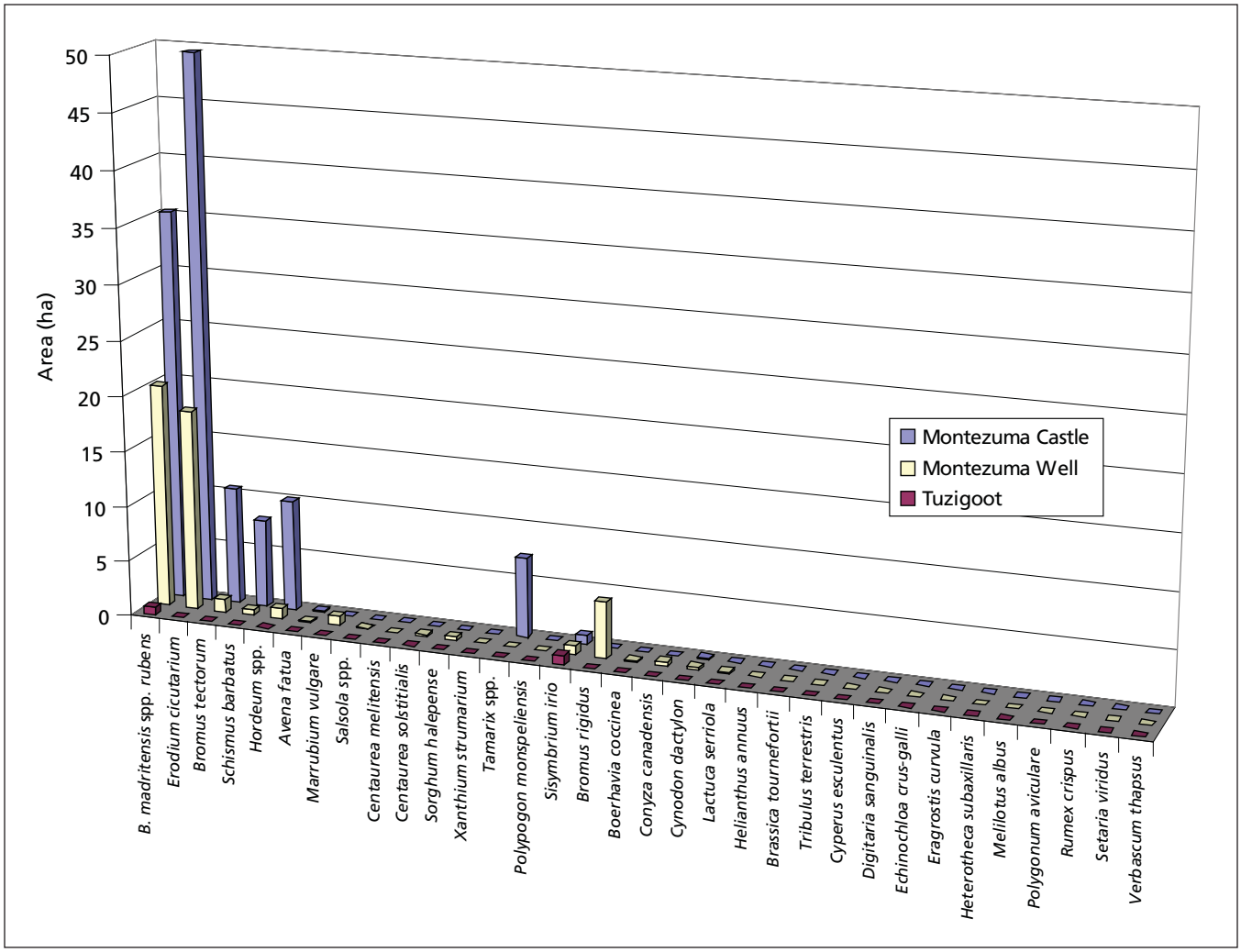

Figure 3-2. Area infested by non-native species, calculated from roaming surveys, 2003.

Table 3-4. Most densely concentrated species, Montezuma Castle National Monument, 2003.

Species	Common name	Unit	Area occupied (ha)	% cover
Cynodon dactylon	Bermuda grass	Castle	0.087	50–75%
Cynodon dactylon	Bermuda grass	Well	0.551	50–75%
Sorghum halepense	johnsongrass	Well	0.740	50–75%
Conyza canadensis	Canadian horseweed	Well	2.226	5–25%
Hordeum spp.	common barley	Well	1.641	5–25%
Marrubium vulgare	horehound	Well	4.811	5–25%
Tamarix spp.	tamarisk	Castle	0.069	5–25%

Table 3-5. Target species point and polygon occurrences mapped by park unit during roaming surveys, summer 2004.

		MOCA				TUZI				Total	
		Castle unit		Well unit		Main unit		Expansion unit			
Scientific name	Common name	Points	Polygons	Points	Polygons	Points	Polygons	Points	Polygons	Points	Polygons
Acroptilon repens	Russian knapweed	0	0	0	0	0	0	11	0	11	0
Ailanthus altissima	tree of heaven	2	0	0	0	0	0	1	0	3	0
Arundo donax	giant reed	0	0	0	0	1	0	0	0	1	0
Avena fatua	wild oats	9	2	0	0	0	0	0	0	9	2
Boerhavia coccinea	scarlet spiderling	3	0	1	2	0	0	2	0	6	2
Bromus japonicus	Japanese brome	0	0	0	0	0	0	9	0	9	0
Bromus madritensis ssp. *rubens*	red brome	15	28	33	16	485	24	15	7	548	75
Bromus rigidus	ripgut brome	42	17	18	10	0	0	6	2	66	29
Bromus tectorum	cheatgrass	28	13	0	9	0	0	9	0	37	22
Centaurea melitensis	Malta starthistle	3	3	1	1	0	0	1	0	5	4
Conyza canadensis	Canadian horseweed	0	0	3	0	0	0	0	0	3	0
Cynodon dactylon	Bermuda grass	48	3	24	3	3	1	32	3	104	10
Digitaria sanguinalis	hairy crabgrass	49	0	15	0	0	0	3	0	67	0
Elaeagnus angustifolia	Russian olive	0	0	0	0	0	0	16	0	16	0
Eragrostis cilianensis	stinkgrass	0	0	0	0	2	0	0	0	2	0
Eragrostis curvula	weeping lovegrass	0	0	14	0	0	0	0	0	14	0
Eragrostis lehmannia	Lehmann lovegrass	12	1	0	0	1	1	0	0	12	2
Erodium cicutarium	redstem storksbill	8	16	7	11	22	27	3	5	40	59
Heterotheca subaxillaris	camphorweed	11	2	7	1	0	0	6	0	24	3
Hordeum leporinum	hare barley	11	17	0	7	0	2	1	5	12	31
Kochia scoparia	fireweed	0	0	0	0	0	0	54	0	54	0
Lactuca serriola	prickly lettuce	9	0	11	1	0	0	2	0	22	1
Lamium amplexicaule	henbit	0	0	0	0	2	0	0	0	2	0
Linaria dalmatica	Dalmatian toadflax	25	2	1	2	0	0	0	0	26	4
Lolium perenne	perennial ryegrass	3	0	0	0	0	0	0	0	3	0
Marrubium vulgare	horehound	9	4	7	8	10	3	4	0	30	15
Medicago sp.	alfalfa	0	0	0	0	1	0	0	0	1	0
Melilotus albus	white sweetclover	7	0	6	0	0	0	6	0	19	0

Table 3-5. Target species point and polygon occurrences mapped by park unit, summer 2004, cont.

		MOCA				TUZI				Total	
		Castle unit		Well unit		Main unit		Expansion unit			
Scientific name	**Common name**	**Points**	**Polygons**	**Points**	**Polygons**	**Points**	**Polygons**	**Points**	**Polygons**	**Points**	**Polygons**
Melilotus indicus	yellow sweetclover	18	0	16	0	0	0	2	0	36	0
Polygonum aviculare	prostrate knotweed	10	0	0	0	0	0	1	0	11	0
Polypogon monspeliensis	rabbitsfoot grass	35	0	33	0	0	0	27	2	95	2
Rumex crispus	curly dock	12	0	5	0	0	0	8	0	25	0
Salsosa kali	Russian thistle	8	4	0	2	0	0	6	1	14	7
Schismus barbatus	common Mediterranean grass	1	7	0	1	4	0	1	1	6	9
Sisymbrium irio	London rocket	6	7	2	0	116	24	3	3	127	34
Solanum elaeagnifolium	silverleaf nightshade	0	0	0	0	0	1	0	0	0	1
Sonchus asper	spiny sowthistle	0	0	13	1	0	0	4	0	17	1
Sonchus oleraceus	common sowthistle	0	0	0	0	0	0	1	0	1	0
Sorghum halepense	johnsongrass	32	0	12	3	0	0	0	0	44	3
Tamarix ramosissima	five-stamen tamarisk	48	0	12	0	0	0	15	0	75	0
Torilis arvensis	spreading hedgeparsley	0	0	0	0	0	0	2	0	2	0
Tribulus terrestris	puncture vine	0	0	0	1	0	0	1	0	1	1
Verbascum thapsus	woolly mullein	12	0	8	0	0	0	2	0	22	0
Xanthium strumarium	rough cocklebur	43	0	14	0	0	0	9	0	66	0

Table 3-6. Area and percent affected by target species measured through roaming surveys, 2004.

		MOCA				TUZI				
		Castle unit		Well unit		Main unit		Expansion unit		
Species	Common name	Ha affected	Percent affected	Ha affected	Percent affected	Ha affected	Percent affected	Ha affected	Percent affected	Total area affected (ha)
Bromus madritensis spp. *rubens*	red brome	195.00	84.2	83.41	80.9	9.06	51.6	34.83	36.9	322.30
Erodium cicutarium	redstem storksbill	143.13	61.8	73.87	71.7	15.55	88.6	28.45	30.2	261.00
Bromus rigidus	ripgut brome	65.60	28.3	27.92	27.1	0.00	-	3.14	3.3	96.66
Bromus tectorum	cheatgrass	58.05	25.1	36.59	35.5	0.00	-	0.00	T	94.64
Hordeum leporinum	hare barley	66.48	28.7	14.18	13.8	0.34	1.9	14.03	14.9	95.04
Sisymbrium irio	London rocket	55.59	24.0	0.00	T	8.92	50.8	7.65	8.1	72.16
Schismus barbatus	common Mediterranean grass	69.13	29.9	0.16	0.2	0.00	T	1.94	2.1	71.23
Eragrostis lehmannia	Lehmann lovegrass	49.36	21.3	0.00	0.0	0.28	1.6	0.00	-	49.64
Avena fatua	wild oats	49.50	21.4	0.00	0.0	0.00		0.00	-	49.50
Cynodon dactylon	Bermuda grass	0.70	0.3	1.15	T	0.28	1.6	34.70	36.8	36.83
Marrubium vulgare	horehound	20.17	8.7	13.46	13.1	1.53	8.7	0.00	T	35.16
Salsosa kali	Russian thistle	26.70	11.5	4.14	0.0	0.00	-	5.16	5.5	36.01
Polypogon monspeliensis	rabbitsfoot grass	0.00	T	0.00	T	0.00	-	30.94	32.8	30.94
Boerhavia coccinea	scarlet spiderling	0.00	T	21.37	20.7	0.00	-	0.00	T	21.37
Heterotheca subaxillaris	camphorweed	12.87	5.6	3.49	3.4	0.00	-	0.00	T	16.36
Linaria dalmatica	Dalmatian toadflax	5.08	2.2	3.75	3.6	0.00	-	0.00	-	8.83
Sorghum halepense	johnsongrass	0.00	T	4.85	4.7	0.00	-	0.00	-	4.85
Sonchus asper	spiny sowthistle	0.00	0.0	2.00	1.9	0.00	-	0.00	T	2.00
Centaurea melitensis	Malta starthistle	0.55	0.2	0.23	0.2	0.00	-	0.00	T	0.78
Lactuca serriola	prickly lettuce	0.00	T	0.46	0.4	0.00	-	0.00	T	0.46
Tribulus terrestris	puncture vine	0.00	0.0	0.16	0.2	0.00	-	0.00	T	0.16
Tamarix ramosissima	five-stamen tamarisk	0.02	T	0.01	T	0.00	-	0.01	T	0.04
Solanum elaeagnifolium	silverleaf nightshade	0.00	0.0	0.00	0.0	0.03	T	-	-	0.03
Kochia scoparia	fireweed	0.00	0.0	0.00	0.0	0.00	-	0.03	T	0.03
Elaeagnus angustifolia	Russian olive	0.00	0.0	0.00	0.0	0.00	-	0.01	T	0.01
Acroptilon repens	Russian knapweed	0.00	0.0	0.00	0.0	0.00	-	0.00	T	T
Ailanthus altissima	tree of heaven	0.00	T	0.00	0.0	0.00	-	0.00	T	T
Arundo donax	giant reed	0.00	0.0	0.00	0.0	0.00	T	0.00	-	T
Bromus japonicus	Japanese brome	0.00	0.0	0.00	0.0	0.00	-	0.00	T	T

Table 3-6. Area and percent affected by target species measured through roaming surveys, 2004, cont.

		MOCA				TUZI				
		Castle unit		Well unit		Main unit		Expansion unit		
Species	**Common name**	**Ha affected**	**Percent affected**	**Ha affected**	**Percent affected**	**Ha affected**	**Percent affected**	**Ha affected**	**Percent affected**	**Total area affected (ha)**
Conyza canadensis	Canadian horseweed	0.00	0.0	0.00	T	0.00	-	0.00	-	T
Digitaria sanguinalis	hairy crabgrass	0.00	T	0.00	T	0.00	-	0.00	T	T
Eragrostis cilianensis	stinkgrass	0.00	0.0	0.00	0.0	0.00	T	0.00	-	T
Eragrostis curvula	weeping lovegrass	0.00	0.0	0.00	T	0.00	-	0.00	-	T
Lamium amplexicaule	henbit	0.00	0.0	0.00	0.0	0.00	-	0.00	T	T
Lolium perenne	perennial ryegrass	0.00	T	0.00	0.0	0.00	-	0.00	-	T
Medicago sp.	alfalfa	0.00	0.0	0.00	0.0	0.00	-	0.00	T	T
Meliotus albus	white sweetclover	0.00	T	0.00	T	0.00	-	0.00	T	T
Meliotus indicus	yellow sweetclover	0.00	T	0.00	T	0.00	-	0.00	T	T
Polygonum aviculare	prostrate knotweed	0.00	T	0.00	0.0	0.00	-	0.00	T	T
Rumex crispus	curly dock	0.00	T	0.00	T	0.00	-	0.00	T	T
Sonchus oleraceus	common sowthistle	0.00	0.0	0.00	0.0	0.00	-	0.00	T	T
Torilis arvensis	spreading hedgeparsley	0.00	0.0	0.00	0.0	0.00	-	0.00	T	T
Verbascum thapsus	woolly mullein	0.00	T	0.00	T	0.00	-	T	T	T
Xanthium strumarium	rough cocklebur	0.00	T	0.00	T	0.00	-	T	T	T

T denotes area of <0.01 ha or <0.1%.
- denotes species not observed.

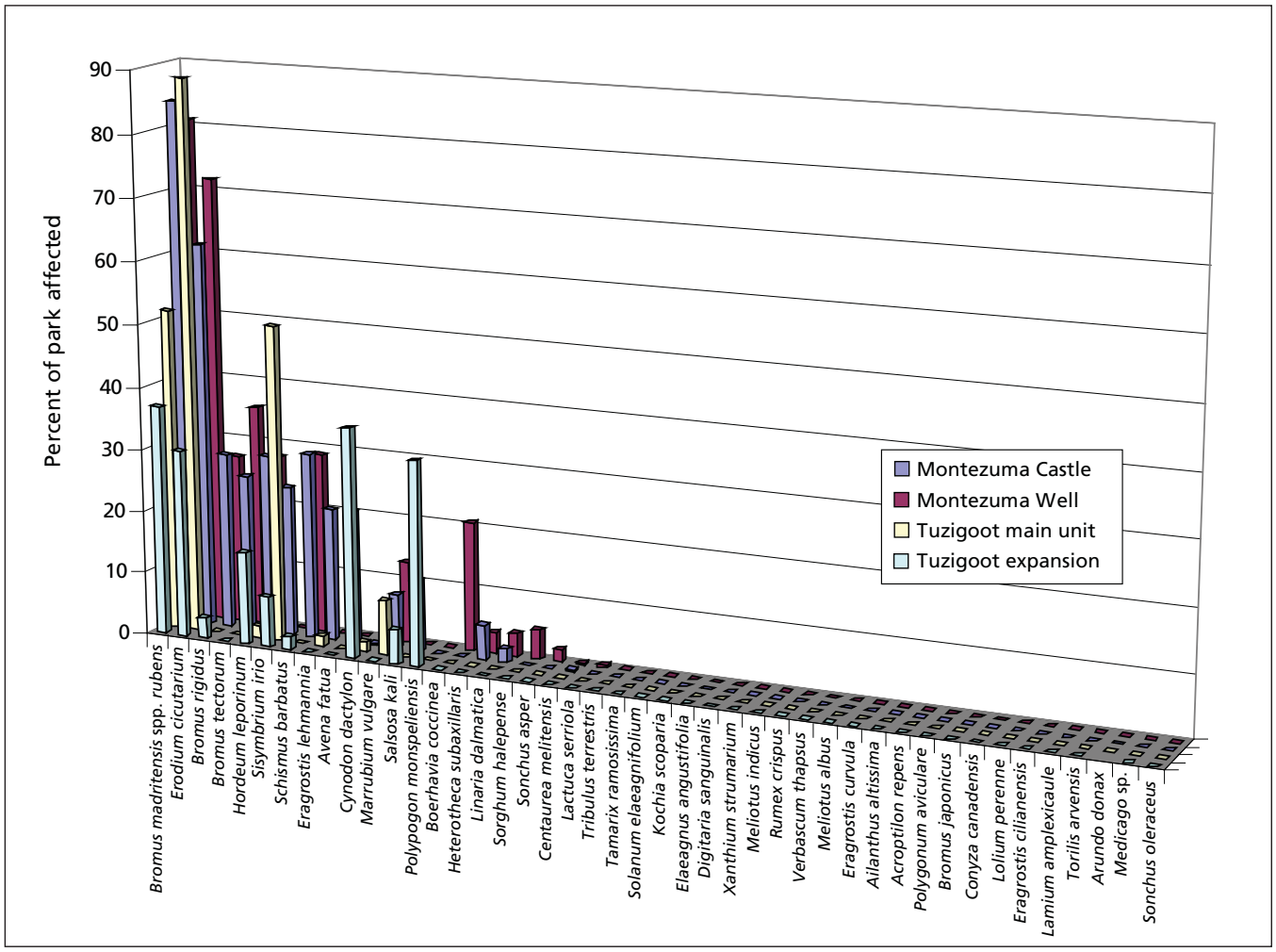

Figure 3-3. Percent land area affected by non-native species, calculated from roaming surveys, 2004.

Table 3-7. Area and percent infested by target species measured by roaming surveys, 2004.

		MOCA				TUZI				
		Castle unit		Well unit		Main unit		Expansion		
Scientific name	Common name	Ha affected	Percent affected	Ha affected	Percent affected	Ha affected	Percent affected	Ha affected	Percent affected	Total ha infested
Bromus madritensis ssp. *rubens*	red brome	53.96	23.3%	21.34	19.9%	1.89	10.7%	6.03	6.4%	83.22
Erodium cicutarium	redstem storksbill	14.94	6.5%	4.15	3.9%	8.47	48.2%	2.81	3.0%	30.38
Bromus rigidus	ripgut brome	20.82	9.0%	5.97	5.6%	-		0.08	0.1%	26.87
Hordeum leporinum	hare barley	14.32	6.2%	2.28	2.1%	T		2.19	2.3%	18.79
Bromus tectorum	cheatgrass	9.63	4.2%	1.45	1.4%	-		T		11.08
Salsosa kali	Russian thistle	2.85	1.2%	0.09	0.1%	-		1.94	2.1%	4.88
Schismus barbatus	common Mediterranean grass	2.83	1.2%	T		T		0.05	0.1%	2.88
Sisymbrium irio	London rocket	0.30	0.1%	T		0.48	2.7%	0.79	0.8%	1.57
Cynodon dactylon	Bermuda grass	0.03	0.0%	0.47	0.4%	0.04	0.2%	0.18	0.2%	0.72
Heterotheca subaxillaris	camphorweed	0.32	0.1%	0.09	0.1%	-		T		0.41
Sorghum halepense	johnsongrass	T		0.31	0.3%	-		-		0.31
Marrubium vulgare	horehound	0.10	0.0%	0.19	0.2%	0.01	0.1%	T		0.30
Linaria dalmatica	Dalmatian toadflax	0.13	0.1%	0.13	0.1%	-		-		0.26
Avena fatua	wild oats	0.25	0.1%	-		-		-		0.25
Eragrostis lehmannia	Lehmann lovegrass	0.25	0.1%	-		T		-		0.25
Polypogon monspeliensis	rabbitsfoot grass	T		T		-		0.16	0.2%	0.16
Boerhavia coccinea	scarlet spiderling	T		0.11	0.1%			T		0.11
Kochia scoparia	fireweed	-		-		-		0.02	0.0%	0.02
Tamarix ramosissima	five-stamen tamarisk	0.02	0.0%	T		-		T		0.02
Xanthium strumarium	rough cocklebur	0.02	0.0%	T		-		-		0.02
Sonchus asper	spiny sowthistel	-		0.01	0.0%	-		T		0.01
Eragrostis curvula	weeping lovegrass	-		-		-		-		0
Acroptilon repens	Russian knapweed	-		-		-		T		T
Ailanthus altissima	tree of heaven	T		-		-		T		T
Arundo donax	giant reed	-		-		T		-		T
Bromus japonicus	Japanese brome	-		-		-		T		T
Centaurea melitensis	Malta starthistle	T		T		-		T		T
Conyza canadensis	Canadian horseweed	-		T		-		-		T
Digitaria sanguinalis	hairy crabgrass	T		T		-		T		T
Elaeagnus angustifolia	Russian olive	-		-		-		T		T

Table 3-7. Area and percent infested by target species measured by roaming surveys, 2004, cont.

		MOCA				TUZI				
		Castle unit		Well unit		Main unit		Expansion		
Scientific name	**Common name**	**Ha affected**	**Percent affected**	**Ha affected**	**Percent affected**	**Ha affected**	**Percent affected**	**Ha affected**	**Percent affected**	**Total ha infested**
Elaeagnus cilianensis	stinkgrass	-	-	-	-	T	-	-	-	T
Lactuca serriola	prickly lettuce	T	-	T	-	-	-	T	-	T
Lamium amplexicaule	henbit	-	-	-	-	T	-	-	-	T
Lolium perenne	perennial ryegrass	T	-	-	-	-	-	-	-	T
Medicago sp.	alfalfa	-	-	-	-	T	-	-	-	T
Melilotus albus	white sweetclover	T	-	T	-	-	-	T	-	T
Melilotus indicus	yellow sweetclover	T	-	T	-	-	-	T	-	T
Polygonum aviculare	prostrate knotweed	T	-	-	-	-	-	T	-	T
Rumex crispus	curly dock	T	-	T	-	-	-	T	-	T
Solanum elaeagnifolium	silverleaf nightshade	-	-	-	-	T	-	-	-	T
Sonchus oleraceus	common sowthistle	-	-	-	-	-	-	T	-	T
Torilis arvensis	spreading hedgeparsley	-	-	-	-	-	-	T	-	T
Tribulus terrestris	puncture vine	-	-	T	-	-	-	T	-	T
Verbascum thapsus	woolly mullein	T	-	T	-	-	-	-	-	T

T denotes area of <0.01 ha.
- denotes species not observed.

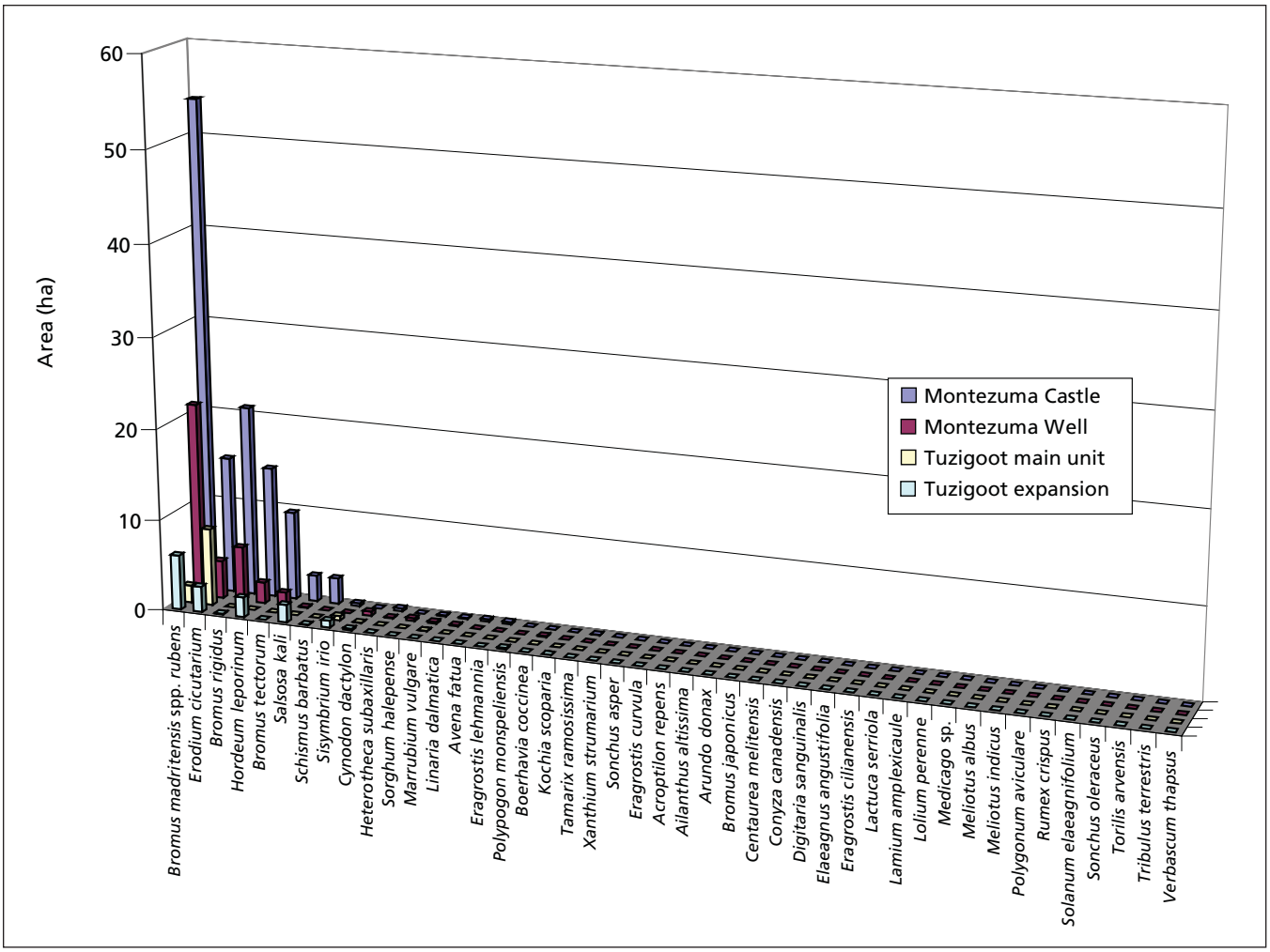

Figure 3-4. Area infested by non-native species, calculated from roaming surveys, 2004.

Table 3-8. Small, concentrated patches of target species in Montezuma Castle and Tuzigoot national monuments, 2004.

Scientific name	Common name	Park unit	Area occupied (ha)	Percent cover
Cynodon dactylon	Bermuda grass	MOWE	0.53	75–95%
Sorghum halepense	johnsongrass	MOWE	2.32	75–95%
Sisymbrium irio	London rocket	TUZI	5.16	5–25%
Schismus barbatus	common Mediterranean grass	MOCC	175.06	5–25%
Salsola kali	Russian thistle	MOCC	175.06	5–25%

Table 3-9. Target species occurrences and relative abundances within circular plots, 2003.

		MOCA				TUZI	
		Castle unit		Well unit			
Species	**Common name**	**Occurrences**	**Foliar cover**	**Occurrences**	**Foliar cover**	**Occurrences**	**Foliar cover**
Avena fatua	wild oats	-	-	1	0.03%	-	-
Boerhavia coccinea	scarlet spiderling	-	-	2	0.11%	-	-
Brassica tournefortii	Sahara mustard	-	-	-	-	-	-
Bromus rigidus	ripgut brome	6	2.78%	3	2.72%	-	-
Bromus madritensis ssp. *rubens*	red brome	20	8.78%	21	5.39%	48	4.02%
Bromus tectorum	cheatgrass	12	2.50%	1	0.03%	-	-
Centaurea melitensis	Malta starthistle	-	-	1	0.03%	-	-
Centaurea solstitialis	yellow starthistle	-	-	-	-	-	-
Conyza canadensis	Canadian horseweed	-	-	-	-	-	-
Cynodon dactylon	Bermuda grass	-	-	1	0.69%	-	-
Cyperus esculentus	yellow nutsedge	-	-	-	-	-	-
Digitaria sanguinalis	hairy crabgrass	-	-	-	-	-	-
Echinochloa crus-galli	barnyard grass	-	-	-	-	-	-
Eragrostis curvula	weeping lovegrass	-	-	-	-	-	-
Erodium cicutarium	redstem storksbill	3	0.08%	8	3.61%	67	1.30%
Helianthus annuus	common sunflower	-	-	-	-	-	-
Heterotheca subaxillaris	camphorweed	-	-	-	-	-	-
Hordeum spp.	common barley	4	1.31%	-	-	-	-
Lactuca serriola	prickly lettuce	-	-	-	-	-	-
Marrubium vulgare	horehound	-	-	1	0.28%	1	0.01%
Melilotus albus	white sweetclover	-	-	-	-	-	-
Polygonum aviculare	prostrate knotweed	-	-	1	T	5	T
Polypogon monspeliensis	rabbitsfoot grass	1	T	-	-	-	-
Rumex crispus	curly dock	1	0.03%	-	-	-	-
Salsola spp.	Russian thistle	-	-	1	0.03%	-	-
Schismus barbatus	common Mediterranean grass	7	0.56%	5	0.14%	-	-
Setaria viridus	green bristlegrass	-	-	-	-	-	-
Sisymbrium irio	London rocket	3	0.61%	4	0.11%	23	0.77%
Sorghum halepense	johnsongrass	1	0.03%	-	-	-	-
Tamarix spp.	tamarisk	-	-	-	-	-	-
Tribulus terrestris	puncture vine	-	-	-	-	-	-
Verbascum thapsus	woolly mullein	-	-	-	-	-	-
Xanthium strumarium	rough cocklebur	-	-	-	-	-	-

T denotes relative abundance <0.01%.
- denotes species not observed.

Table 3-10. Target species occurrences and relative abundances within circular plots, 2004.

		MOCA				TUZI	
		Castle unit		Well unit			
Scientific name	Common name	Occurrences	Foliar cover	Occurrences	Foliar cover	Occurrences	Foliar cover
Acroptilon repens	Russian knapweed	-	-	-	-	-	-
Ailanthus altissima	tree of heaven	-	-	-	-	-	-
Avena fatua	wild oats	-	-	-	-	-	-
Boerhavia coccinea	scarlet spiderling	-	-	-	-	-	-
Bromus japonicus	Japanese brome	-	-	2	2.3%	-	-
Bromus madritensis ssp. *rubens*	red brome	10	1.3%	8	1.3%	10	4.7%
Bromus rigidus	ripgut brome	-	-	-	-	-	-
Bromus tectorum	cheatgrass	-	-	2	0.1%	-	-
Centaurea melitensis	Malta starthistle	-	-	-	-	-	-
Conyza canadensis	Canadian horseweed	-	-	-	-	-	-
Cynodon dactylon	Bermuda grass	-	-	-	-	-	-
Digitaria sanguinalis	hairy crabgrass	-	-	-	-	-	-
Elaeagnus angustifolia	Russian olive	-	-	-	-	-	-
Eragrostis lehmannia	Lehmann lovegrass	-	-	-	-	-	-
Erodium cicutarium	redstem storksbill	5	2.7%	6	1.5%	10	25.6%
Heterotheca subaxillaris	camphorweed	-	-	-	-	-	-
Hordeum leporinum	hare barley	1	1.1%	3	T	-	-
Kochia scoparia	fireweed	-	-	-	-	-	-
Lactuca serriola	prickly lettuce	1	T	-	-	-	-
Linaria dalmatica	Dalmatian toadflax	-	-	-	-	-	-
Lolium perenne	perennial ryegrass	-	-	-	-	-	-
Marrubium vulgare	horehound	-	-	1	1.7%	1	T
Melilotus albus	white sweetclover	-	-	-	-	-	-
Melilotus indicus	yellow sweetclover	-	-	-	-	-	-
Polygonum aviculare	prostrate knotweed	-	-	-	-	-	-
Polypogon monspeliensis	rabbitsfoot grass	-	-	-	-	-	-
Rumex crispus	curly dock	-	-	-	-	-	-
Salsosa kali	Russian thistle	2	T	3	0.2%	-	-
Schismus barbatus	common Mediterranean grass	6	0.1%	-	-	-	-
Sisymbrium irio	London rocket	-	-	-	-	8	0.2%
Sonchus asper	spiny sowthistle	-	-	-	-	-	-
Sorghum halepense	johnsongrass	-	-	-	-	-	-
Tamarix ramosissima	five-stamen tamarisk	-	-	-	-	-	-
Torilis arvensis	spreading hedgeparsley	-	-	-	-	-	-
Tribulus terrestris	puncture vine	-	-	-	-	-	-
Verbascum thapsus	woolly mullein	-	-	-	-	-	-
Xanthium strumarium	rough cocklebur	-	-	-	-	-	-

T denotes relative abundance <0.01%.
- denotes species not observed.

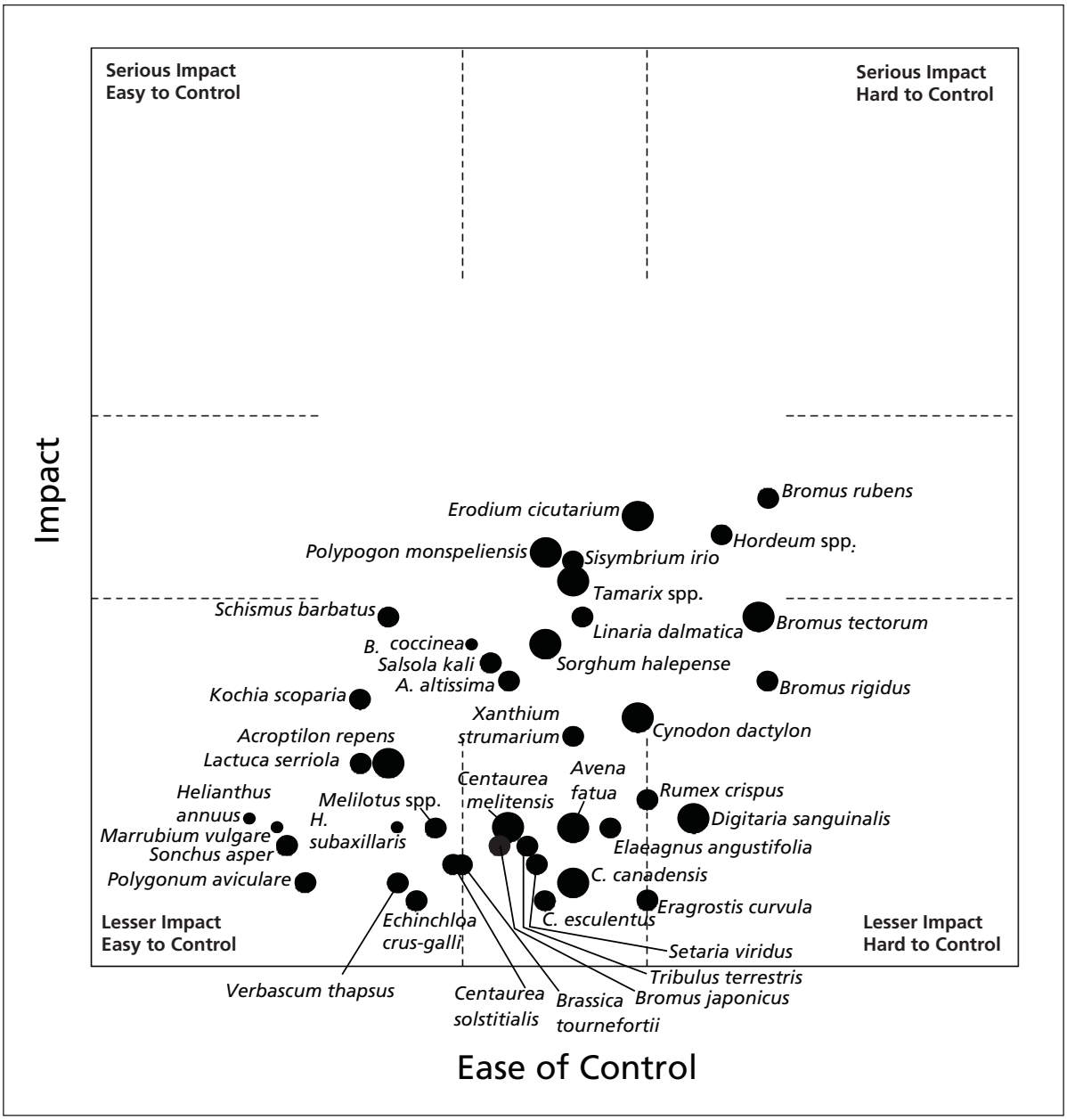

Figure 3-5. Plot of species ranked using the APRS, showing ease of control versus level of impact. Size of dot represents the pest score derived using the APRS.

Table 3-11. On a 100-point scale, ranks of target species for significance of impact, innate ability to become a pest, and feasibility of control or management.

Scientific name	Common name	Impact	Pest	Control
Bromus tectorum	cheatgrass	78	38	72
Bromus madritensis ssp. *rubens*	red brome	59	51	73
Erodium cicutarium	redstem storksbill	70	49	59
Tamarix spp.	tamarisk	79	42	52
Hordeum spp.	common barley	56	47	68
Bromus rigidus	ripgut brome	59	31	73
Sorghum halepense	johnsongrass	75	35	49
Polypogon monspeliensis	rabbitsfoot grass	65	45	49
Sisymbrium irio	London rocket	59	44	52
Cynodon dactylon	Bermuda grass	65	27	59
Linaria dalmatica	Dalmatian toadflax	60	38	53
Digitaria sanguinalis	hairy crabgrass	63	16	65
Salsola kali	Russian thistle	60	33	43
Ailanthus altissima	tree of heaven	57	31	45
Avena fatua	wild oats	65	15	52
Schismus barbatus	common Mediterranean grass	59	38	32
Xanthium strumarium	rough cocklebur	52	25	52
Centaurea melitensis	Malta starthistle	67	15	45
Elaegnus angustifolia	Russian olive	56	15	56
Conyza canadensis	Canadian horseweed	63	9	52
Rumex crispus	curly dock	44	18	60
Acroptilon repens	Russian knapweed	62	22	32
Bromus japonicus	Japanese brome	59	13	44
Setaria viridis	green bristlegrass	56	11	48
Eragrostis curvula	weeping lovegrass	48	7	60
Brassica tournefortii	Sahara mustard	60	11	40
Tribulus terrestris	puncture vine	51	13	47
Boerhavia coccinea	scarlet spiderling	35	35	41
Kochia scoparia	fireweed	52	29	29
Centaurea solstitialis	yellow starthistle	57	11	39
Cyperus esculentus	yellow nutsedge	46	7	49
Lactuca serriola	prickly lettuce	46	22	29
Melilotus albus or *indicus*	sweetclover	44	15	37
Echinochloa crus-galli	barnyard grass	49	7	35
Verbascum thapsus	woolly mullein	40	9	33
Polygonum aviculare	prostrate knotweed	49	9	23
Heterotheca subaxillaris	camphorweed	33	15	33
Sonchus asper	spiny sowthistle	41	13	21
Marrubium vulgare	horehound	38	15	20
Helianthus annuus	common sunflower	37	16	17

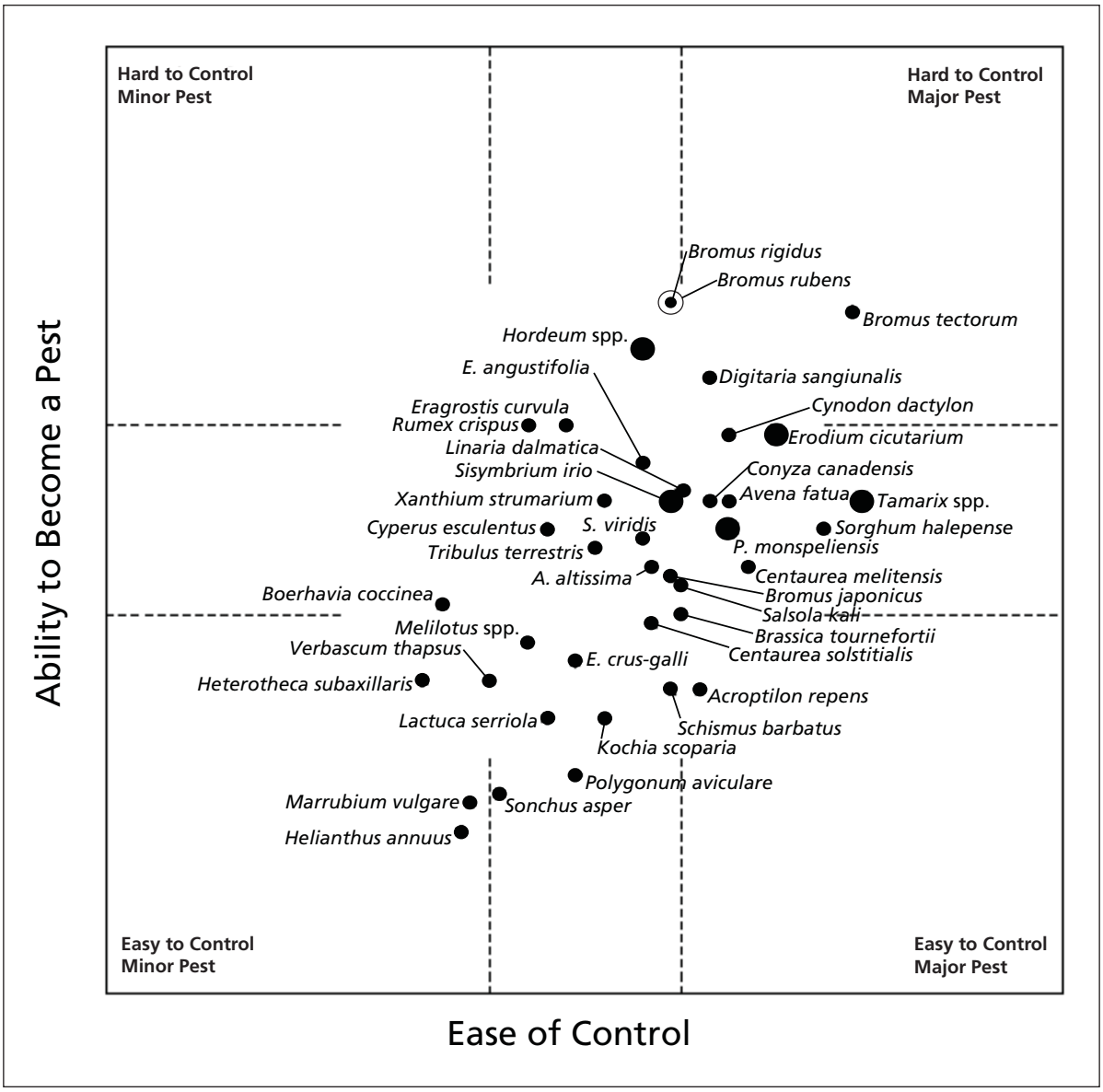

Figure 3-6. Plot of species ranked using the APRS, showing ease of control versus ability to become a pest. Size of dot represents the impact score derived using the APRS.

4 Discussion

To our knowledge, this represents one of the first applications of roaming surveys to non-native species mapping in Arizona. As a result, this effort served as a test of the method as well as a data-collection exercise. Some adjustments were made as data collection proceeded. For example, the number of circular plots collected for MOCC and MOWE was drastically reduced (from 100 to 19 per park unit) in 2003. In addition, we believe that several species were underestimated in 2003 due to the time of year of the surveys. By July, several of the annual species were already dormant or dead, making them difficult to identify, so additional fieldwork was conducted earlier in the growing season in 2004.

This method has yielded detailed maps of the location, distribution, and abundance of the most problematic plants within Arizona national parks, which will enhance decisions made by land managers. In addition, the data collected will serve as a baseline for long-term monitoring, allowing for evaluation in changes of weed populations over time. It will also feed directly into the Exotic Plant Management Plan under development for Montezuma Castle and Tuzigoot national monuments.

4.1 Comparison of methods

The circular plots were implemented to estimate spatial bias and accuracy of the roaming surveys. Stohlgren et al. (no date) suggest randomly locating these plots and comparing the foliar cover of the target species within to the foliar cover of target species collected during the roaming surveys. This comparison identifies observer bias to particular regions of the study area (i.e., near roads or riparian areas).

As a whole, the circular plots detected fewer numbers and lower abundances of target species (Table 4-1). In 2003, the circular-plot method added one target species each at MOCC and MOWE, and two target species at TUZI. The stark difference in target species detected by the two methods in 2003 suggests that MOCC and MOWE were not sufficiently sampled using the circular-plot method. Per unit area, TUZI received many more circular plots (1 plot/0.9 ha, compared to 1 plot/19.3 ha for MOCC and 1 plot/8.6 ha for MOWE). However, Stohlgren et al. (no date) suggest allocating only 10% of field resources to the supplemental circular-plot method. Nineteen circular plots for TUZI were sampled in 2½ days, and roaming surveys for TUZI were completed in three days, allocating 45% of field resources to sufficient circular plots. Based on these numbers, circular plots were drastically reduced for the remaining two park units. As a result, fewer species were detected by circular plots within the 10%-of-resources rule.

Table 4-1. Target species detected by roaming surveys and circular plots, 2003.

Method	MOCA				TUZI	
	Castle unit		Well unit			
	2003	2004	2003	2004	2003	2004
Roaming surveys	26	28	32	27	3	8
Circular plots	10	6	13	7	5	4
Species in common	9	6	12	6	3	4

In 2004, approximately 10% of field resources were allocated to collecting circular-plot data. However, it appears, from Table 4-1, that more time spent with the circular-plot method would have yielded many more target species. The target species detected with the circular-plot method repeated those species located using the roaming surveys for all three units.

The circular-plot method described by Stohlgren et al. (no date) for assessing the roaming surveys performed similarly to previous efforts (Mau-Crimmins et al. 2003), but seemed to require much more than the 10% of resources specified in these guidelines. The small sample sizes of circular plots employed for MOCC and MOWE in 2003 performed much worse than roaming surveys for detecting target species; however, foliar cover for detected species was consistent among the methods. In 2004, the small sample sizes of circular plots yielded much smaller calculated relative abundances for the target species, suggesting the need for many more circular plots. When implemented in small numbers, the circular-plot method appears to be most useful for checking the consistency in measurements made by field crew members. Larger numbers of circular plots are required to assess consistency in estimating foliar cover across the two methods, as in previous efforts (Mau-Crimmins et al. 2003).

Overall, roaming surveys consistently estimated higher percent cover than circular plots. This may be due to the cover classes used in roaming surveys, or due to the small number of circular

plots that can be estimated using the 10% of field resources suggested by Stohlgren et al. (no date). From these two seasons of surveys, we conclude that the roaming surveys are performing well on these small park units, and that the best use of the circular plots is to check the consistency of estimates made by the field observers.

Figures 4-1 and 4-2 depict foliar cover of target species collected via circular plots against that collected via roaming surveys in 2003 and 2004, respectively. Both datasets were transformed using a cube-root transformation. The relative abundance of target species was somewhat consistent between the methods: $R^2 = 0.77$ (2003) and $R^2 = 0.53$ (2004). However, abundance calculated from the circular plots in 2004 was two orders of magnitude lower than that calculated from the roaming surveys. The positive correlation observed in this study is consistent with that of a previous study (Mau-Crimmins et al. 2003). However, in the previous study, much more time in the field was allocated to the circular-plot method.

The maps and weeds rankings produced in this report reflect approximately 700 hours of fieldwork and 360 hours of work in the office. Based on the accuracy assessment performed and the effort expended to yield these products, we feel that roaming surveys are a cost-effective method for producing maps of non-native species for these park units.

4.2 Alien Plants Ranking System

The Alien Plants Ranking System (Hiebert and Stubbendieck 1993) is a sensible approach to prioritizing non-native species for management efforts. The data collected and ranking performed for this project creates a foundation for the recommendations to be made in the Exotic Plant Management Plan being drafted for Montezuma Castle and Tuzigoot national monuments. A prioritized list of the target species, based on their impacts, ability to become a pest, and ease of control is a strong complement to the distribution and abundance data collected in the field.

Hiebert and Stubbendieck (1993) recommend implementing the APRS to identify species that are easy to control but have large impacts and to concentrate management efforts on these plants first. No species fell within this quadrant of the graph for Montezuma Castle and Tuzigoot NMs (see Figure 3-5). Several target species fall within the quadrant labeled "easy to control, lesser impact." Efforts could be placed on this group of species to minimize the overall impact of the weed communities at the parks. Alternatively, some of the most widespread species, red brome, redstem storksbill, barley, London rocket, and cheatgrass (see Tables 3-2 and 3-6), are also the most difficult to control of the target species, and have the greatest impact (see Figure 3-5).

Additionally, several of these (ripgut brome, red brome, cheatgrass, and barley) also exhibit the greatest ability to become pests (see Figure 3-6). Careful consideration of these plants' potential for control, likelihood of spread, and current level of infestation should be weighed as recommendations are made for the Exotic Plant Management Plan.

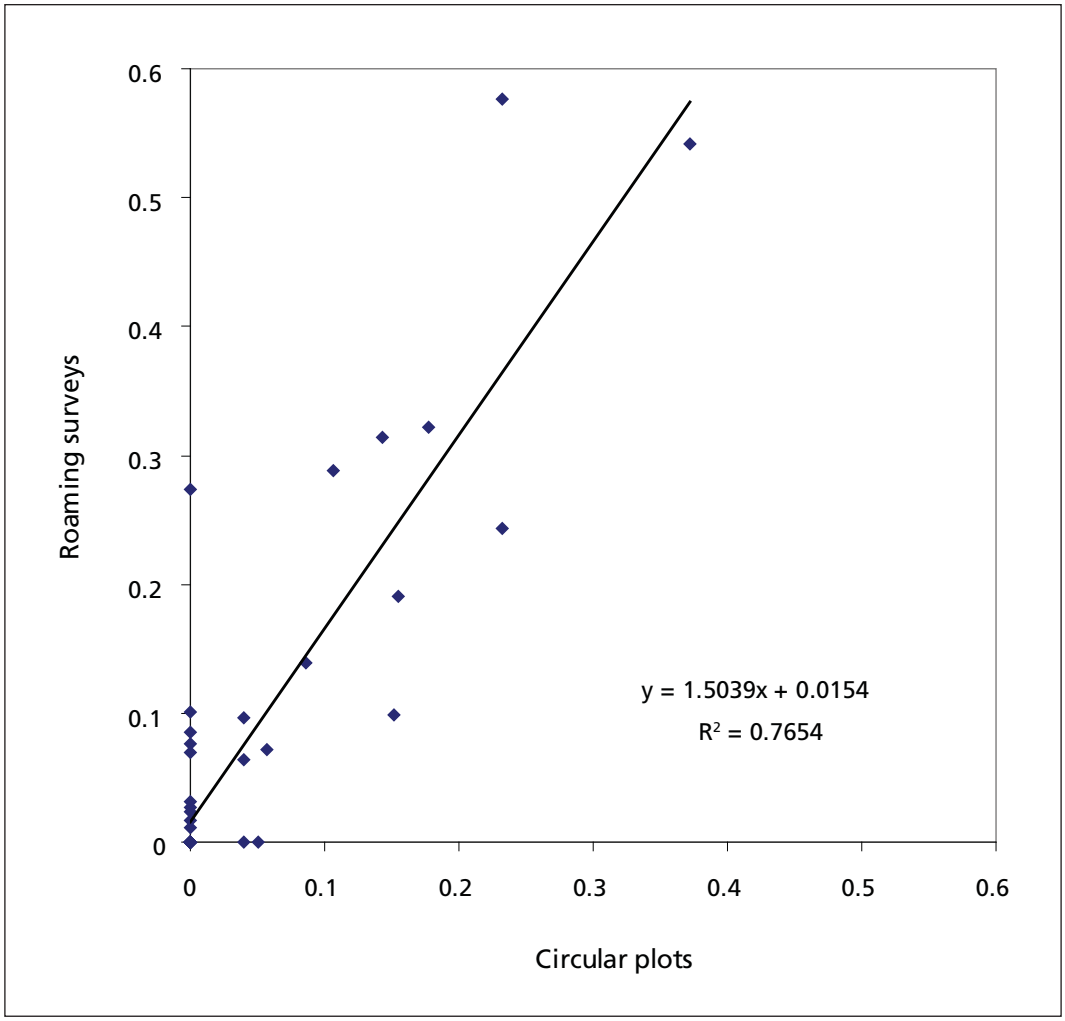

Figure 4-1. Relative abundance of target species collected via roaming surveys and circular plots, 2003.

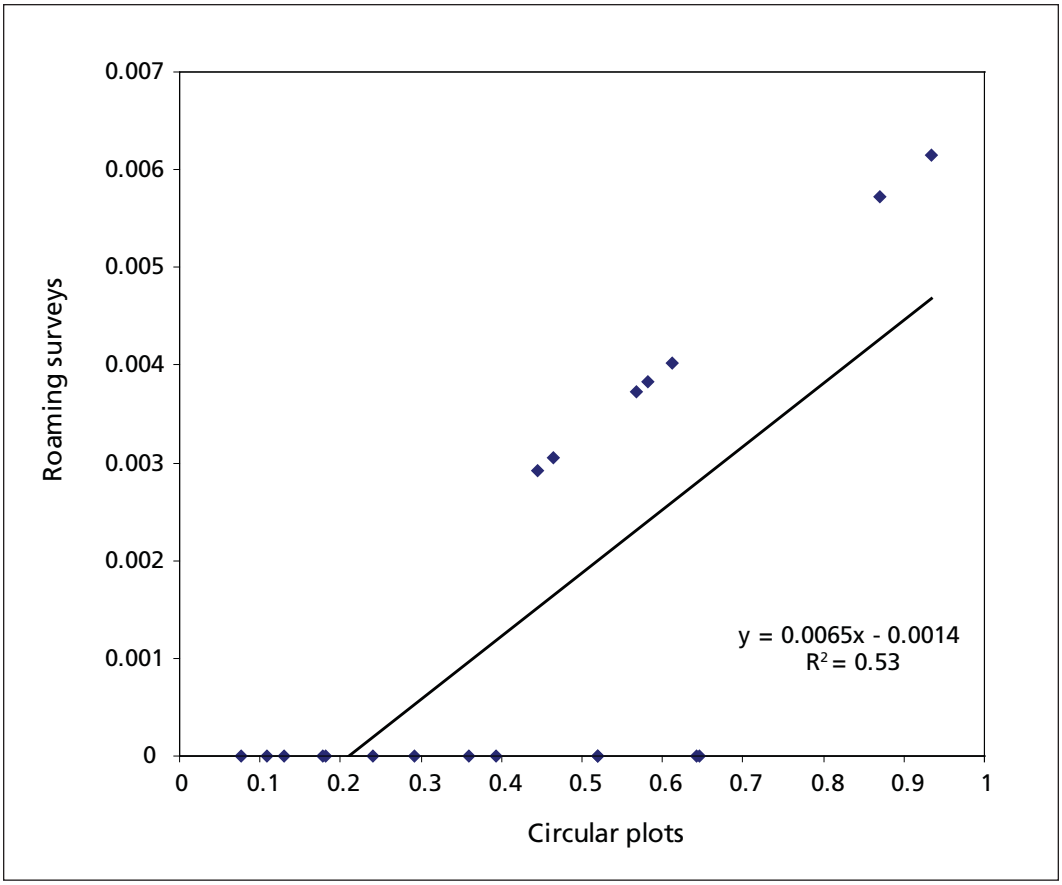

Figure 4-2. Relative abundance of target species collected via roaming surveys and circular plots, 2004.

5 Literature Cited

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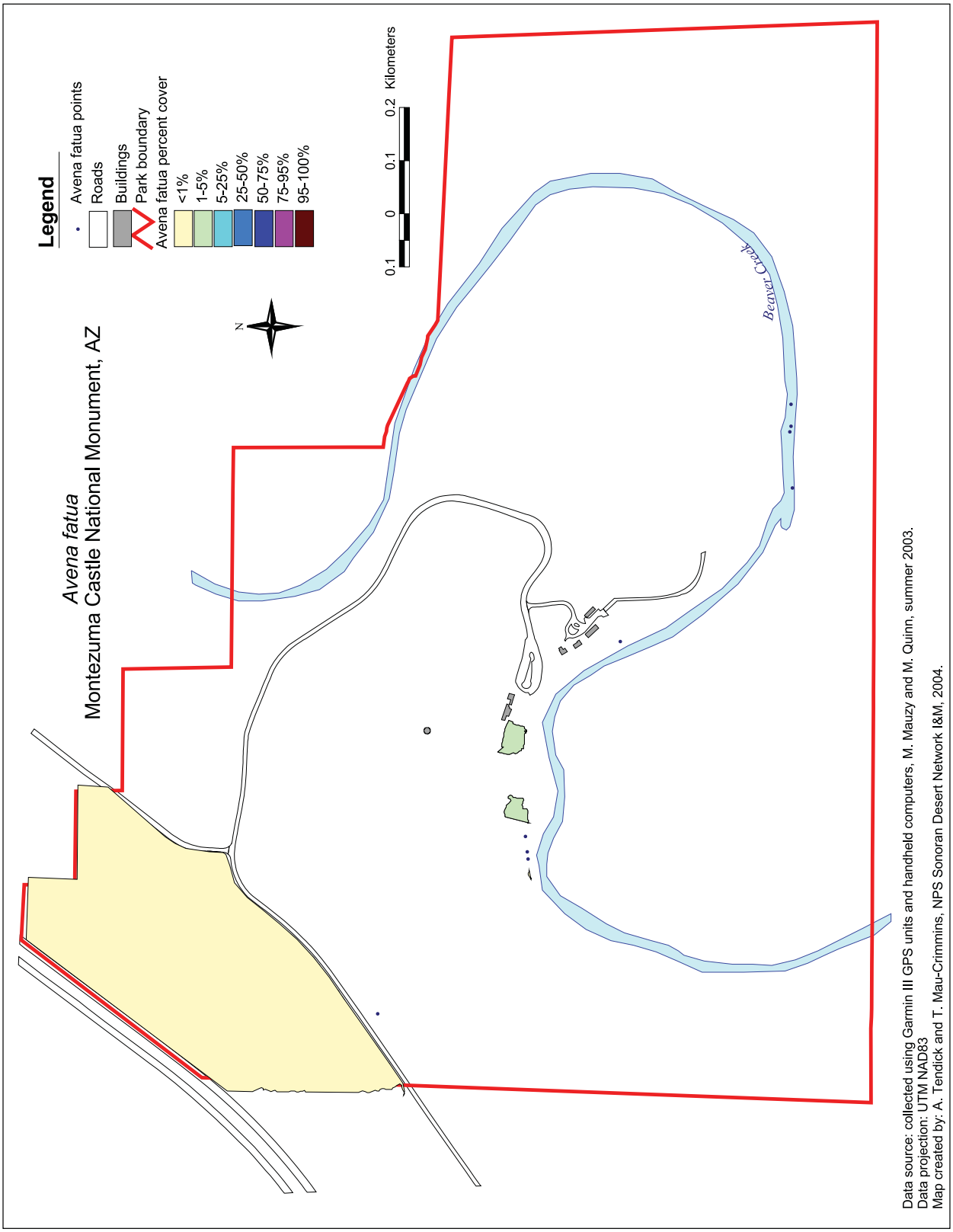
Appendix A. Sample Circular Plot Field Data Collection Sheet

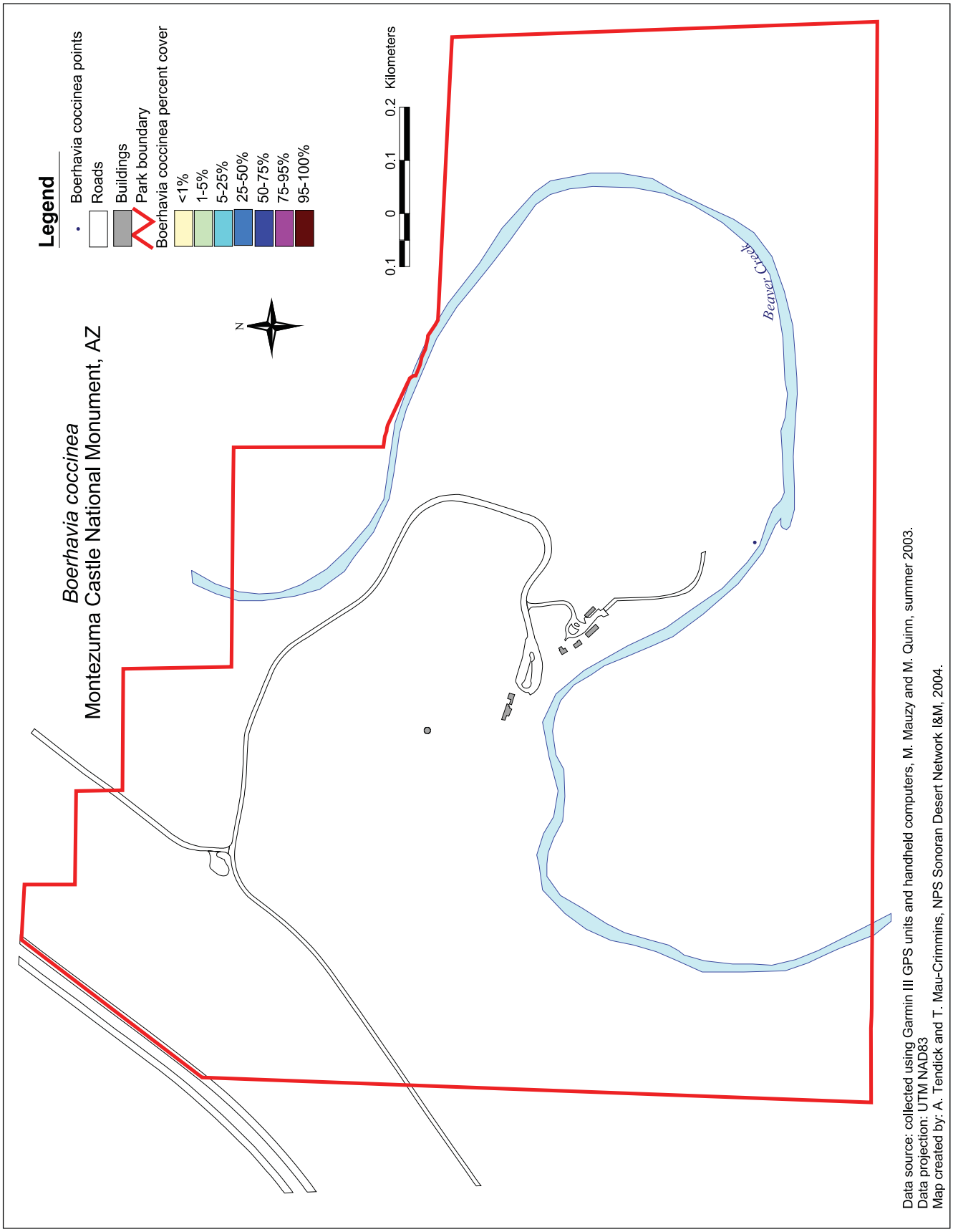
Sample data sheet

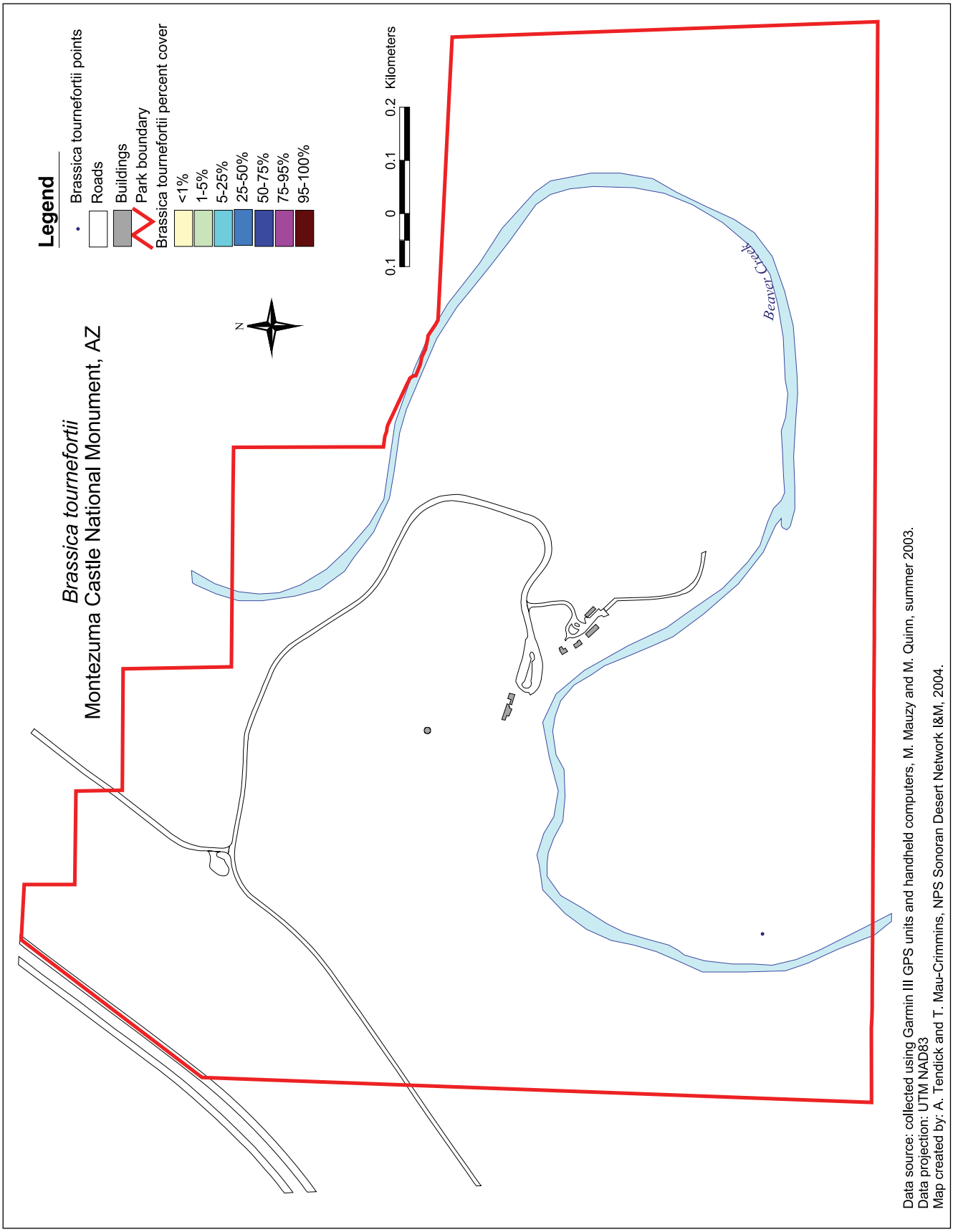
	Q = QUAD
Botanist:	SS = SUBPLOT SEARCH (1 for presence)
Date:	TRAMPLING: 1 undisturbed, 2 moderate, 3 heavy
UTM:	.01 indicates less than 1 percent cover
Plot Number	1 indicates species presence in the subplot search column
Location:	All cover estimates are to the closest 1%
	N/I Native or introduced

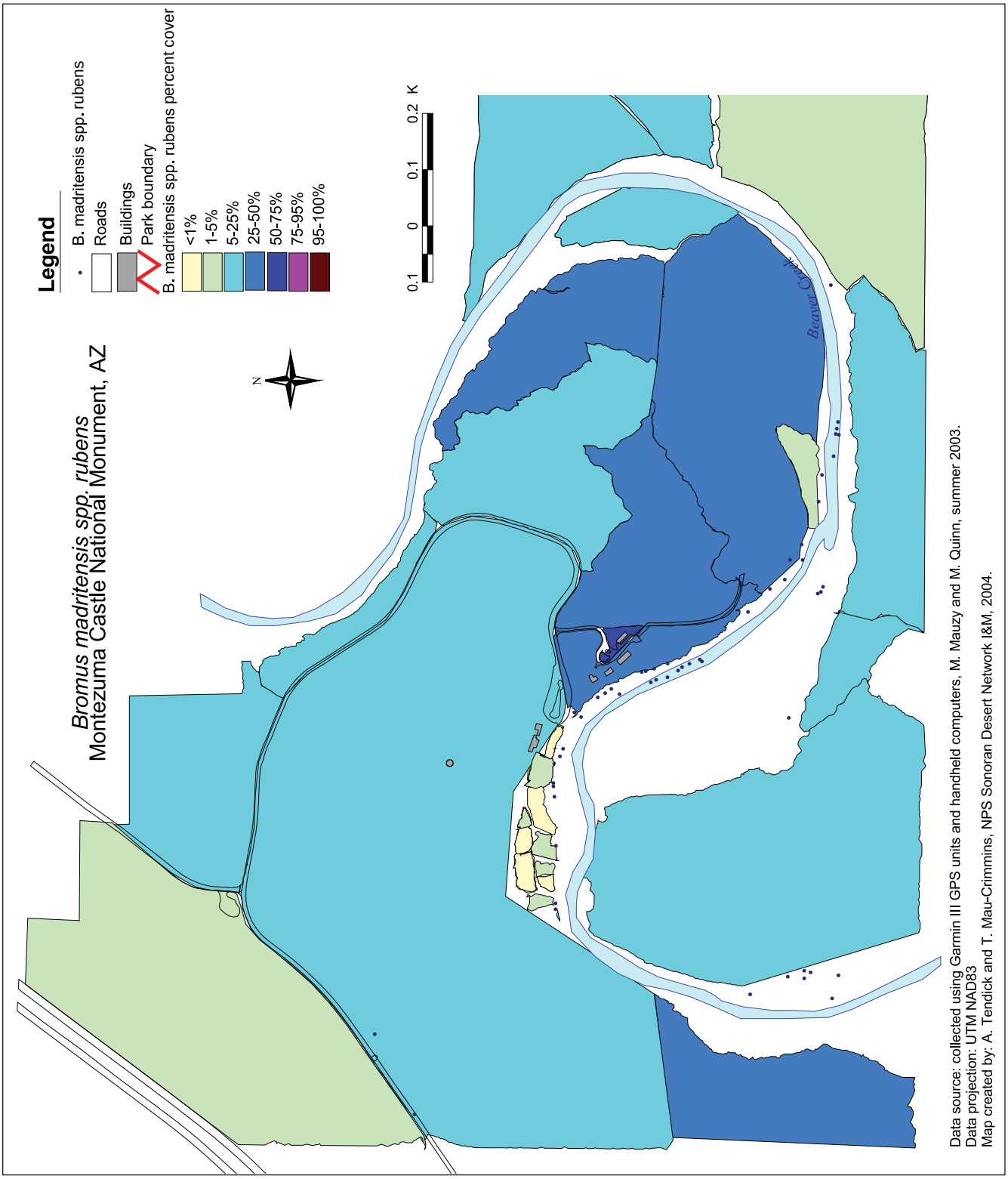
		Grnd Variables	**Q1**	**Q2**	**Q3**	
		dung				
		lichen				
		litter/duff				
		moss				
		road				
		rock				
		root/bole				
		soil				
		stream				
		trash/junk				
		water				
		wood				
		Condition Class				
		Trampling				
Comment	**N/I**	**Species**	**Q1**	**Q2**	**Q3**	**SS**

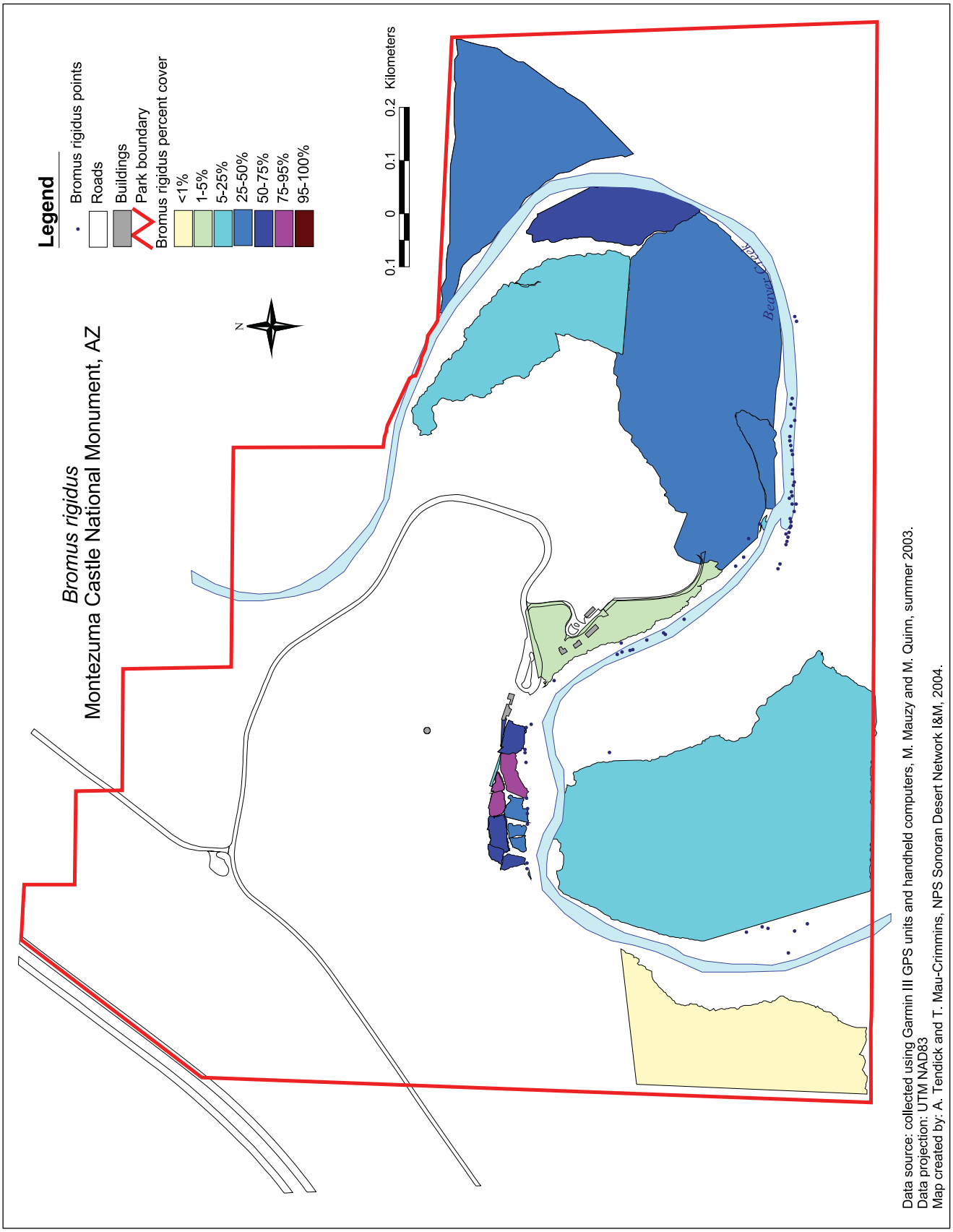
Appendix B. Maps of Species Detected During Roaming Surveys, 2003.



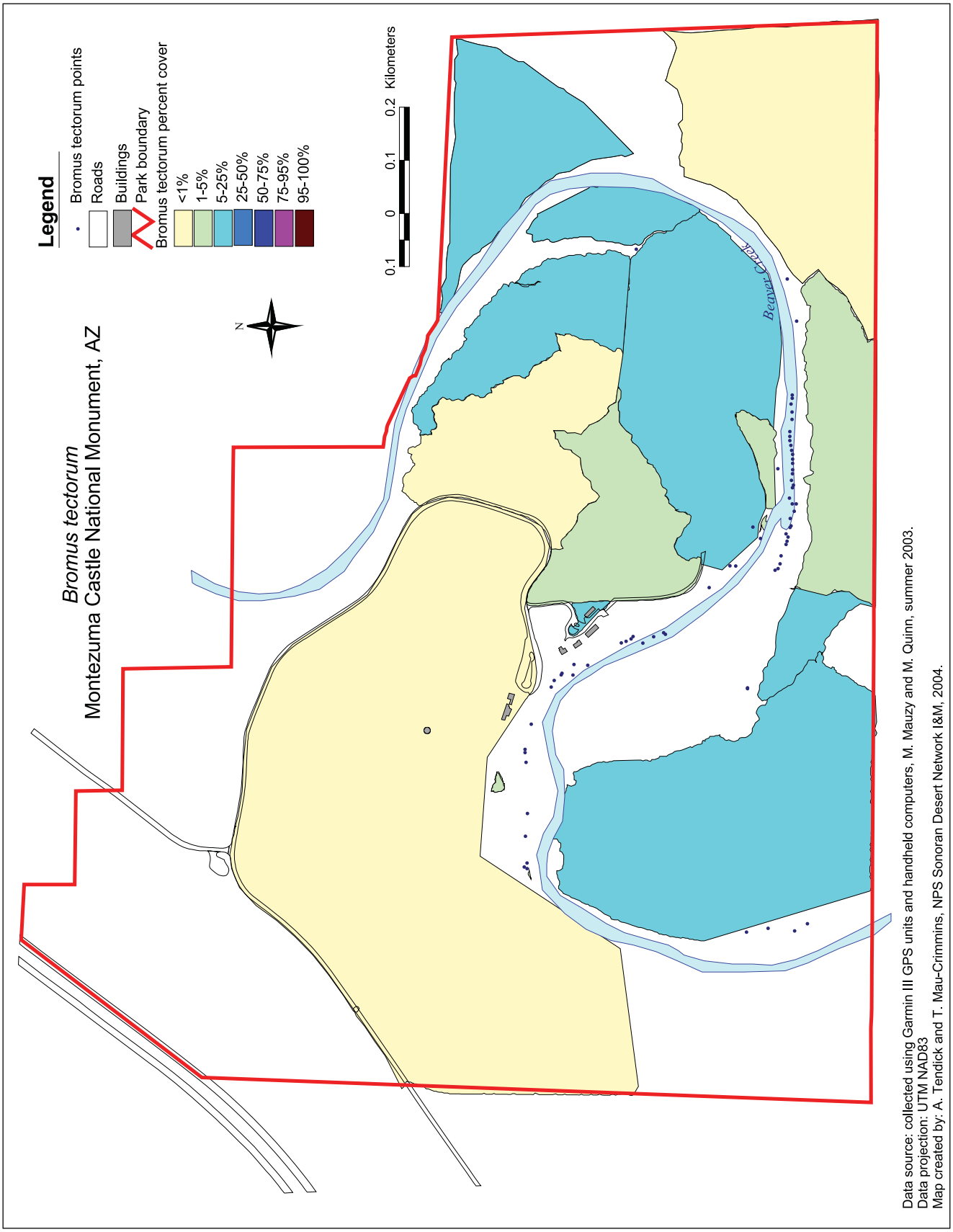

Legend
Boerhavia coccinea points
Roads
Buildings
Park boundary
Boerhavia coccinea percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
0.1 0 0.1 0.2 Kilometers
N
Boerhavia coccinea
Montezuma Castle National Monument, AZ
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

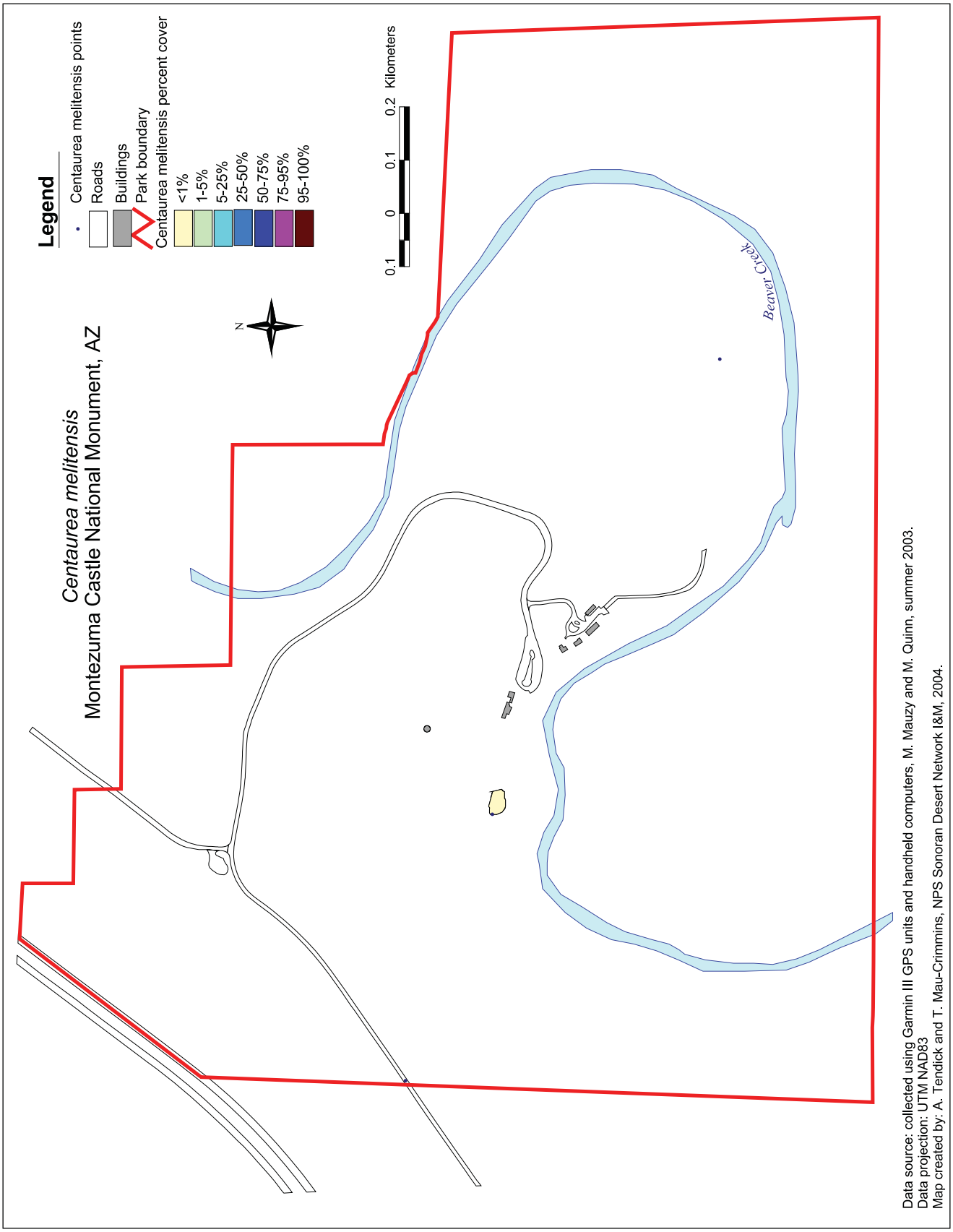

Brassica tournefortii
Montezuma Castle National Monument, AZ
Legend
Brassica tournefortii points
Roads
Buildings
Park boundary
Brassica tournefortii percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

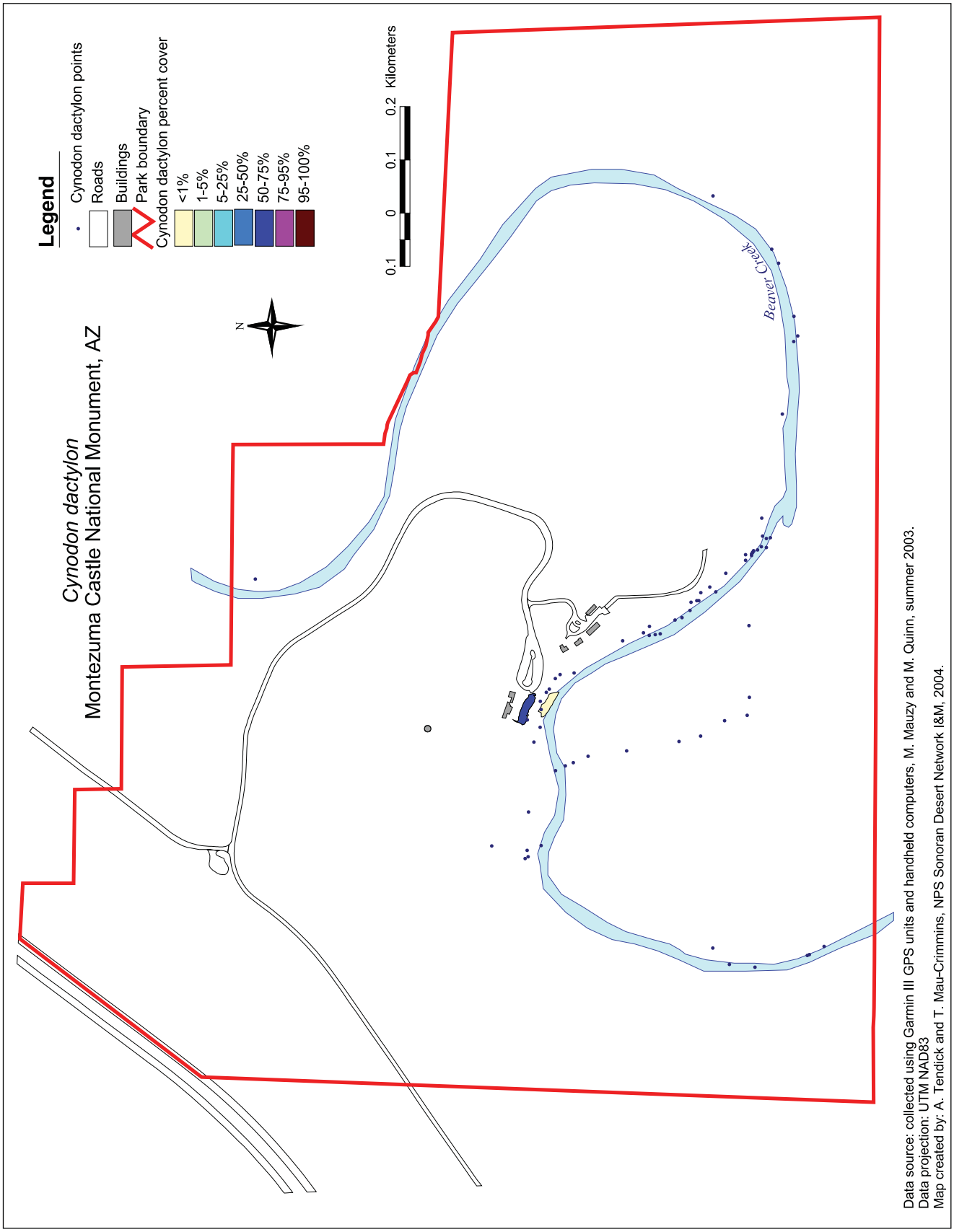

Bromus madritensis spp. rubens
Montezuma Castle National Monument, AZ
Legend
B. madritensis spp. rubens
Roads
Buildings
Park boundary
B. madritensis spp. rubens percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 K
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

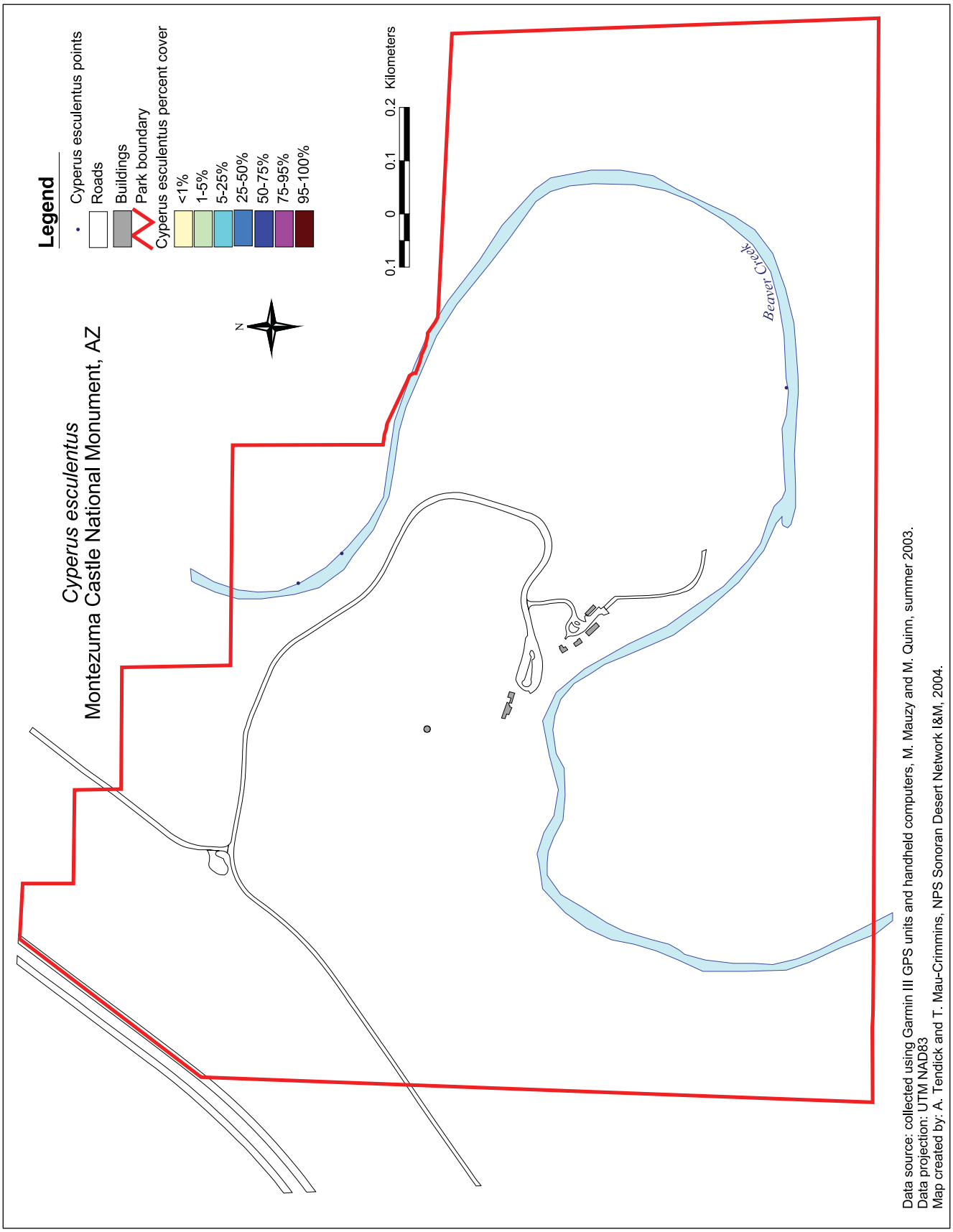


Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

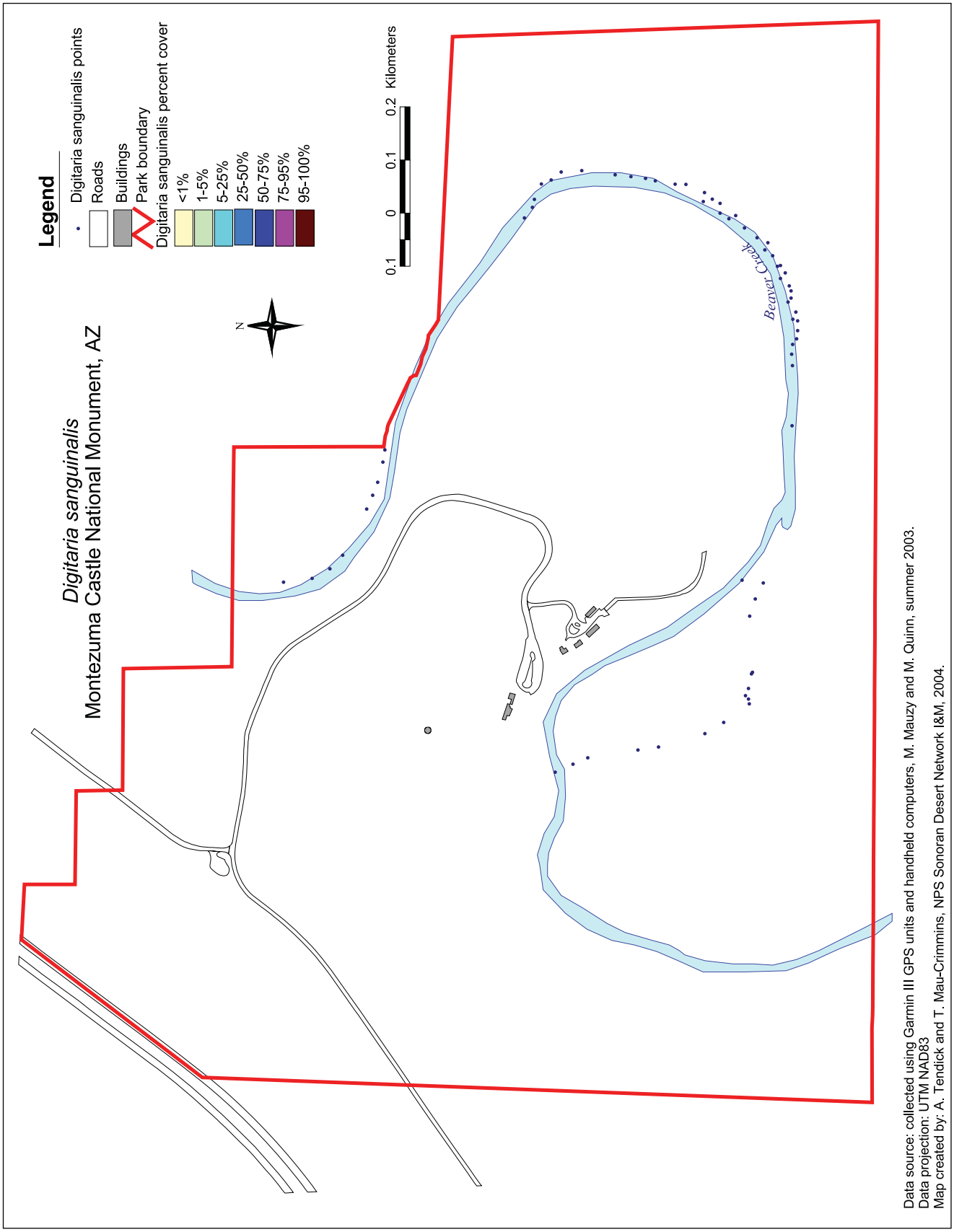

Bromus tectorum
Montezuma Castle National Monument, AZ
Legend
Bromus tectorum points
Roads
Buildings
Park boundary
Bromus tectorum percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

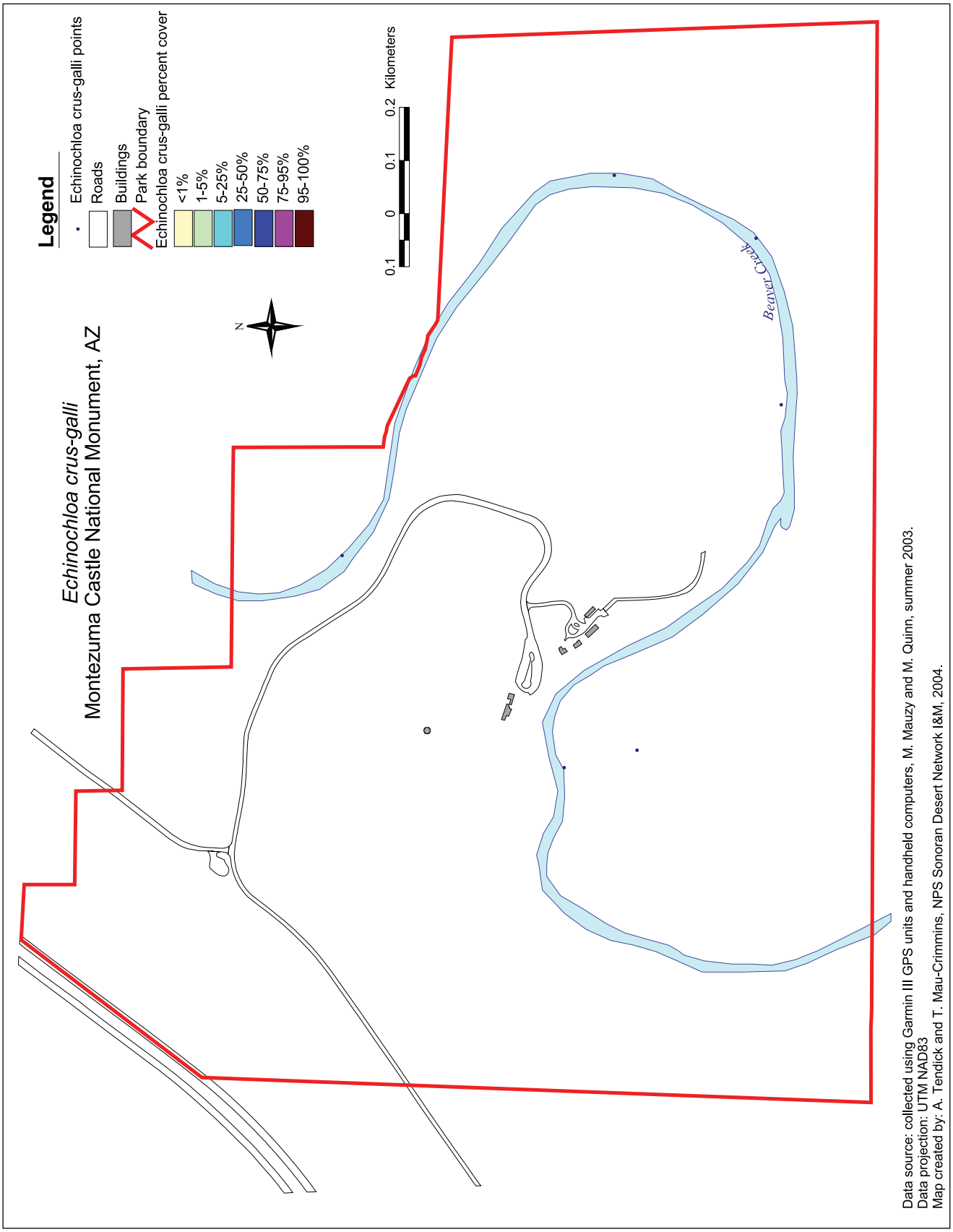

Legend
Centaurea melitensis points
Roads
Buildings
Park boundary
Centaurea melitensis percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
0.1 0 0.1 0.2 Kilometers
N
Centaurea melitensis
Montezuma Castle National Monument, AZ
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

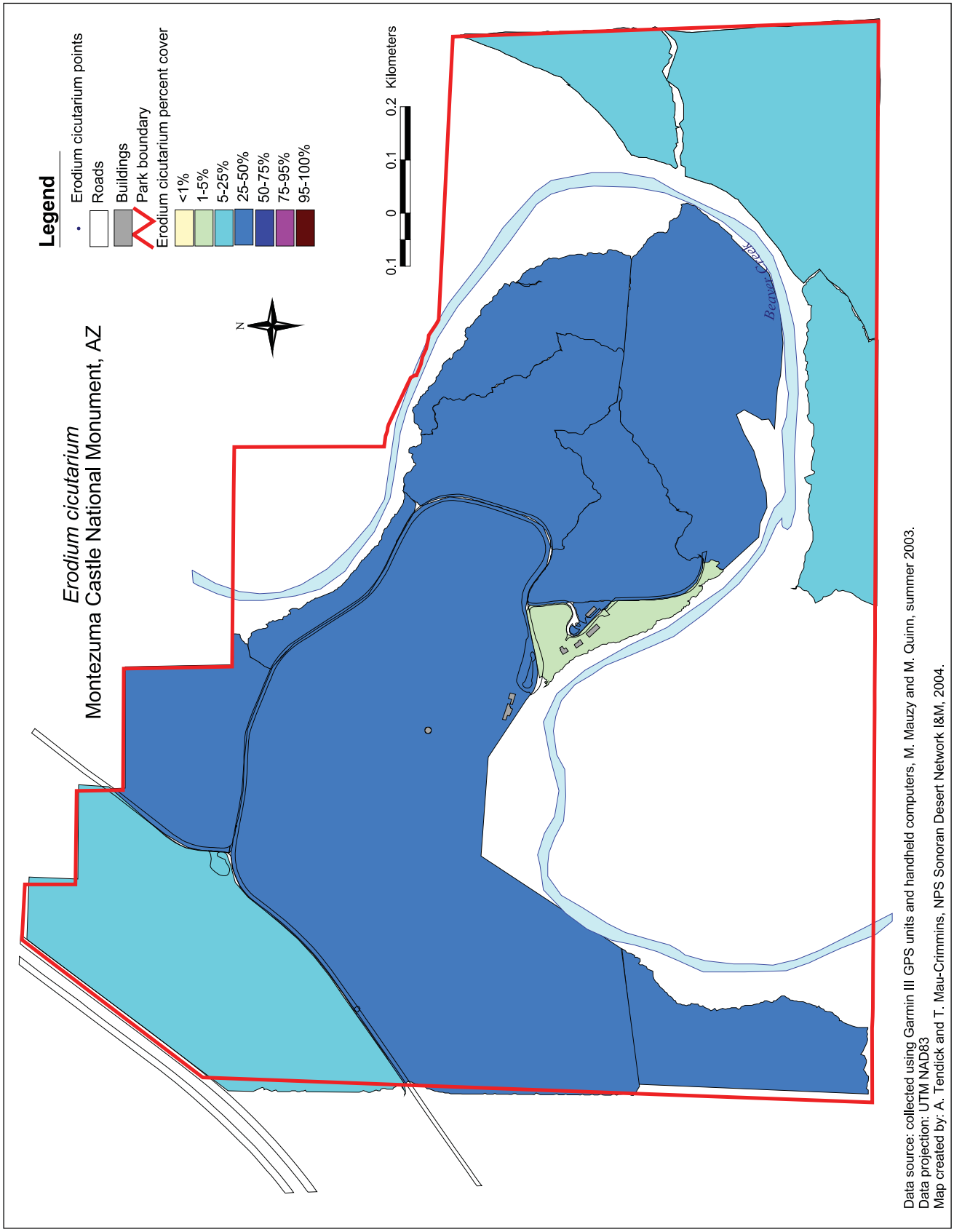

Cynodon dactylon
Montezuma Castle National Monument, AZ
Legend
Cynodon dactylon points
Roads
Buildings
Park boundary
Cynodon dactylon percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

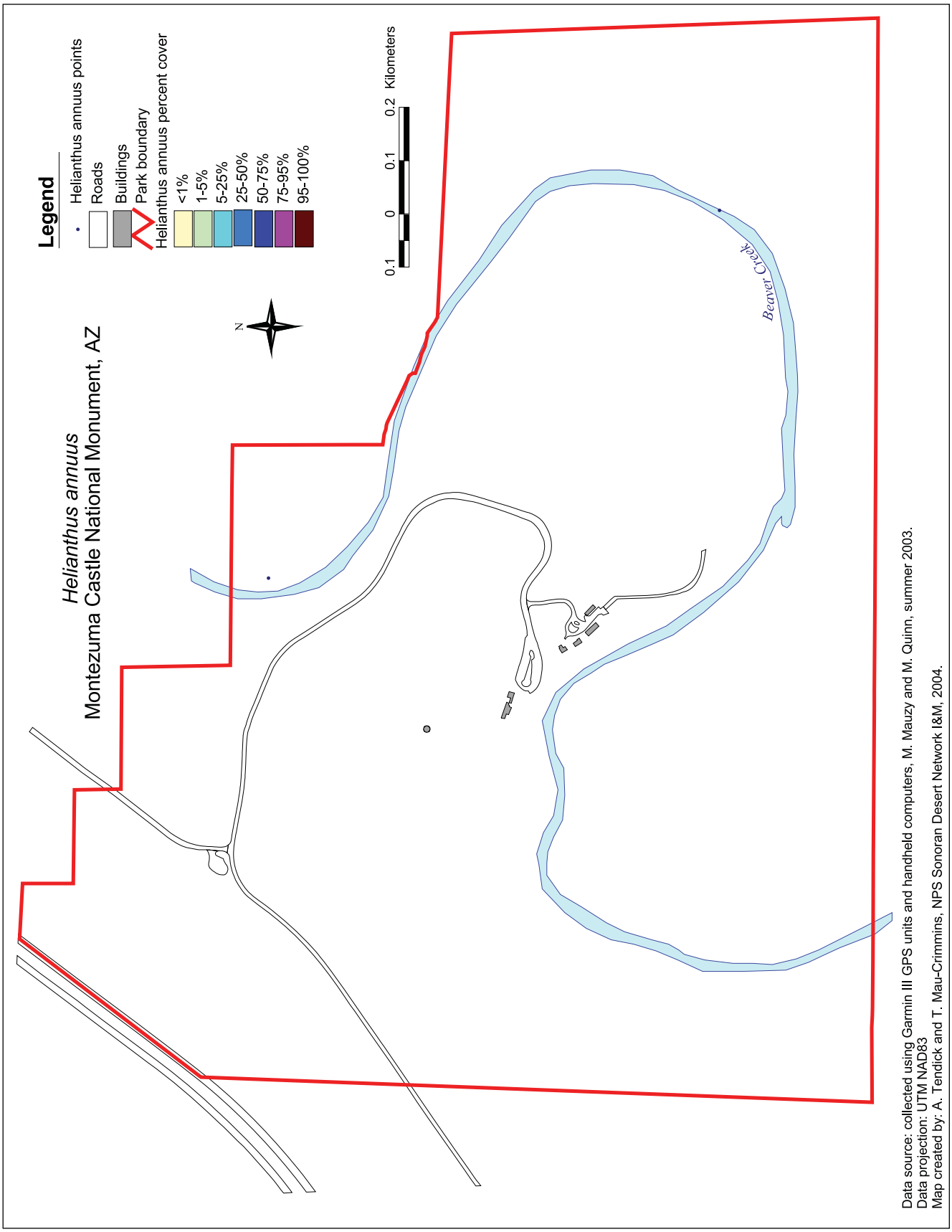


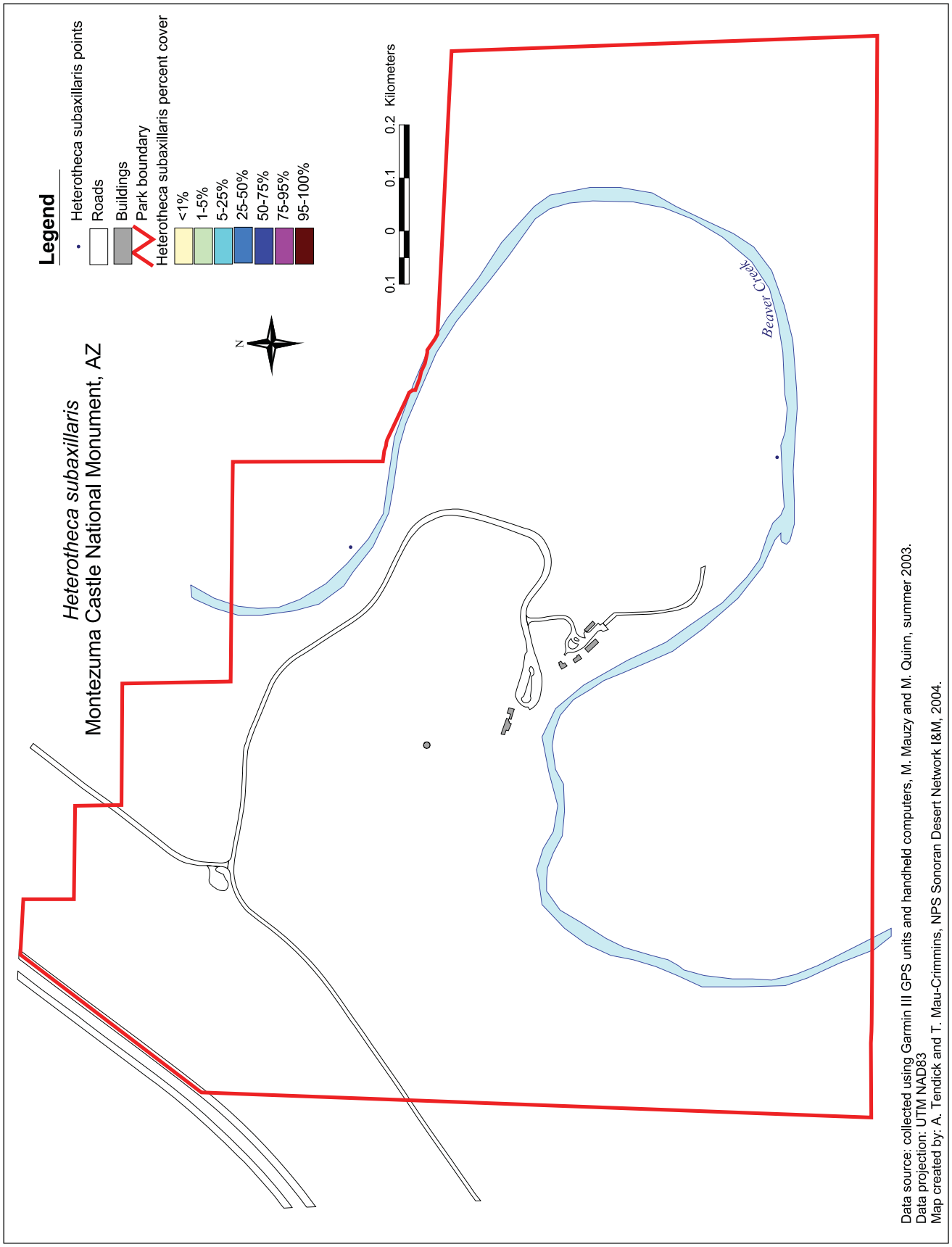
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

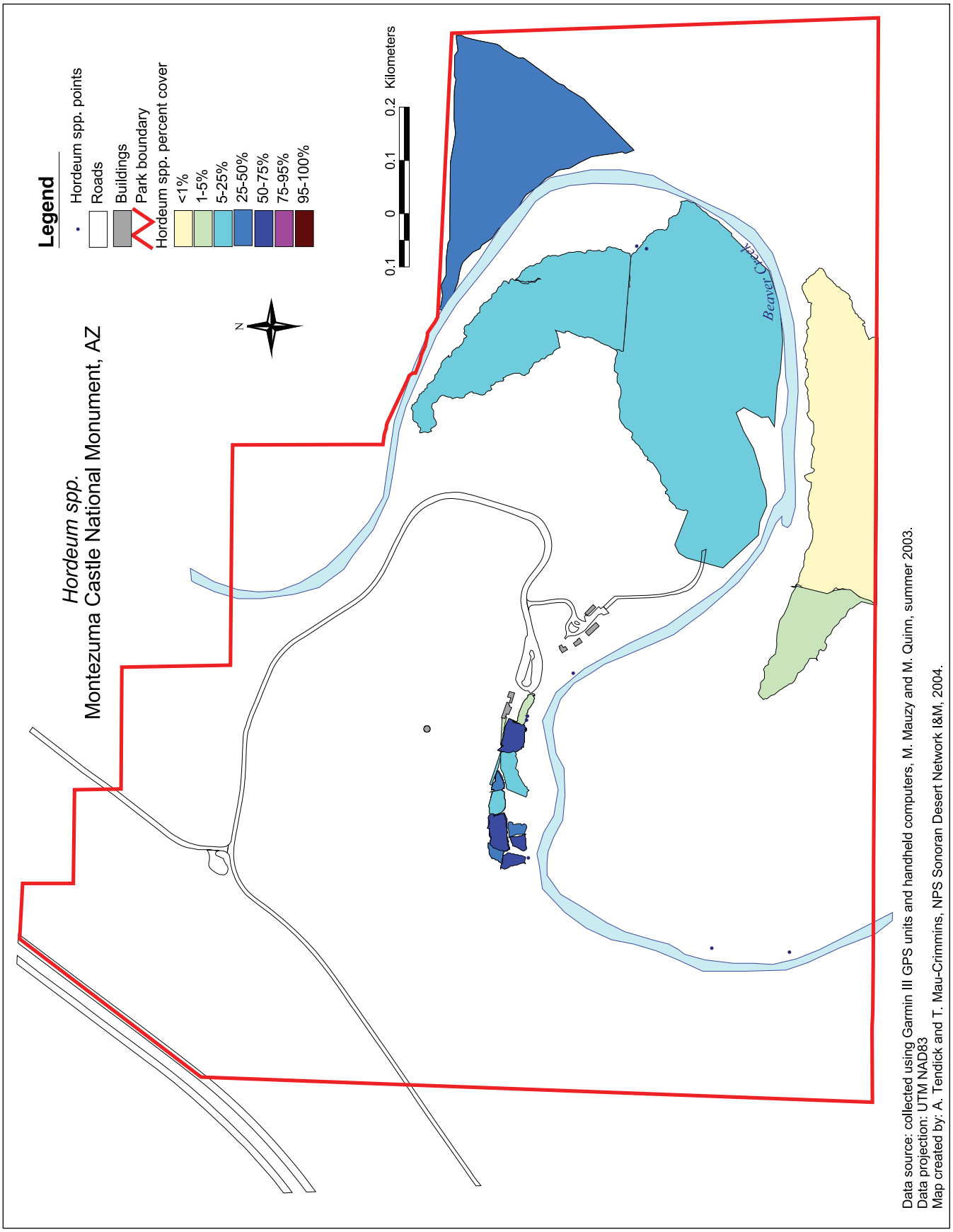

Digitaria sanguinalis
Montezuma Castle National Monument, AZ
Legend
Digitaria sanguinalis points
Roads
Buildings
Park boundary
Digitaria sanguinalis percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.


Echinochloa crus-galli
Montezuma Castle National Monument, AZ
Legend
Echinochloa crus-galli points
Roads
Buildings
Park boundary
Echinochloa crus-galli percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

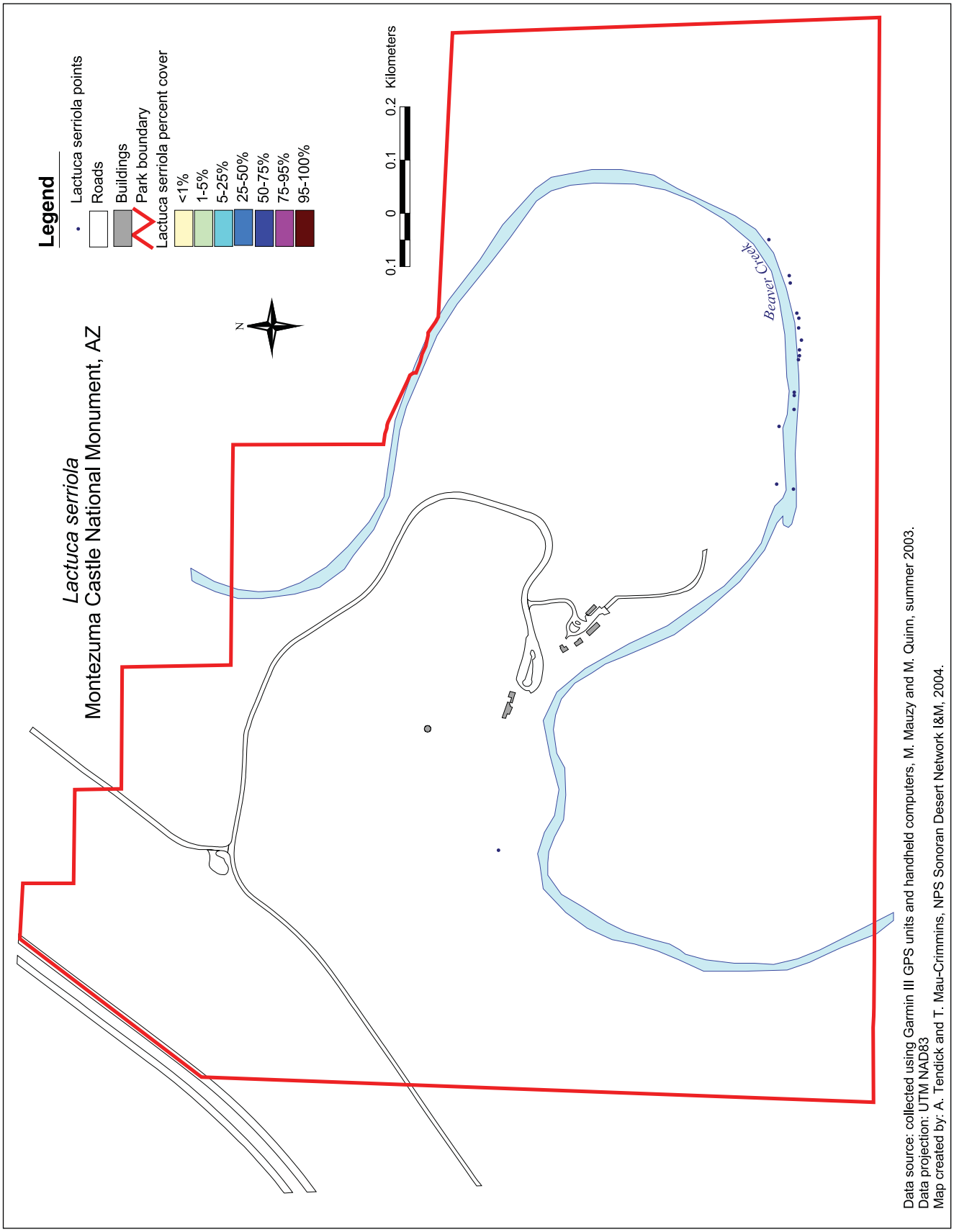

Erodium cicutarium
Montezuma Castle National Monument, AZ
Legend
Erodium cicutarium points
Roads
Buildings
Park boundary
Erodium cicutarium percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

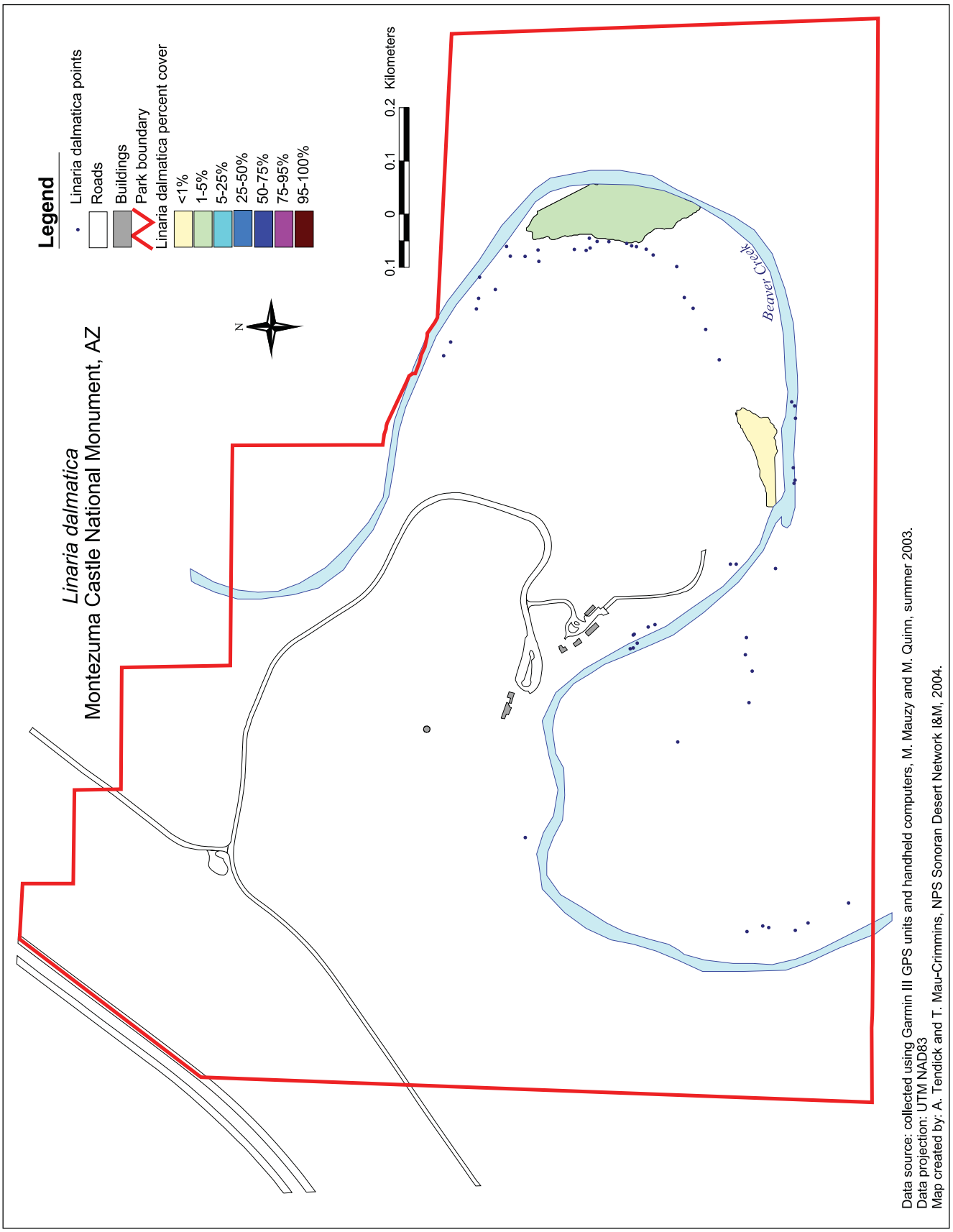

Legend
Helianthus annuus points
Roads
Buildings
Park boundary
Helianthus annuus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
0.1 0 0.1 0.2 Kilometers
N
Beaver Creek
Helianthus annuus
Montezuma Castle National Monument, AZ
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

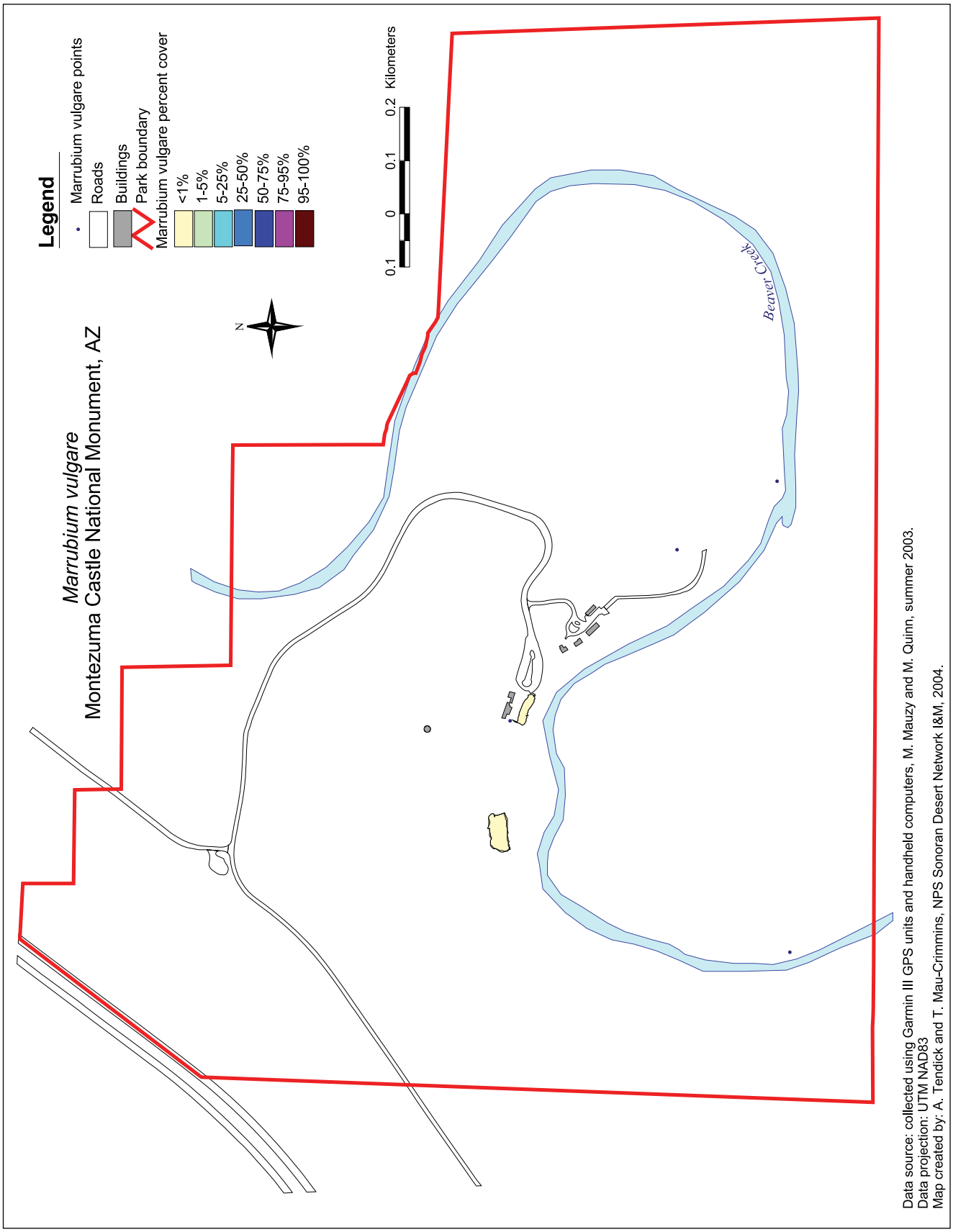

Heterotheca subaxillaris
Montezuma Castle National Monument, AZ
Legend
Heterotheca subaxillaris points
Roads
Buildings
Park boundary
Heterotheca subaxillaris percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

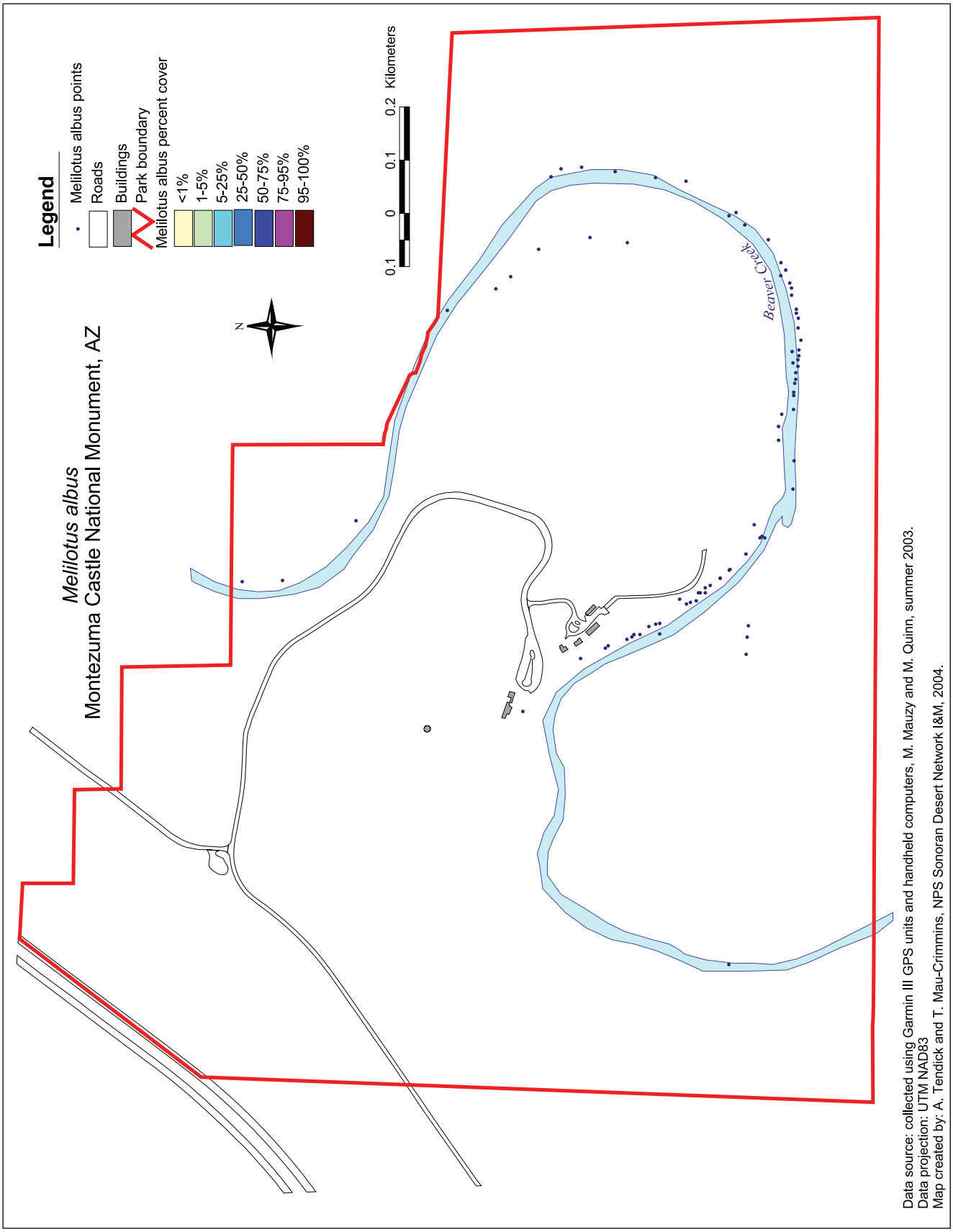


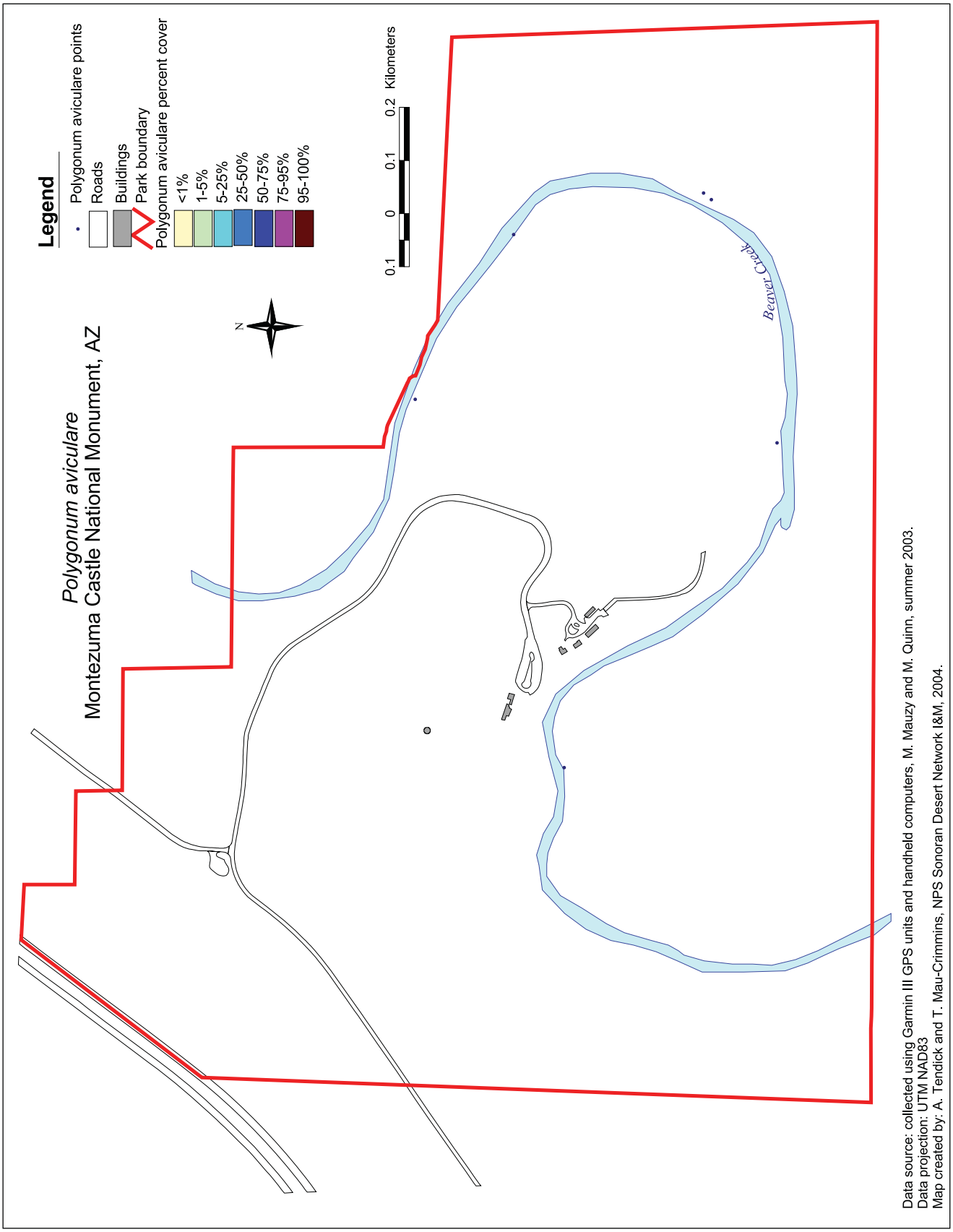
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

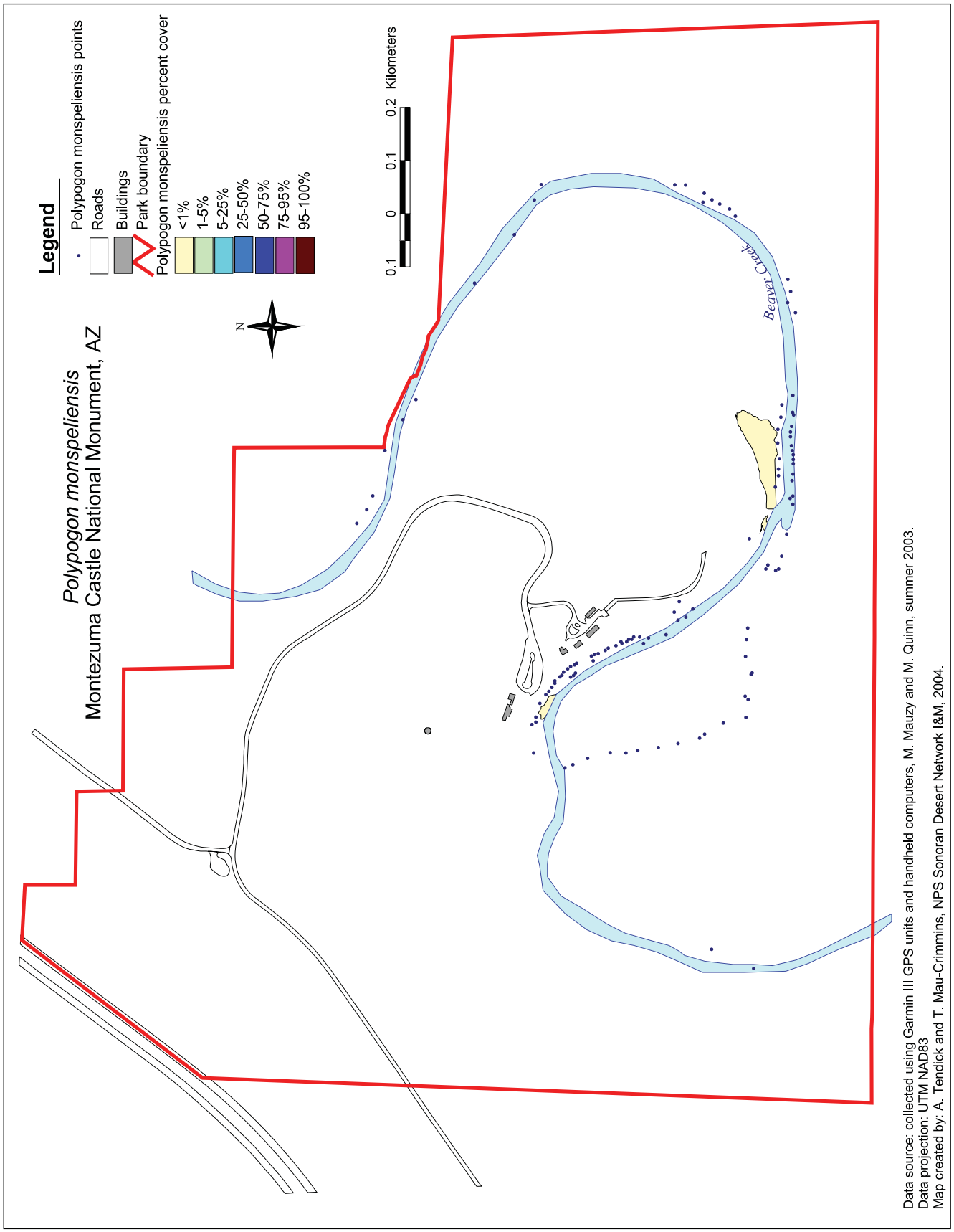

Legend
Lactuca serriola points
Roads
Buildings
Park boundary
Lactuca serriola percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
0.1 0 0.1 0.2 Kilometers
N
Lactuca serriola
Montezuma Castle National Monument, AZ
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.


Legend
Linaria dalmatica points
Roads
Buildings
Park boundary
Linaria dalmatica percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
0.1 0 0.1 0.2 Kilometers
N
Linaria dalmatica
Montezuma Castle National Monument, AZ
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

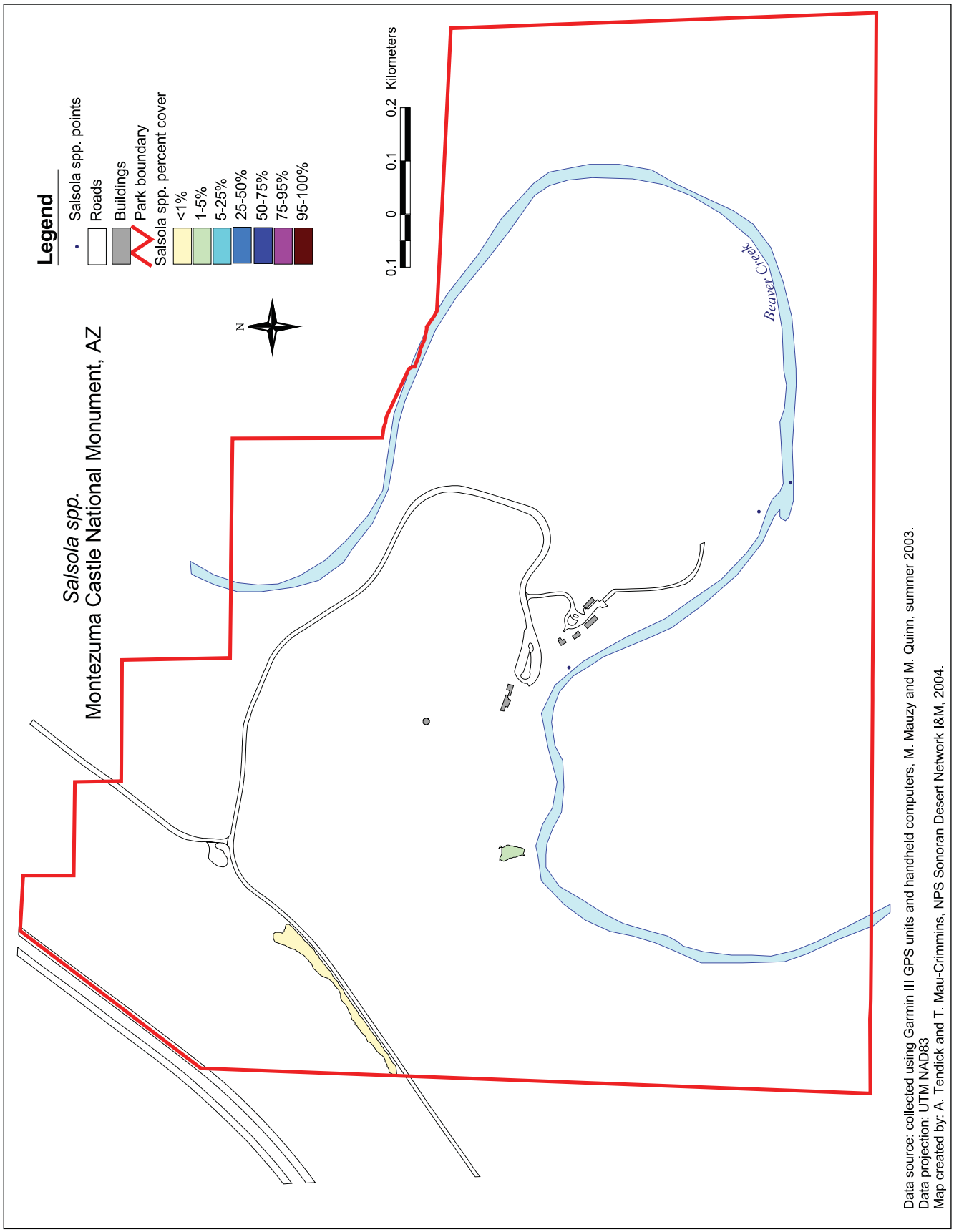

Marrubium vulgare
Montezuma Castle National Monument, AZ
Legend
Marrubium vulgare points
Roads
Buildings
Park boundary
Marrubium vulgare percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

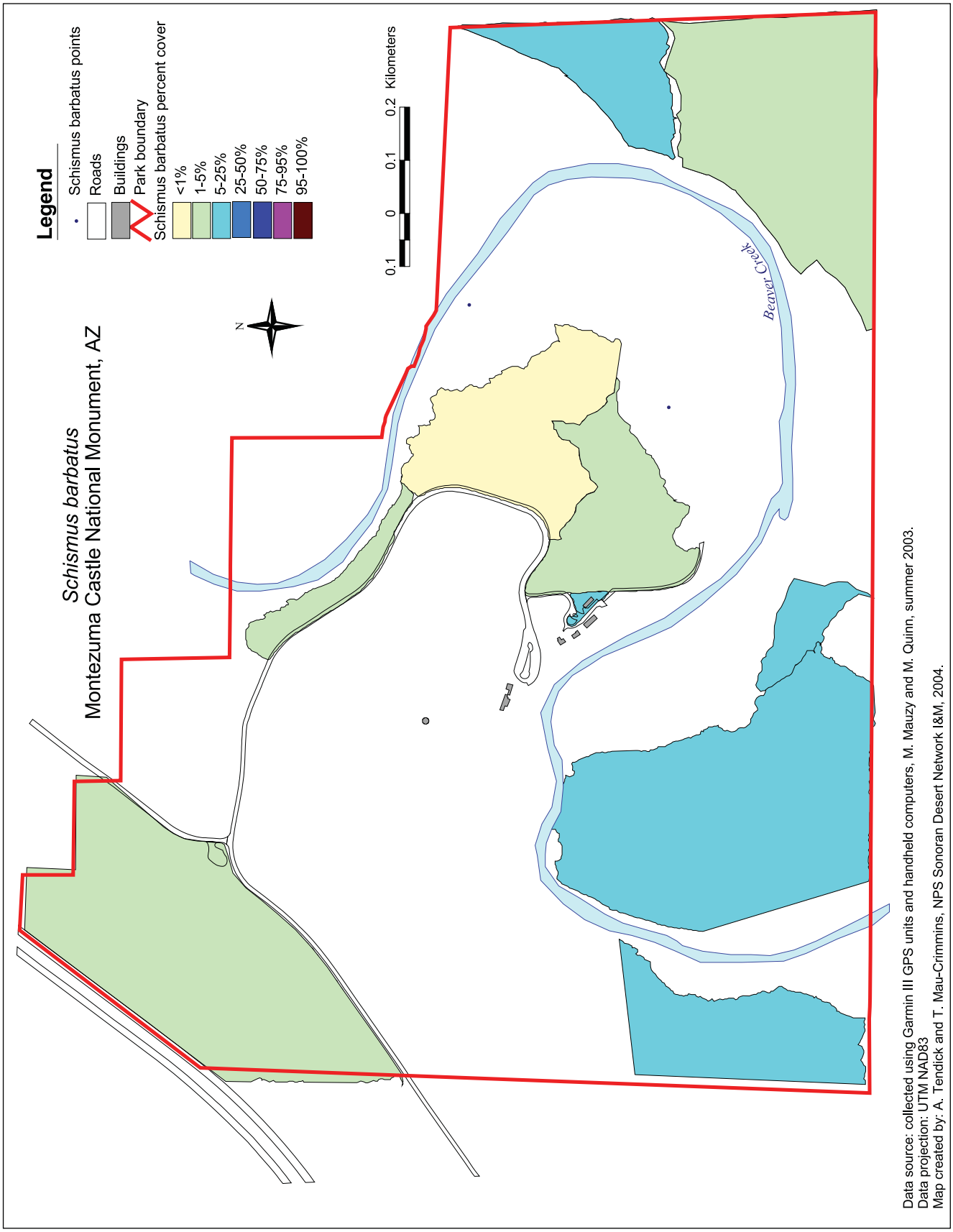

Melilotus albus
Montezuma Castle National Monument, AZ
Legend
Melilotus albus points
Roads
Buildings
Park boundary
Melilotus albus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

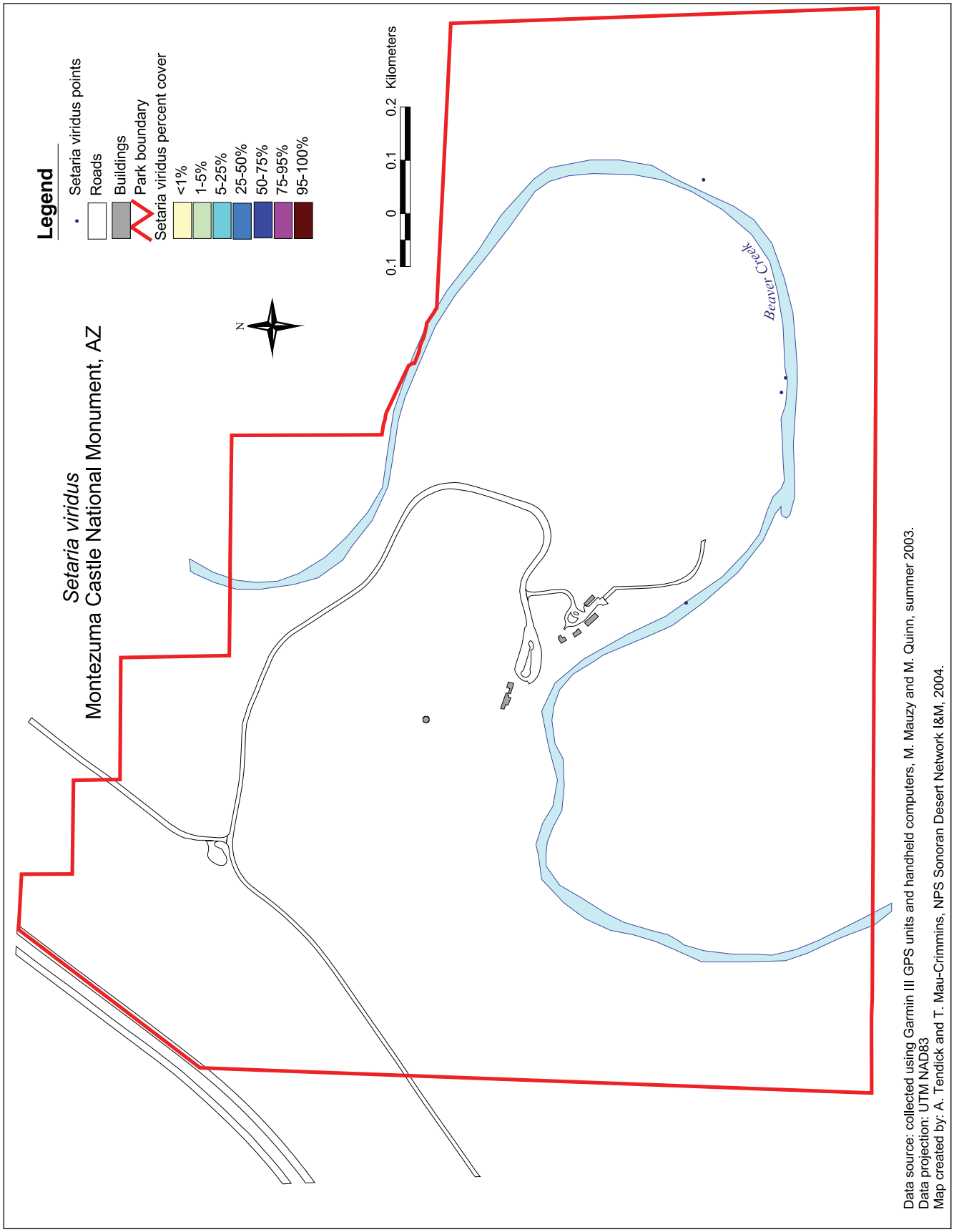

Polygonum aviculare
Montezuma Castle National Monument, AZ
Legend
Polygonum aviculare points
Roads
Buildings
Park boundary
Polygonum aviculare percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

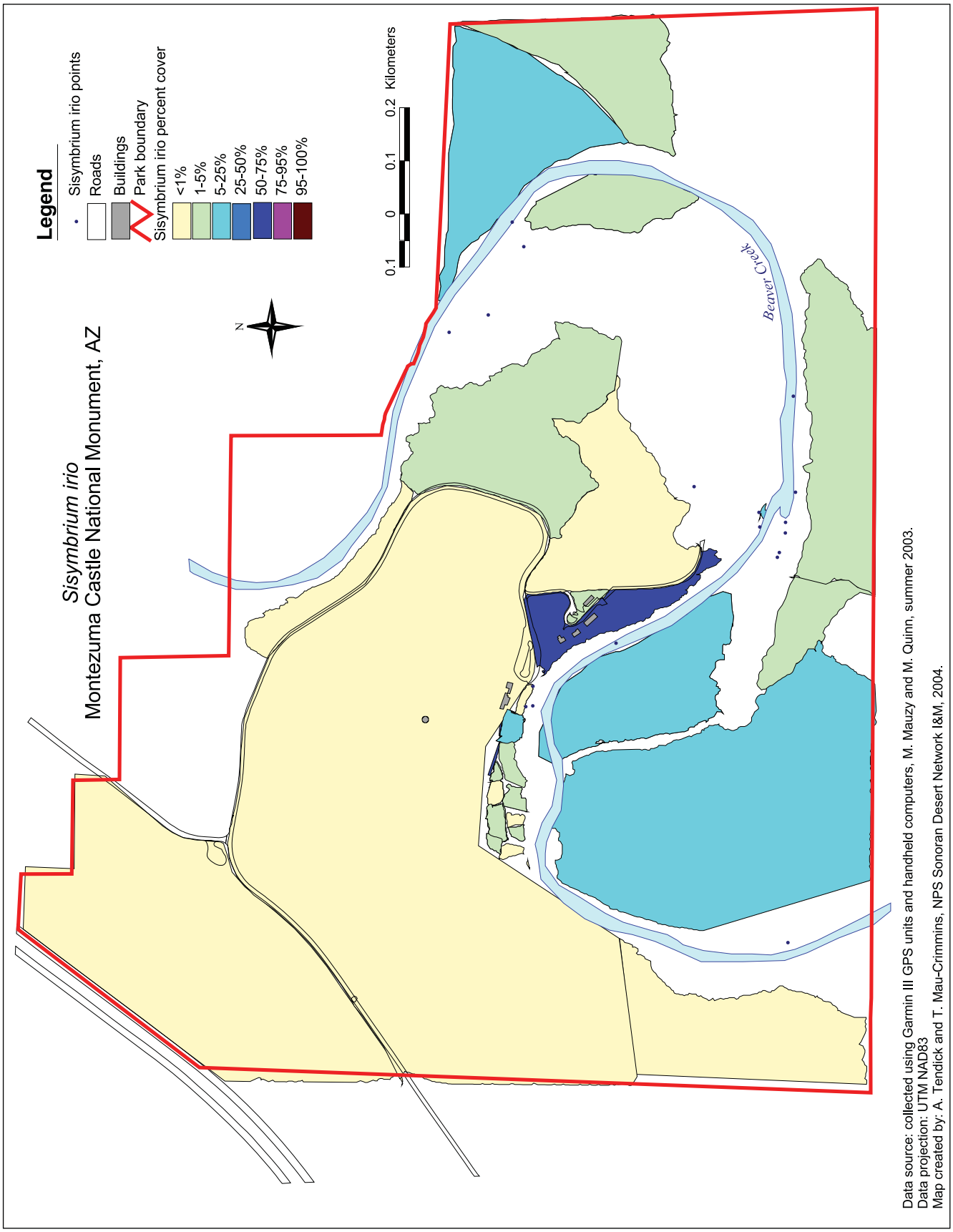


Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

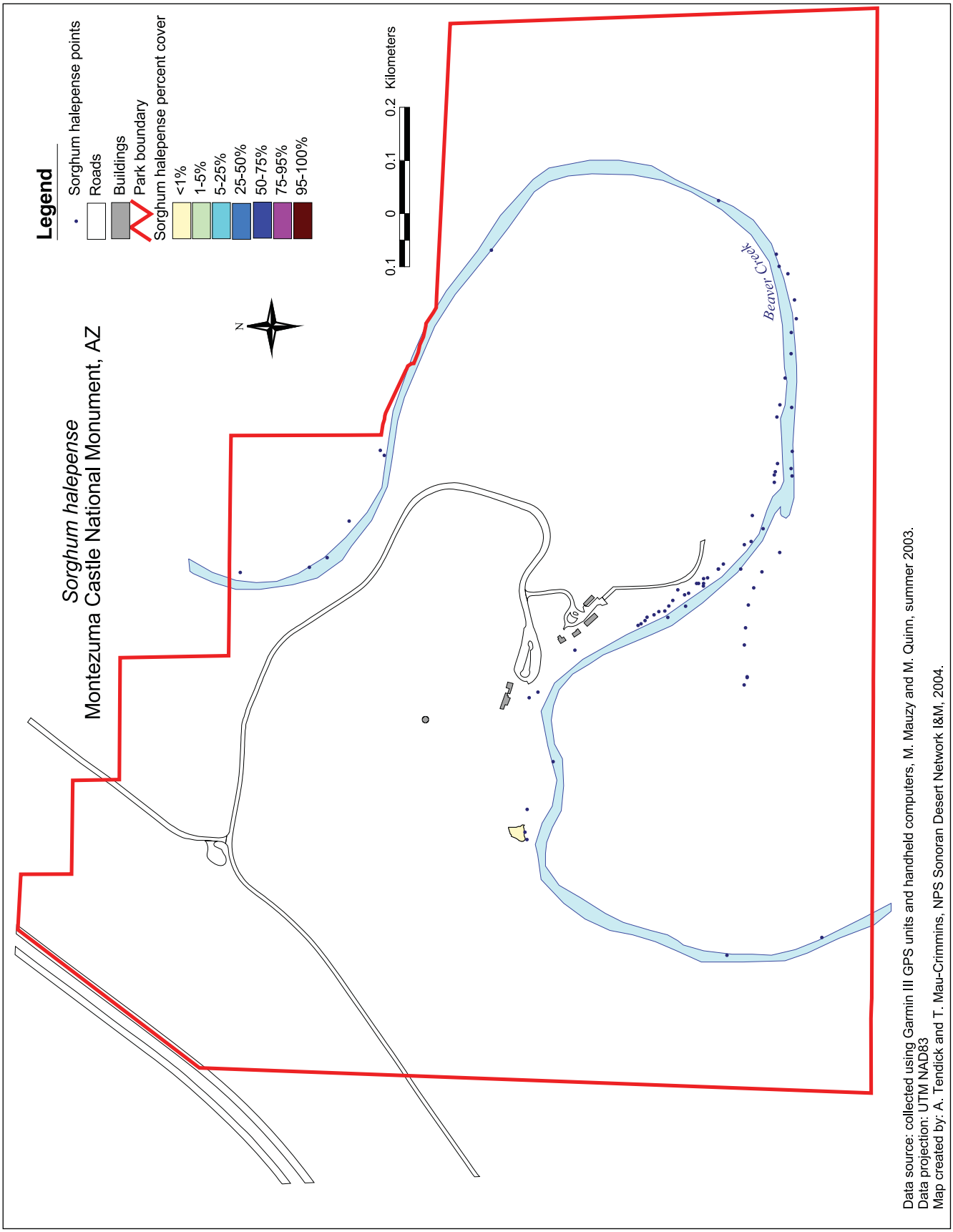

Salsola spp.
Montezuma Castle National Monument, AZ
Legend
Salsola spp. points
Roads
Buildings
Park boundary
Salsola spp. percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

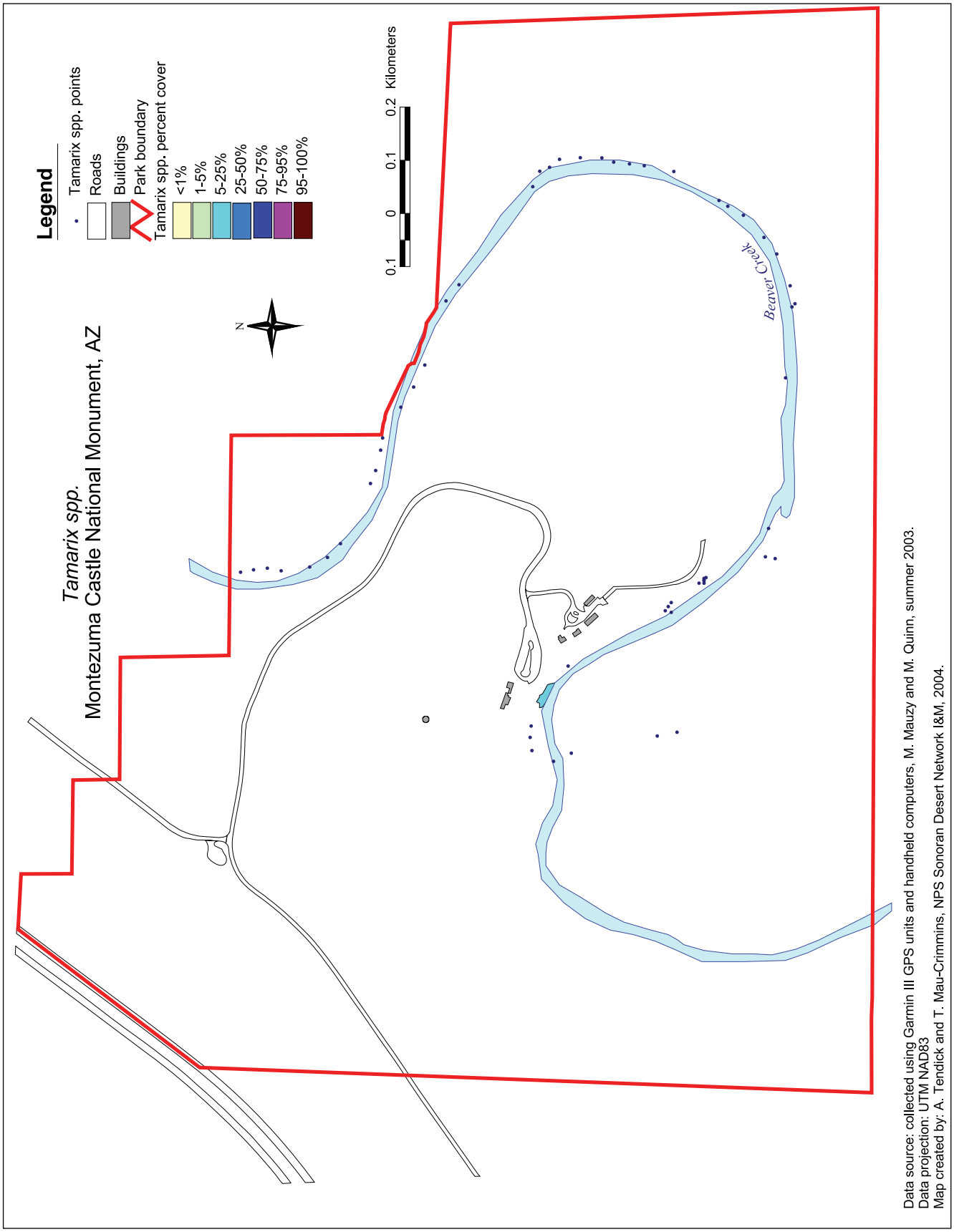

Schismus barbatus
Montezuma Castle National Monument, AZ
Legend
Schismus barbatus points
Roads
Buildings
Park boundary
Schismus barbatus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.


Setaria viridus
Montezuma Castle National Monument, AZ
Legend
Setaria viridus points
Roads
Buildings
Park boundary
Setaria viridus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

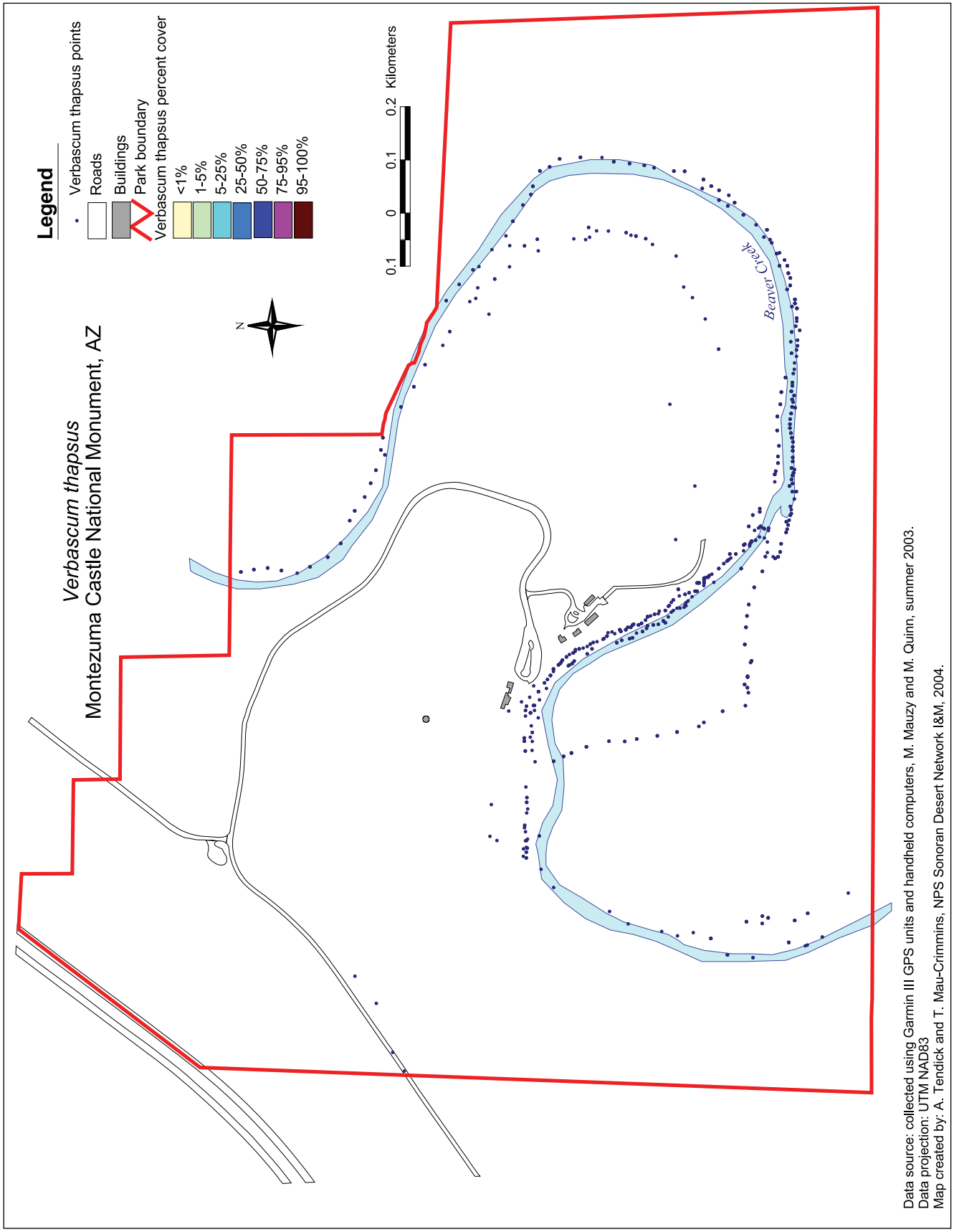


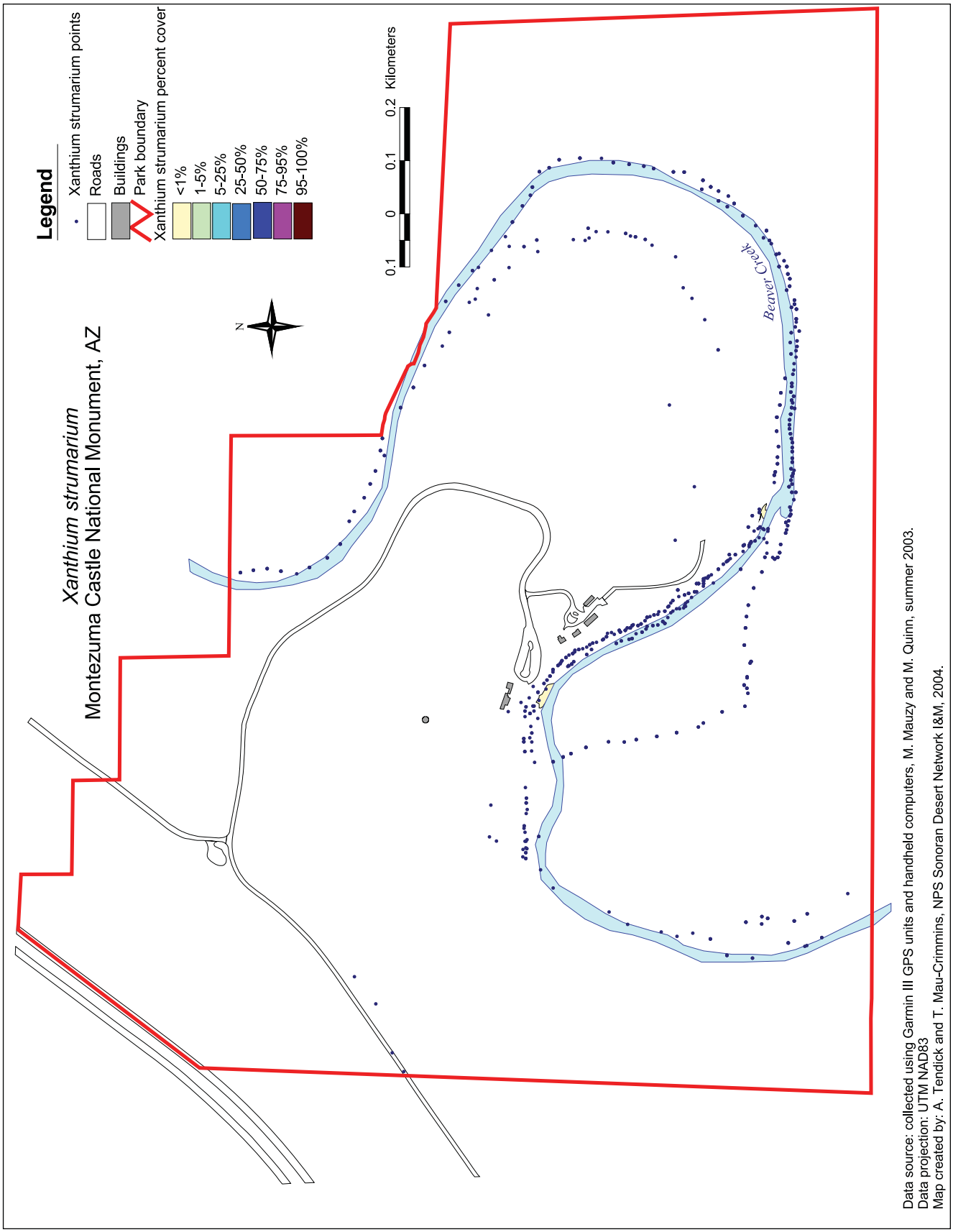
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.


Sorghum halepense
Montezuma Castle National Monument, AZ
Legend
Sorghum halepense points
Roads
Buildings
Park boundary
Sorghum halepense percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

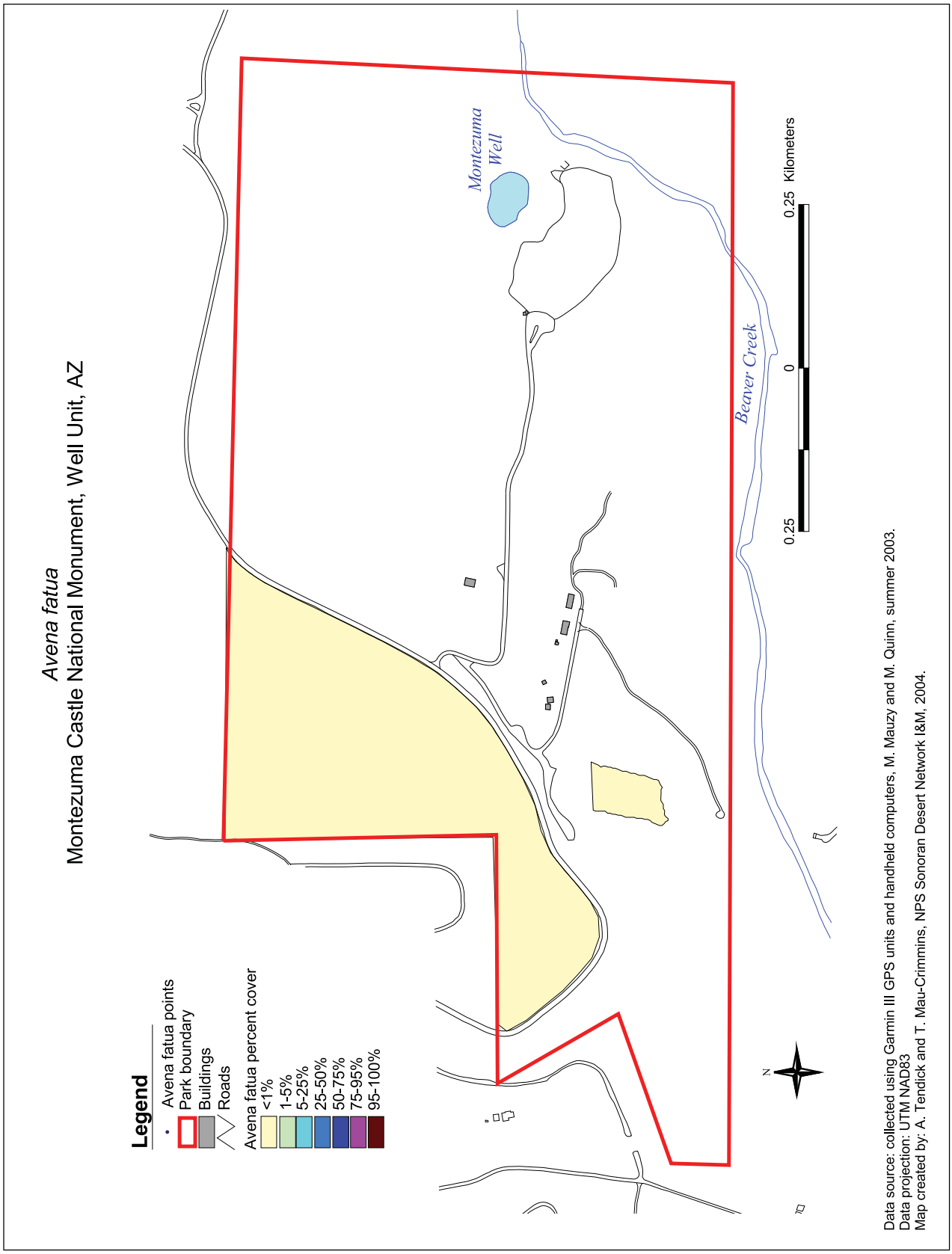


Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

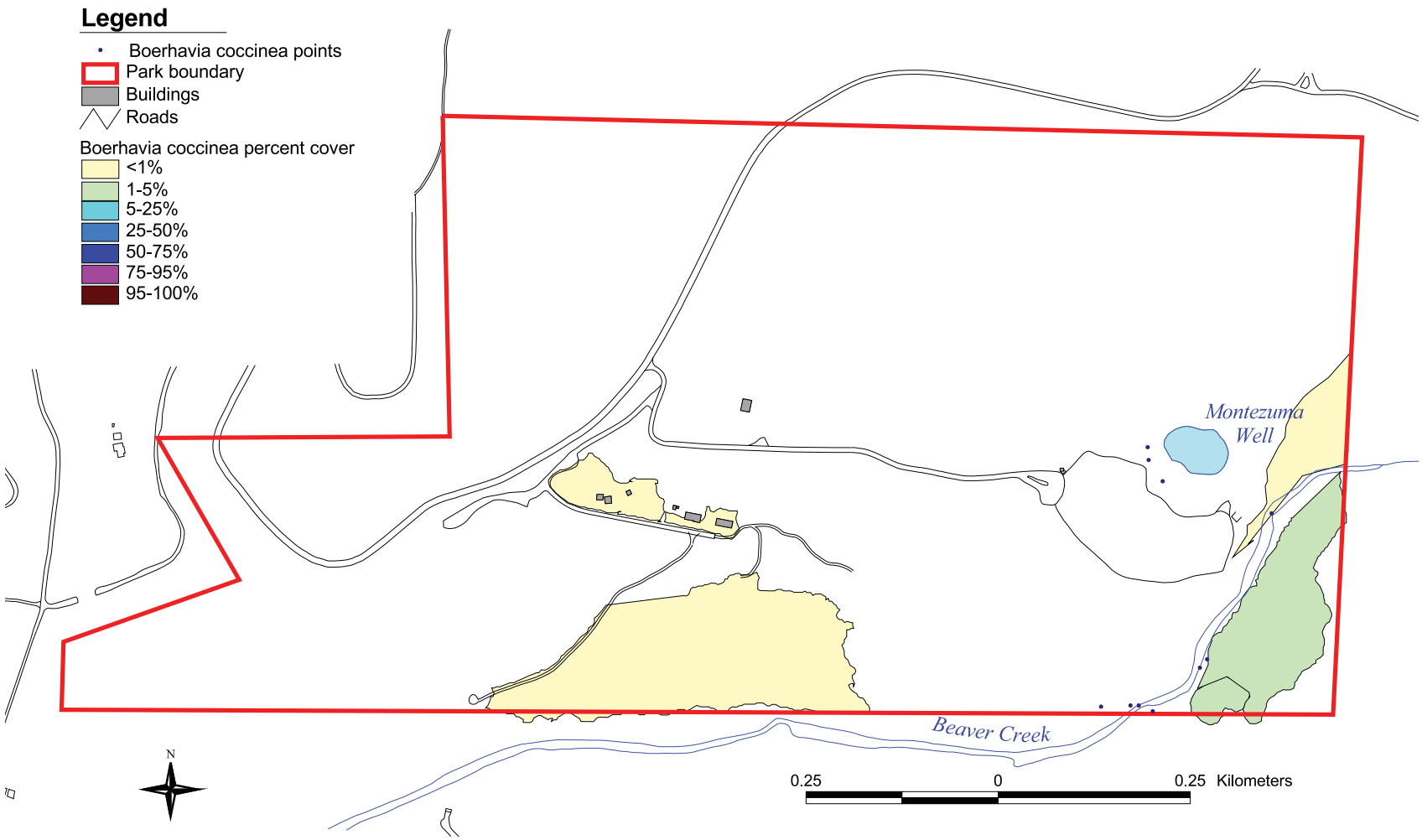

Verbascum thapsus
Montezuma Castle National Monument, AZ
Legend
Verbascum thapsus points
Roads
Buildings
Park boundary
Verbascum thapsus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.



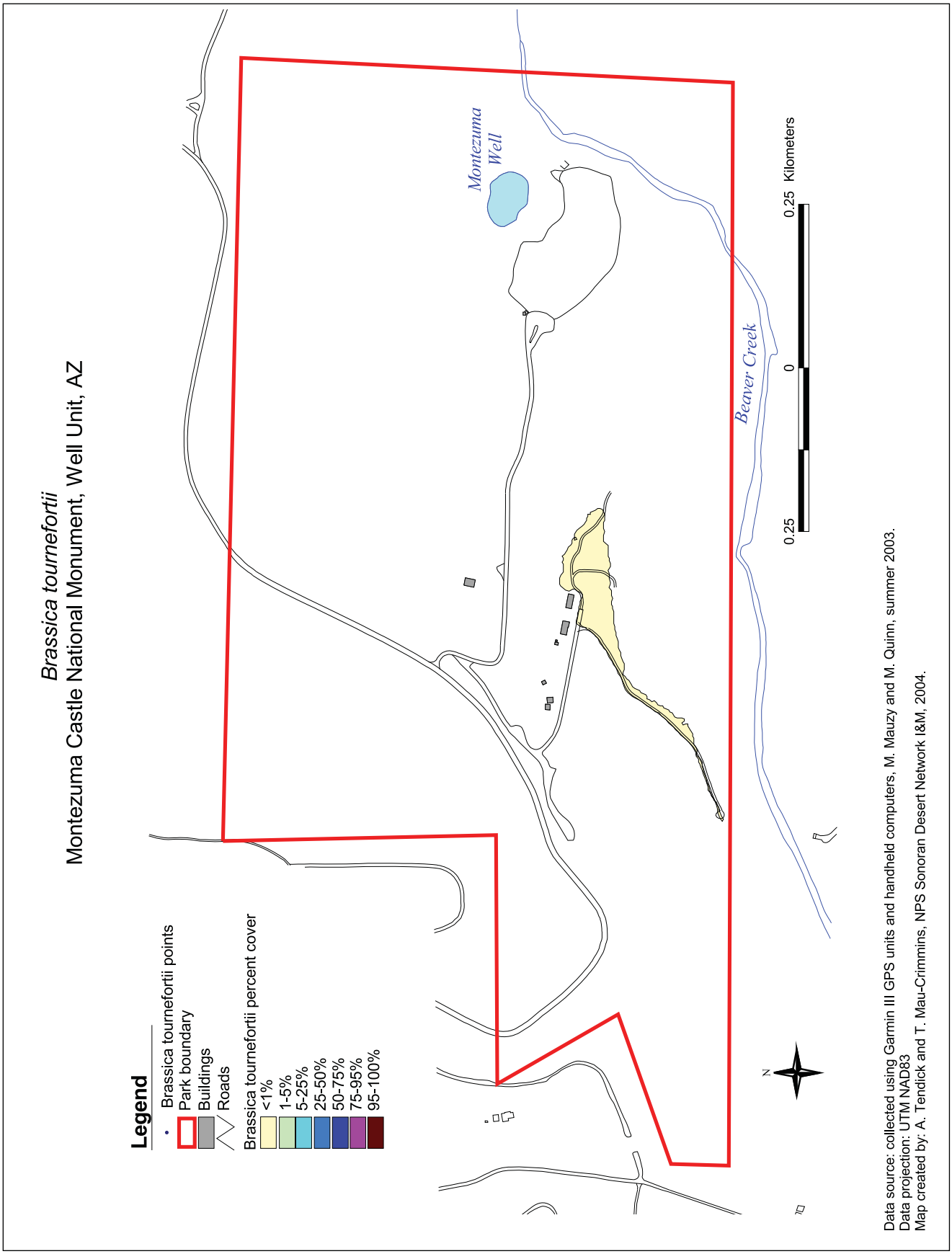
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.


Avena fatua
Montezuma Castle National Monument, Well Unit, AZ
Legend
Avena fatua points
Park boundary
Buildings
Roads
Avena fatua percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

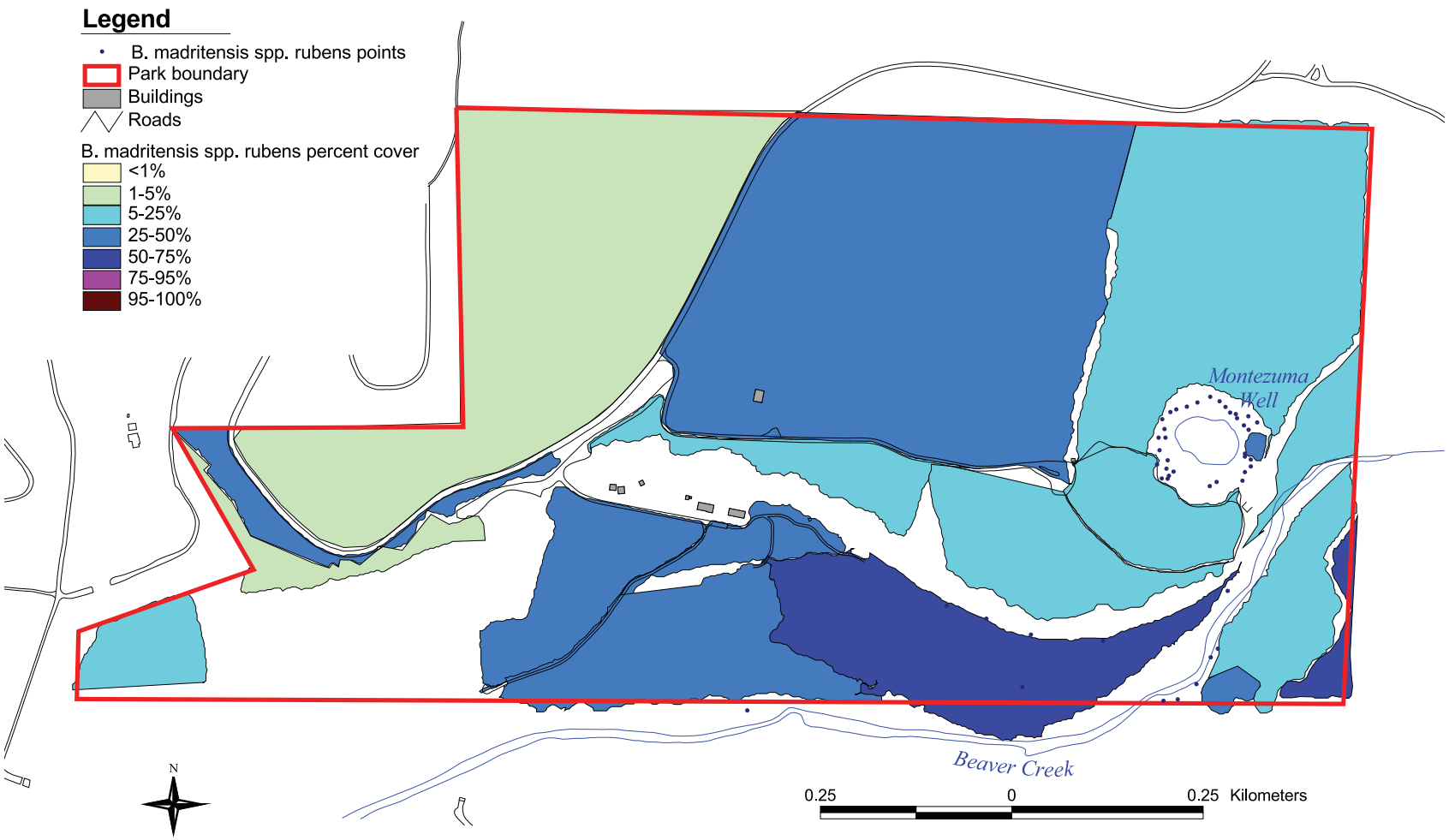
Boerhavia coccinea
Montezuma Castle National Monument, Well Unit, AZ



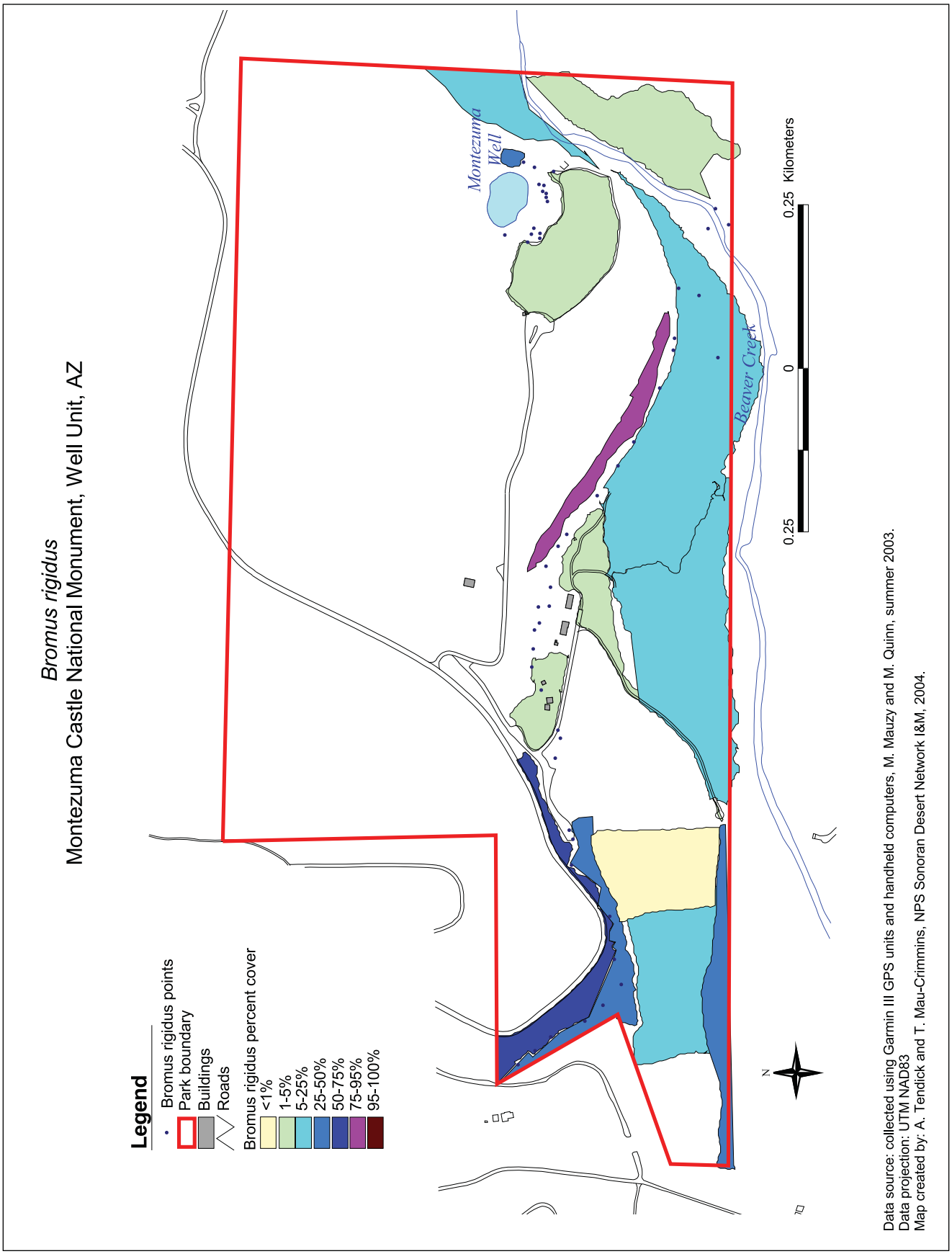
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

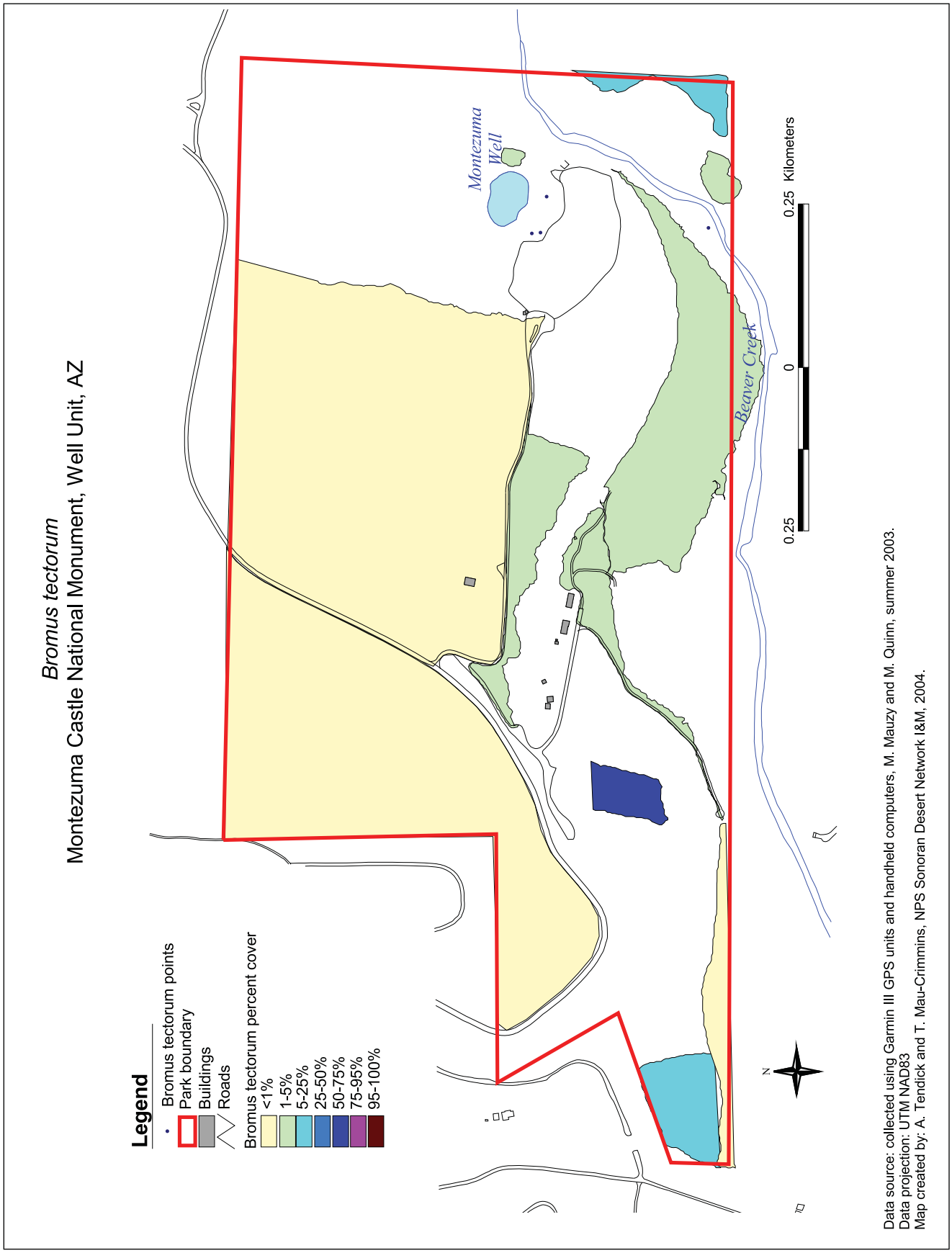

Brassica tournefortii
Montezuma Castle National Monument, Well Unit, AZ
Legend
Brassica tournefortii points
Park boundary
Buildings
Roads
Brassica tournefortii percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

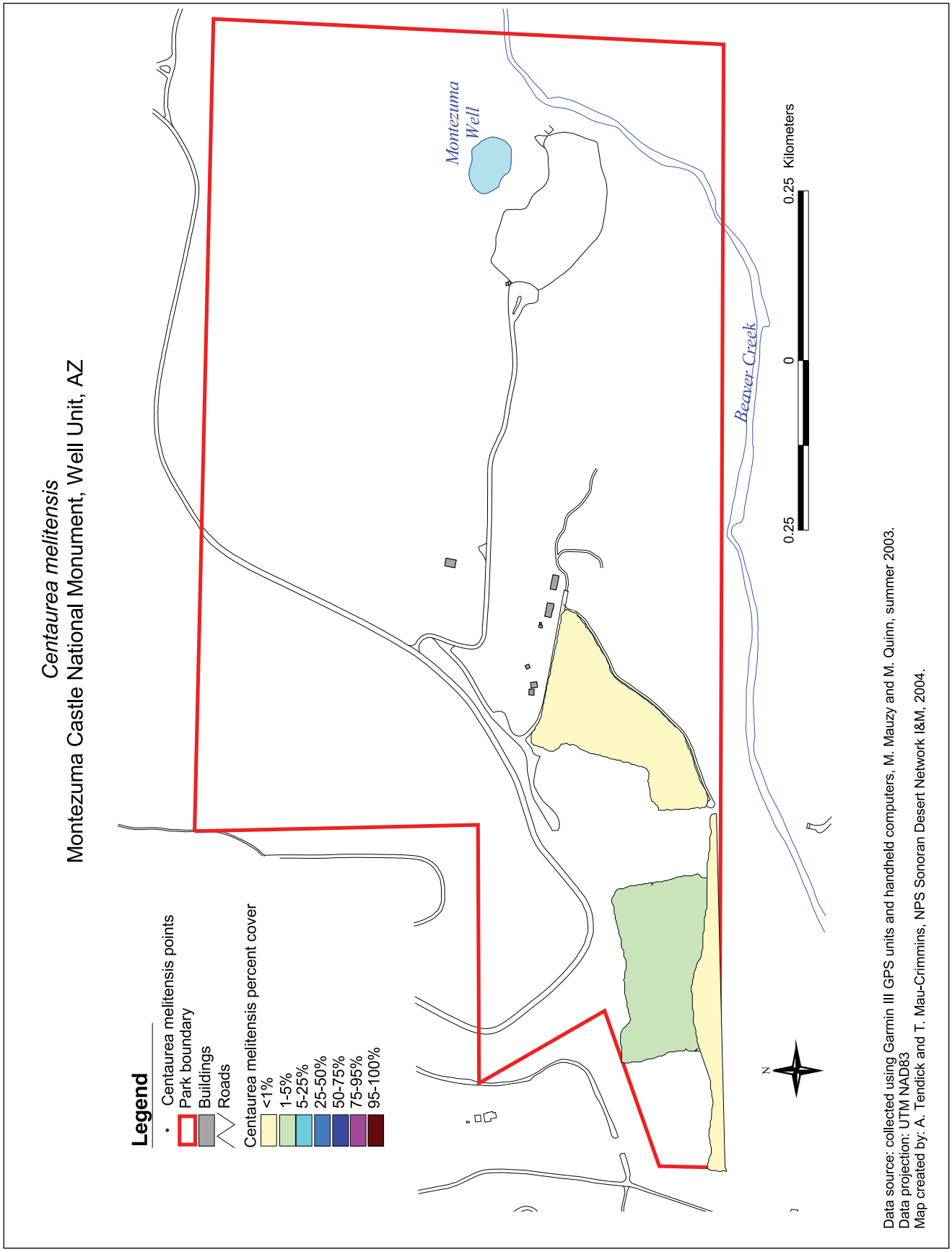
Bromus madritensis spp. rubens
Montezuma Castle National Monument, Well Unit, AZ

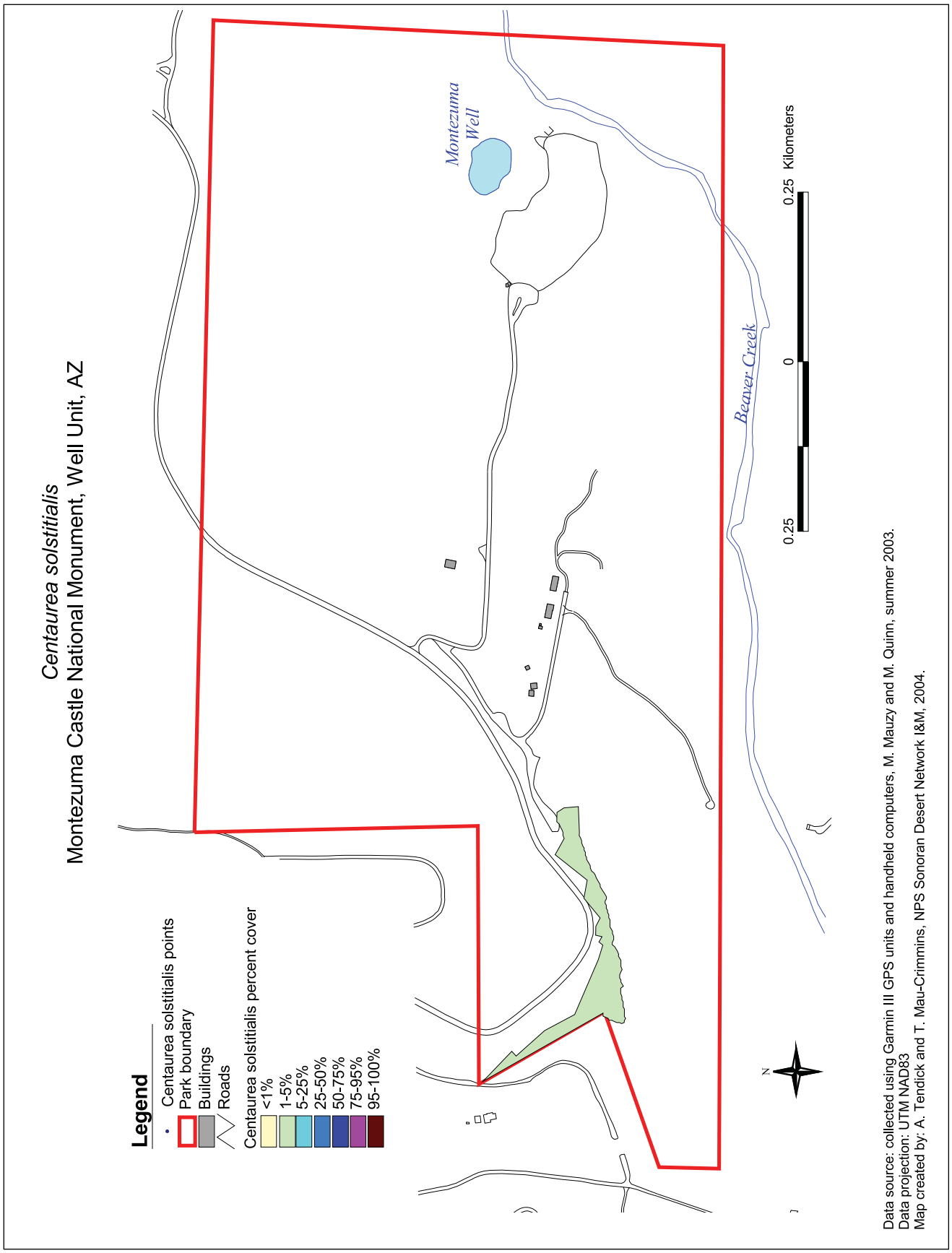


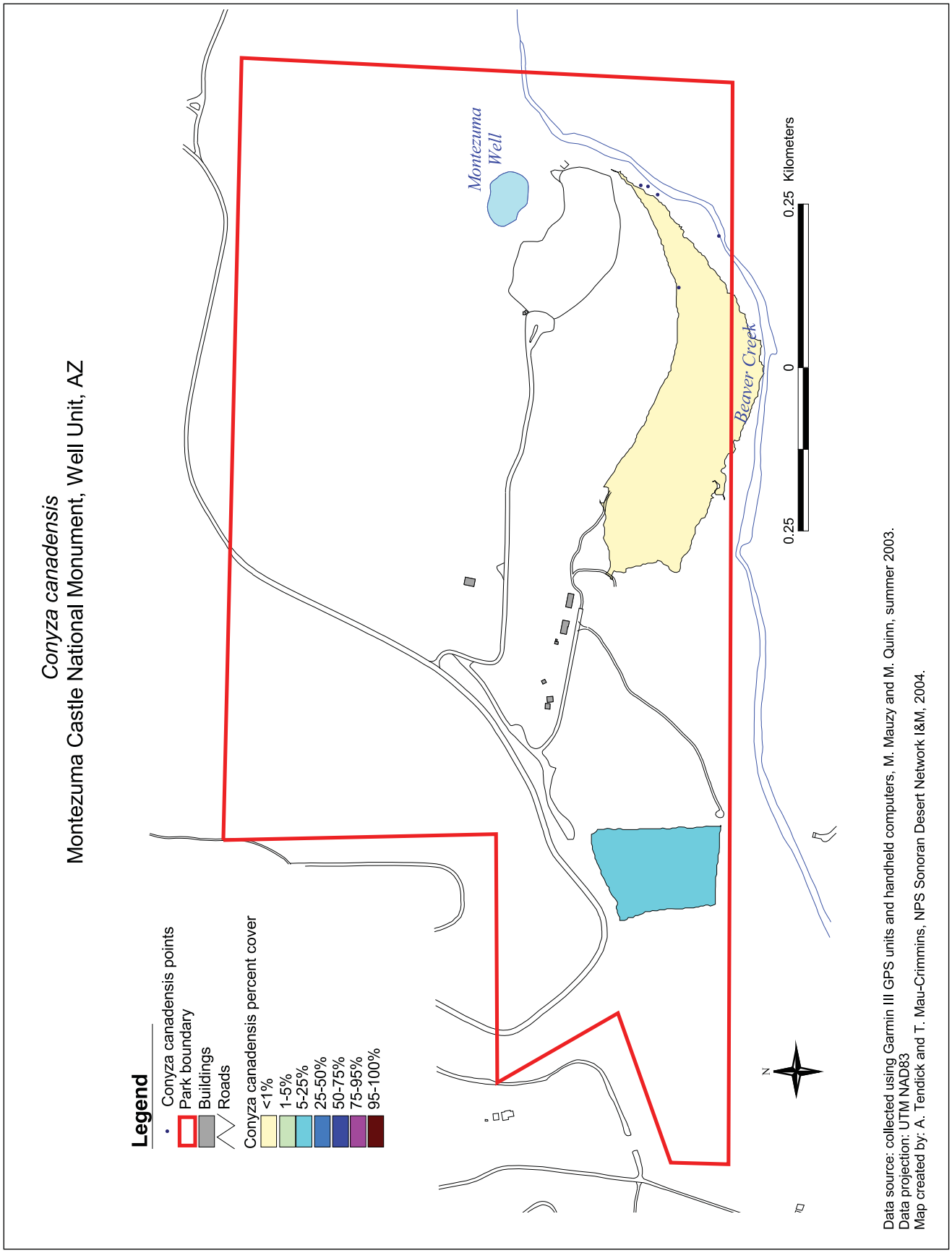
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

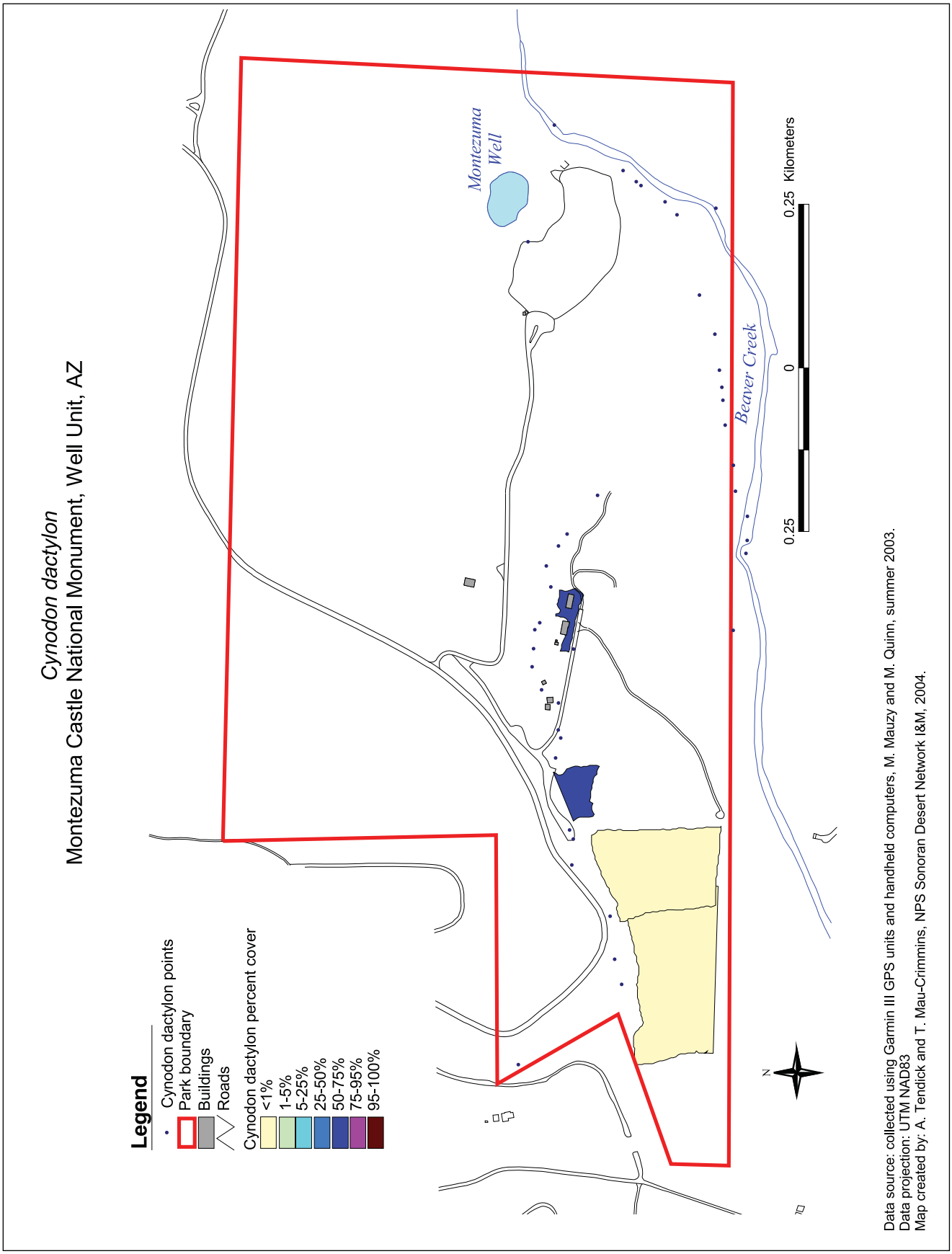

Bromus rigidus
Montezuma Castle National Monument, Well Unit, AZ
Legend
Bromus rigidus points
Park boundary
Buildings
Roads
Bromus rigidus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

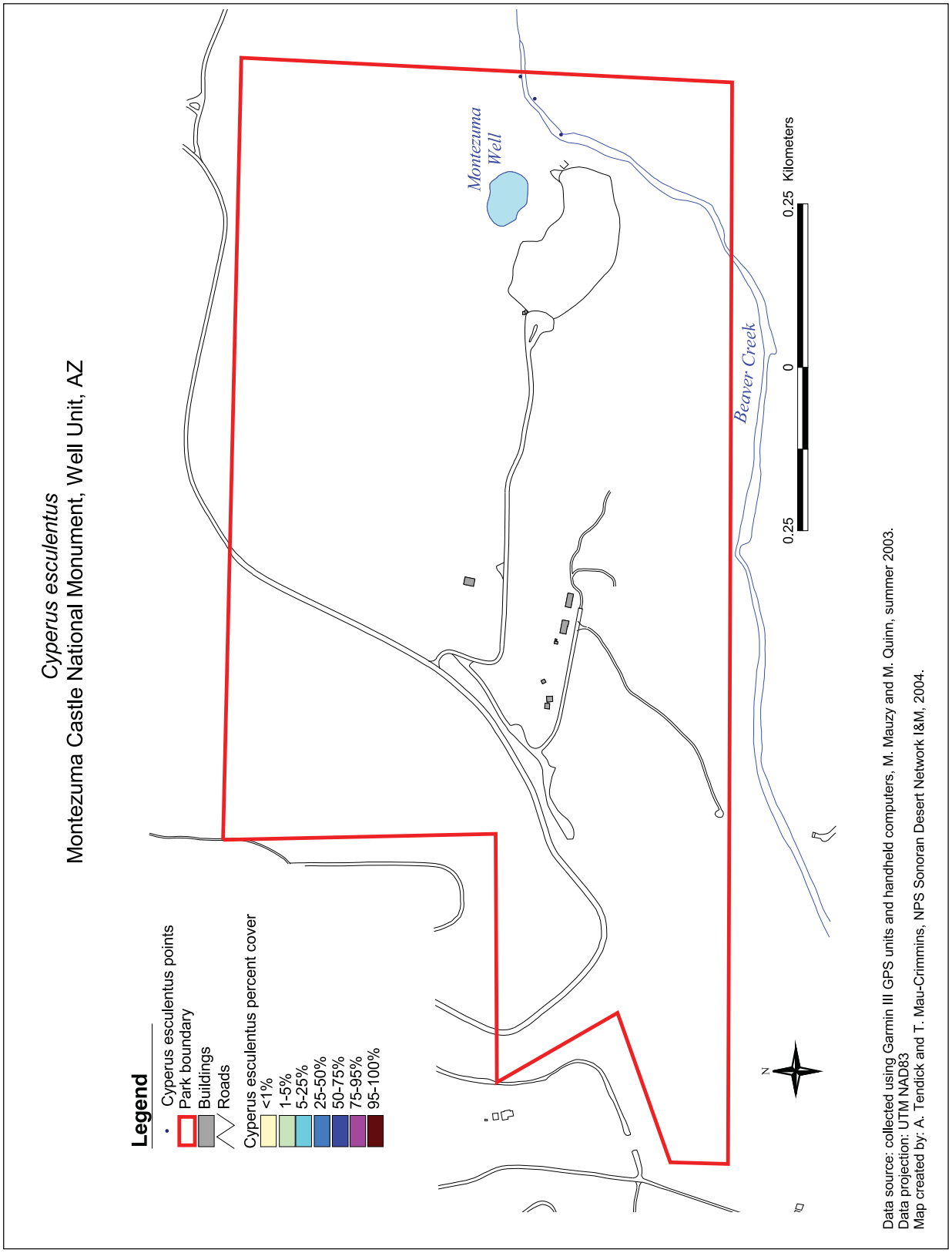

Bromus tectorum
Montezuma Castle National Monument, Well Unit, AZ
Legend
Bromus tectorum points
Park boundary
Buildings
Roads
Bromus tectorum percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.


Centaurea melitensis
Montezuma Castle National Monument, Well Unit, AZ
Legend
Centaurea melitensis points
Park boundary
Buildings
Roads
Centaurea melitensis percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.


Centaurea solstitialis
Montezuma Castle National Monument, Well Unit, AZ
Legend
Centaurea solstitialis points
Park boundary
Buildings
Roads
Centaurea solstitialis percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

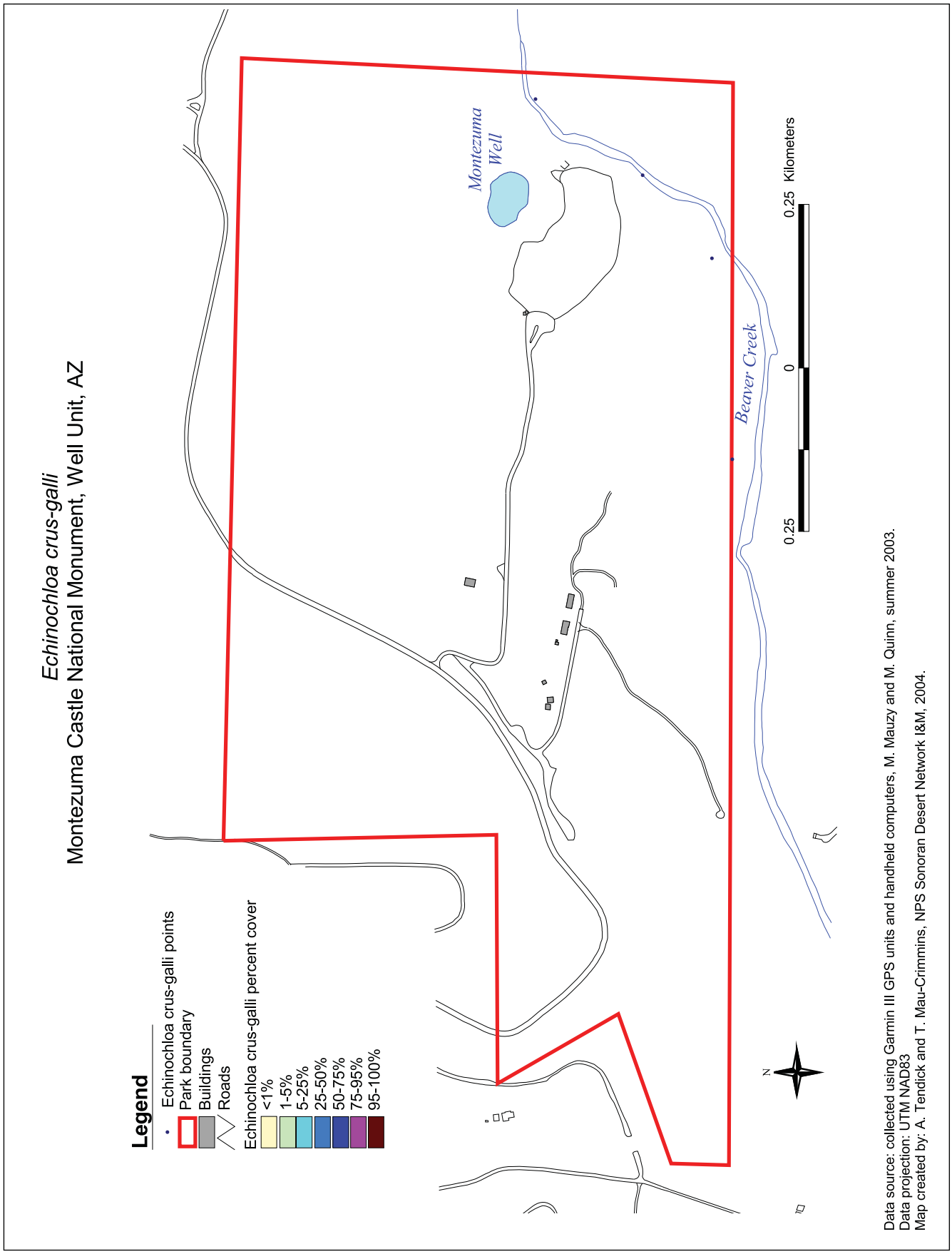

Conyza canadensis
Montezuma Castle National Monument, Well Unit, AZ
Legend
Conyza canadensis points
Park boundary
Buildings
Roads
Conyza canadensis percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

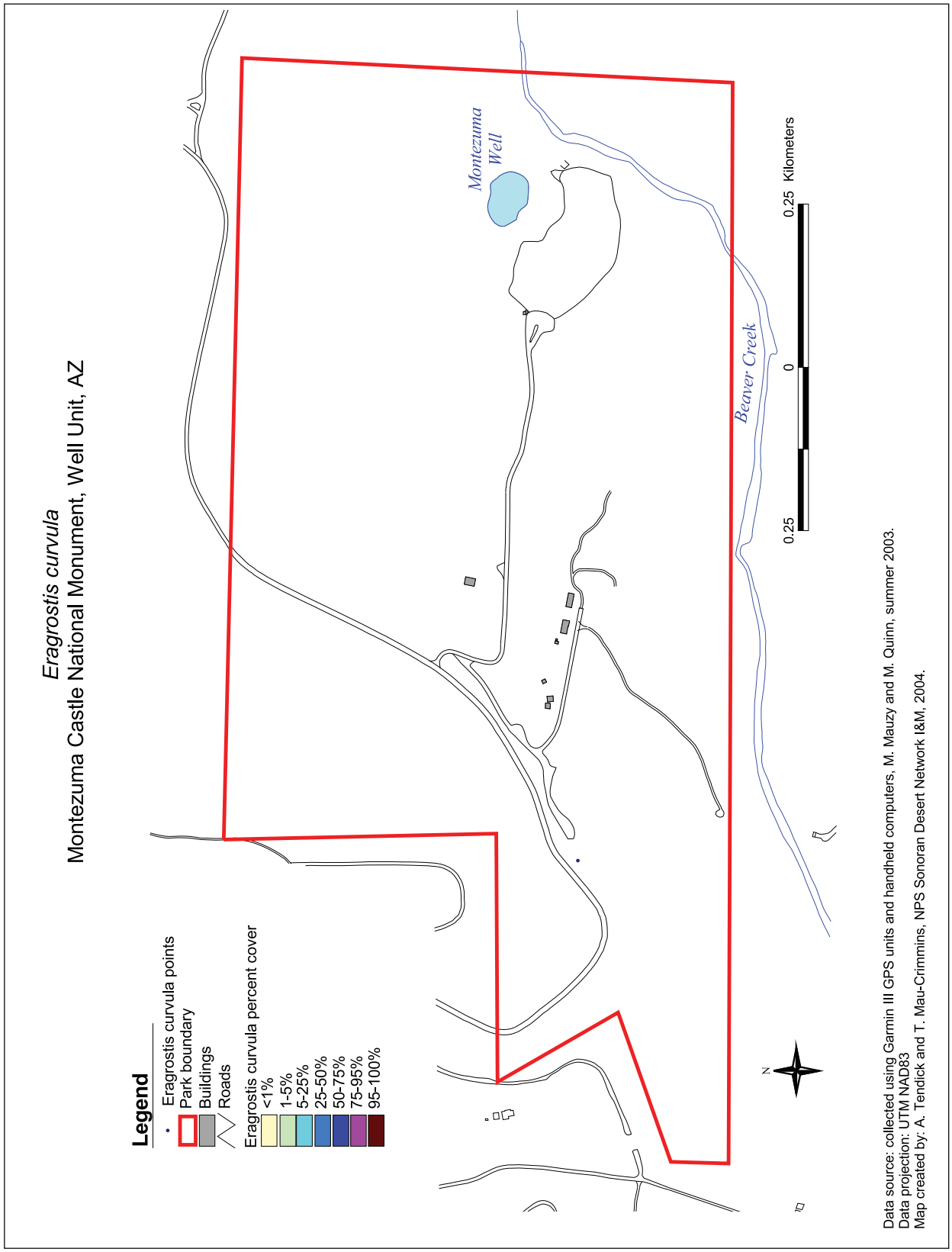

Cynodon dactylon
Montezuma Castle National Monument, Well Unit, AZ
Legend
Cynodon dactylon points
Park boundary
Buildings
Roads
Cynodon dactylon percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

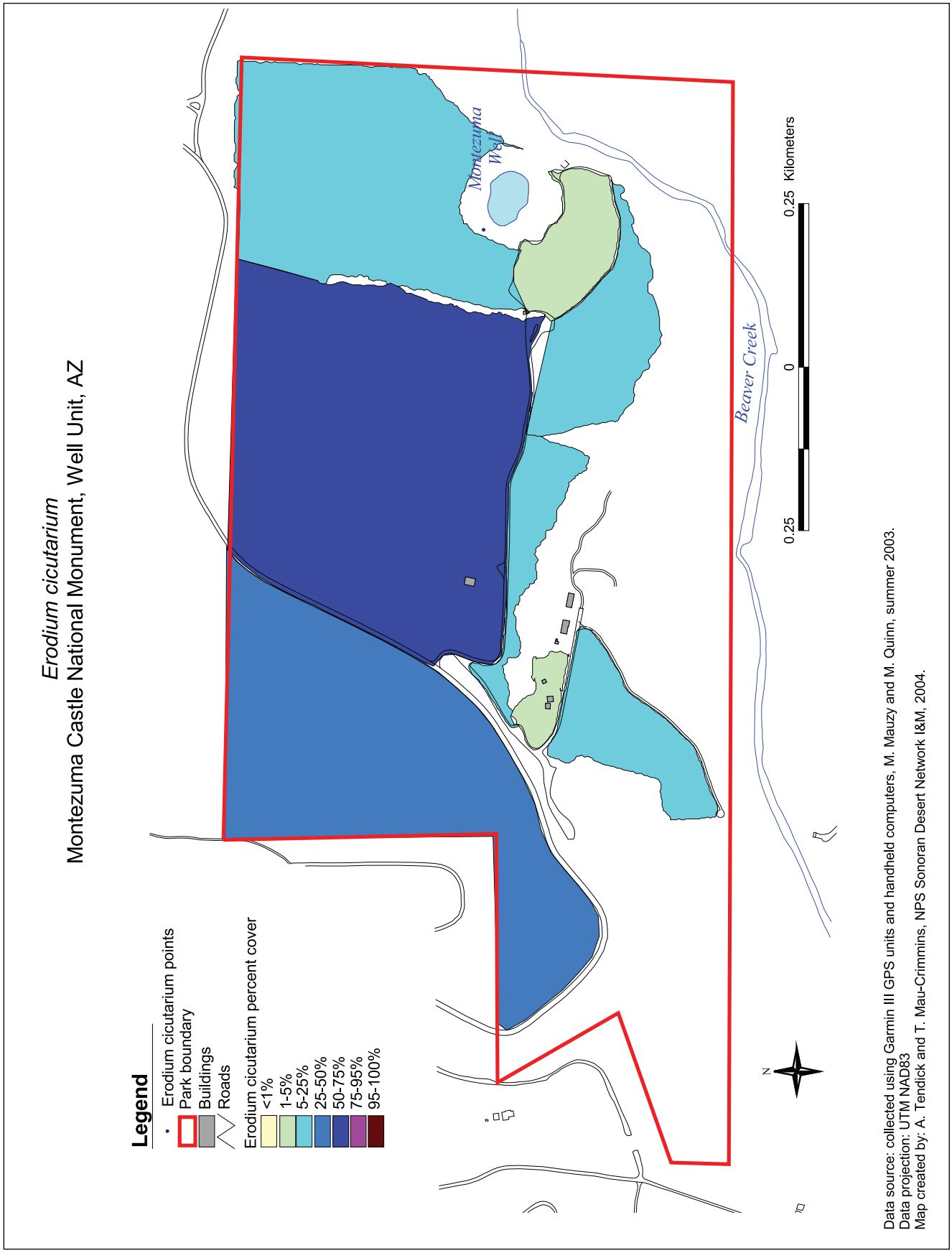

Cyperus esculentus
Montezuma Castle National Monument, Well Unit, AZ
Legend
Cyperus esculentus points
Park boundary
Buildings
Roads
Cyperus esculentus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

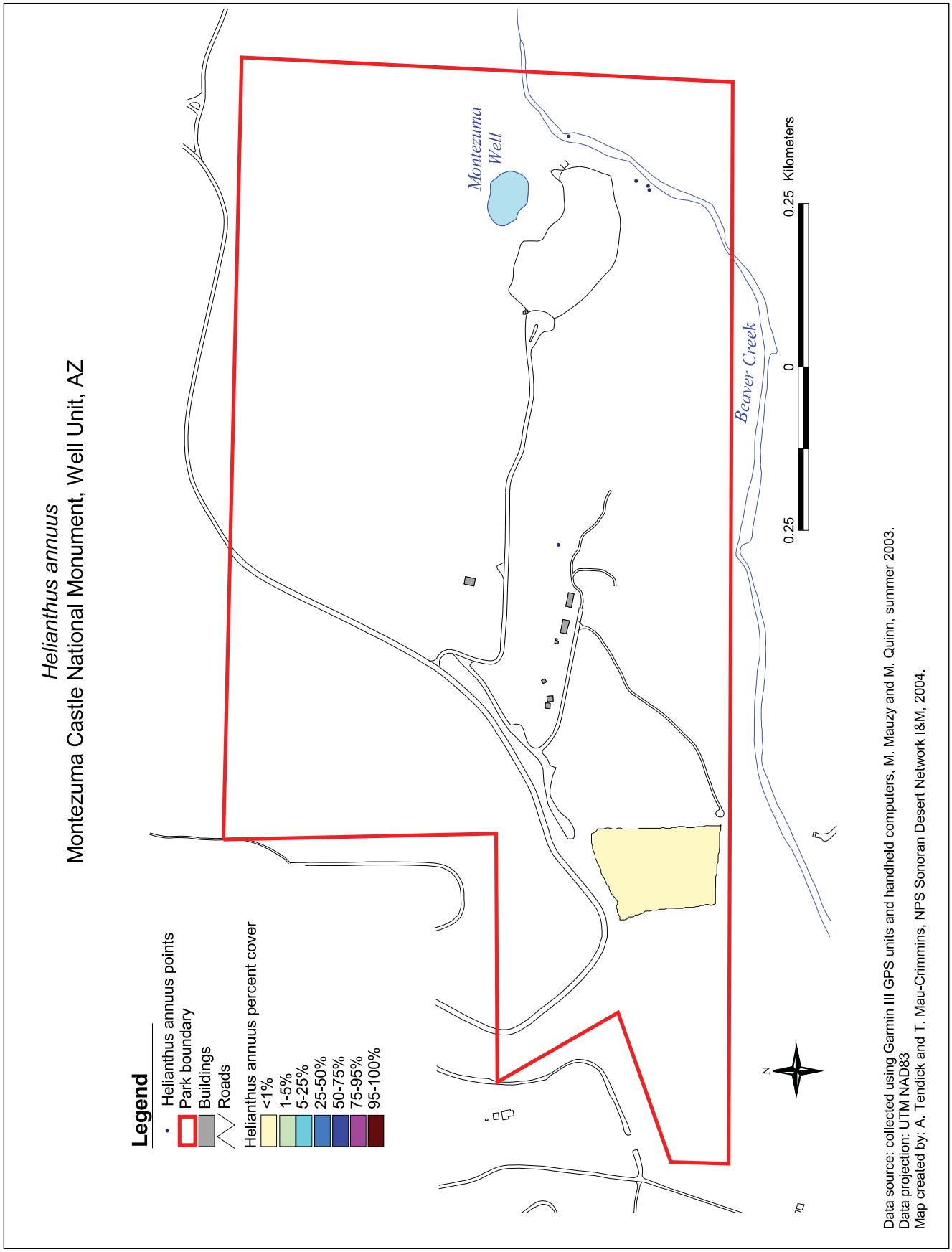
Digitaria sanguinalis
Montezuma Castle National Monument, Well Unit, AZ

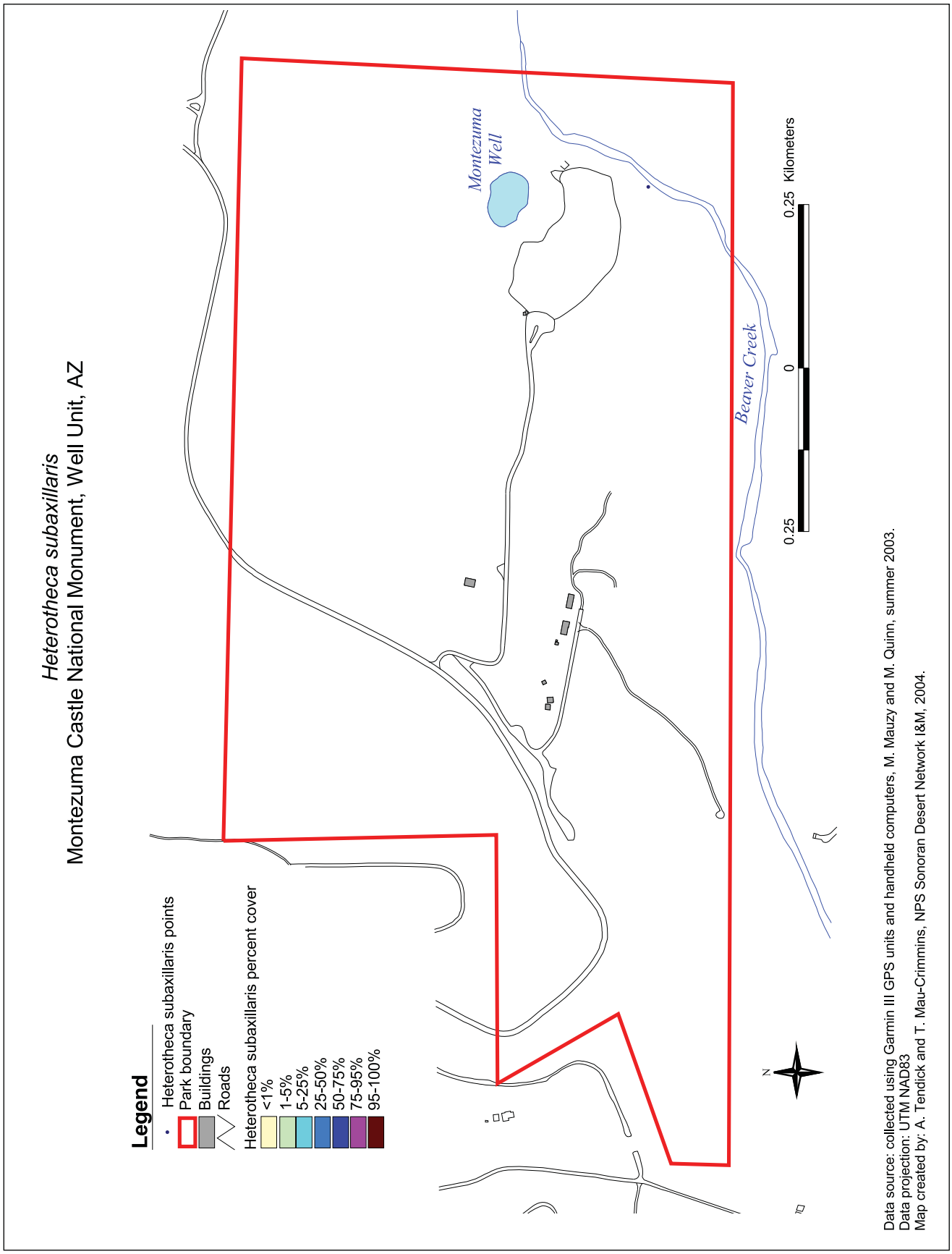
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.


Echinochloa crus-galli
Montezuma Castle National Monument, Well Unit, AZ
Legend
Echinochloa crus-galli points
Park boundary
Buildings
Roads
Echinochloa crus-galli percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

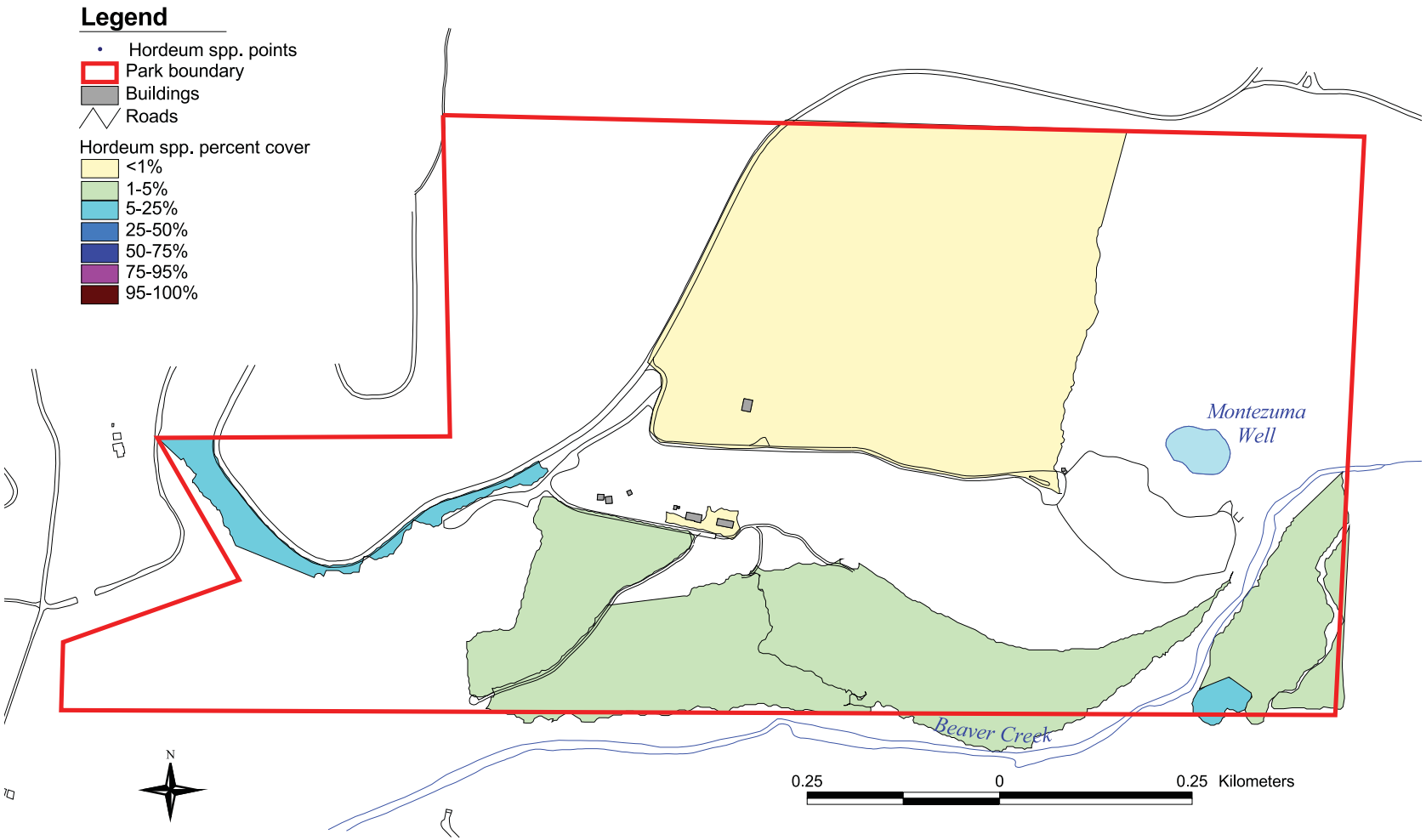

Eragrostis curvula
Montezuma Castle National Monument, Well Unit, AZ
Legend
Eragrostis curvula points
Park boundary
Buildings
Roads
Eragrostis curvula percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.


Erodium cicutarium
Montezuma Castle National Monument, Well Unit, AZ
Legend
Erodium cicutarium points
Park boundary
Buildings
Roads
Erodium cicutarium percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

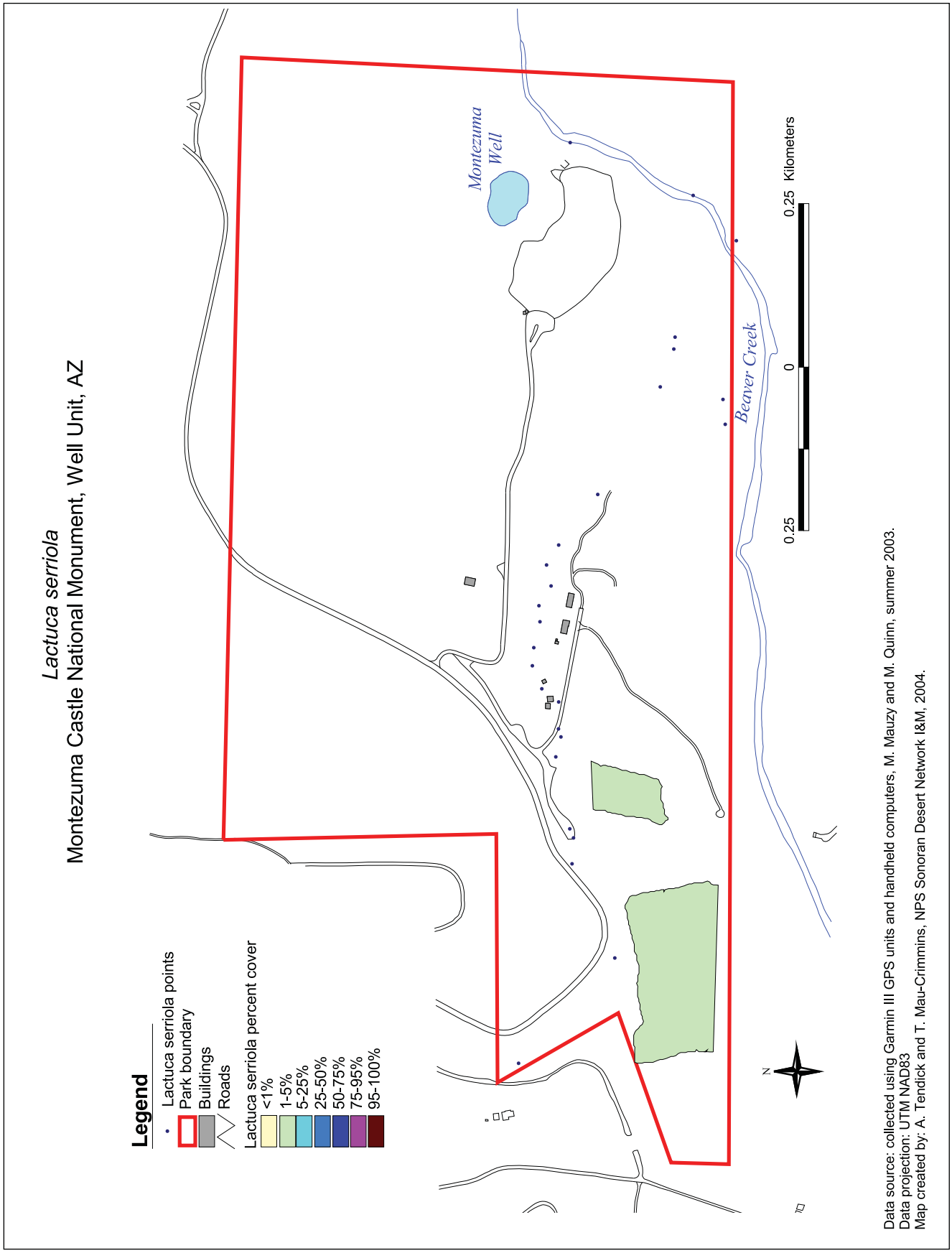

Helianthus annuus
Montezuma Castle National Monument, Well Unit, AZ
Legend
Helianthus annuus points
Park boundary
Buildings
Roads
Helianthus annuus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.


Heterotheca subaxillaris
Montezuma Castle National Monument, Well Unit, AZ
Legend
Heterotheca subaxillaris points
Park boundary
Buildings
Roads
Heterotheca subaxillaris percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

Hordeum spp.
Montezuma Castle National Monument, Well Unit, AZ

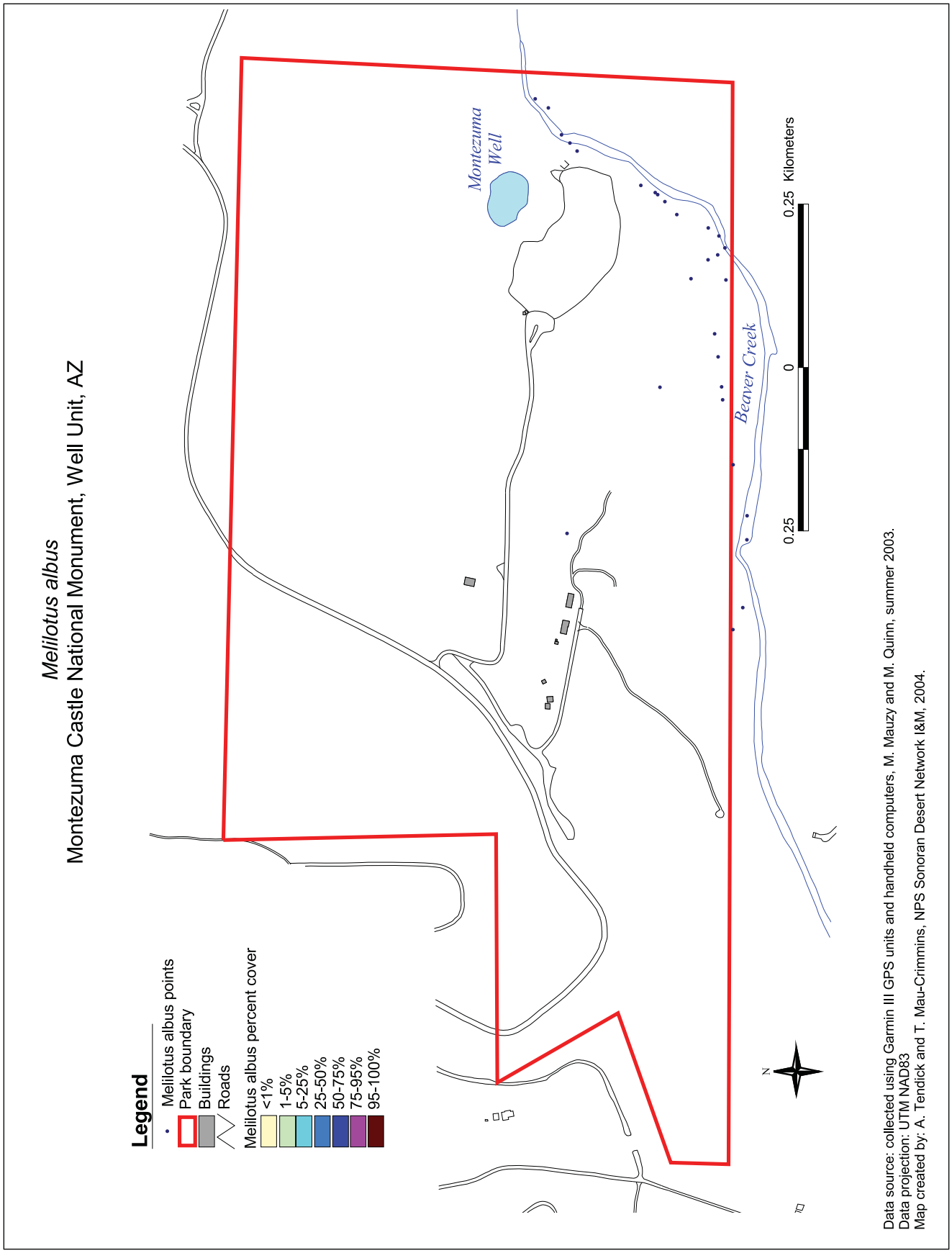


Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.


Lactuca serriola
Montezuma Castle National Monument, Well Unit, AZ
Legend
Lactuca serriola points
Park boundary
Buildings
Roads
Lactuca serriola percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

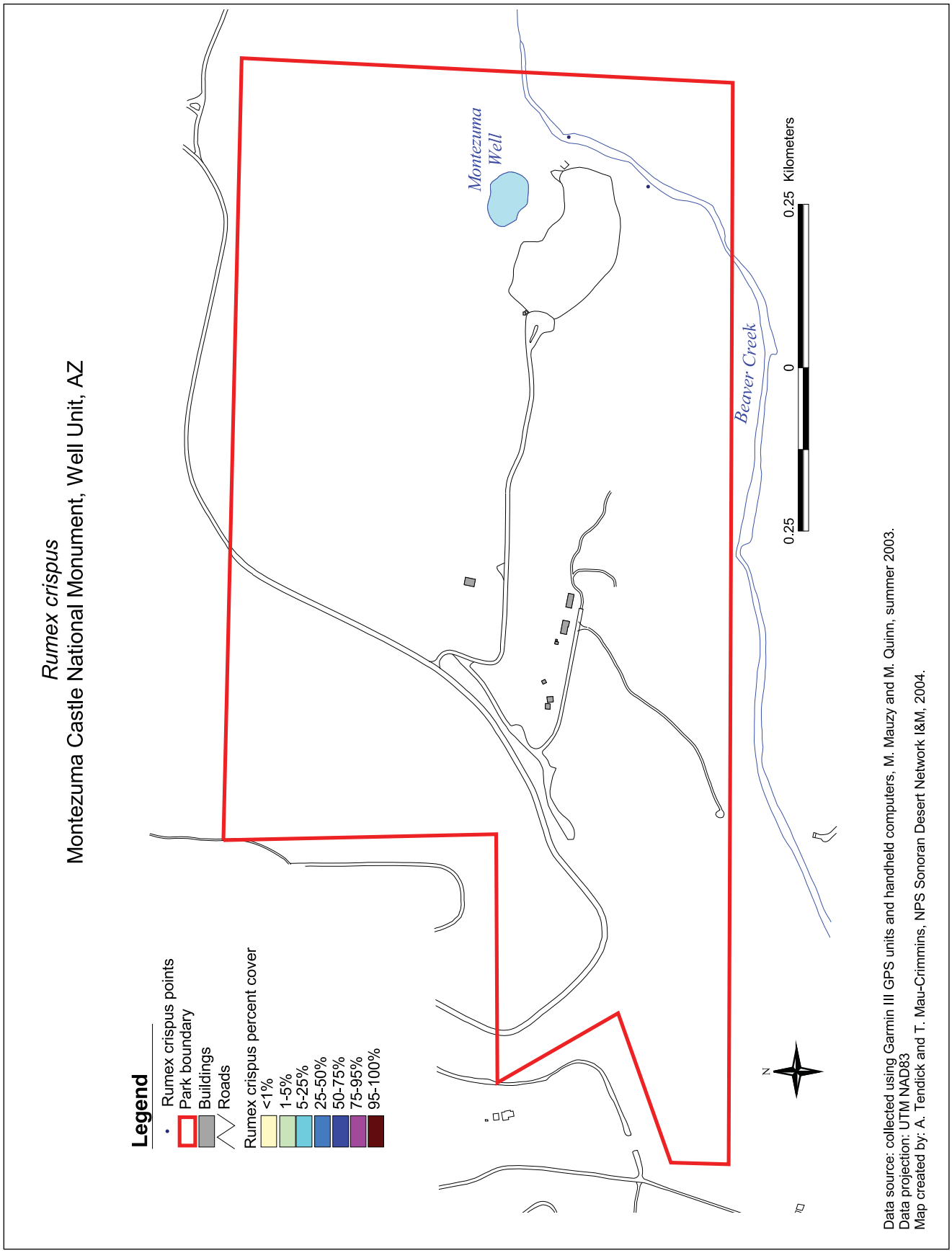
Marrubium vulgare
Montezuma Castle National Monument, Well Unit, AZ

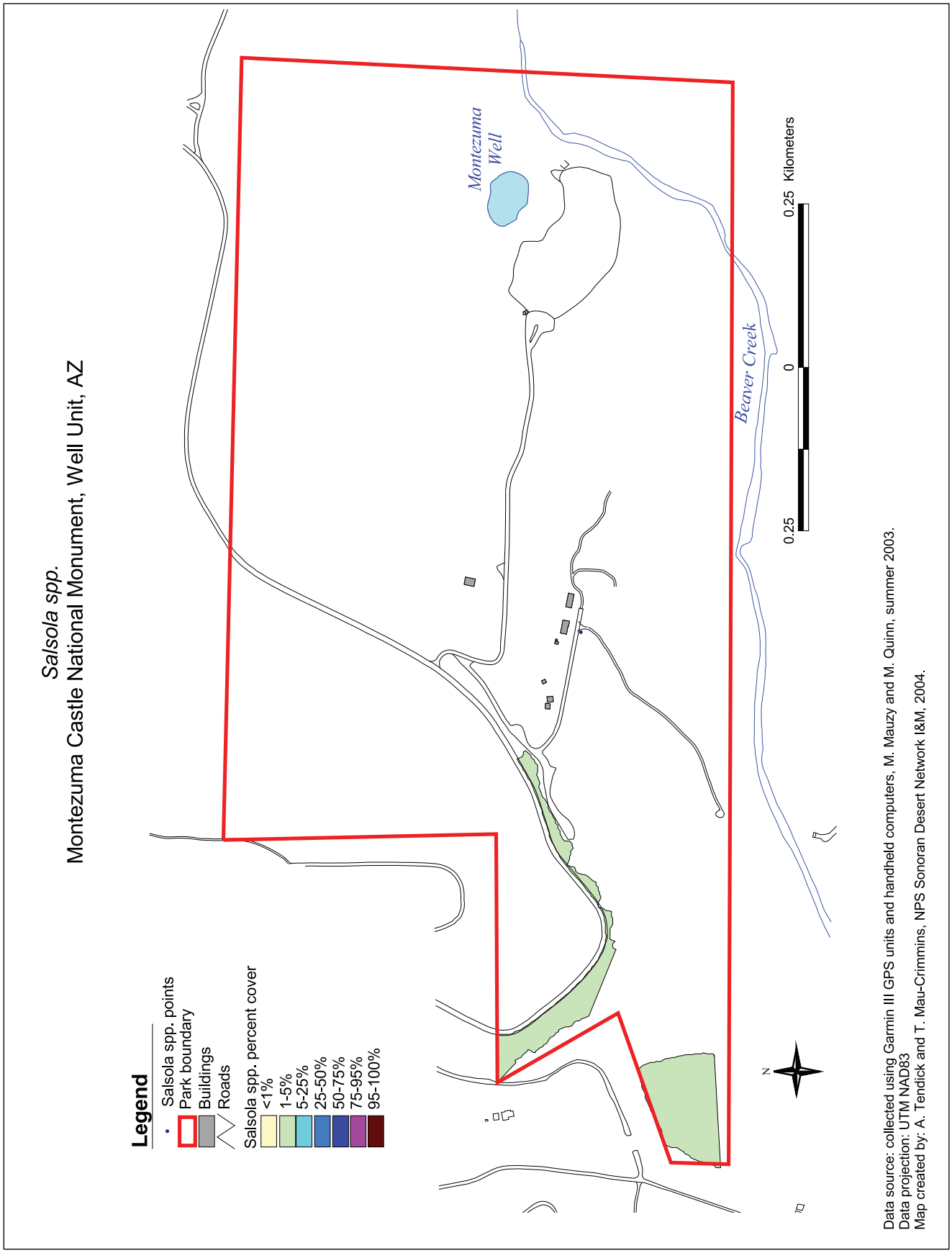
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

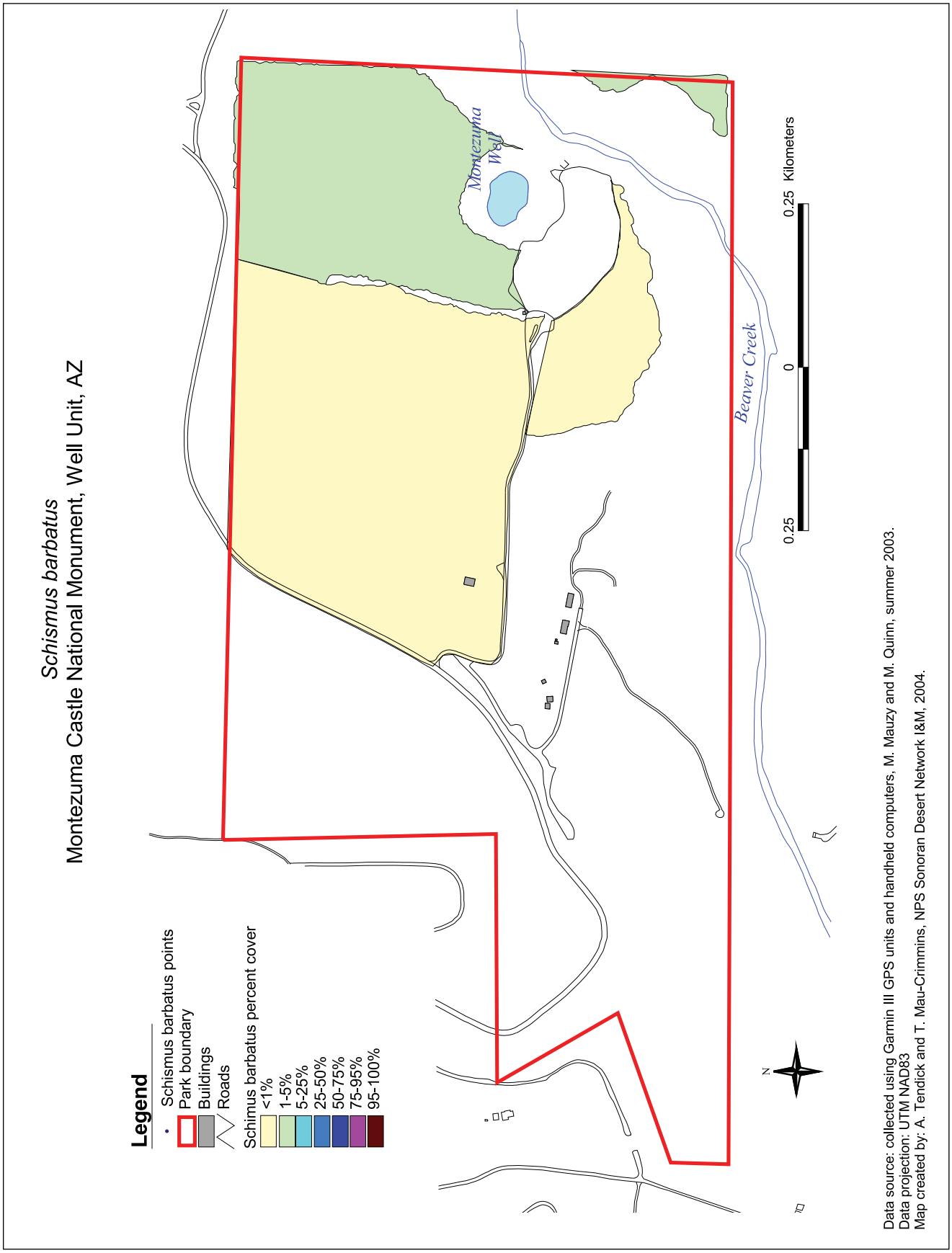

Melilotus albus
Montezuma Castle National Monument, Well Unit, AZ
Legend
Melilotus albus points
Park boundary
Buildings
Roads
Melilotus albus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

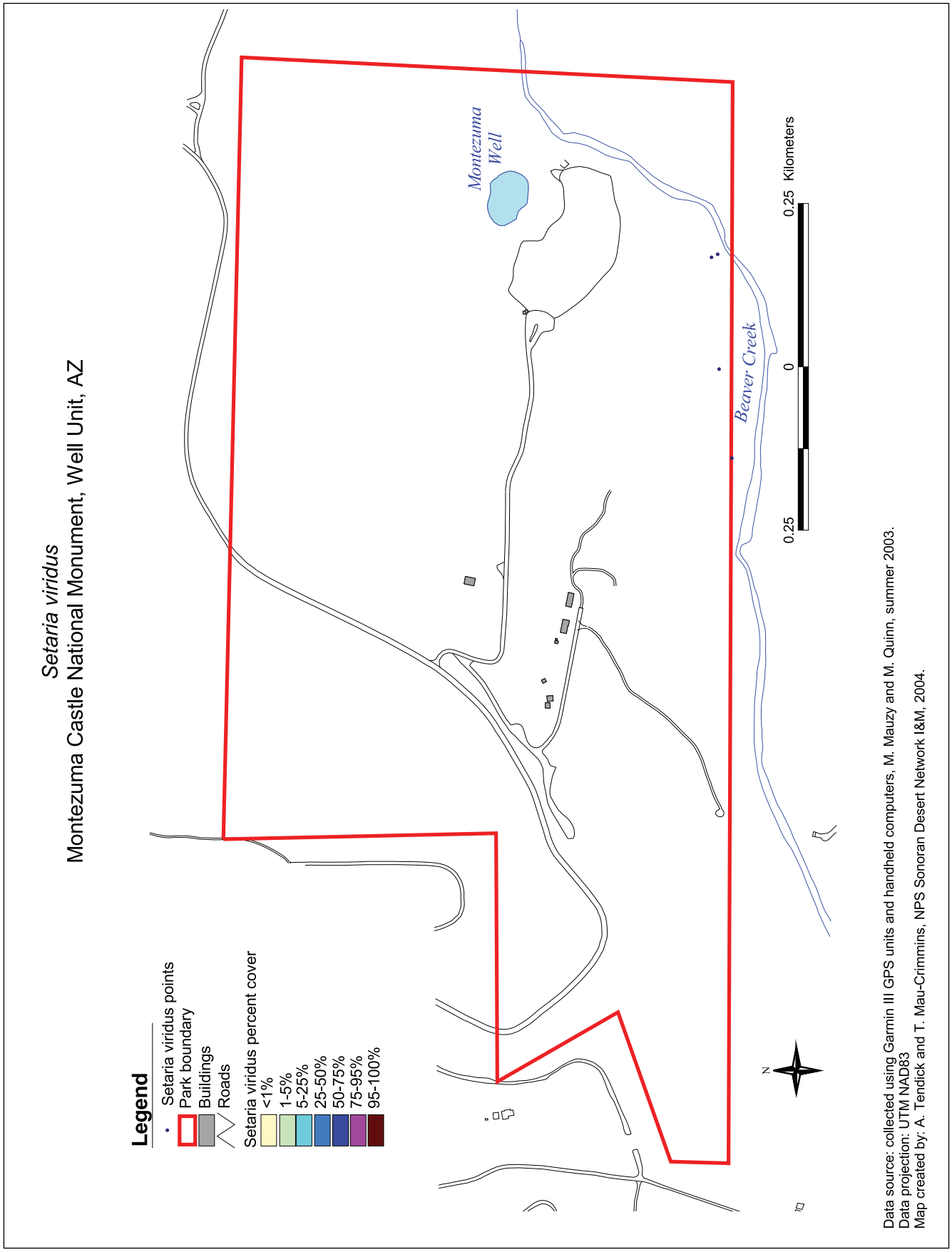
Polypogon monspeliensis
Montezuma Castle National Monument, Well Unit, AZ

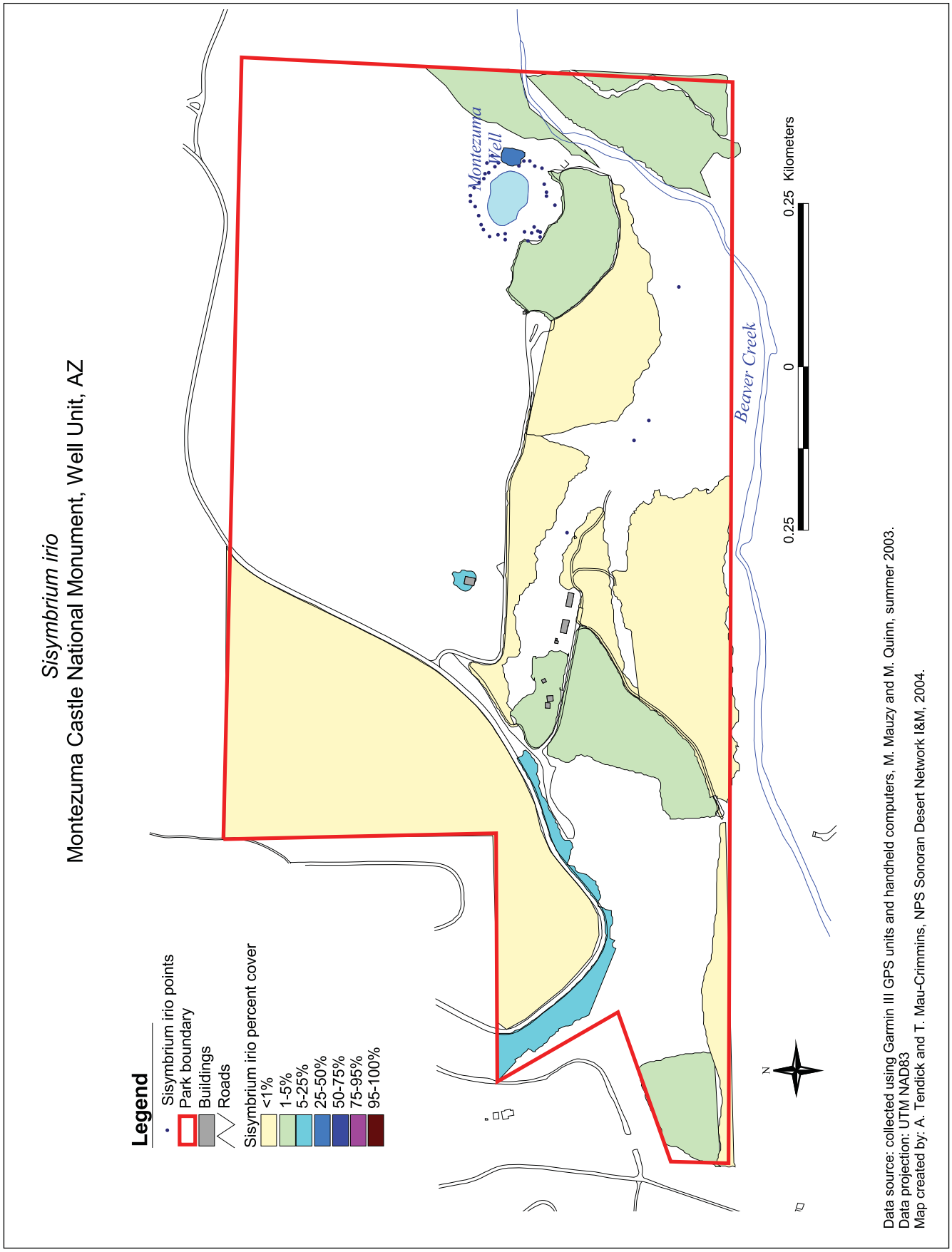
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

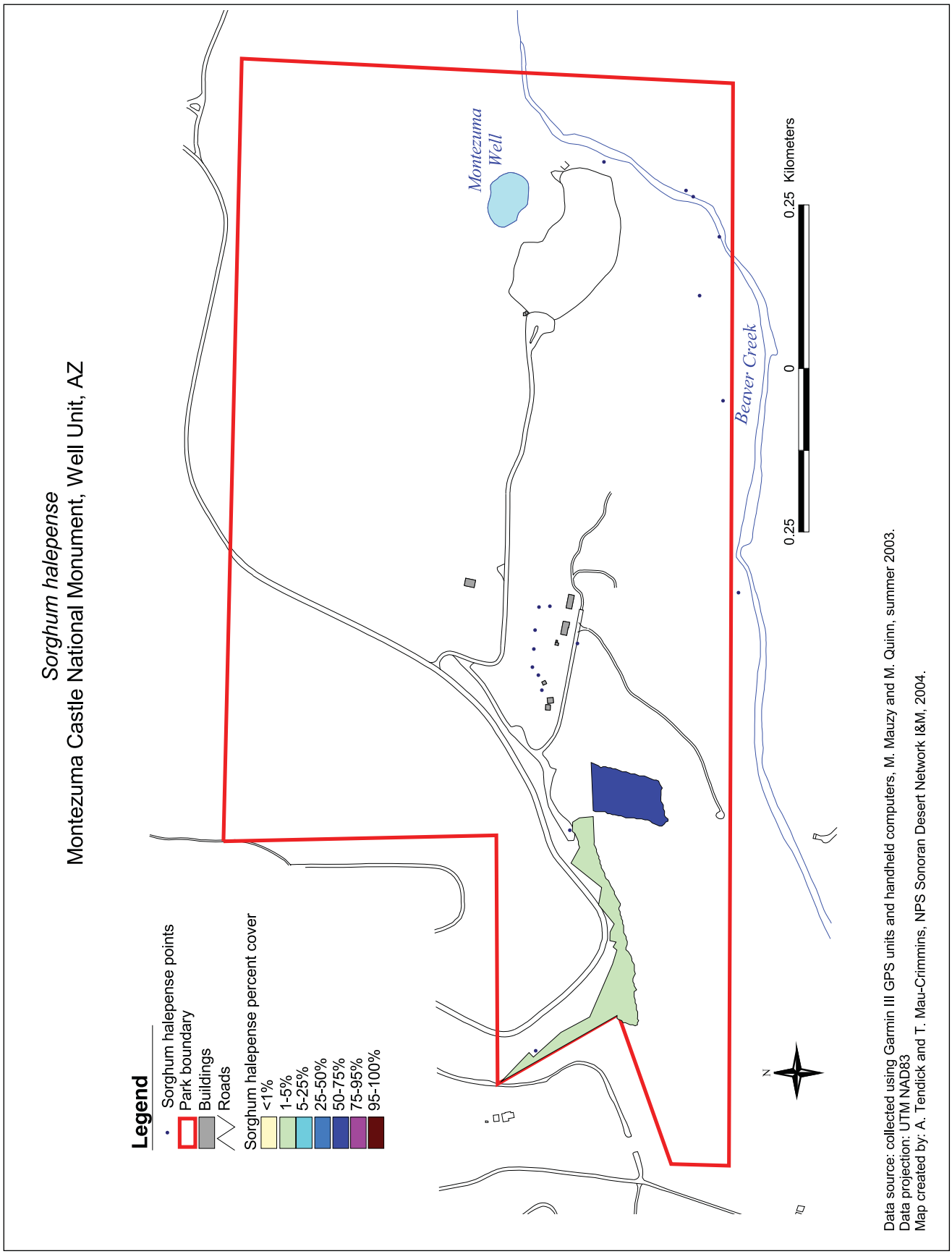

Rumex crispus
Montezuma Castle National Monument, Well Unit, AZ
Legend
Rumex crispus points
Park boundary
Buildings
Roads
Rumex crispus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

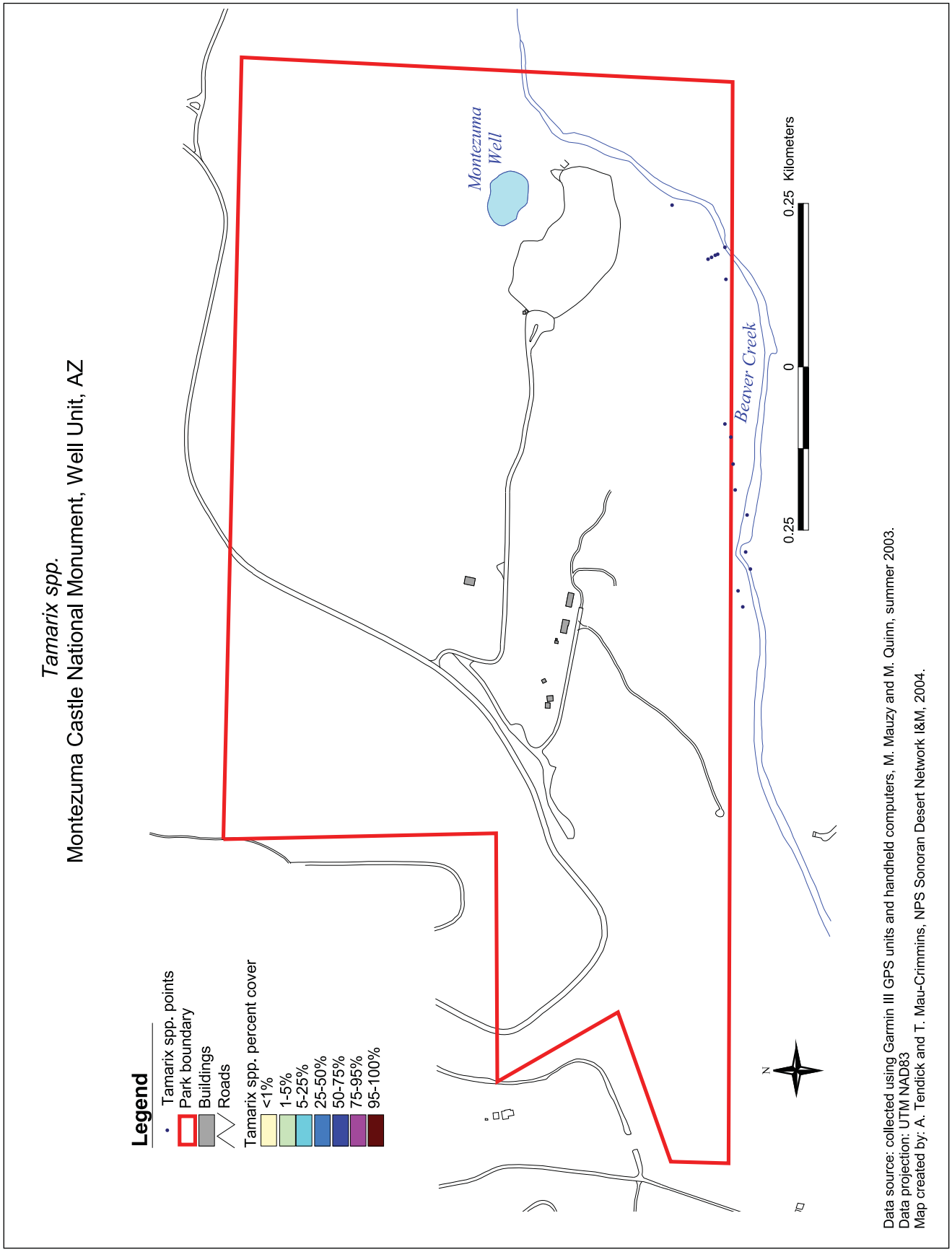

Salsola spp.
Montezuma Castle National Monument, Well Unit, AZ
Legend
Salsola spp. points
Park boundary
Buildings
Roads
Salsola spp. percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.


Schismus barbatus
Montezuma Castle National Monument, Well Unit, AZ
Legend
Schismus barbatus points
Park boundary
Buildings
Roads
Schimus barbatus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

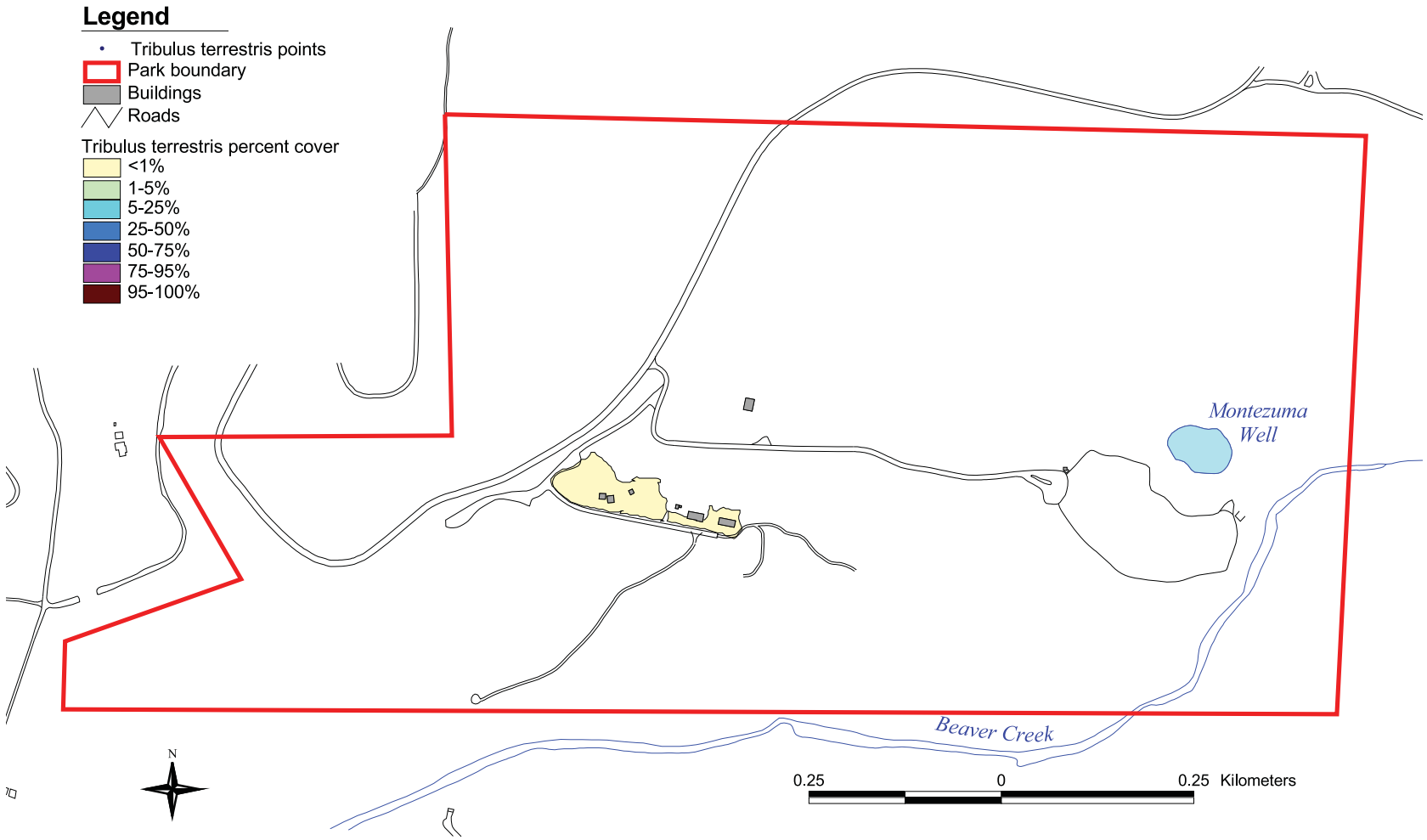

Setaria viridus
Montezuma Castle National Monument, Well Unit, AZ
Legend
Setaria viridus points
Park boundary
Buildings
Roads
Setaria viridus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.


Sisymbrium irio
Montezuma Castle National Monument, Well Unit, AZ
Legend
Sisymbrium irio points
Park boundary
Buildings
Roads
Sisymbrium irio percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

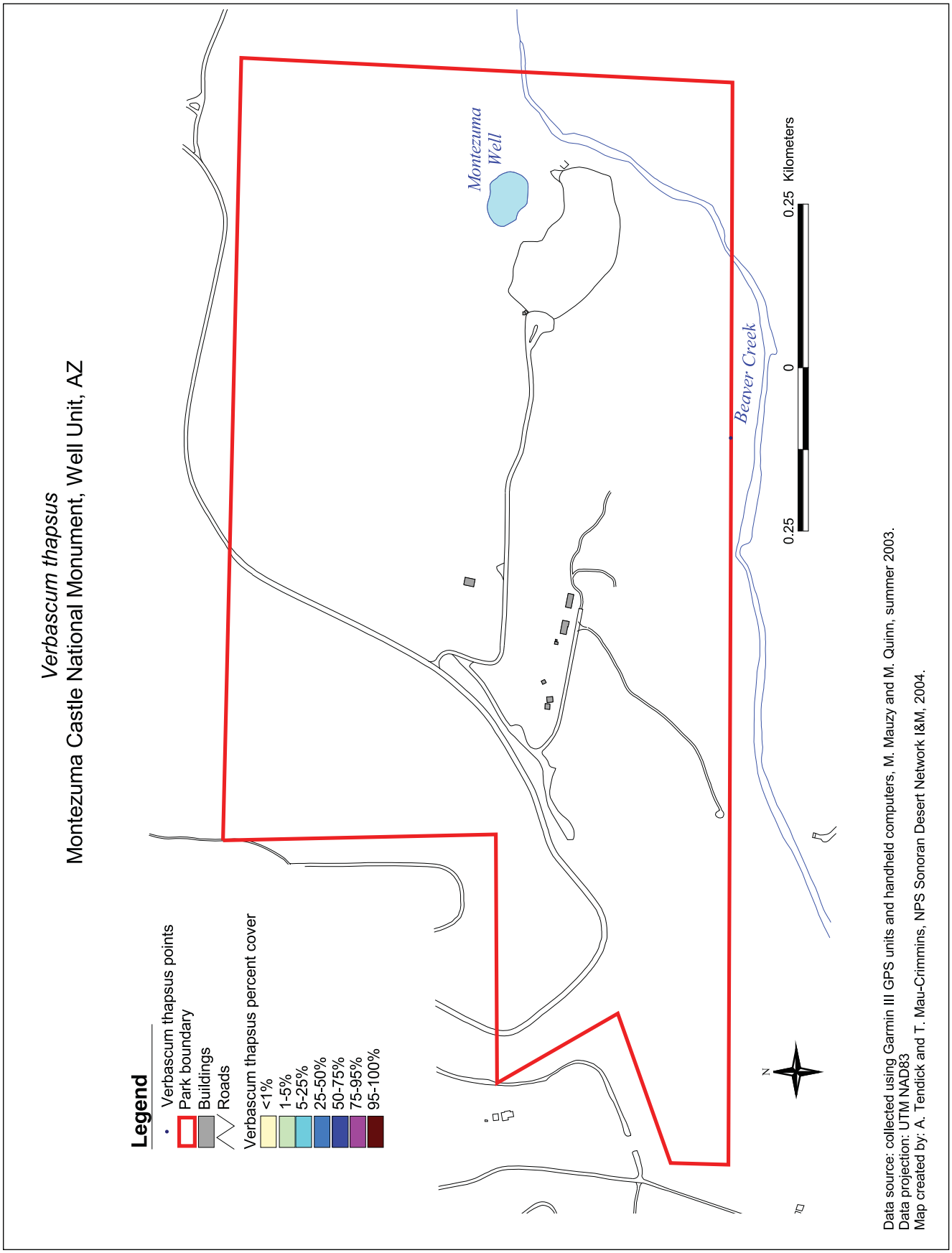

Sorghum halepense
Montezuma Castle National Monument, Well Unit, AZ
Legend
Sorghum halepense points
Park boundary
Buildings
Roads
Sorghum halepense percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.


Tamarix spp.
Montezuma Castle National Monument, Well Unit, AZ
Legend
Tamarix spp. points
Park boundary
Buildings
Roads
Tamarix spp. percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

Tribulus terrestris
Montezuma Castle National Monument, Well Unit, AZ

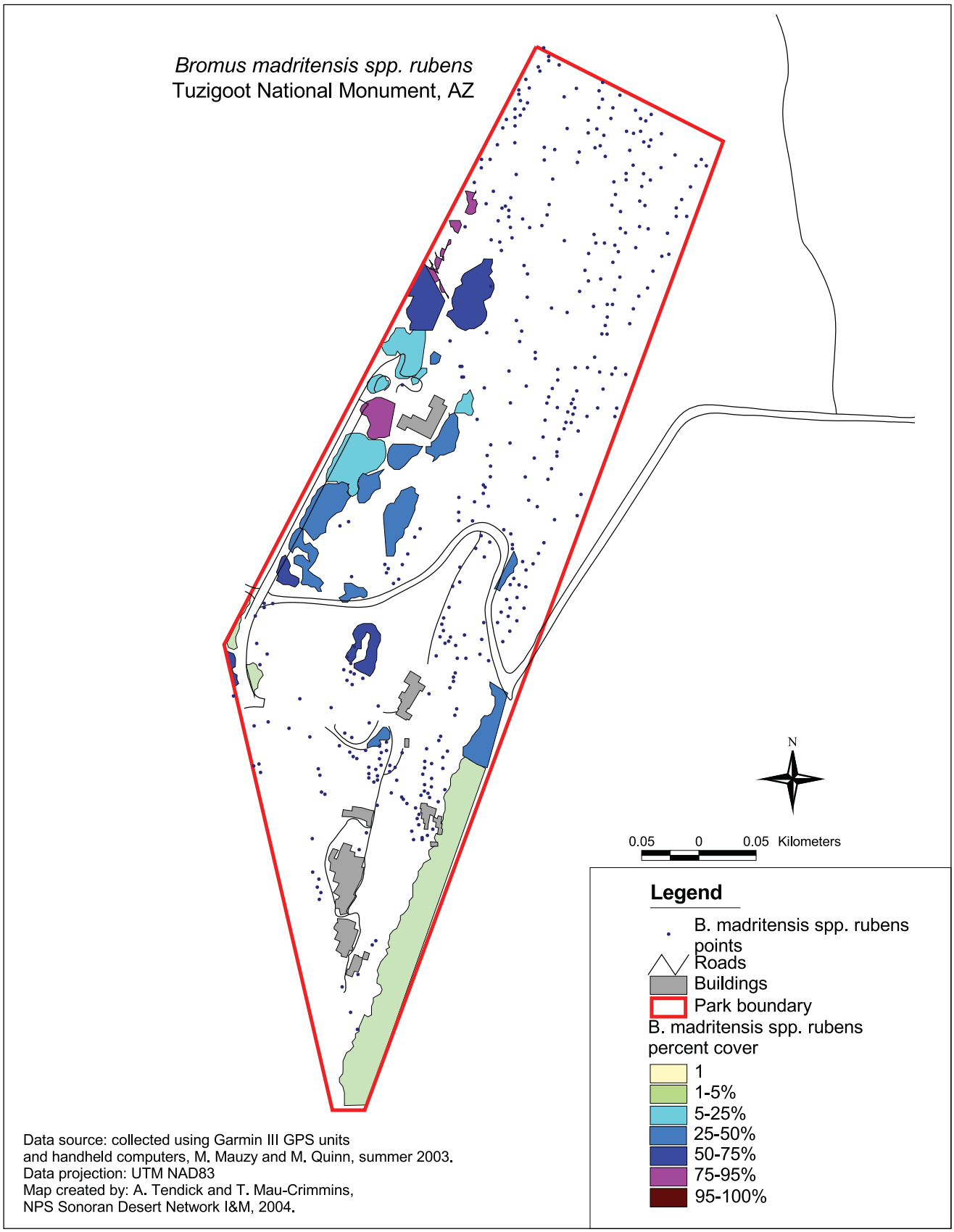


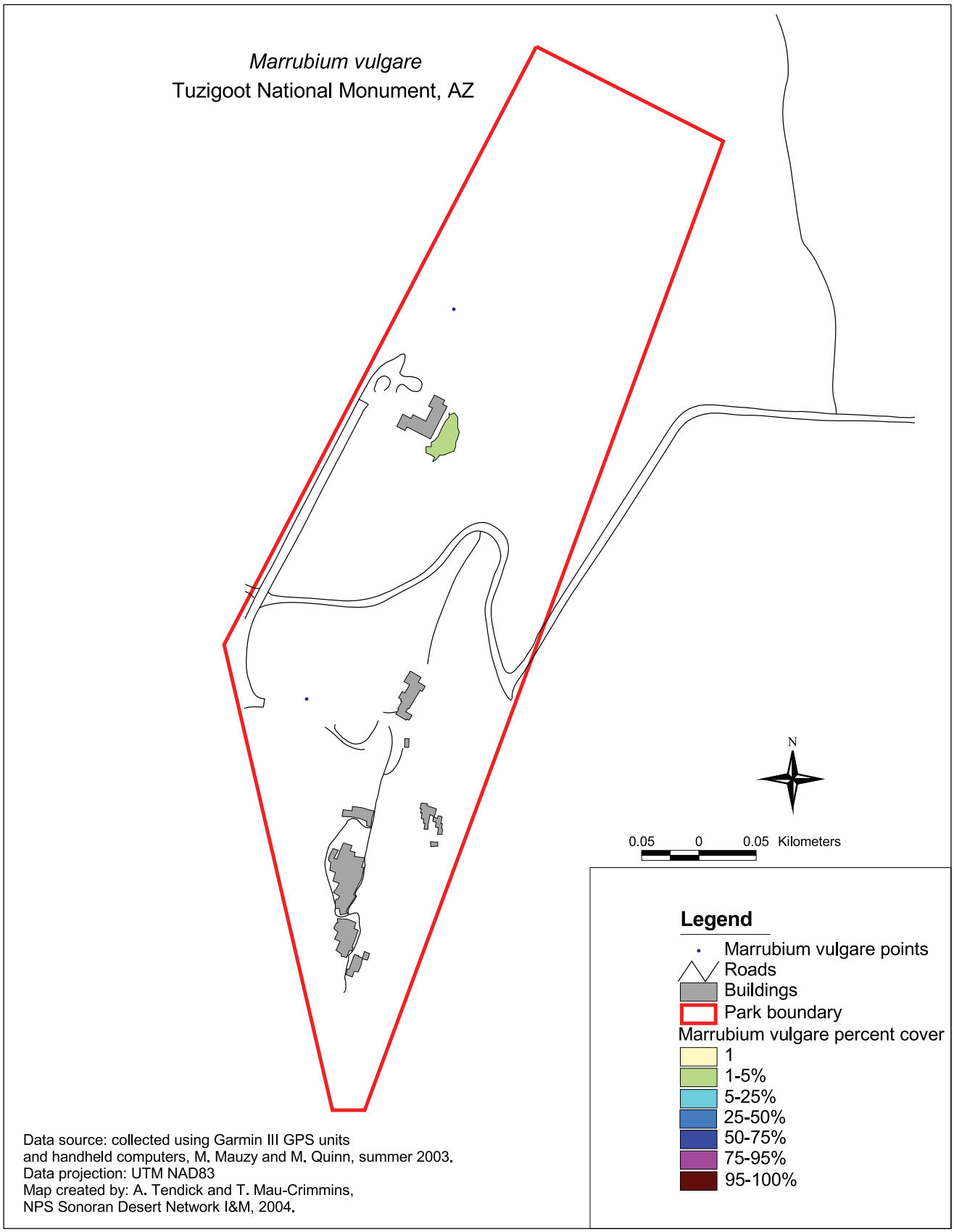
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

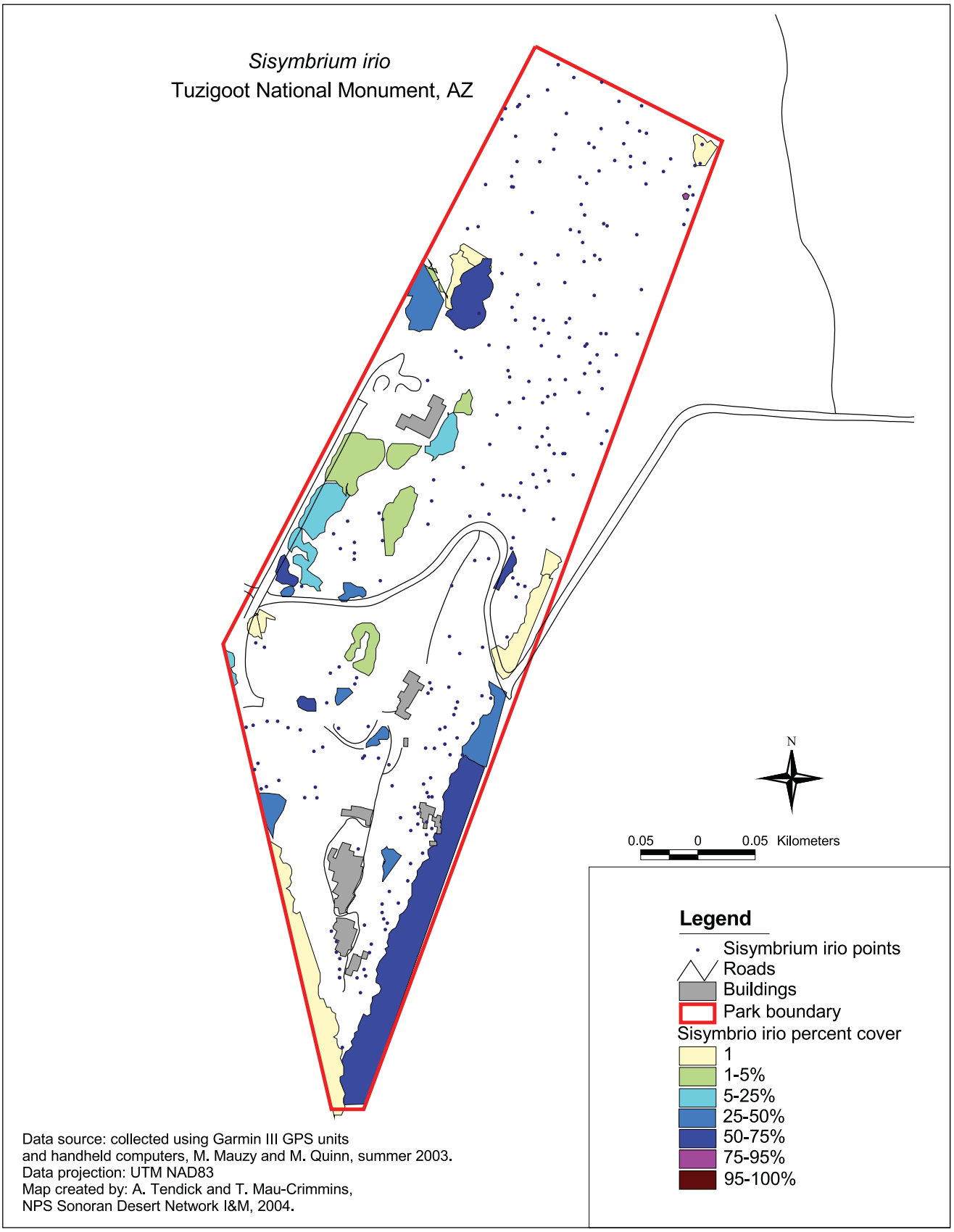

Verbascum thapsus
Montezuma Castle National Monument, Well Unit, AZ
Legend
Verbascum thapsus points
Park boundary
Buildings
Roads
Verbascum thapsus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

Xanthium strumarium
Montezuma Castle National Monument, Well Unit, AZ

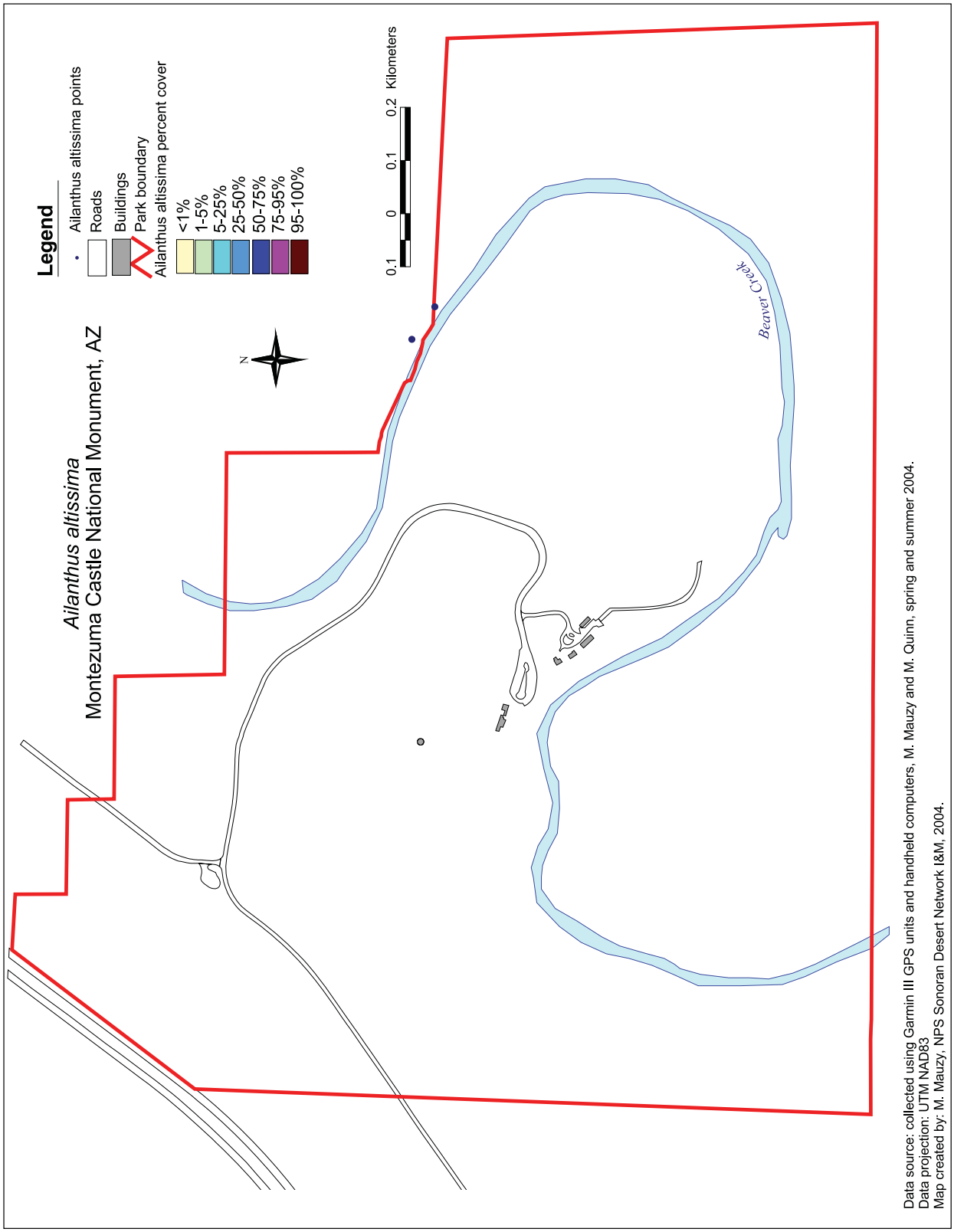
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

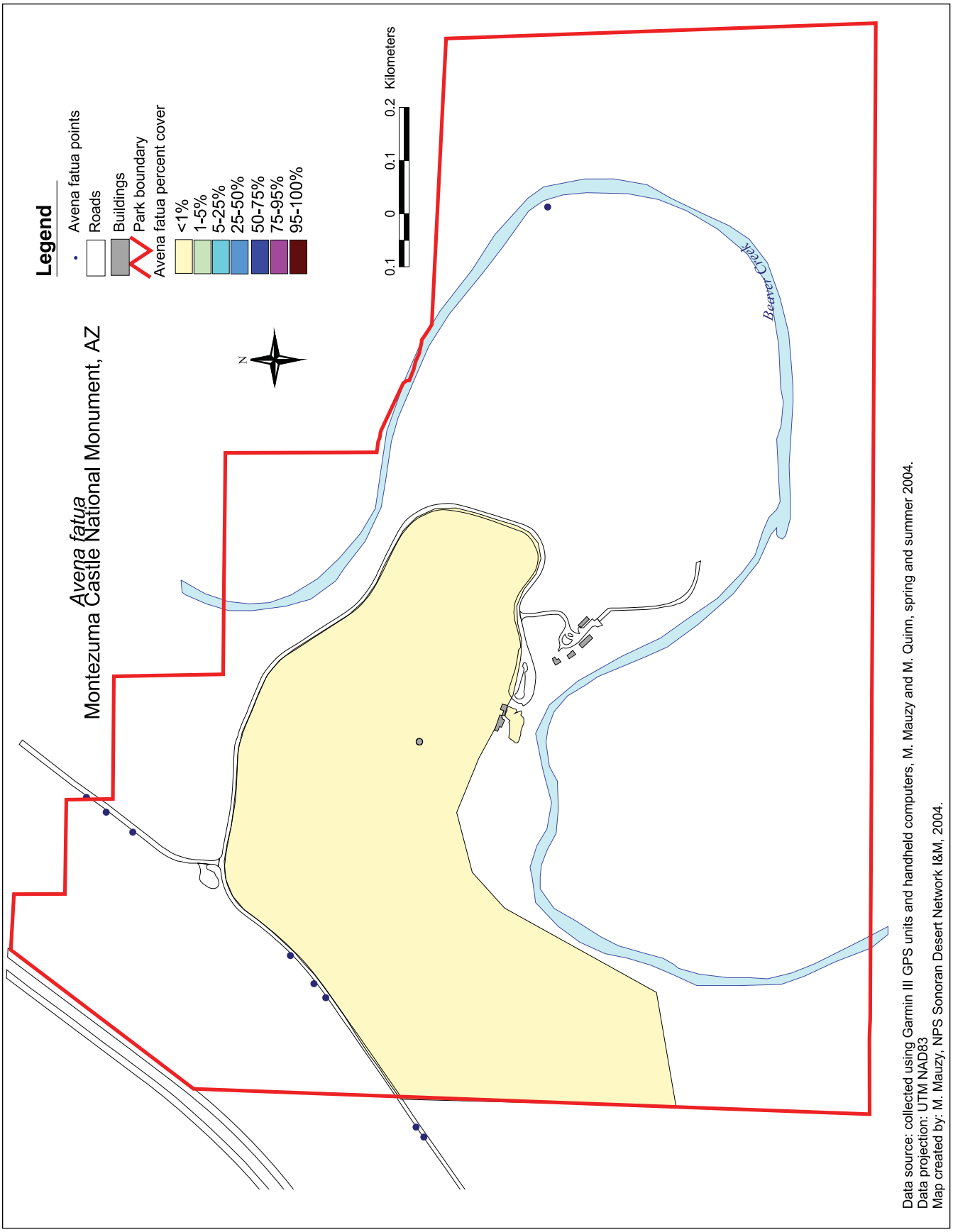

Bromus madritensis spp. rubens
Tuzigoot National Monument, AZ
N
0.05 0 0.05 Kilometers
Legend
B. madritensis spp. rubens points
Roads
Buildings
Park boundary
B. madritensis spp. rubens percent cover
1
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins, NPS Sonoran Desert Network I&M, 2004.

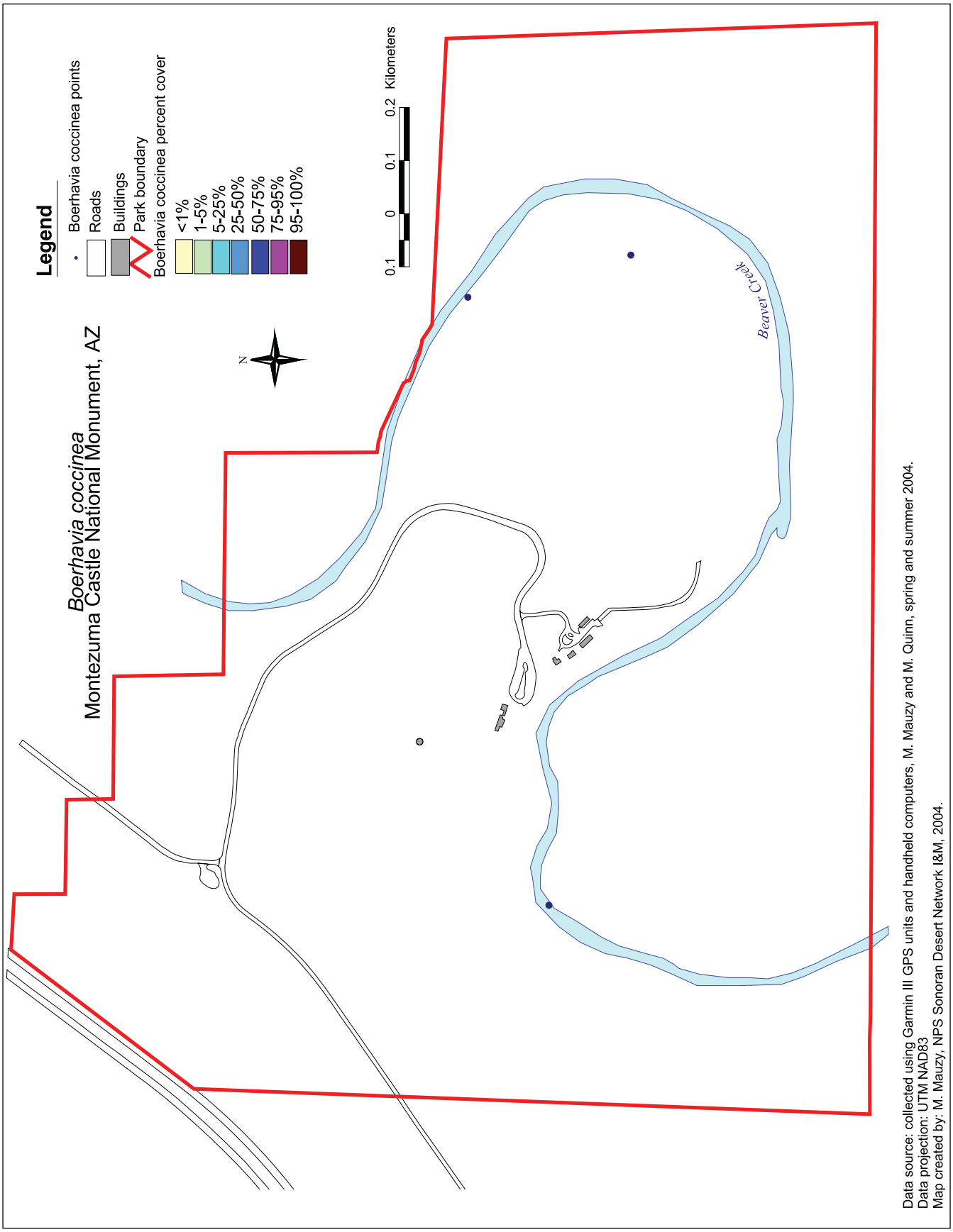

Marrubium vulgare
Tuzigoot National Monument, AZ
N
0.05 0 0.05 Kilometers
Legend
Marrubium vulgare points
Roads
Buildings
Park boundary
Marrubium vulgare percent cover
1
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins,
NPS Sonoran Desert Network I&M, 2004.


Sisymbrium irio
Tuzigoot National Monument, AZ
N
0.05 0 0.05 Kilometers
Legend
Sisymbrium irio points
Roads
Buildings
Park boundary
Sisymbrio irio percent cover
1
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2003.
Data projection: UTM NAD83
Map created by: A. Tendick and T. Mau-Crimmins,
NPS Sonoran Desert Network I&M, 2004.

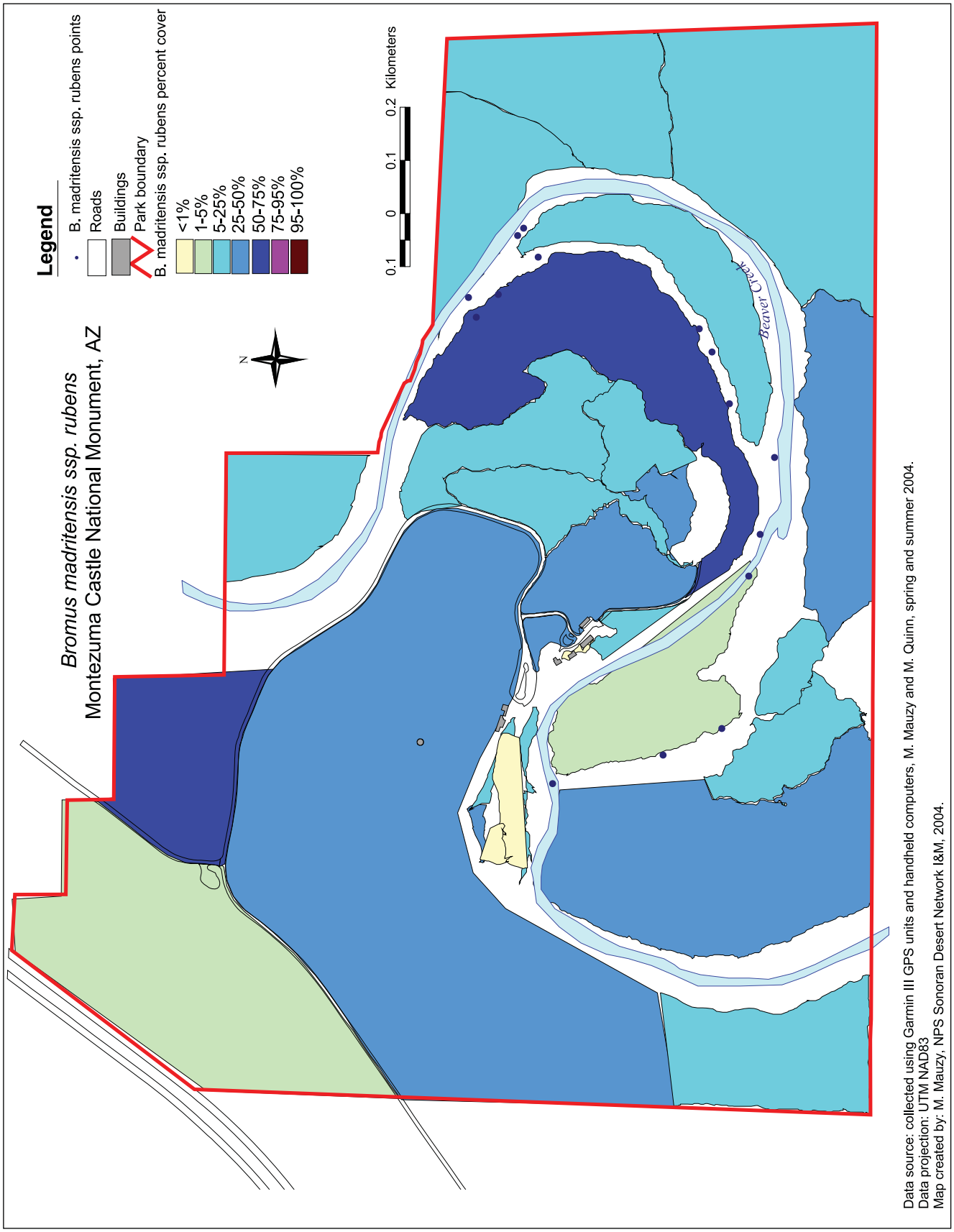
Appendix C. Maps of Species Detected During Roaming Surveys, 2004.



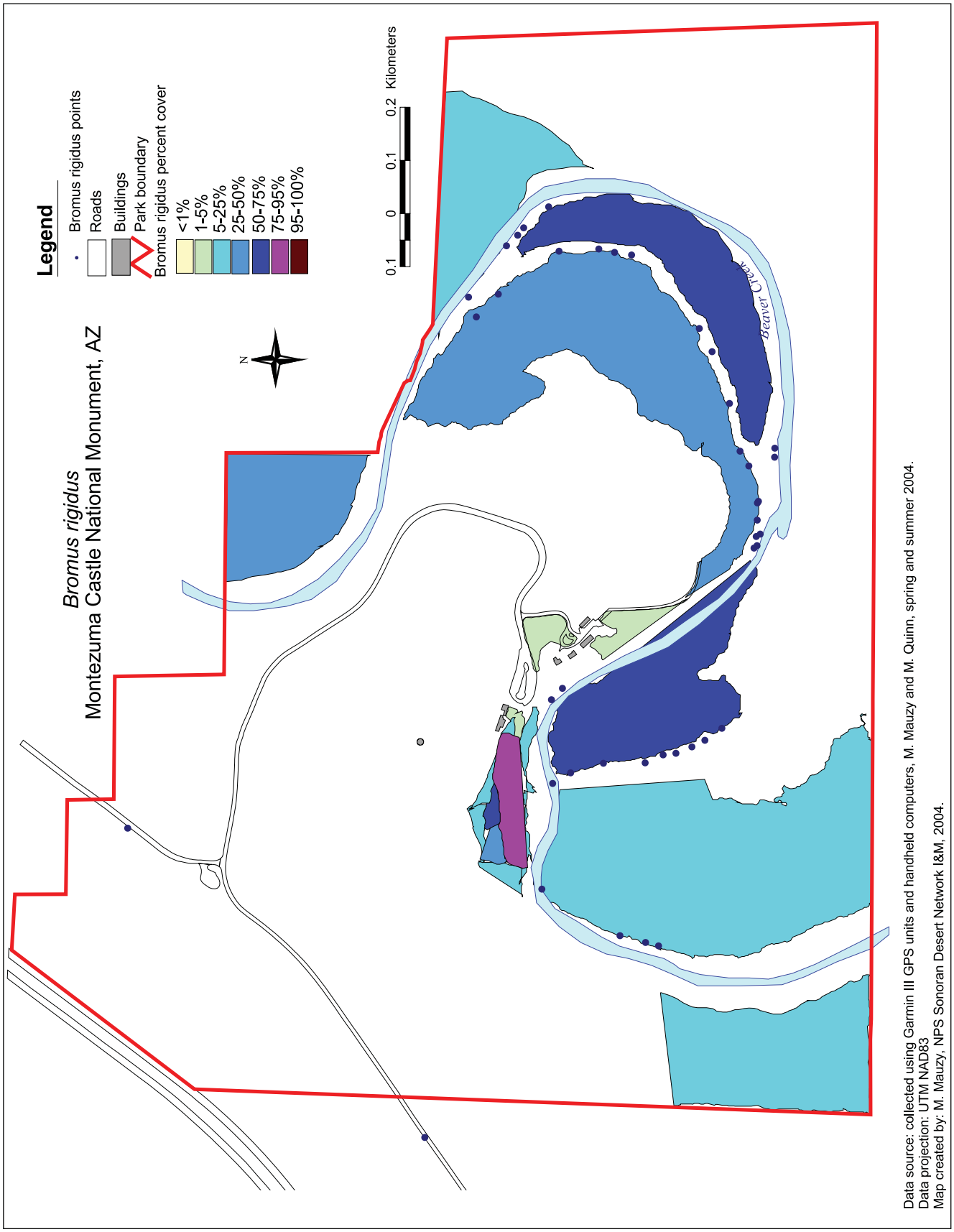

Avena fatua
Montezuma Castle National Monument, AZ
Legend
Avena fatua points
Roads
Buildings
Park boundary
Avena fatua percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.



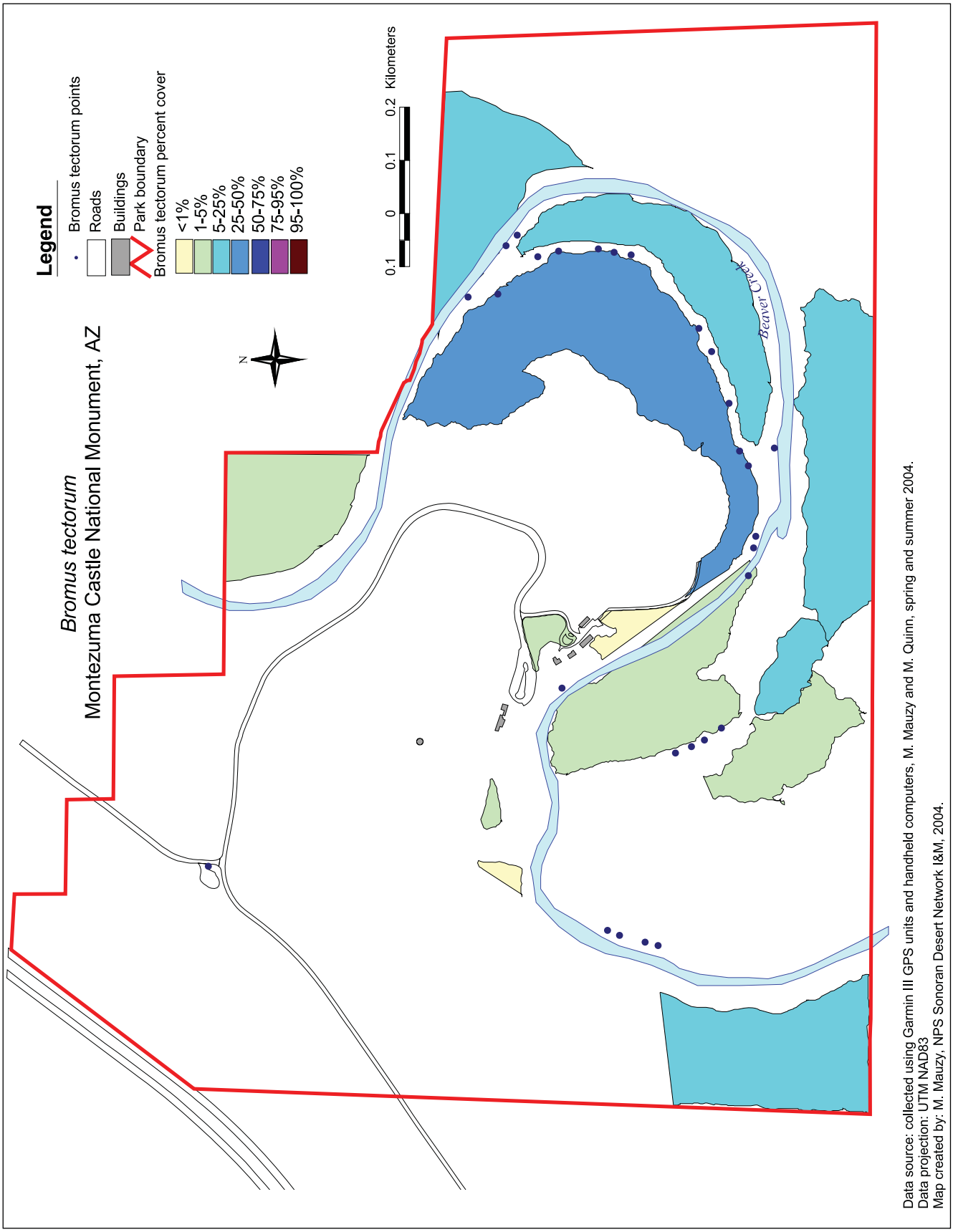
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

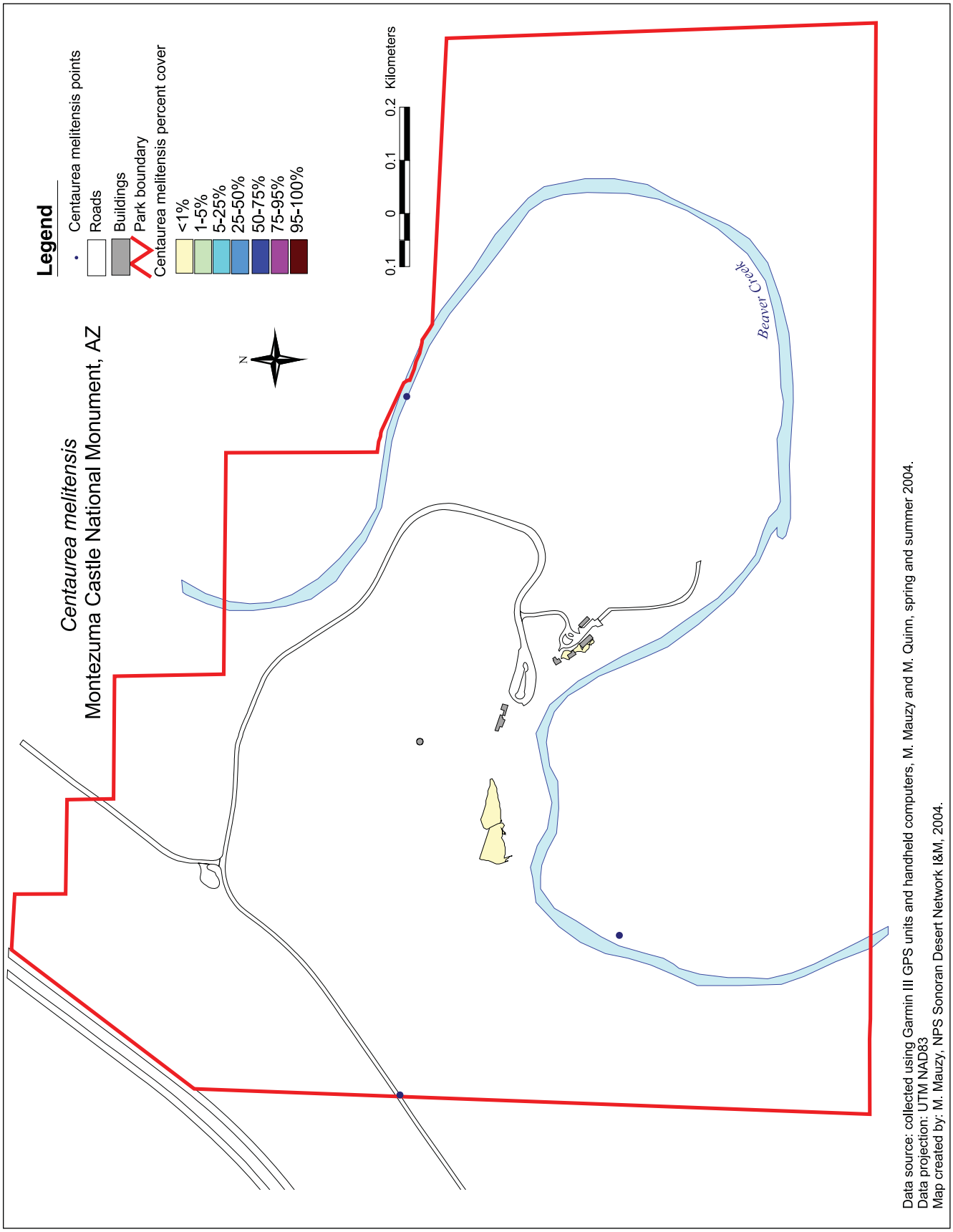


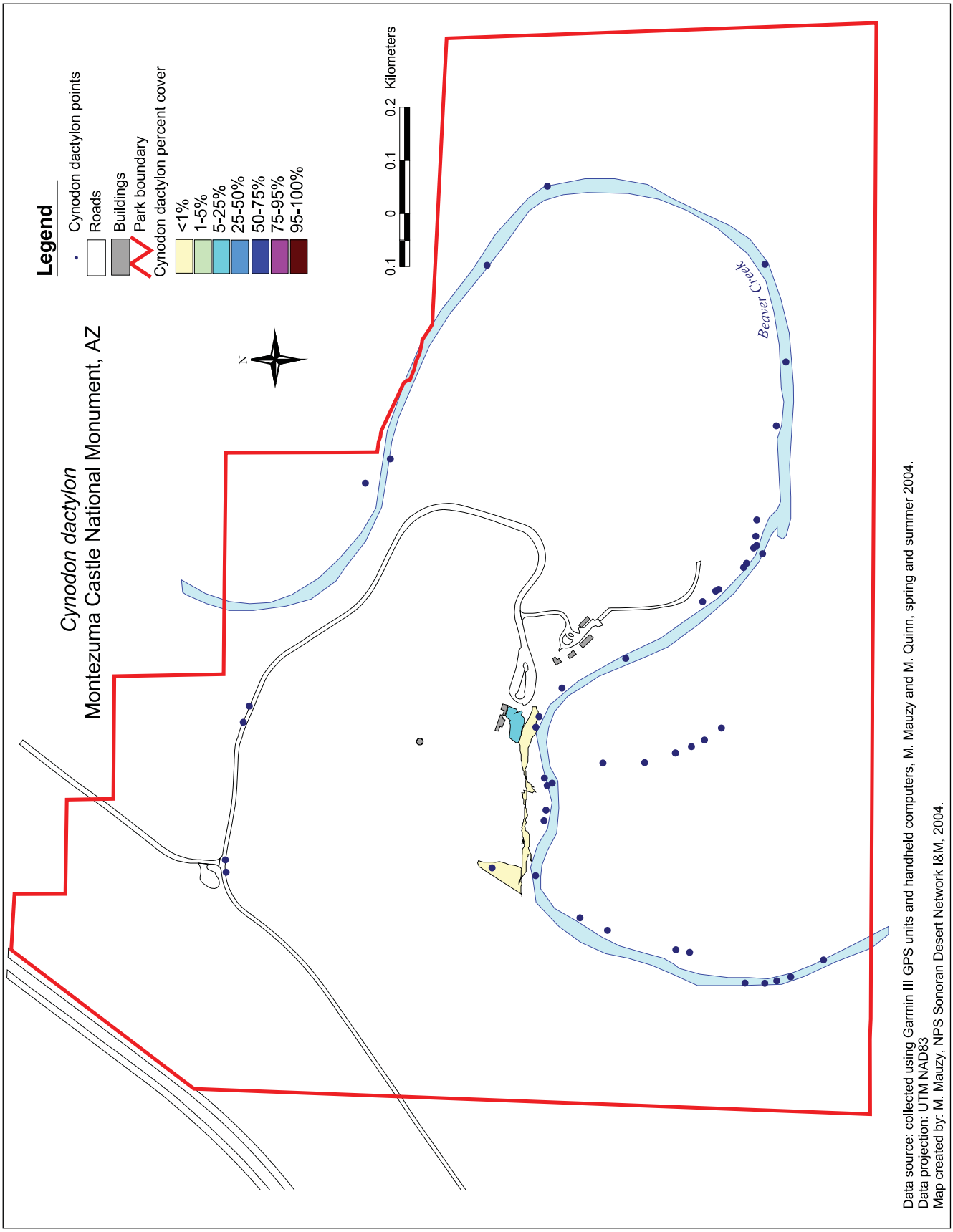
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.



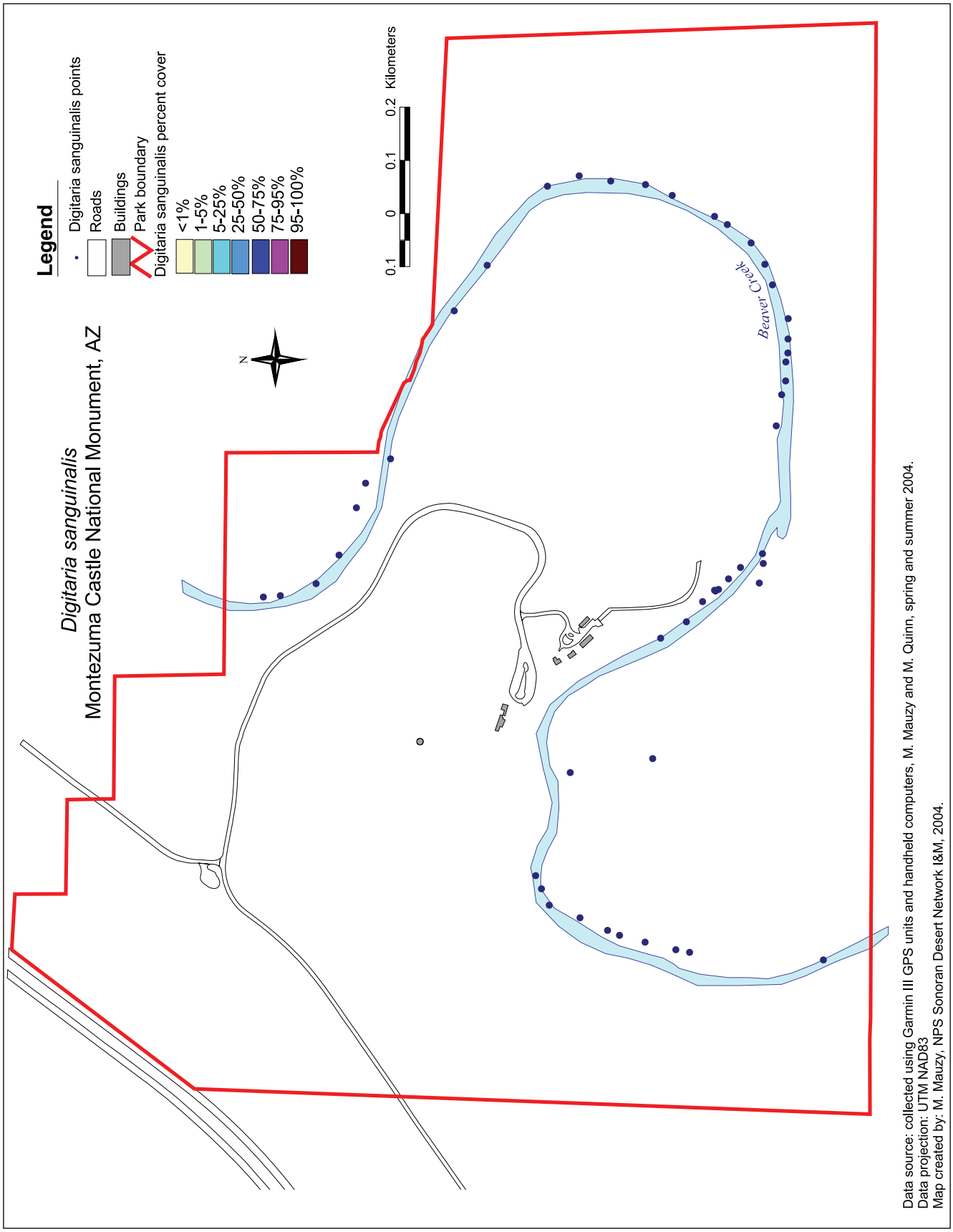
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

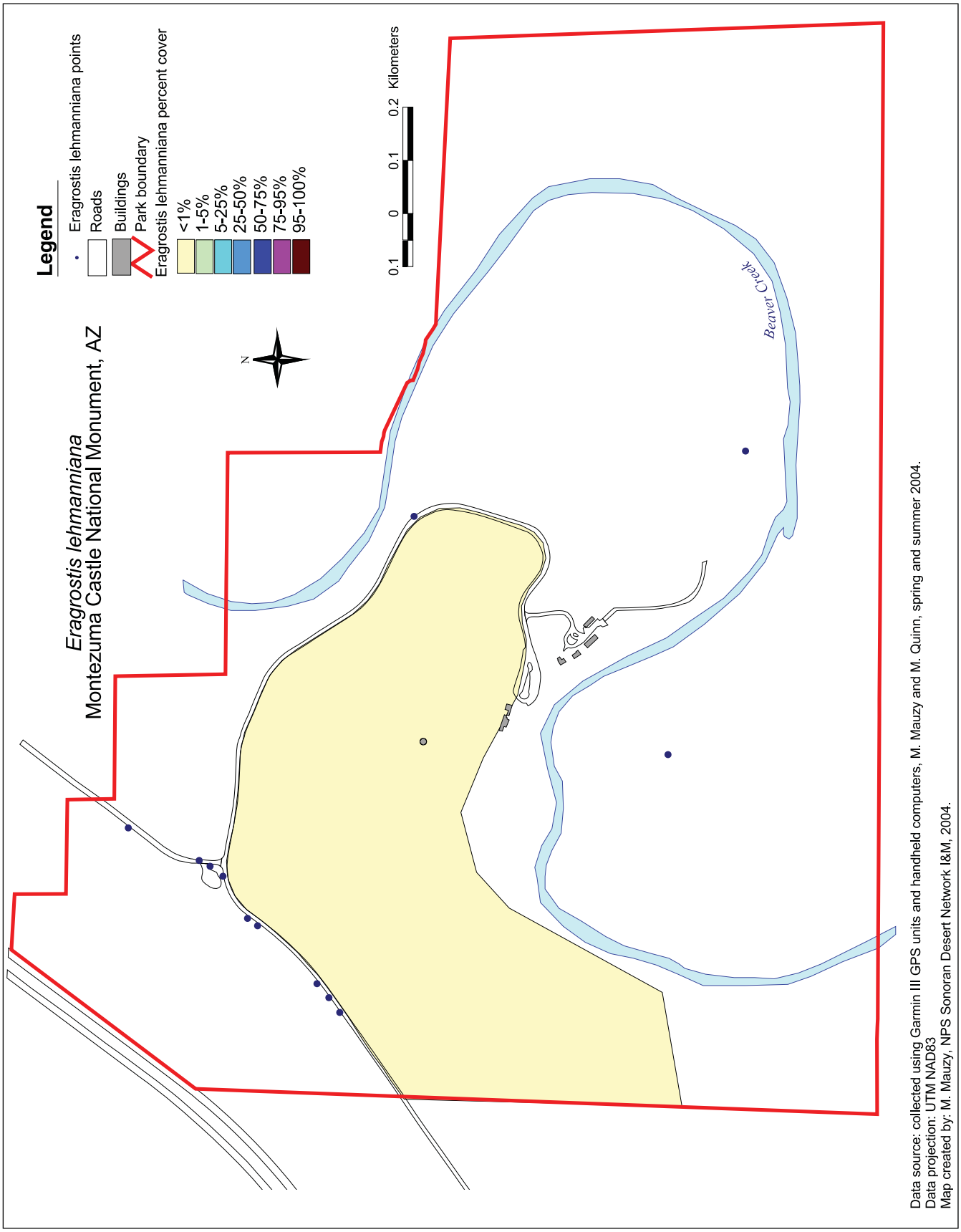

Bromus tectorum
Montezuma Castle National Monument, AZ
Legend
Bromus tectorum points
Roads
Buildings
Park boundary
Bromus tectorum percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

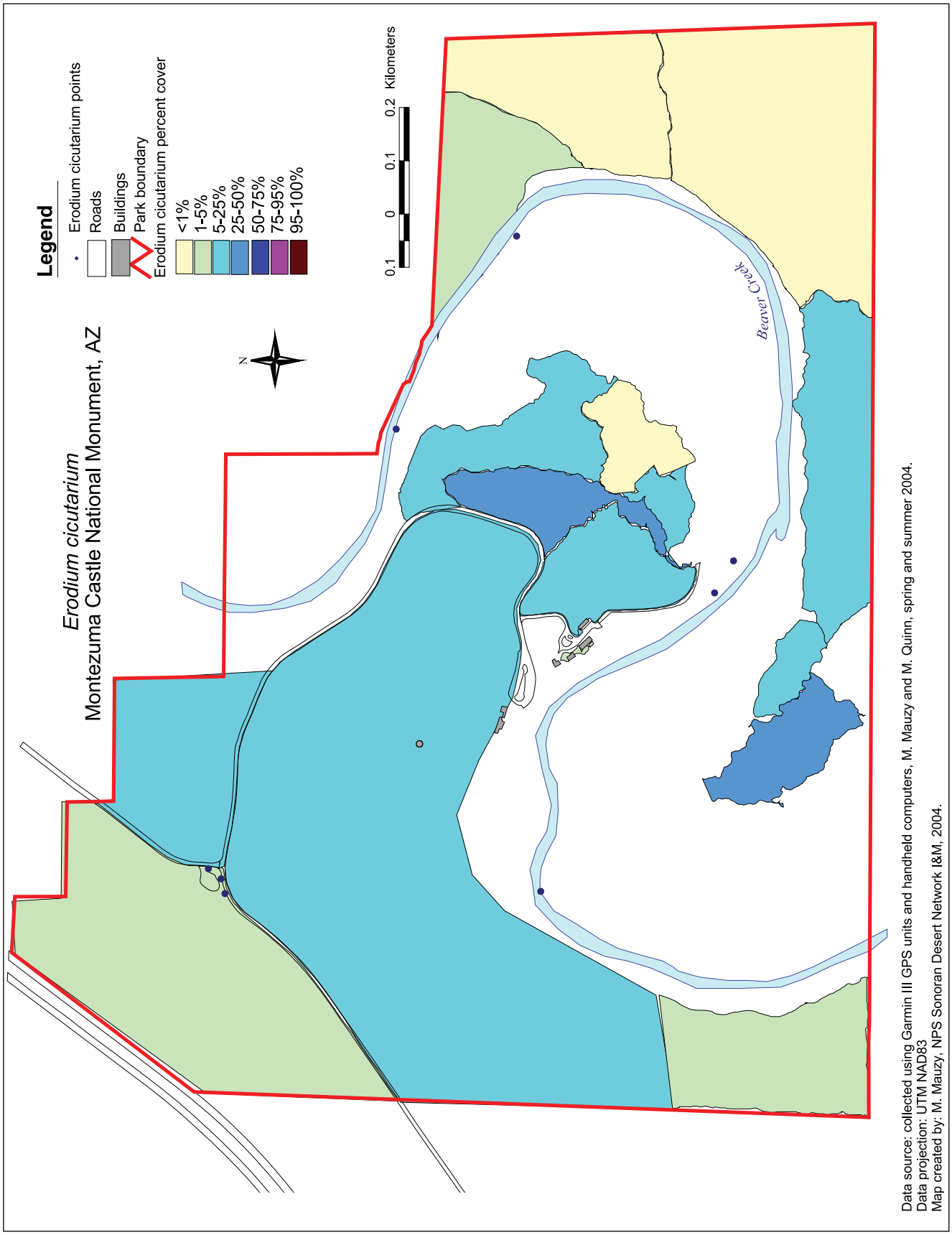

Centaurea melitensis
Montezuma Castle National Monument, AZ
Legend
Centaurea melitensis points
Roads
Buildings
Park boundary
Centaurea melitensis percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.



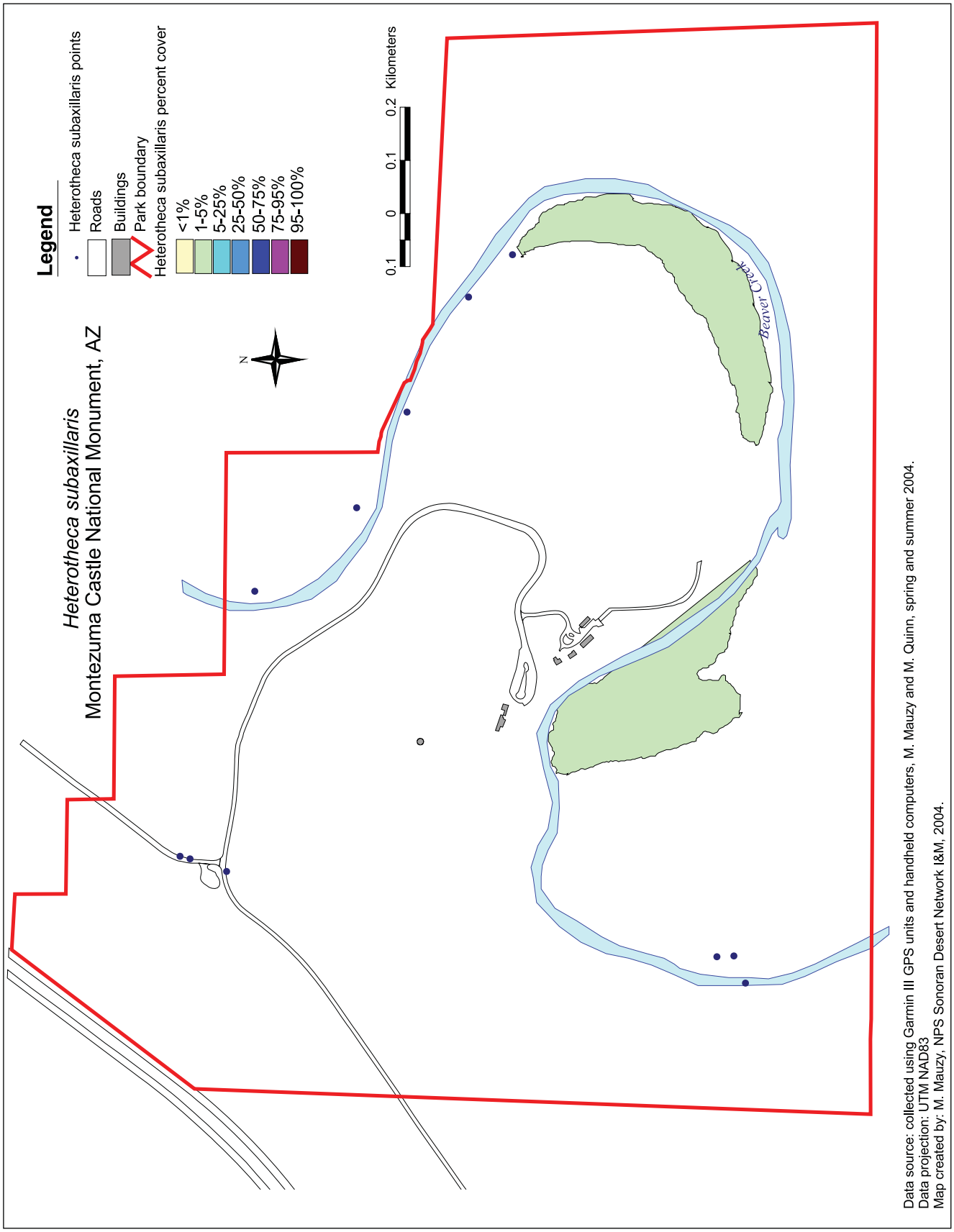
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

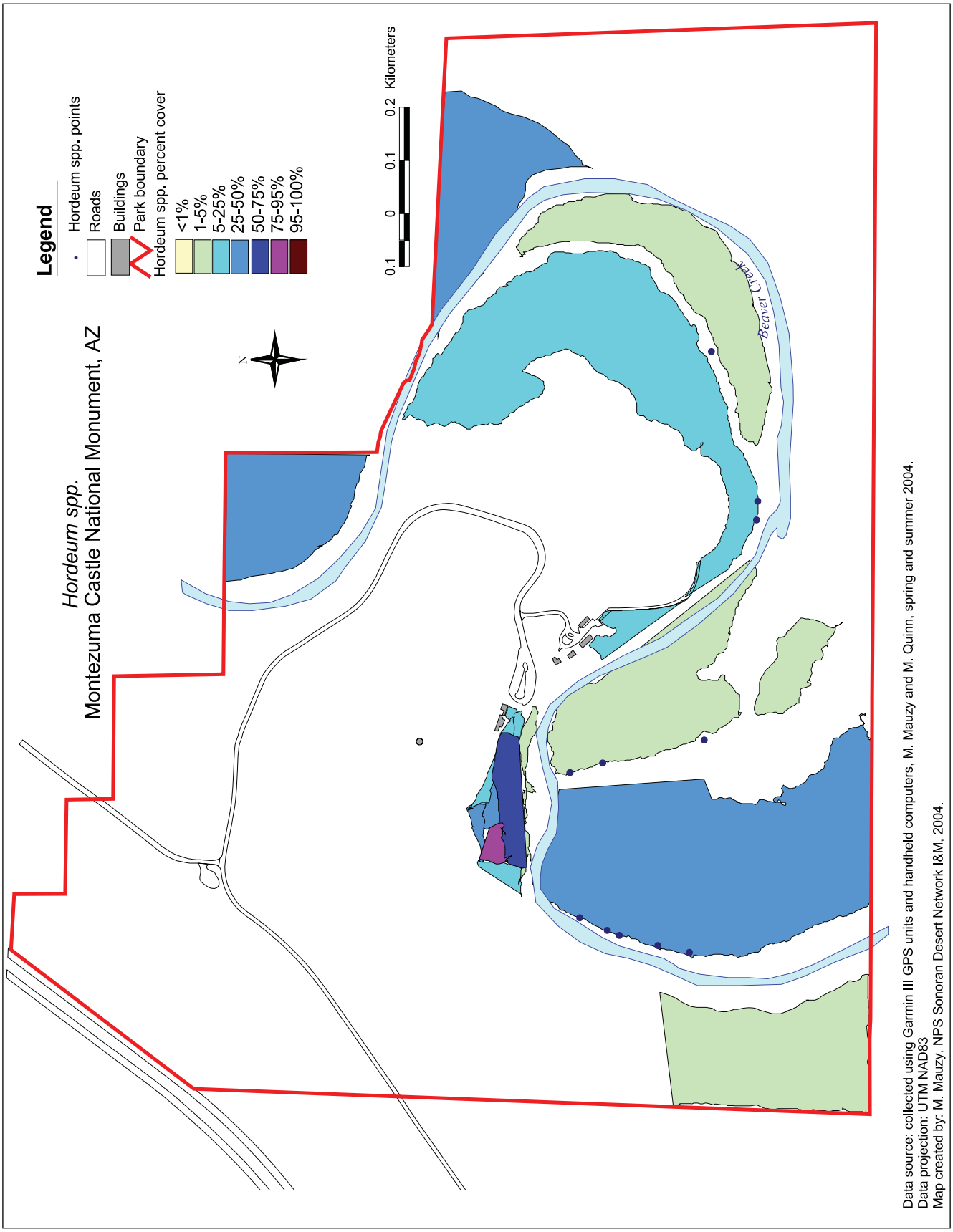

Digitaria sanguinalis
Montezuma Castle National Monument, AZ
Legend
Digitaria sanguinalis points
Roads
Buildings
Park boundary
Digitaria sanguinalis percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

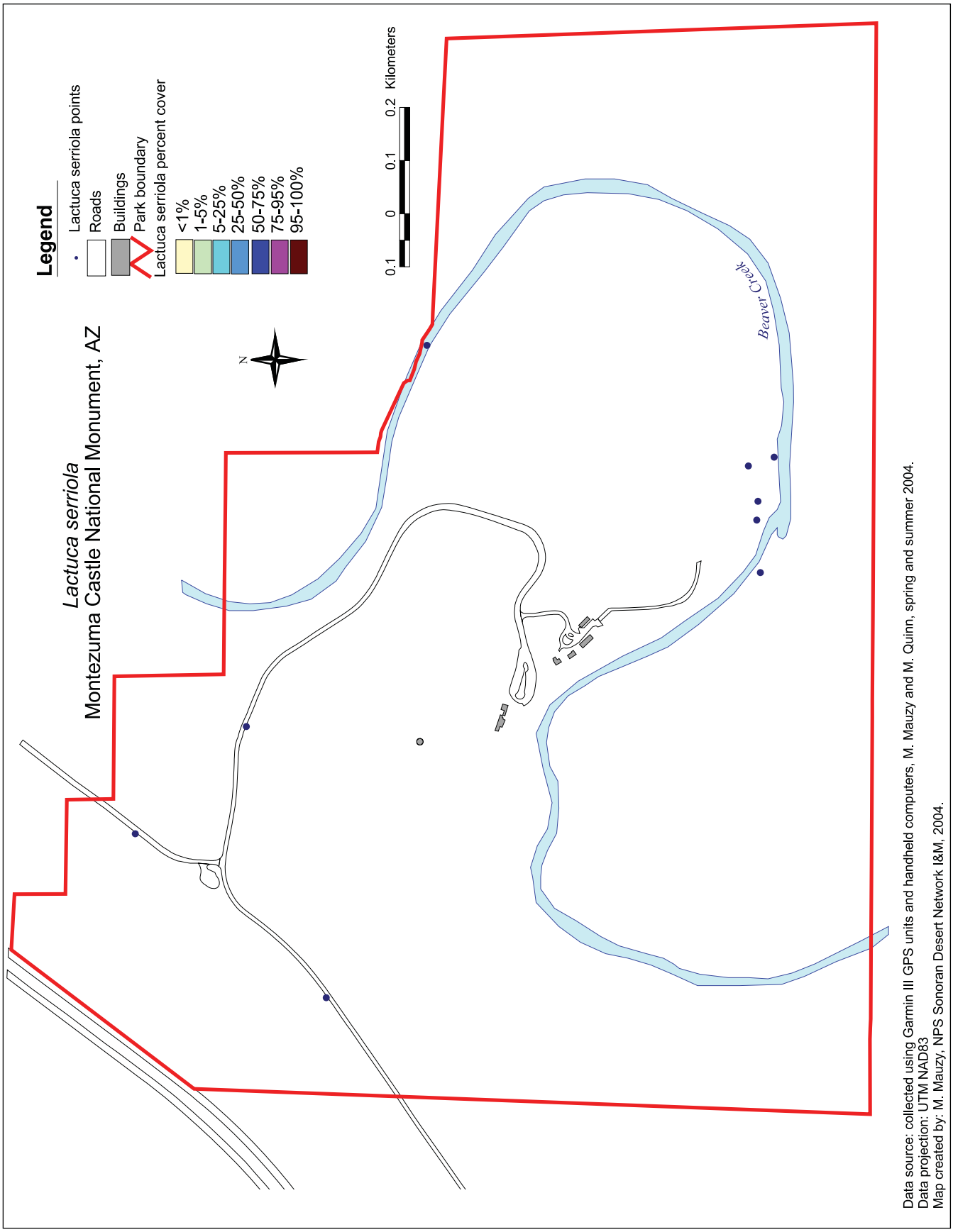

Eragrostis lehmanniana
Montezuma Castle National Monument, AZ
Legend
Eragrostis lehmanniana points
Roads
Buildings
Park boundary
Eragrostis lehmanniana percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

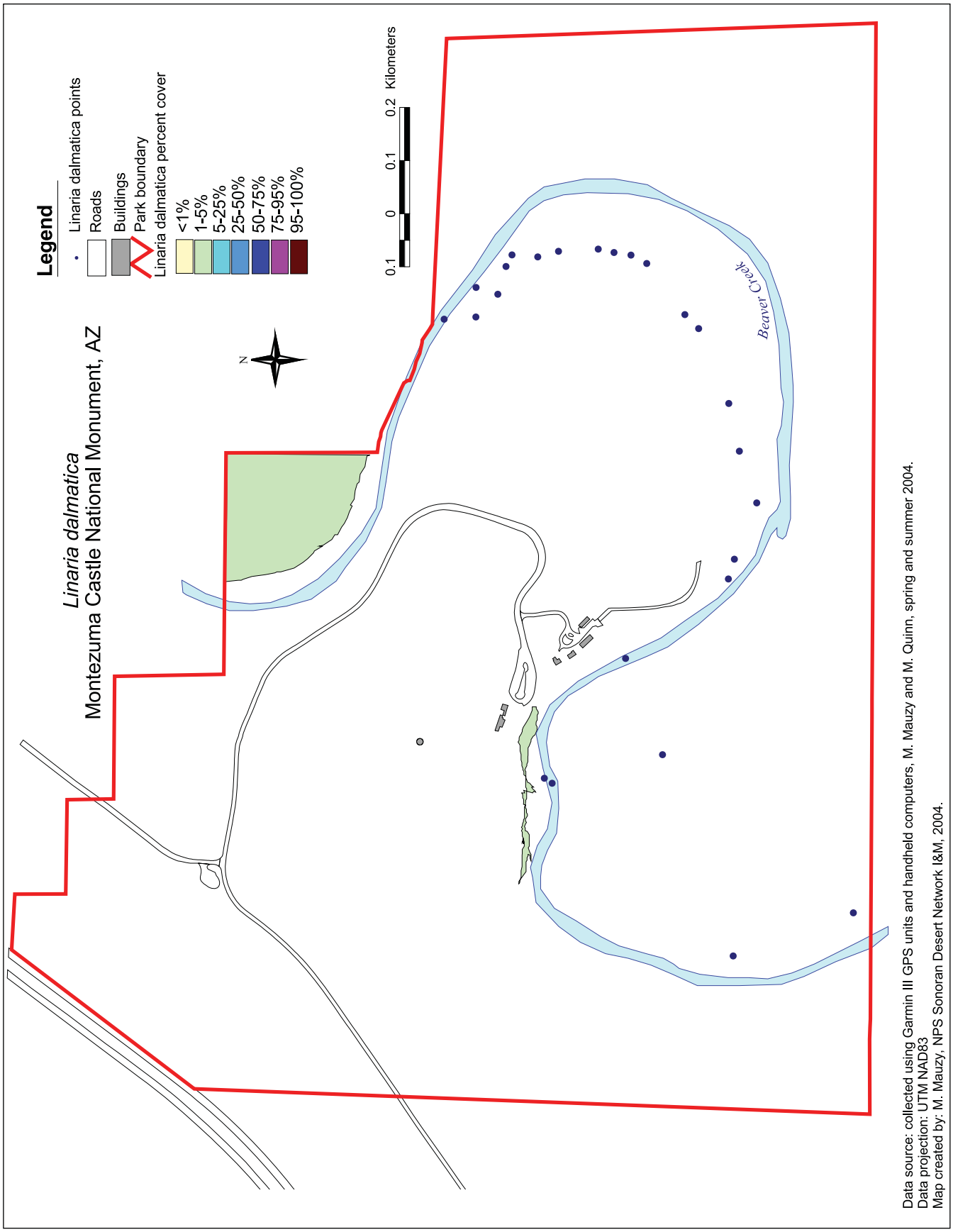


Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

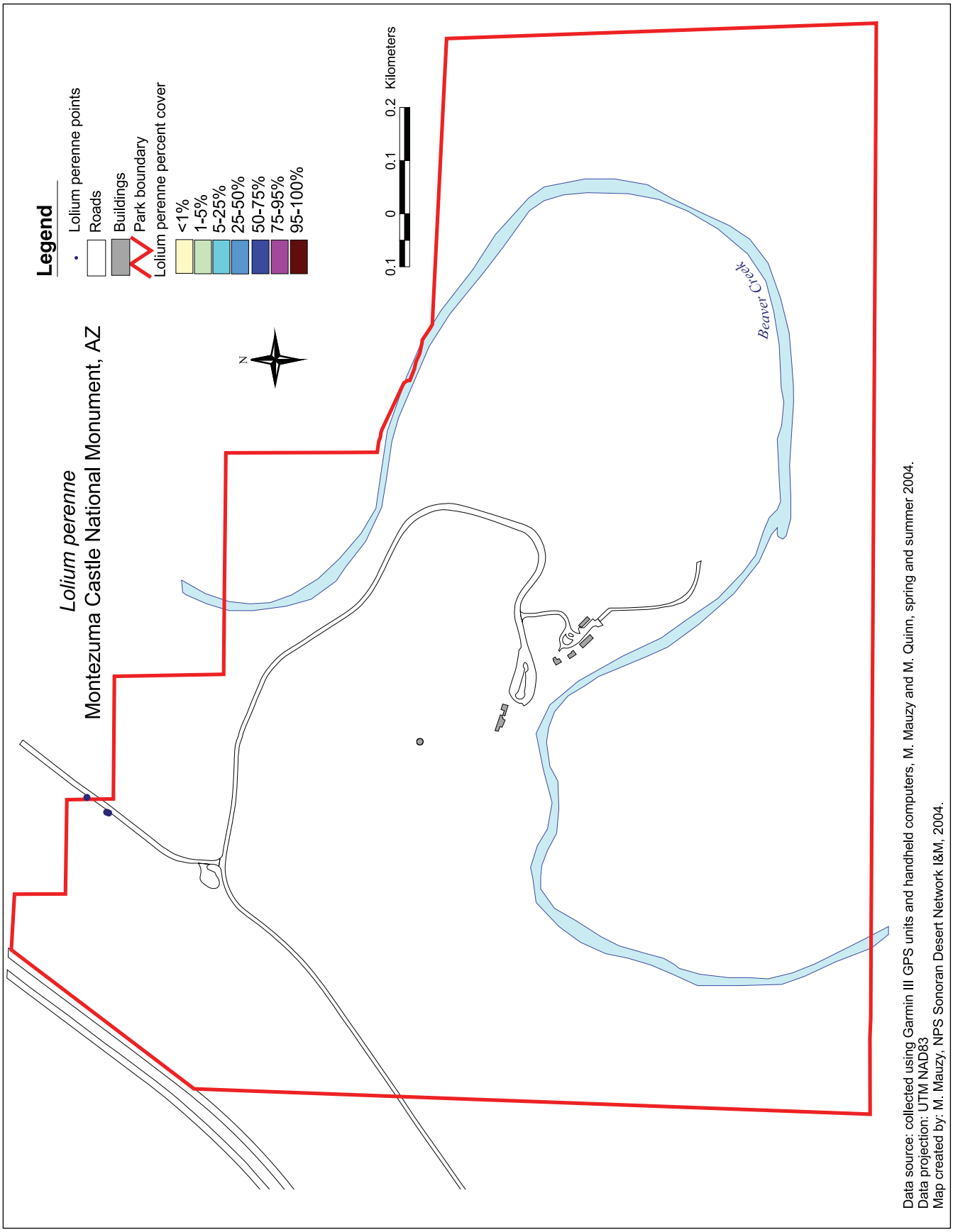

Heterotheca subaxillaris
Montezuma Castle National Monument, AZ
Legend
Heterotheca subaxillaris points
Roads
Buildings
Park boundary
Heterotheca subaxillaris percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.


Hordeum spp.
Montezuma Castle National Monument, AZ
Legend
Hordeum spp. points
Roads
Buildings
Park boundary
Hordeum spp. percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

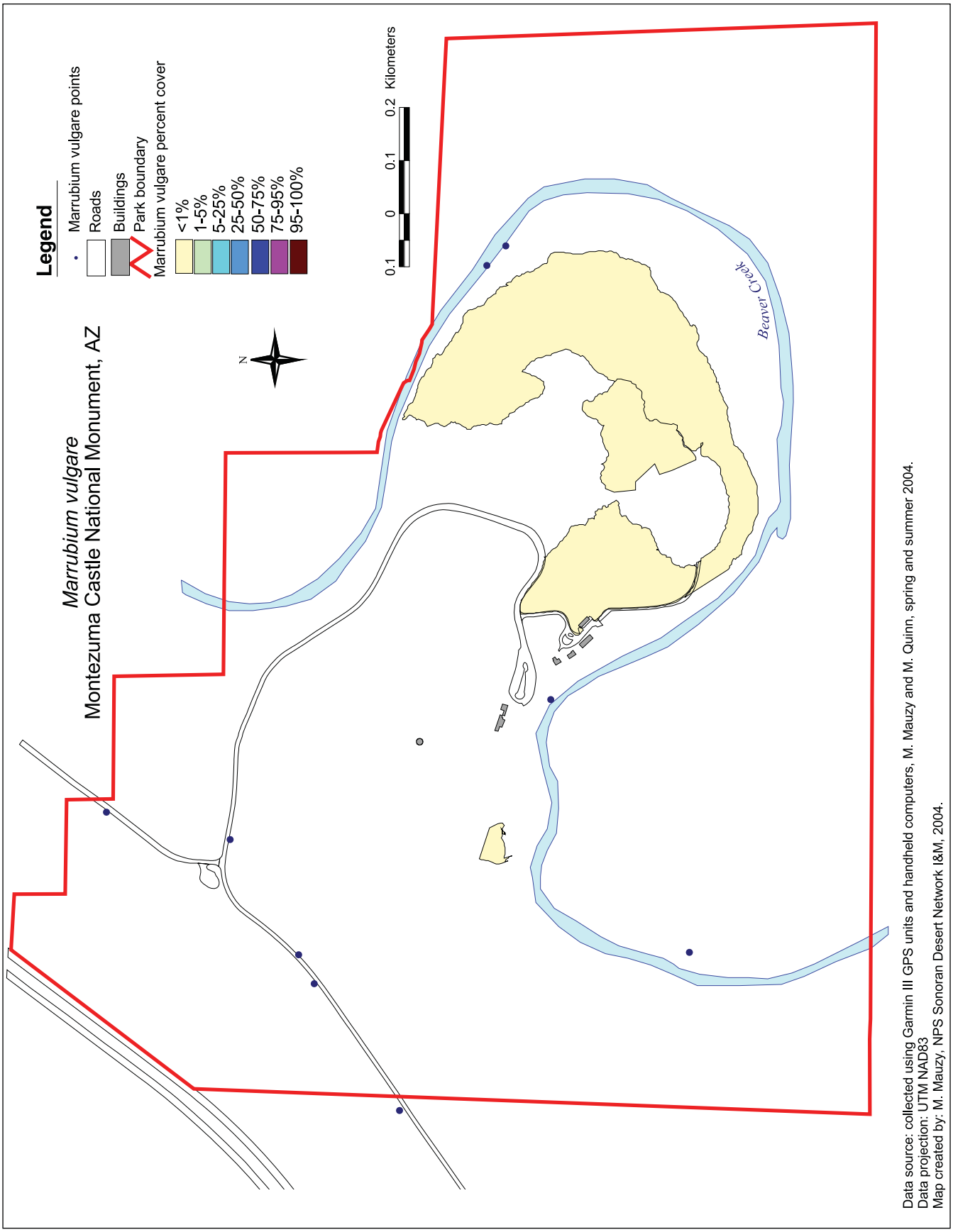

Legend
Lactuca serriola points
Roads
Buildings
Park boundary
Lactuca serriola percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
0.1 0 0.1 0.2 Kilometers
N
Lactuca serriola
Montezuma Castle National Monument, AZ
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.



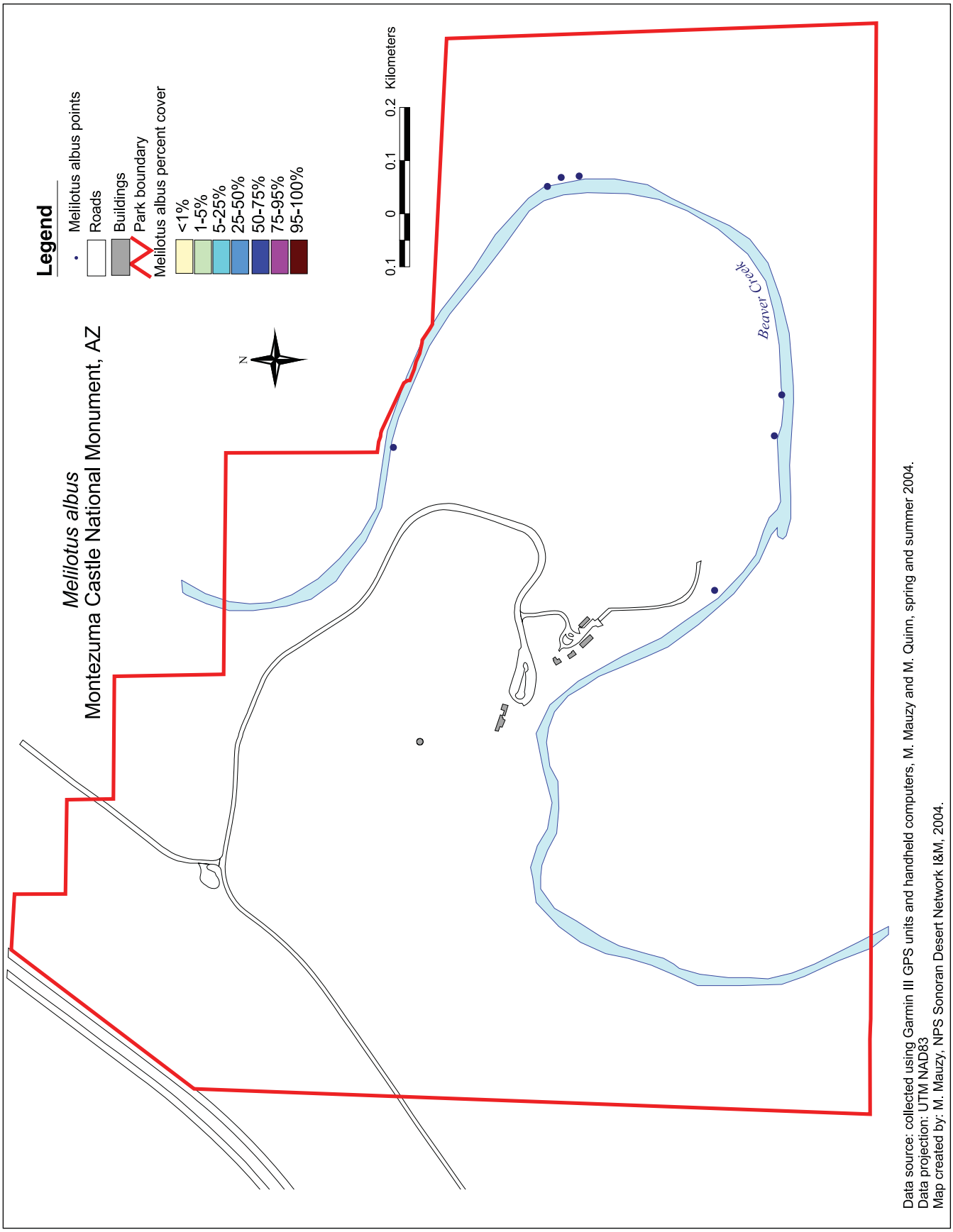
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

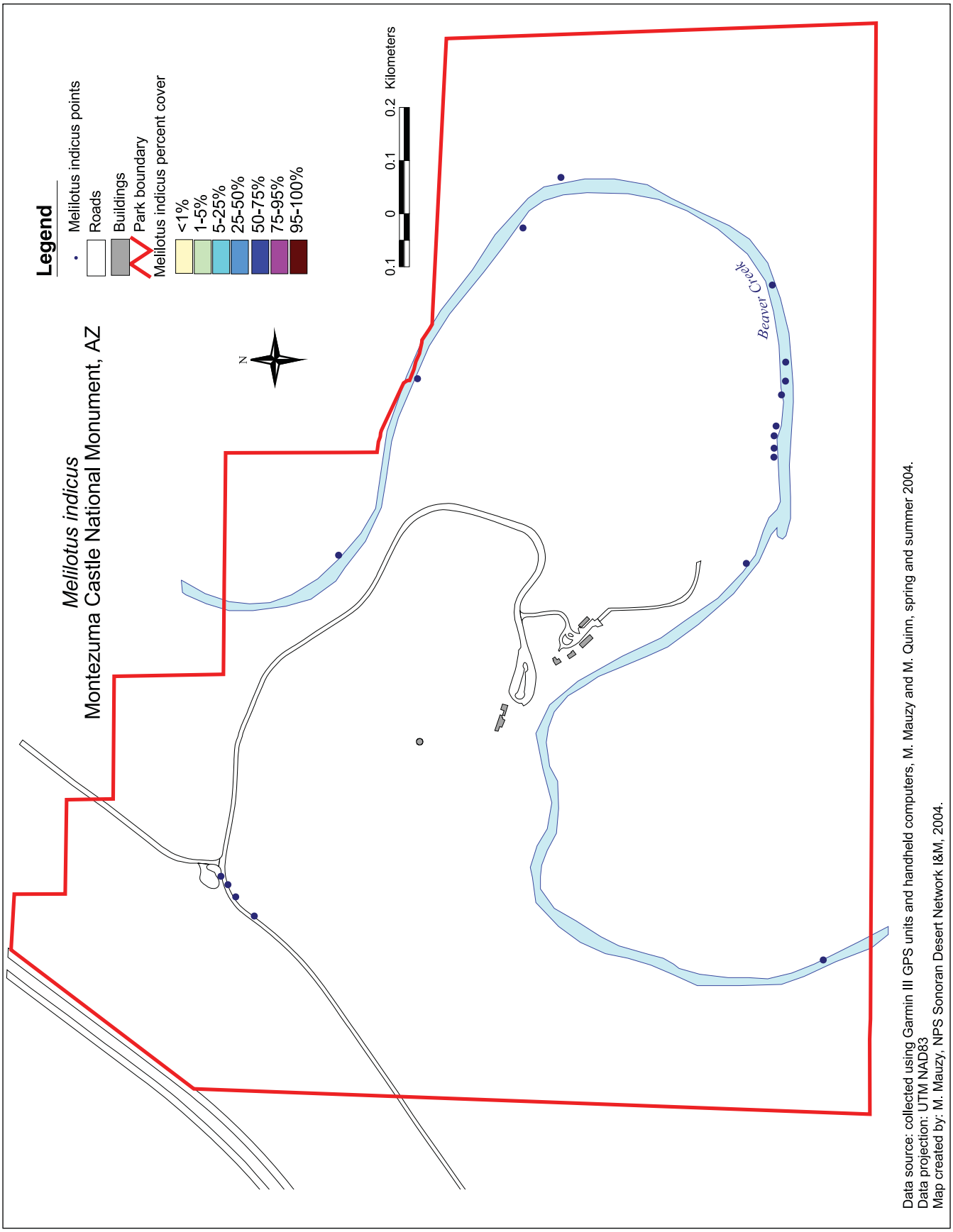


Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

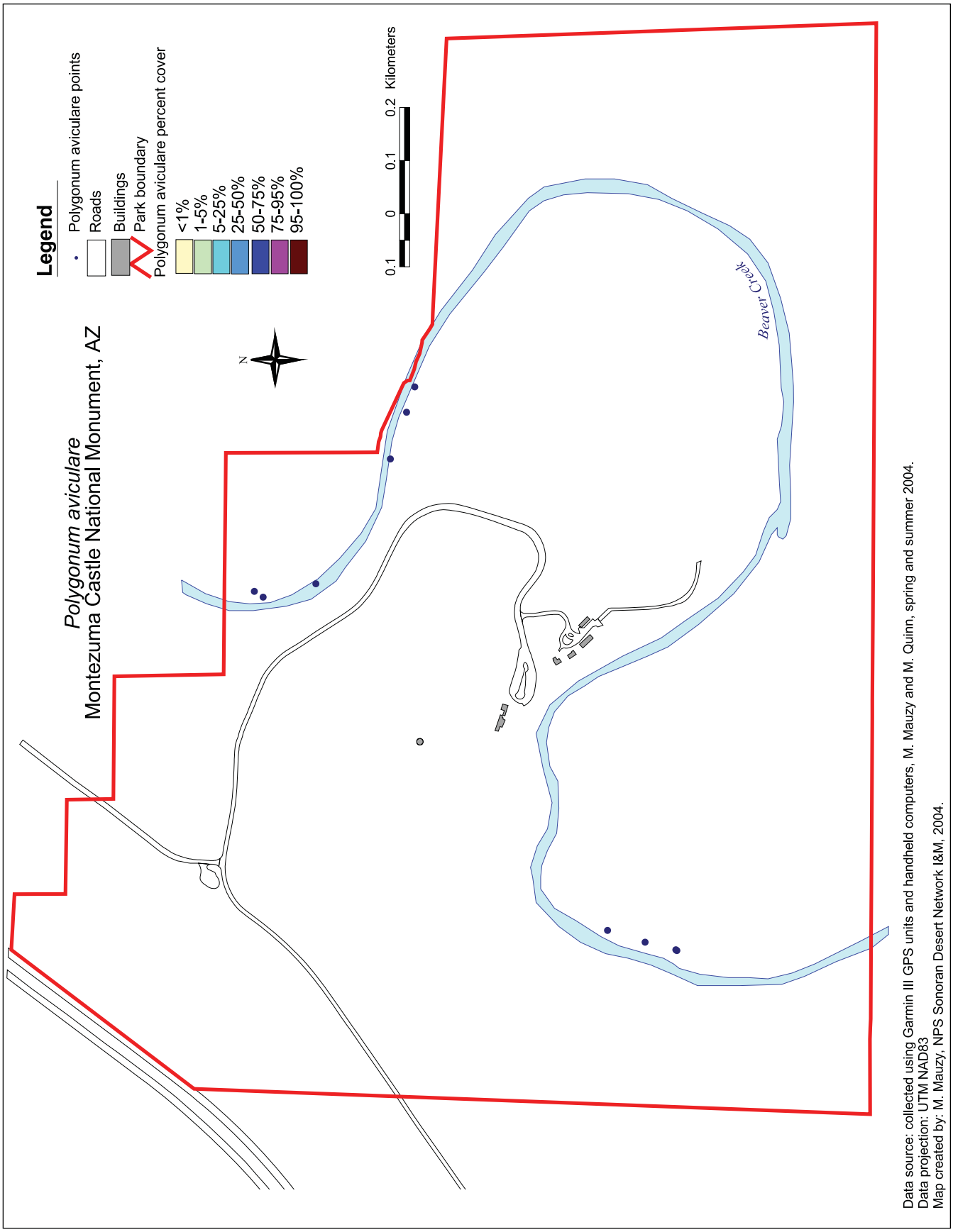


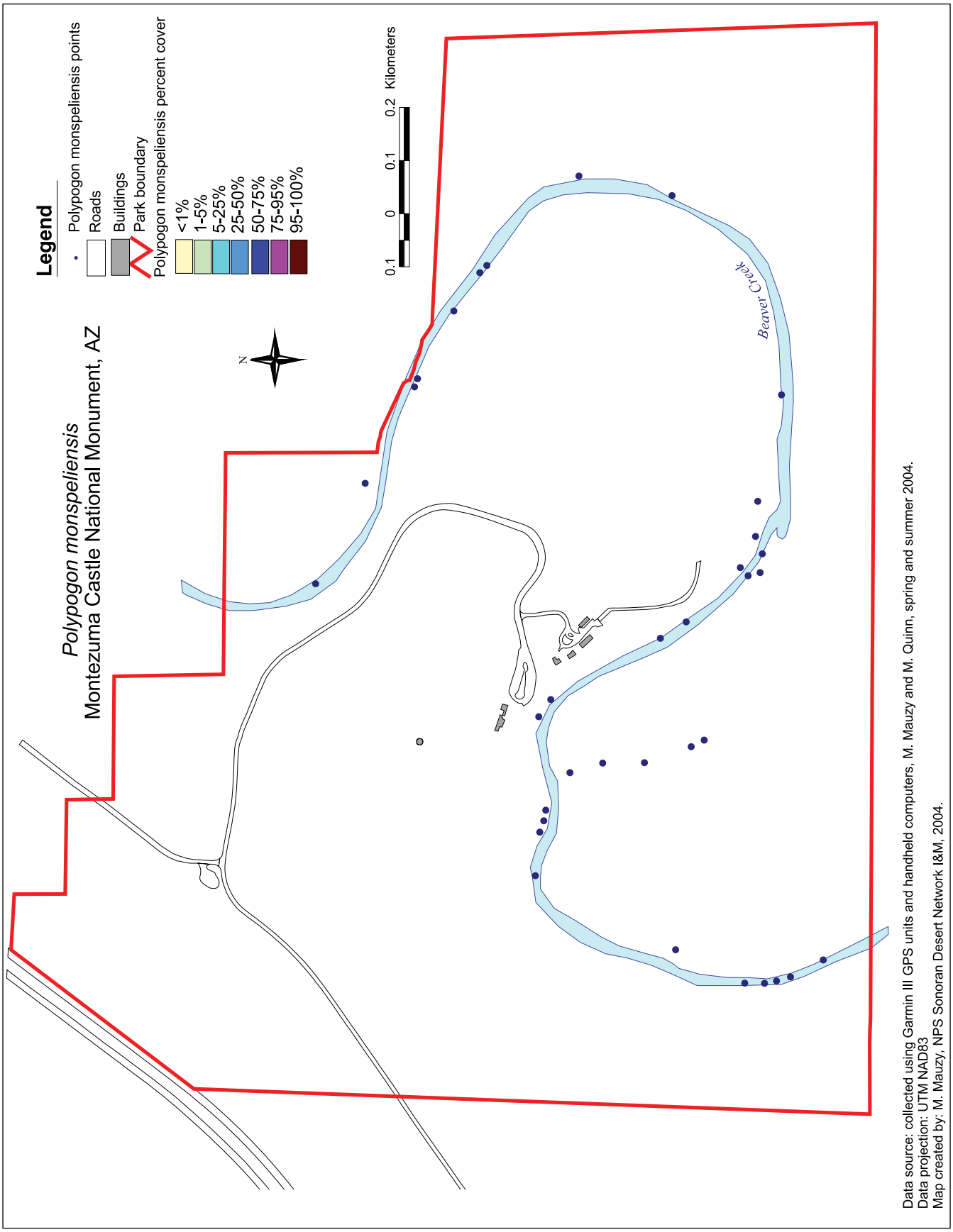
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

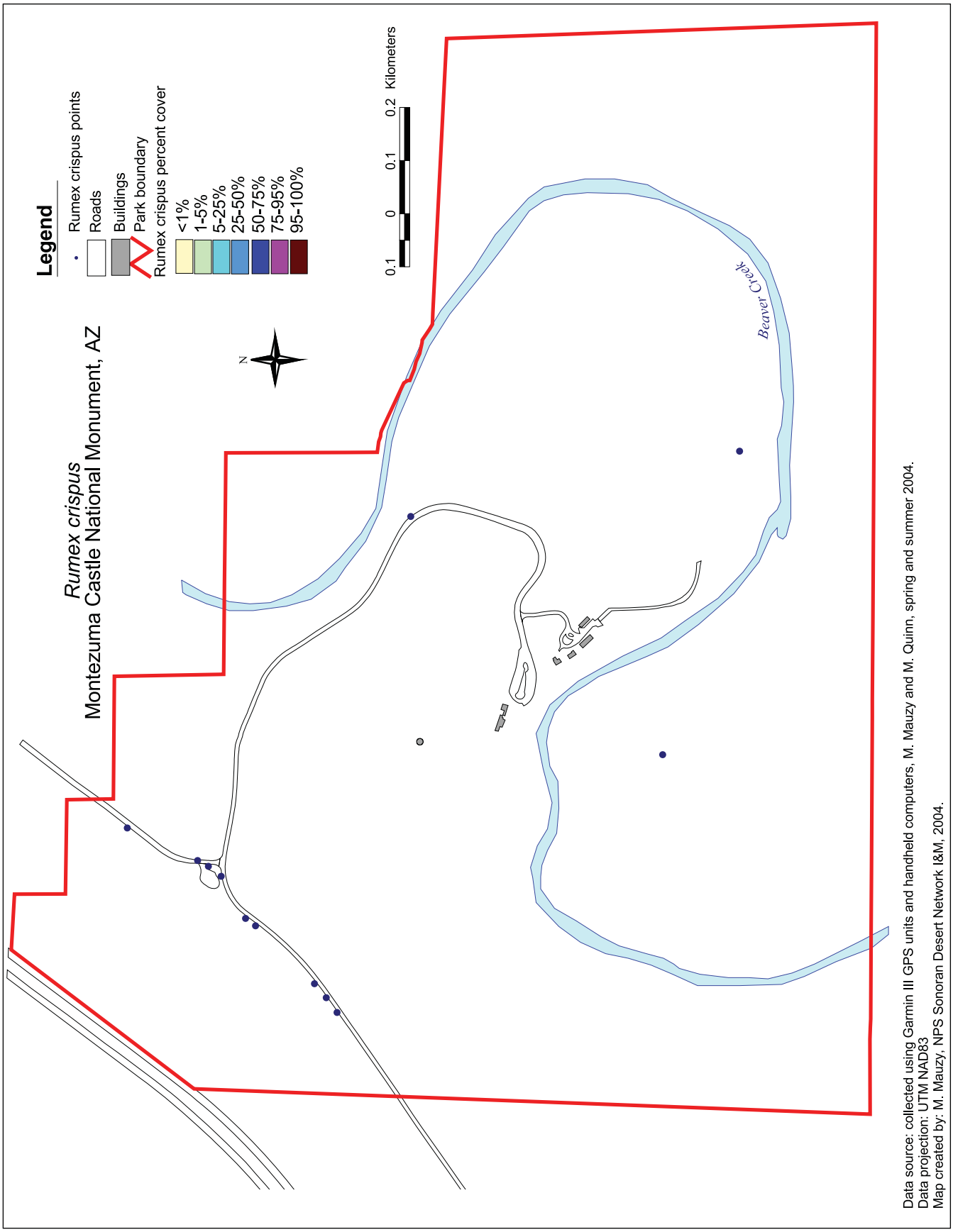

Melilotus albus
Montezuma Castle National Monument, AZ
Legend
Melilotus albus points
Roads
Buildings
Park boundary
Melilotus albus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

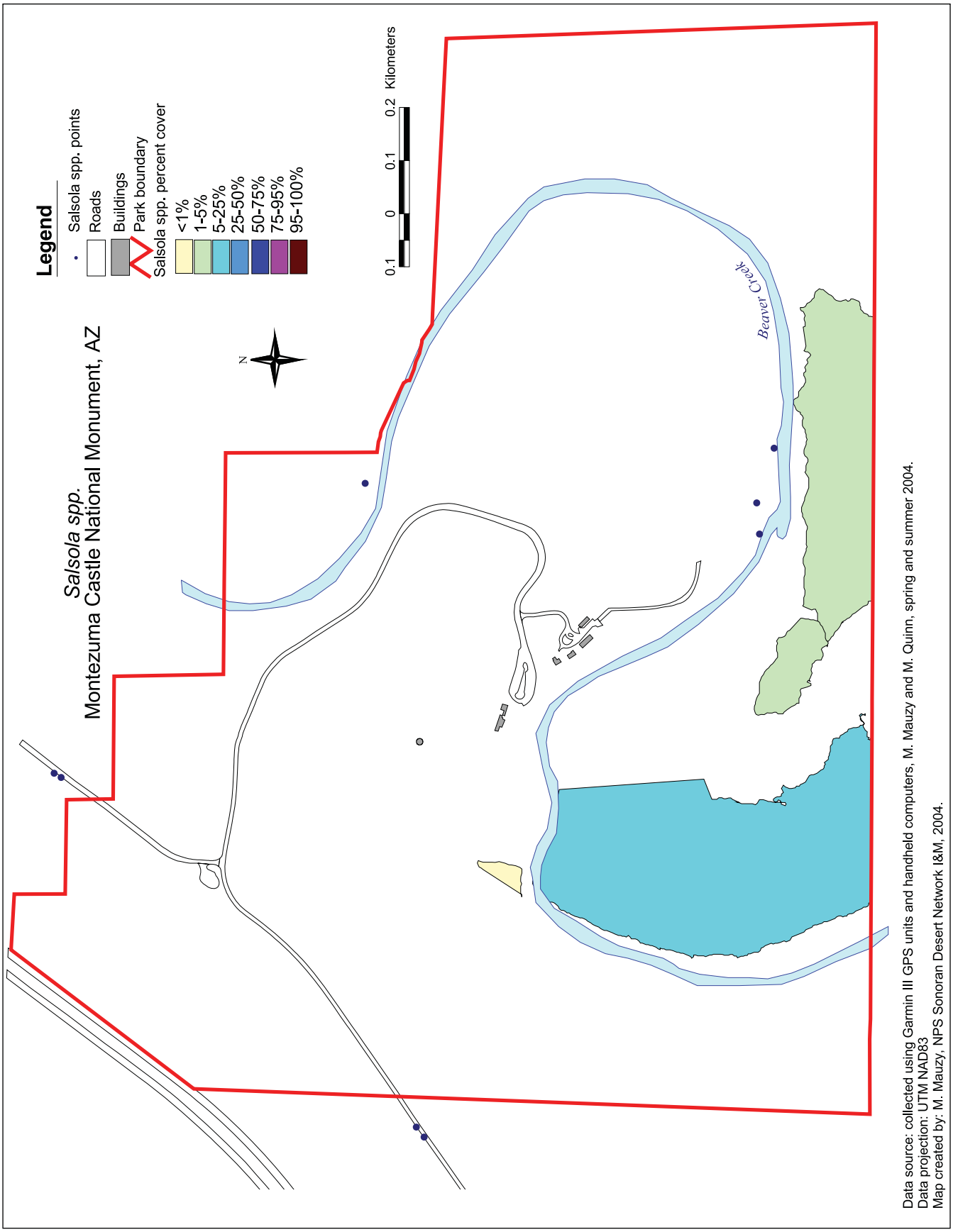


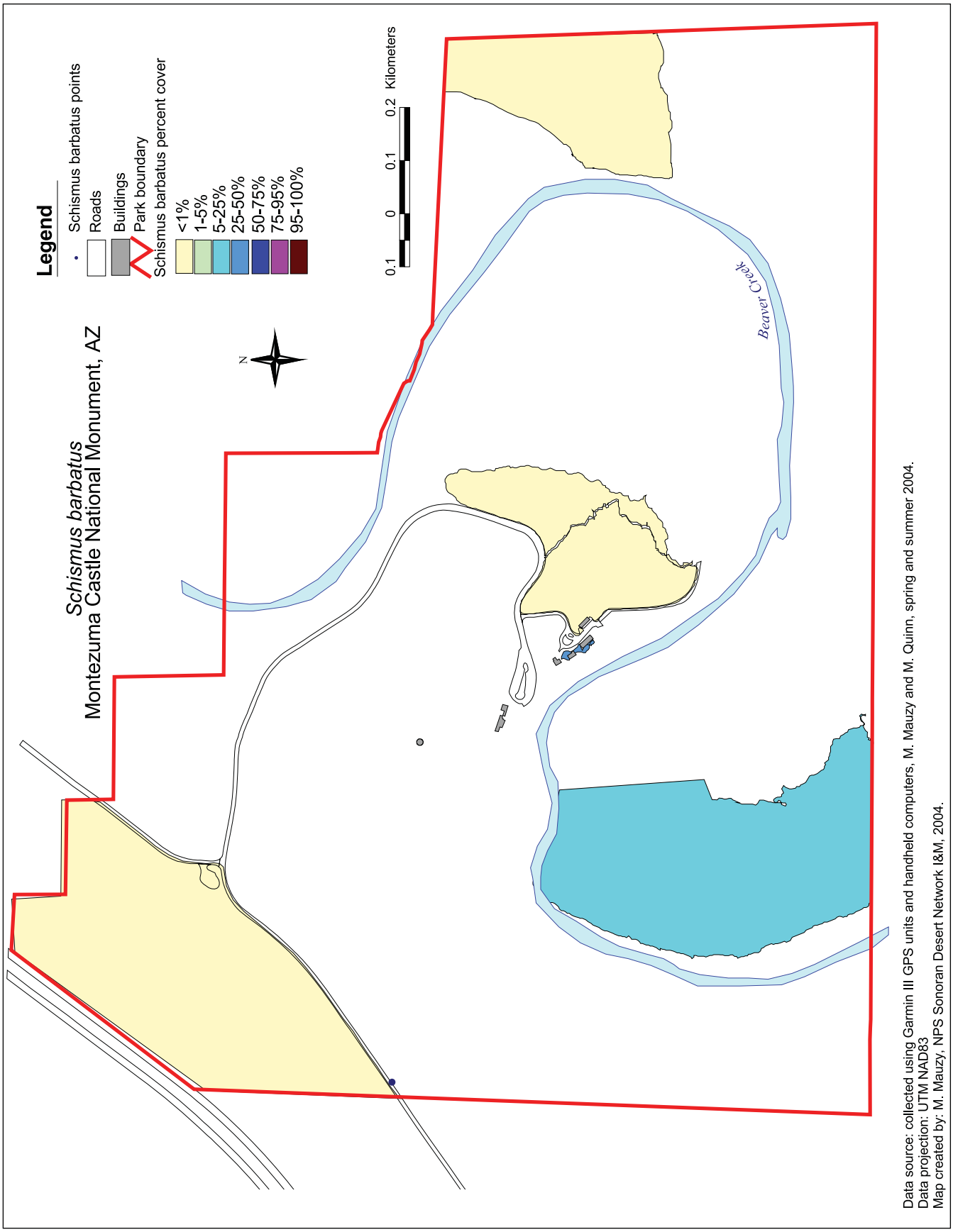
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

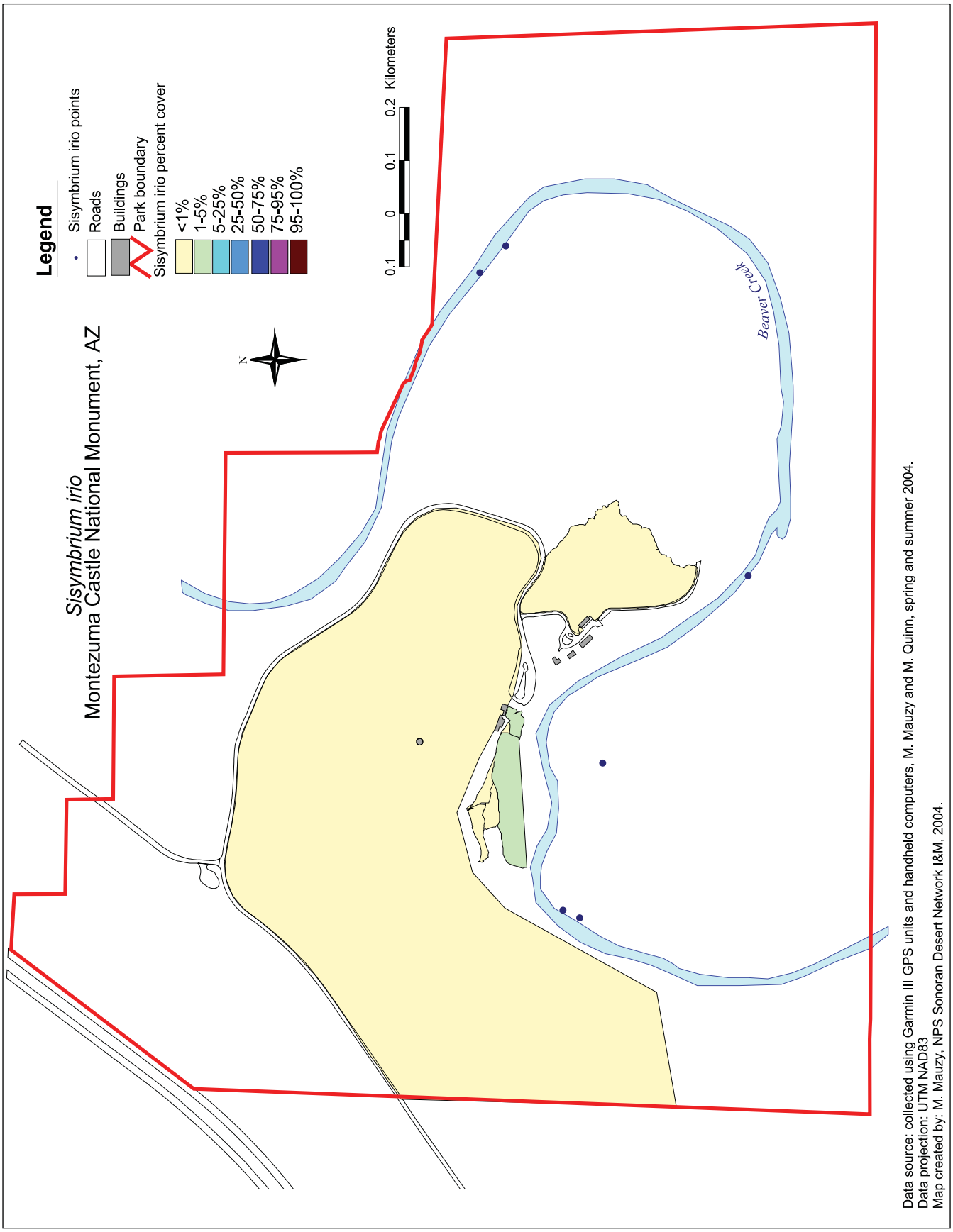

Polygonum aviculare
Montezuma Castle National Monument, AZ
Legend
Polygonum aviculare points
Roads
Buildings
Park boundary
Polygonum aviculare percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.


Polypogon monspeliensis
Montezuma Castle National Monument, AZ
Legend
Polypogon monspeliensis points
Roads
Buildings
Park boundary
Polypogon monspeliensis percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

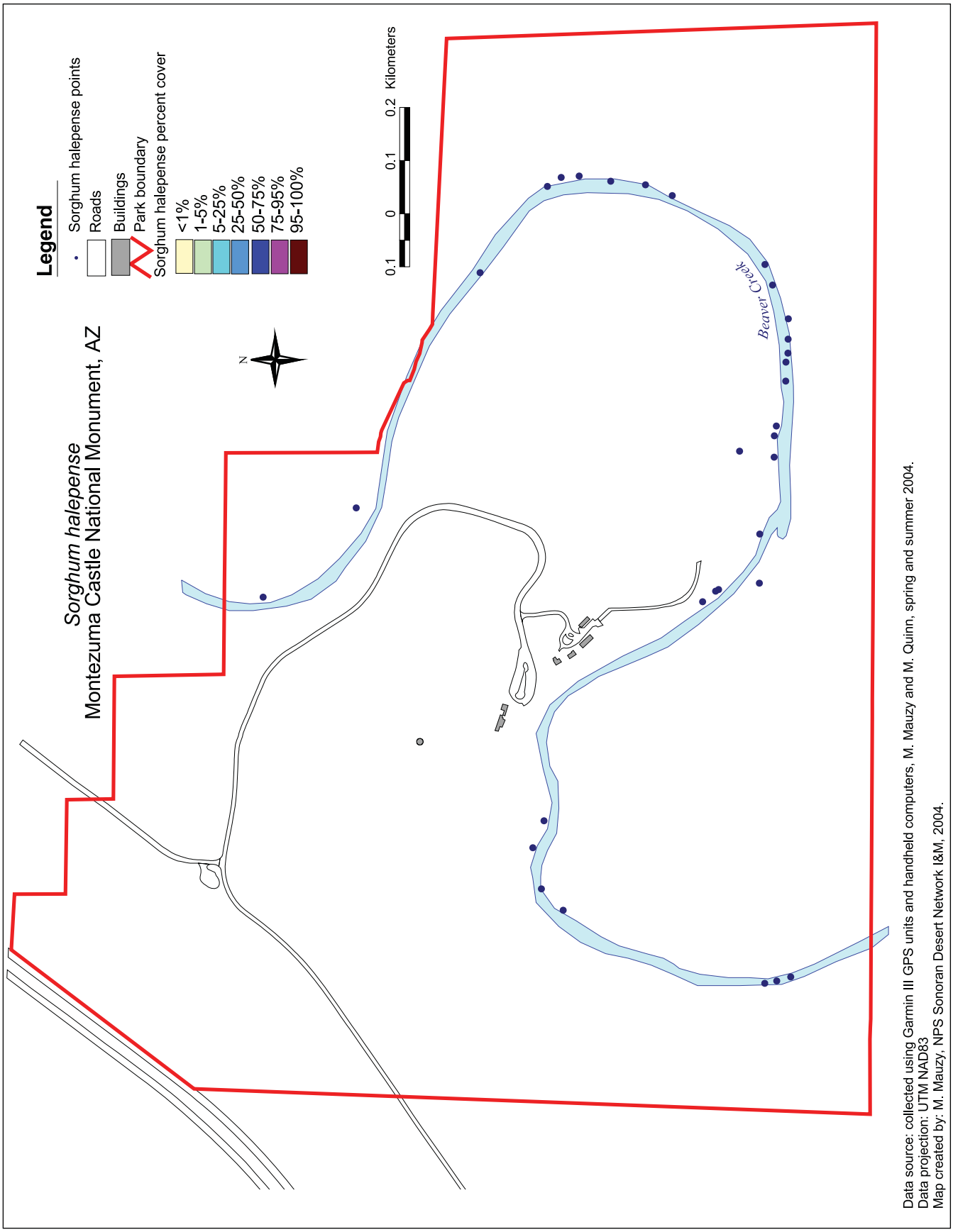

Rumex crispus
Montezuma Castle National Monument, AZ
Legend
Rumex crispus points
Roads
Buildings
Park boundary
Rumex crispus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

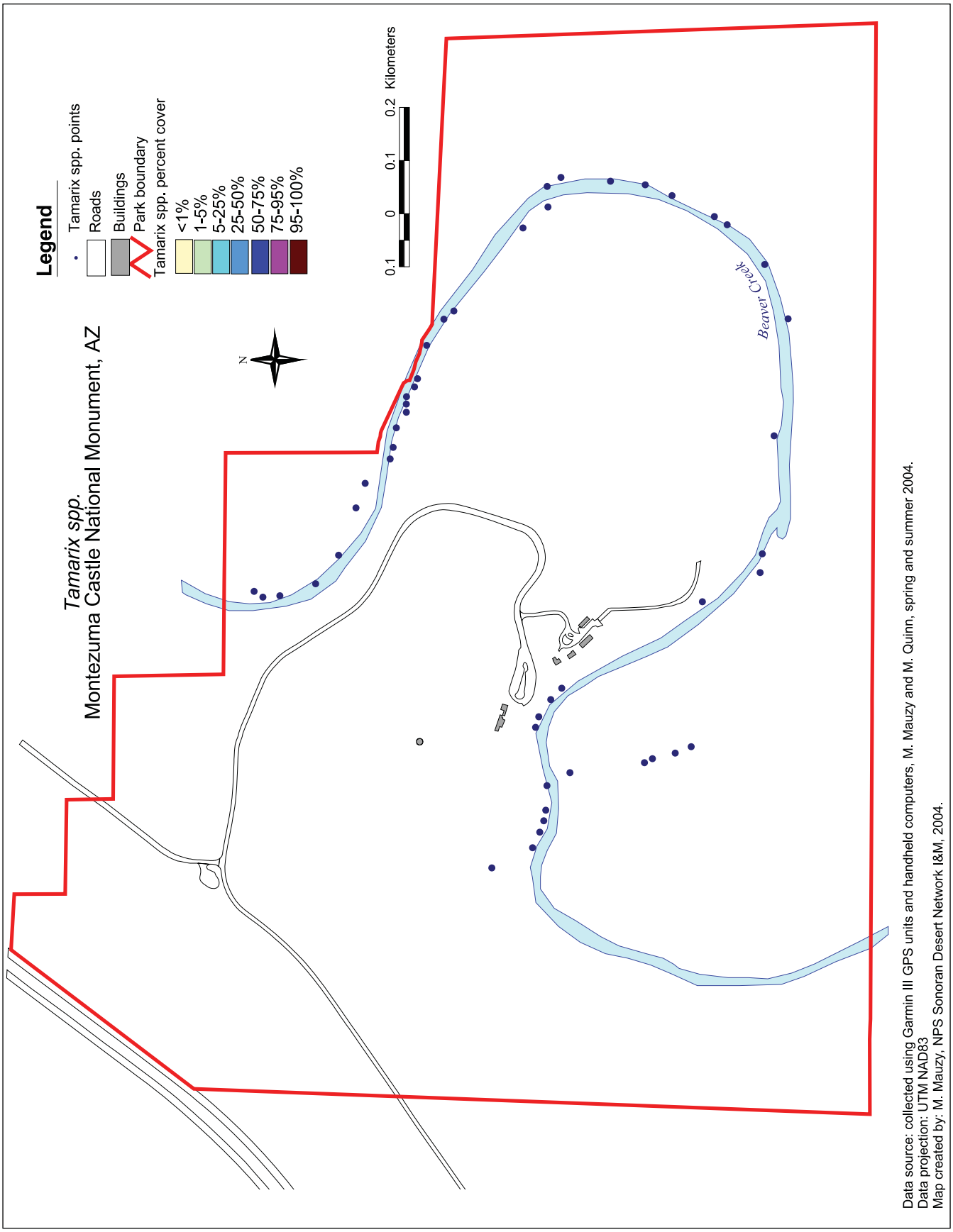

Salsola spp.
Montezuma Castle National Monument, AZ
Legend
Salsola spp. points
Roads
Buildings
Park boundary
Salsola spp. percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.


Schismus barbatus
Montezuma Castle National Monument, AZ
Legend
Schismus barbatus points
Roads
Buildings
Park boundary
Schismus barbatus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

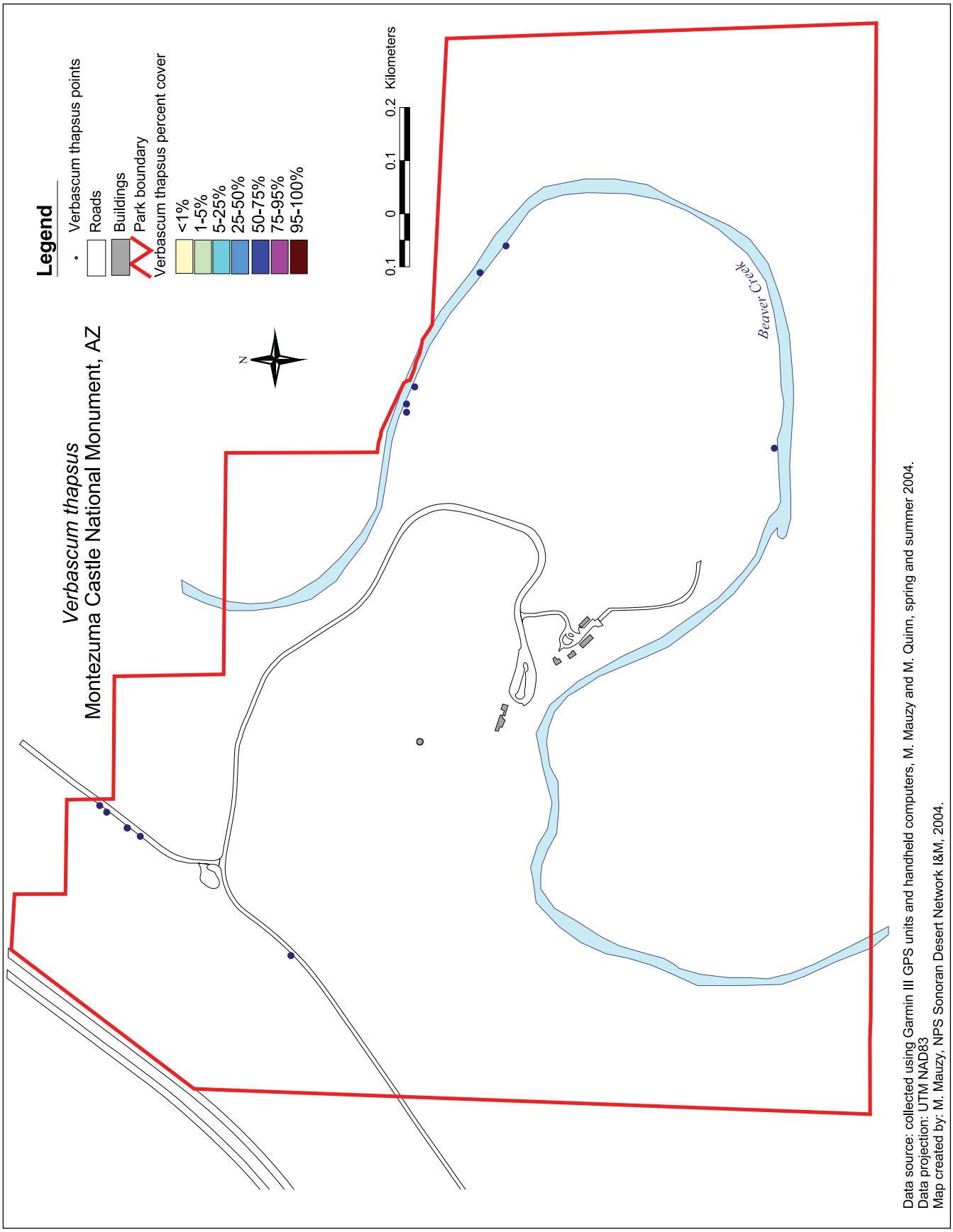


Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

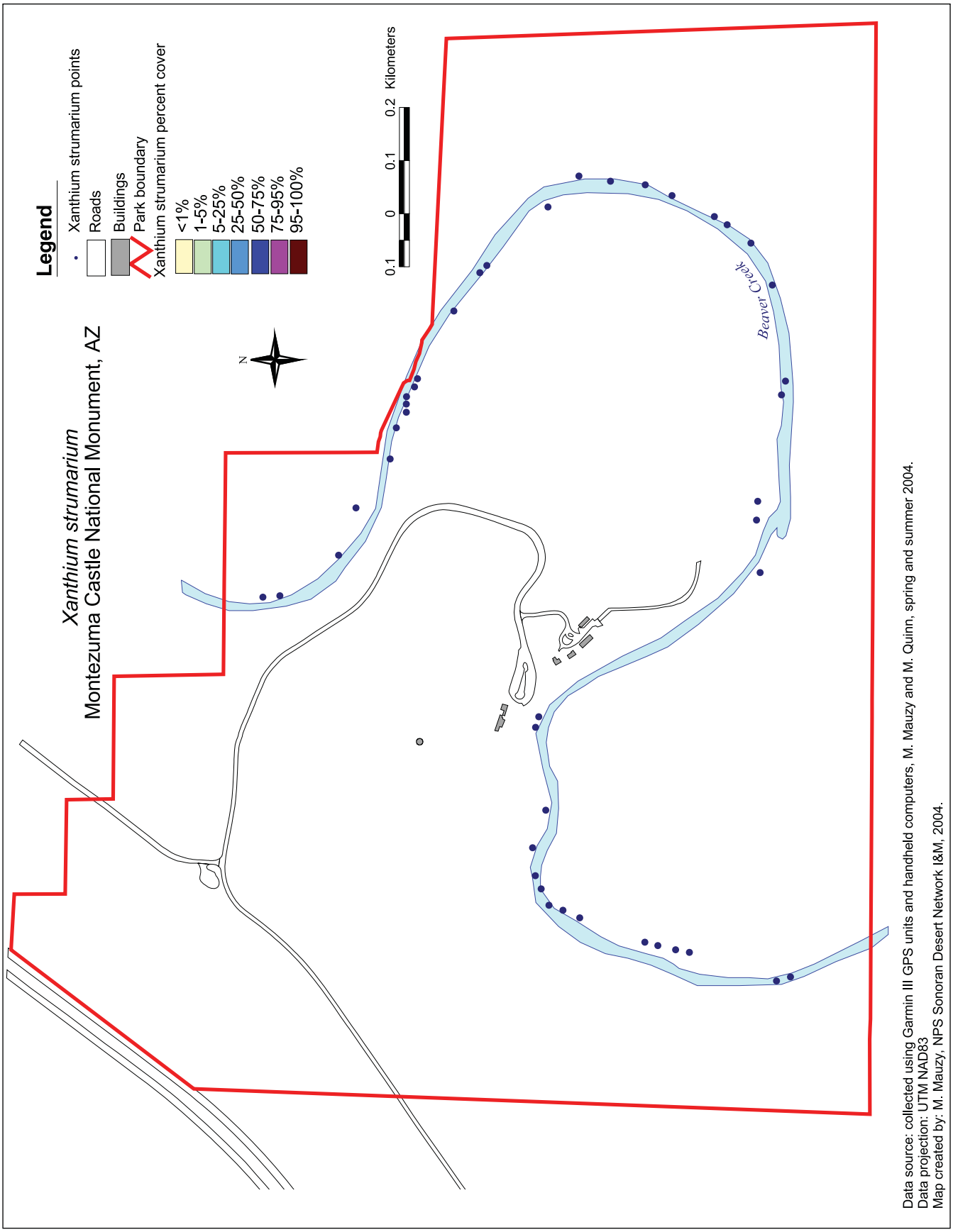

Sorghum halepense
Montezuma Castle National Monument, AZ
Legend
Sorghum halepense points
Roads
Buildings
Park boundary
Sorghum halepense percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
N
0.1 0 0.1 0.2 Kilometers
Beaver Creek
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.



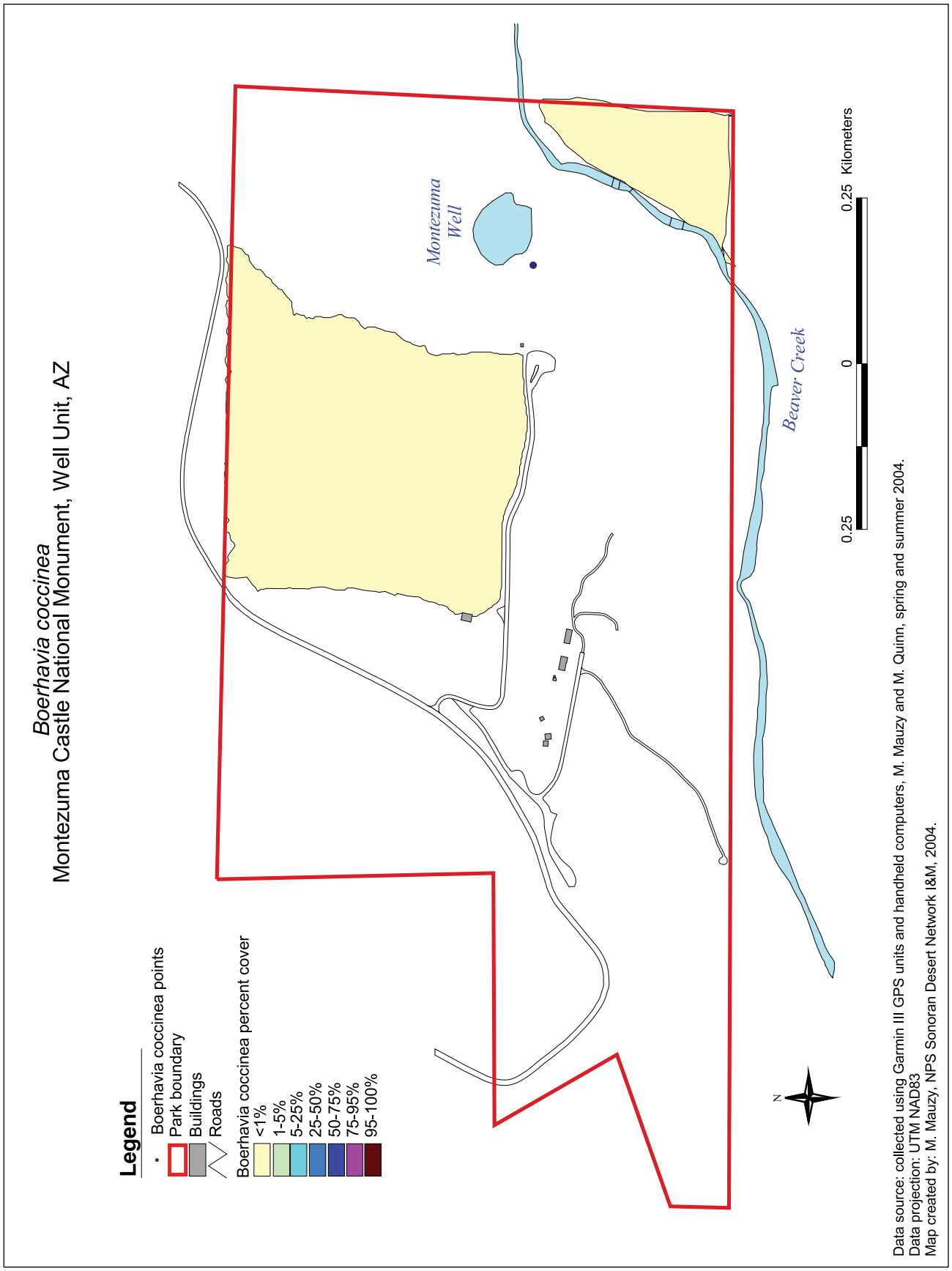
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.



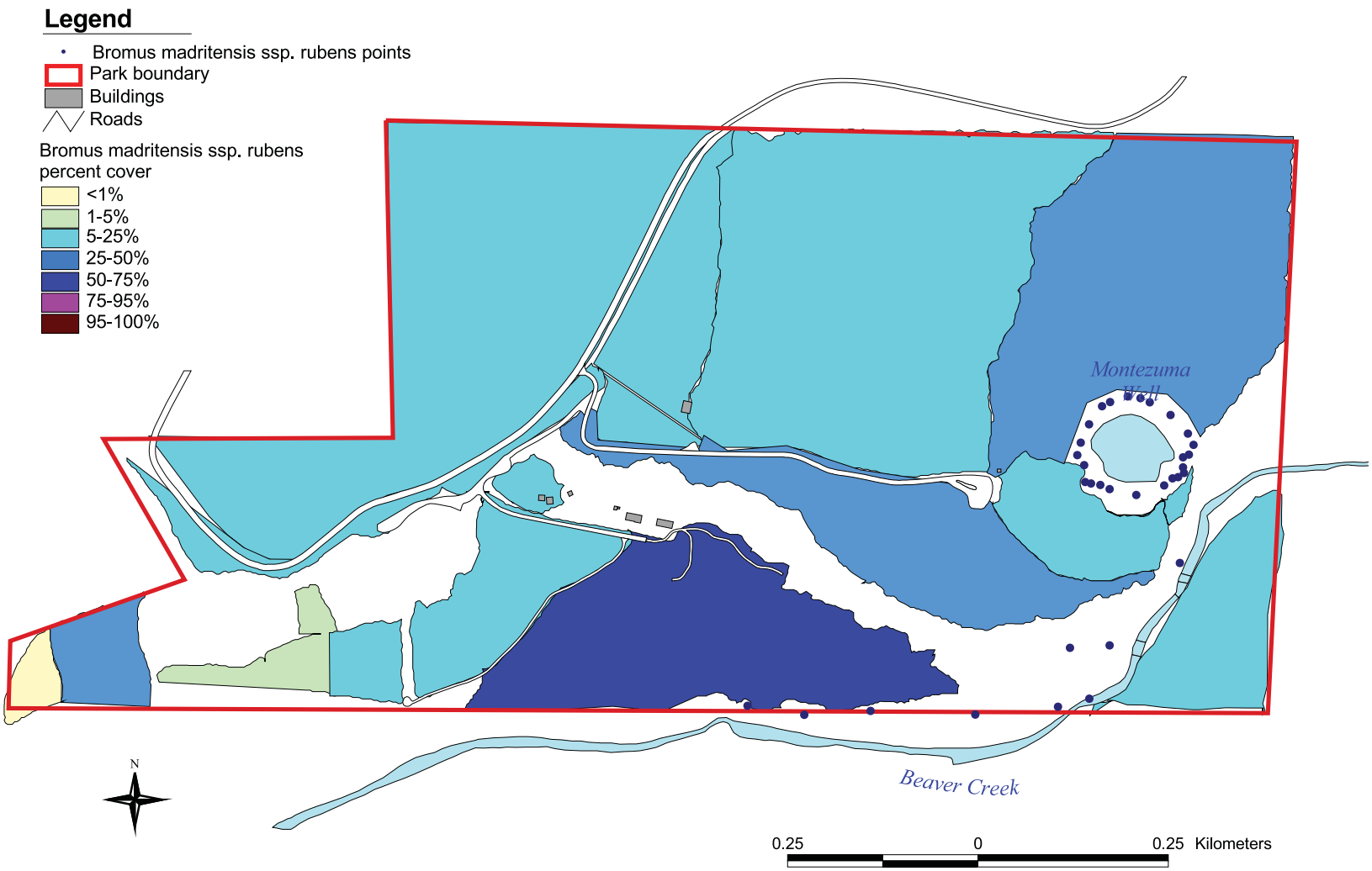
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.



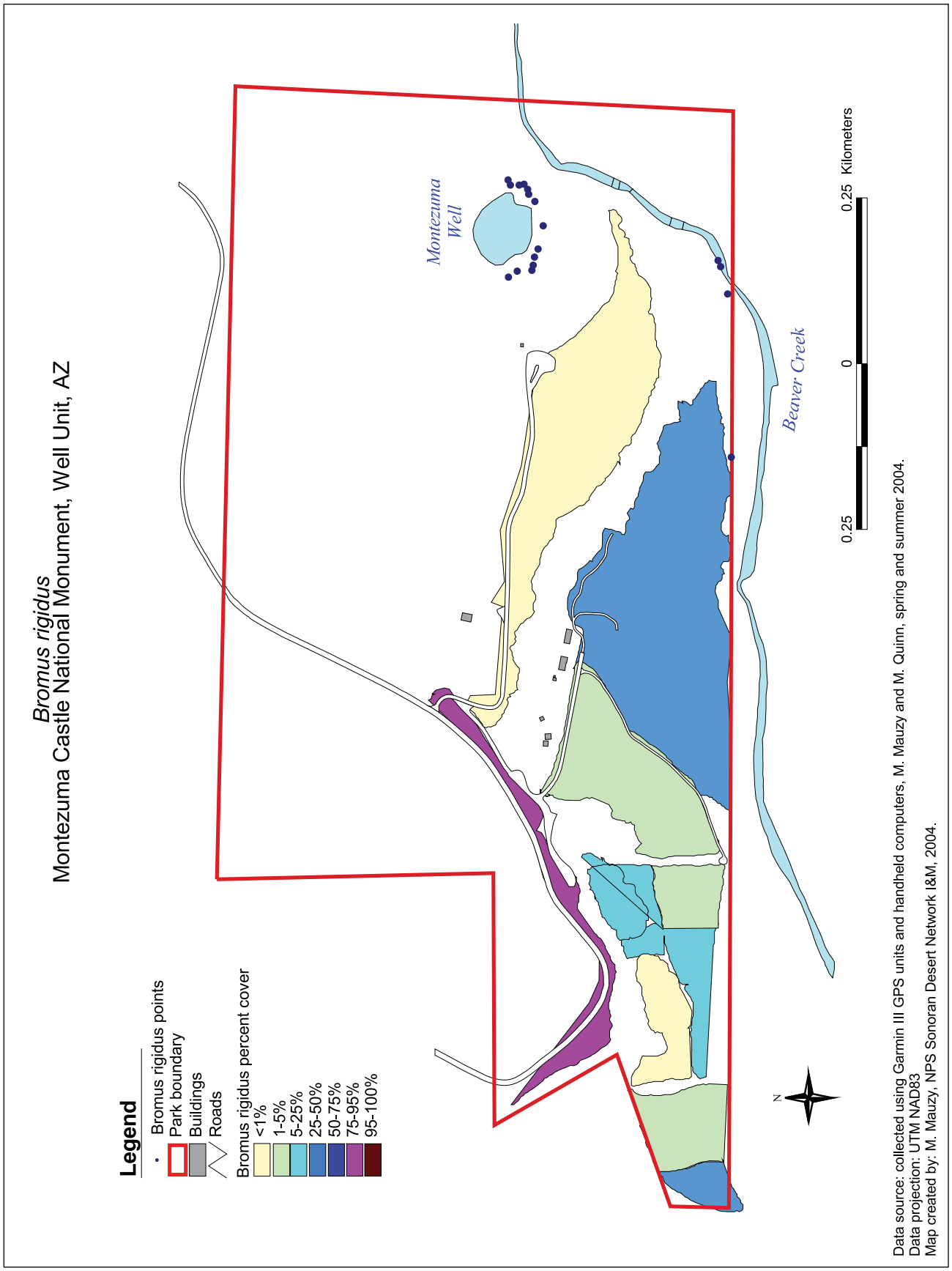
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

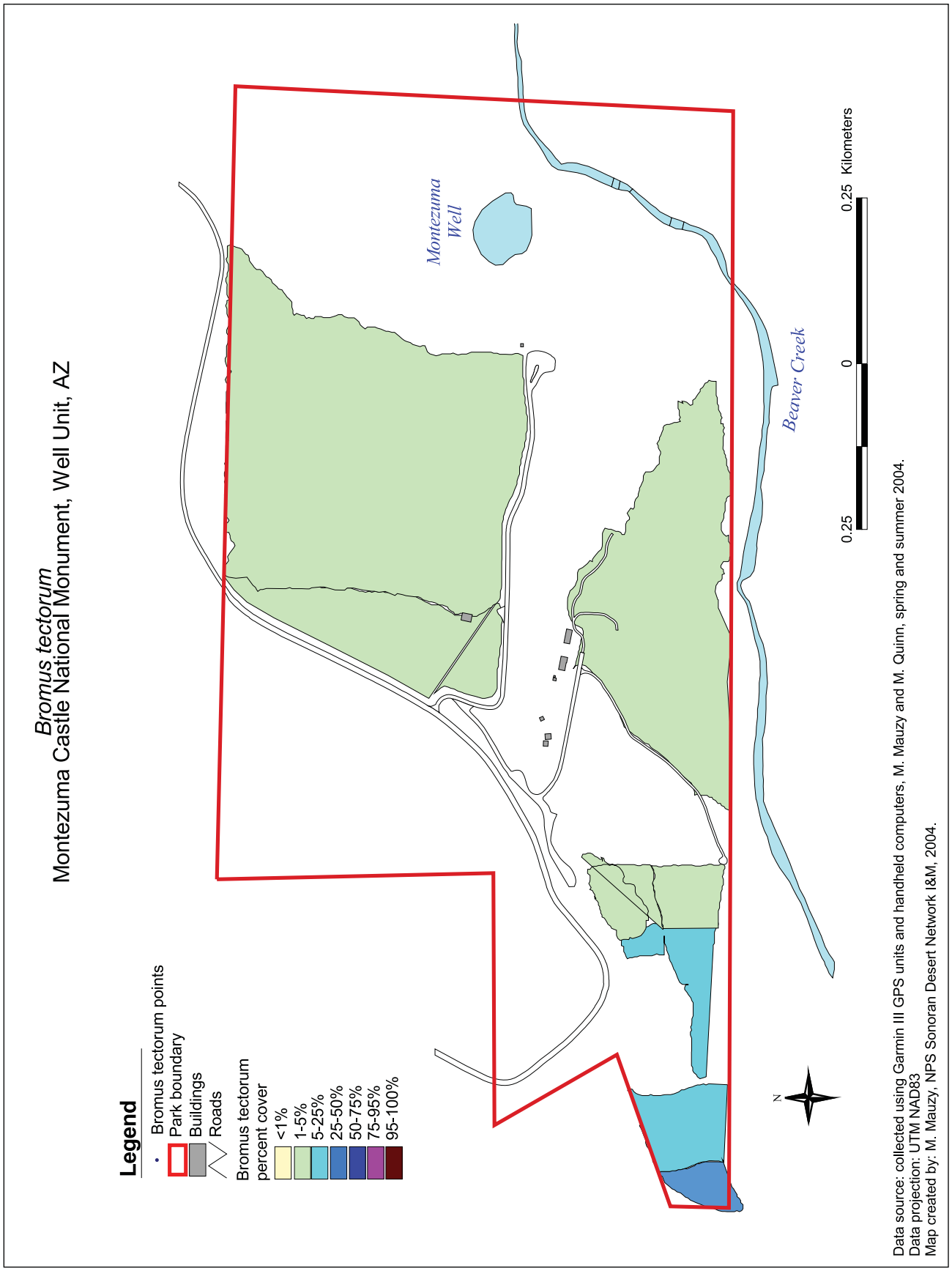

Boerhavia coccinea
Montezuma Castle National Monument, Well Unit, AZ
Legend
Boerhavia coccinea points
Park boundary
Buildings
Roads
Boerhavia coccinea percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
N
0.25
0
0.25
Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

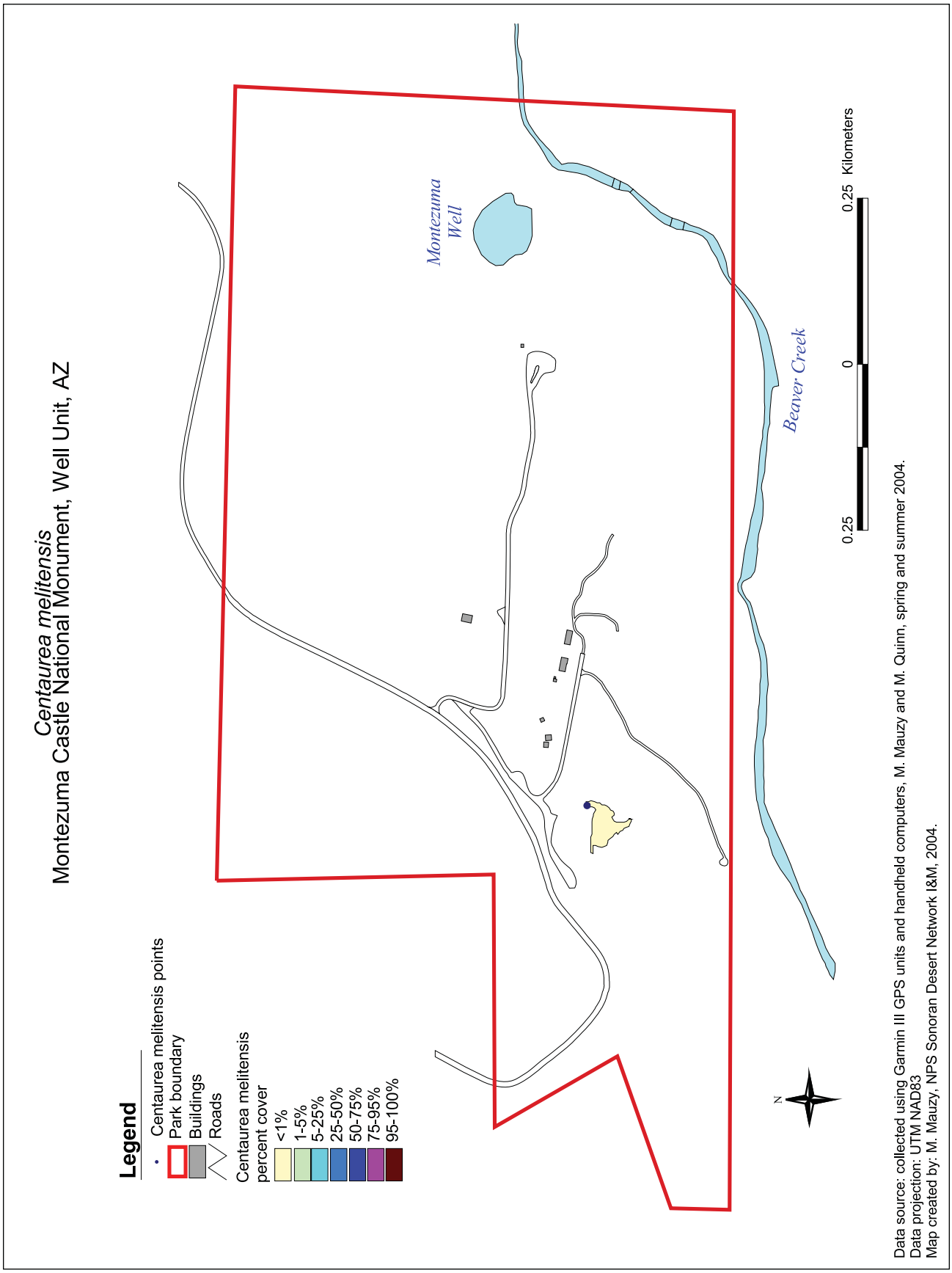
Bromus madritensis ssp. rubens
Montezuma Castle National Monument, Well Unit, AZ

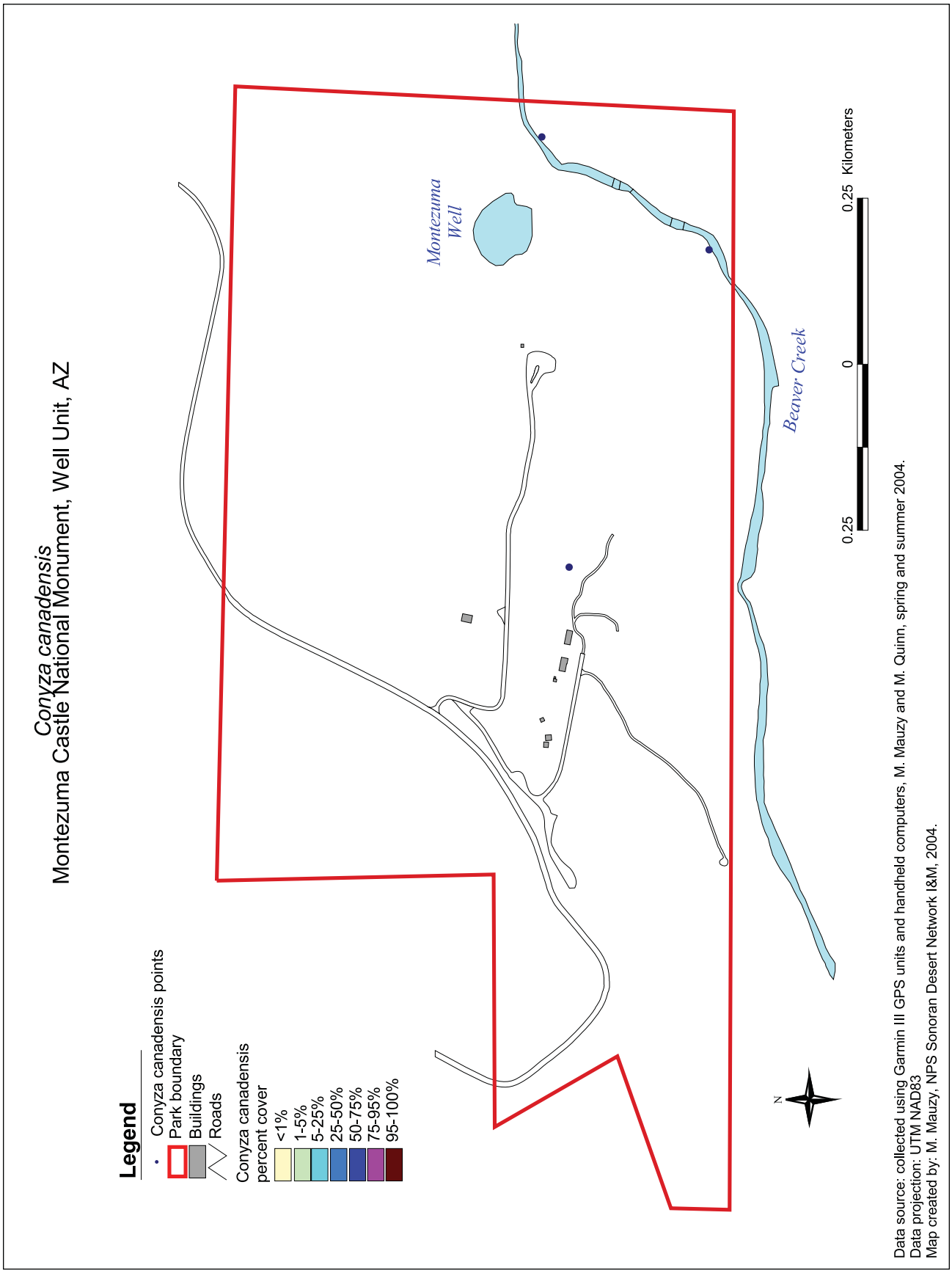


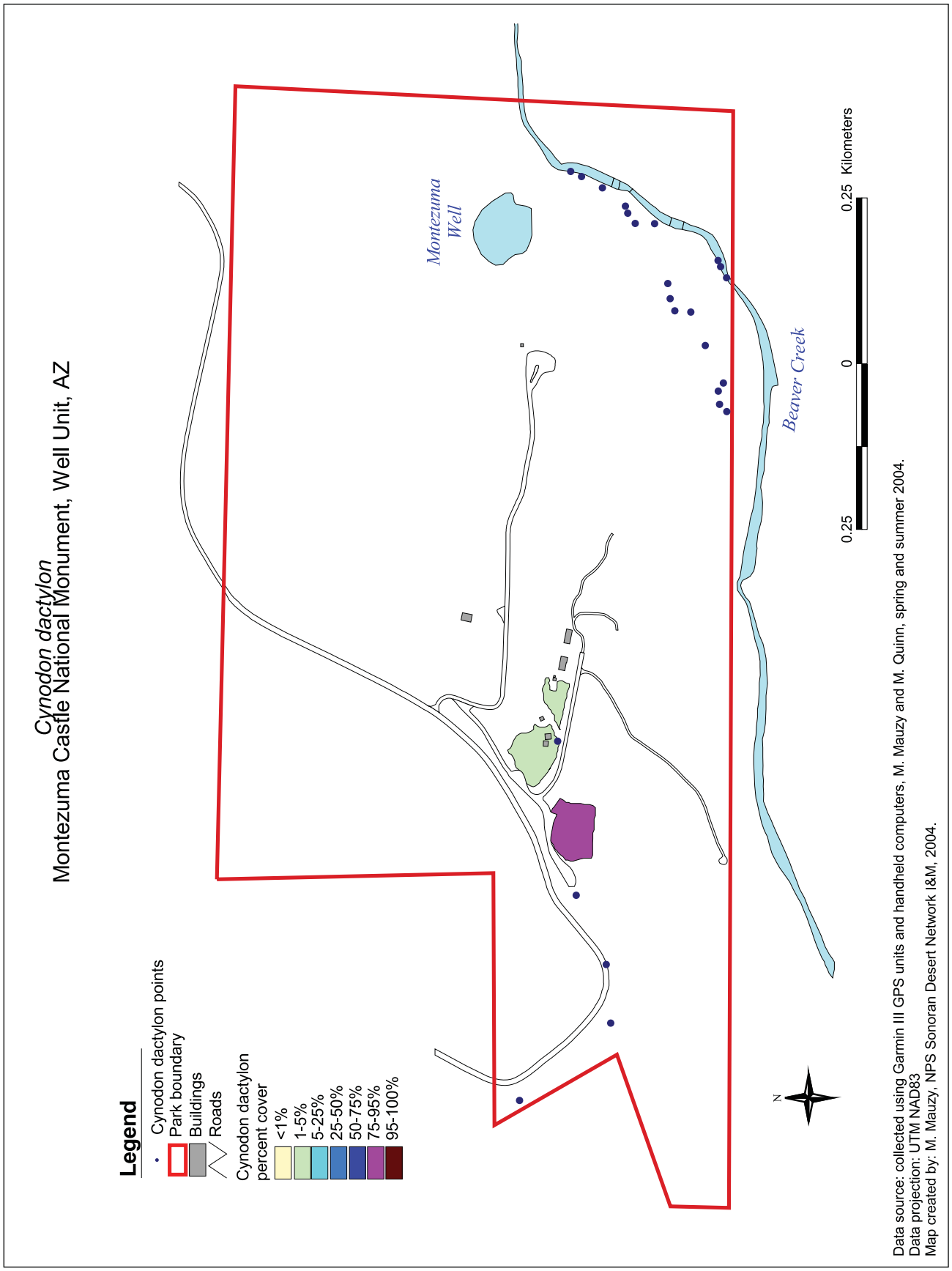
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

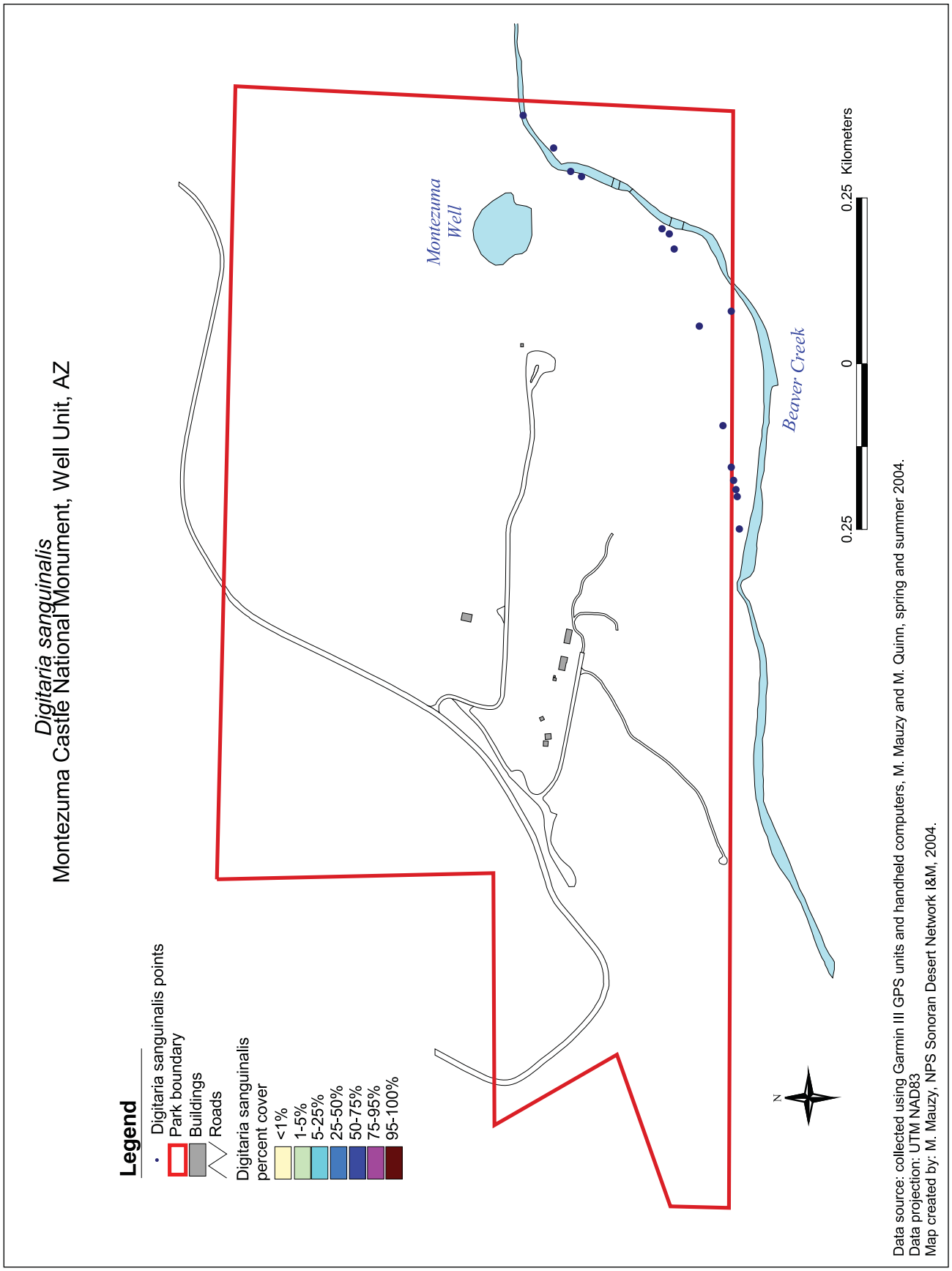

Bromus rigidus
Montezuma Castle National Monument, Well Unit, AZ
Legend
Bromus rigidus points
Park boundary
Buildings
Roads
Bromus rigidus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
N
0.25
0
0.25 Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

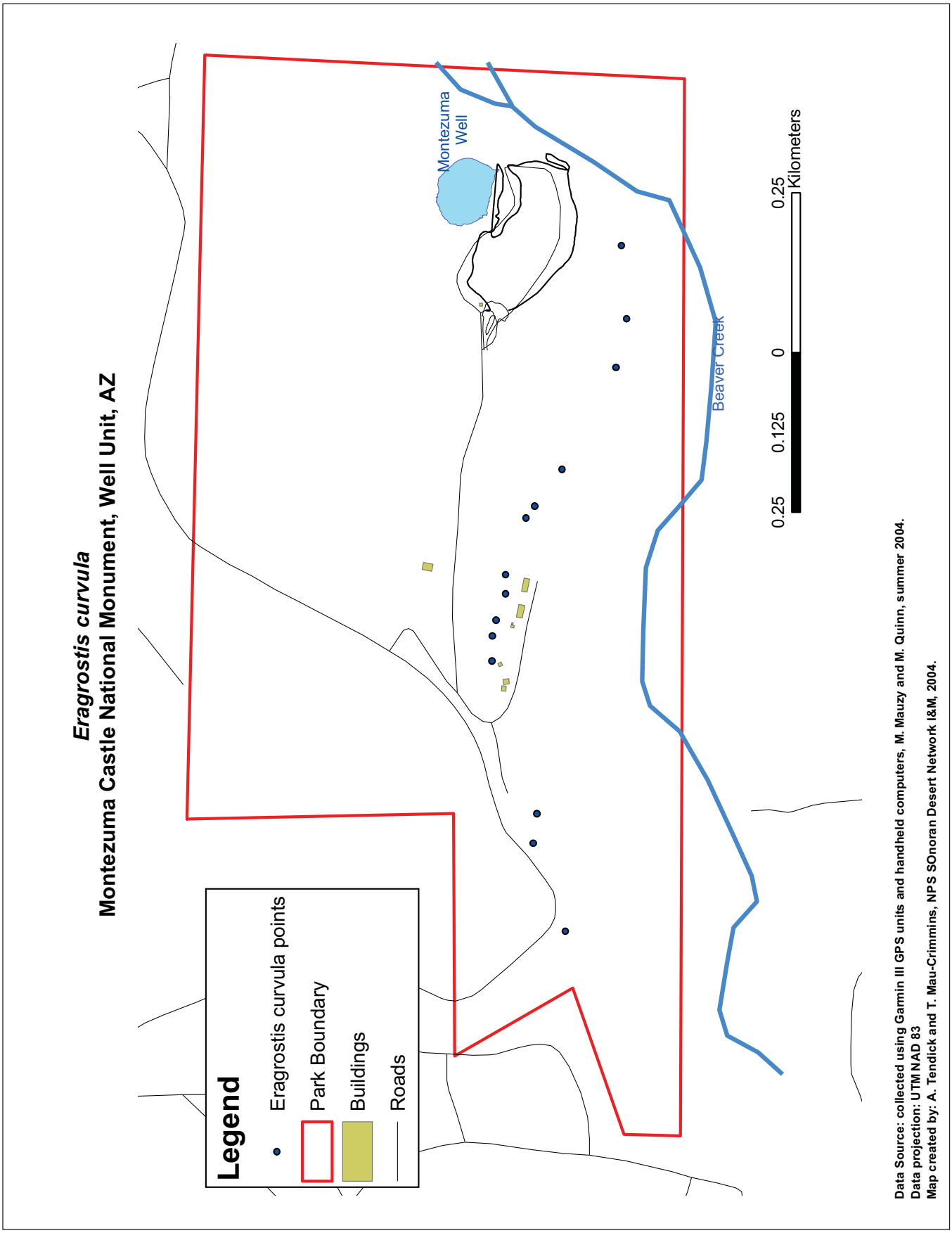

Bromus tectorum
Montezuma Castle National Monument, Well Unit, AZ
Legend
Bromus tectorum points
Park boundary
Buildings
Roads
Bromus tectorum percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
N
0.25
0
0.25
Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.


Centaurea melitensis
Montezuma Castle National Monument, Well Unit, AZ
Legend
Centaurea melitensis points
Park boundary
Buildings
Roads
Centaurea melitensis
percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma
Well
Beaver Creek
N
0.25
0
0.25 Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

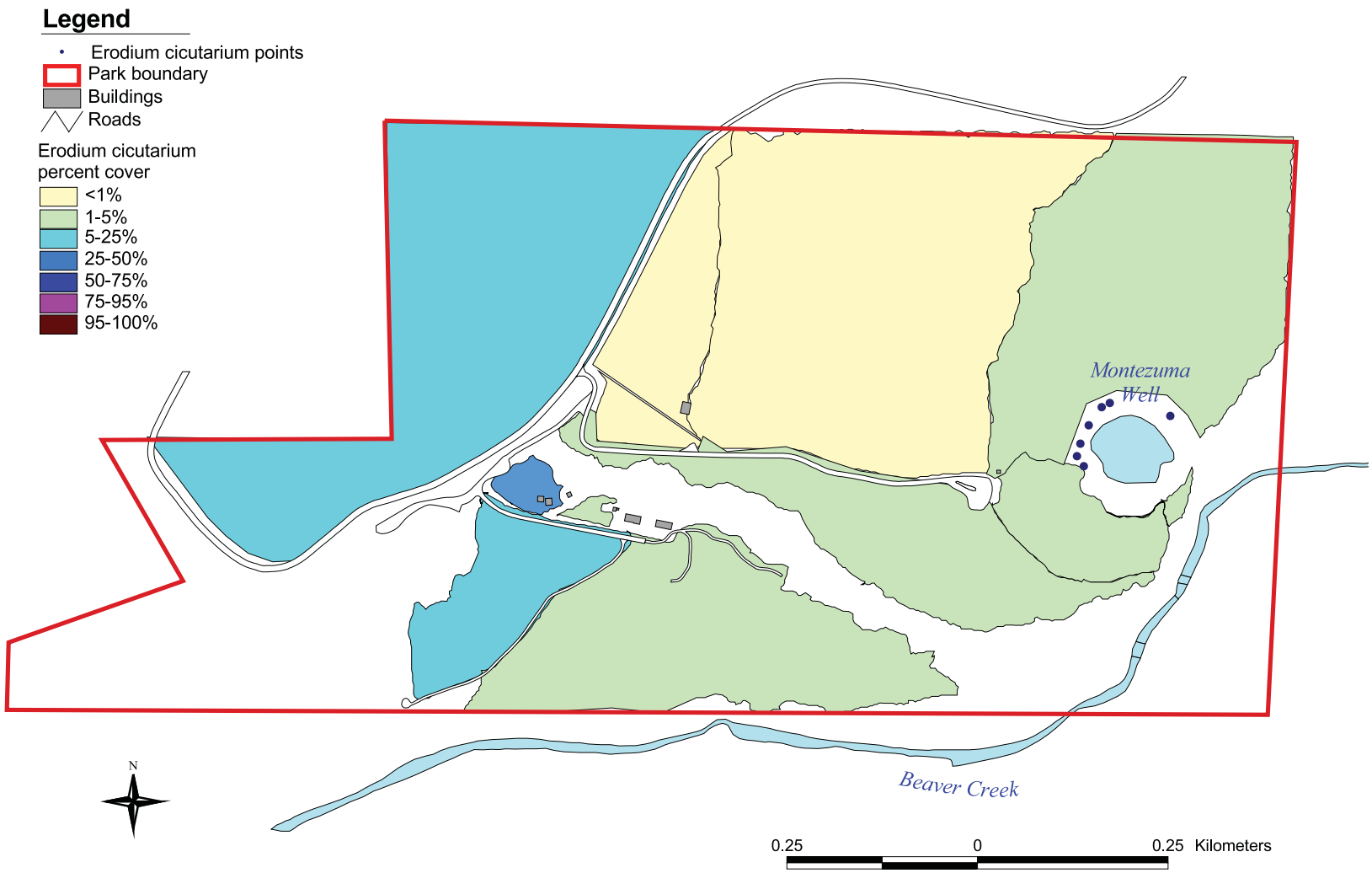

Conyza canadensis
Montezuma Castle National Monument, Well Unit, AZ
Legend
Conyza canadensis points
Park boundary
Buildings
Roads
Conyza canadensis percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
N
0.25
0
0.25
Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.


Cynodon dactylon
Montezuma Castle National Monument, Well Unit, AZ
Legend
Cynodon dactylon points
Park boundary
Buildings
Roads
Cynodon dactylon percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
N
0.25
0
0.25 Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

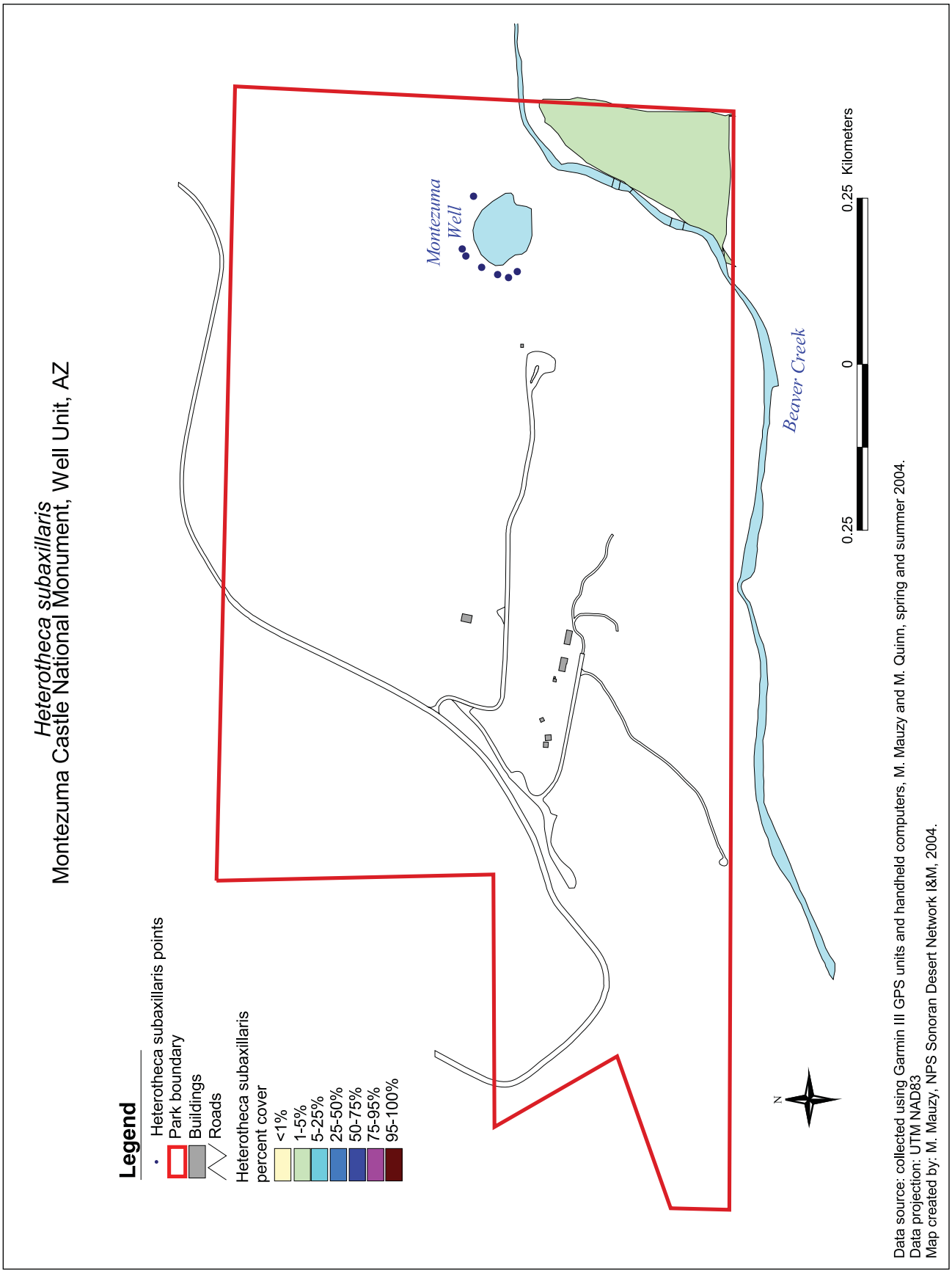

Digitaria sanguinalis
Montezuma Castle National Monument, Well Unit, AZ
Legend
Digitaria sanguinalis points
Park boundary
Buildings
Roads
Digitaria sanguinalis percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
N
0.25
0
0.25
Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

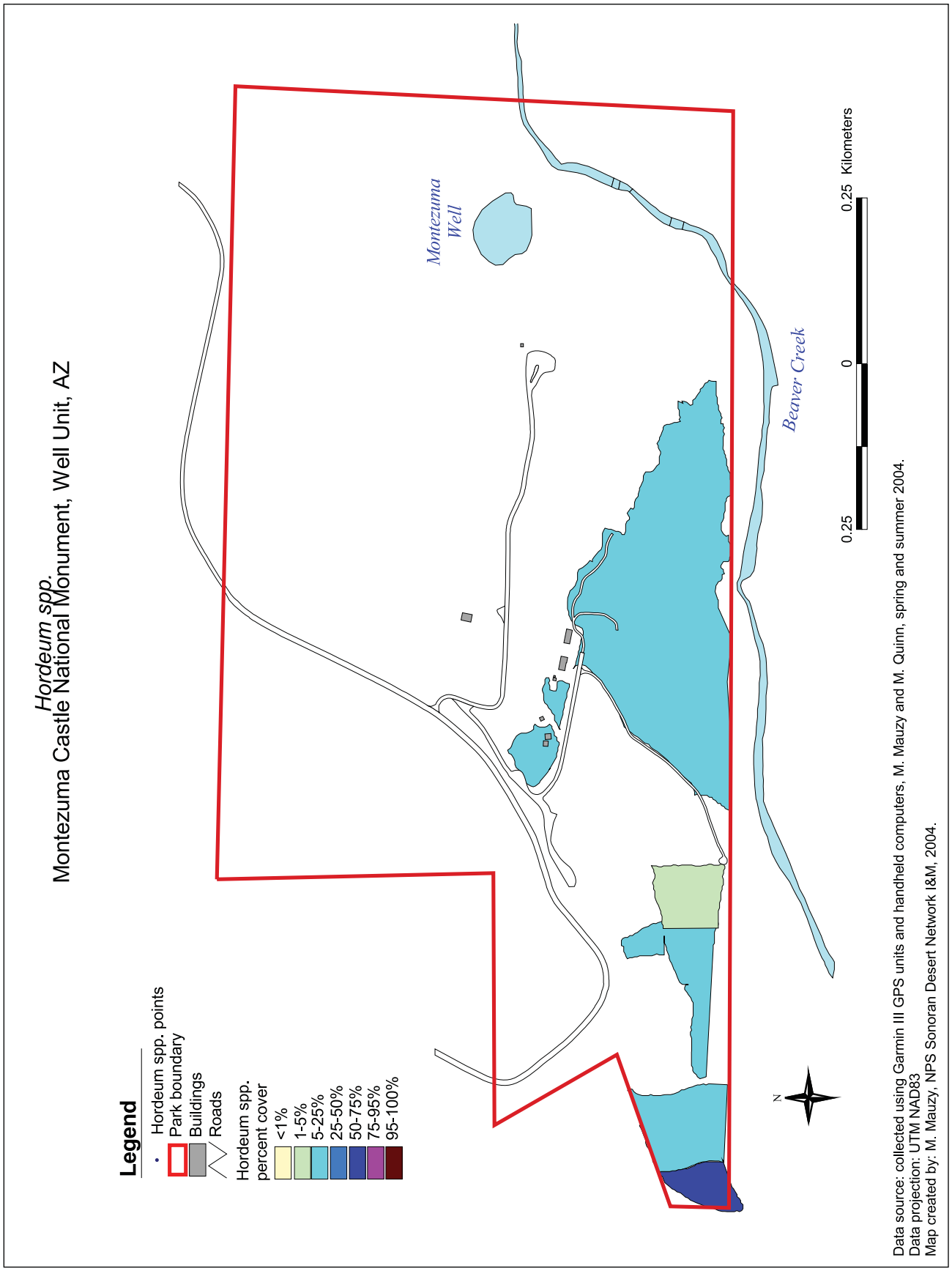

Eragrostis curvula
Montezuma Castle National Monument, Well Unit, AZ
Legend
Eragrostis curvula points
Park Boundary
Buildings
Roads
Montezuma Well
Beaver Creek
0.25
0.125
0
0.25
Kilometers
Data Source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD 83
Map created by: A. Tendick and T. Mau-Crimmins, NPS SOnoran Desert Network I&M, 2004.

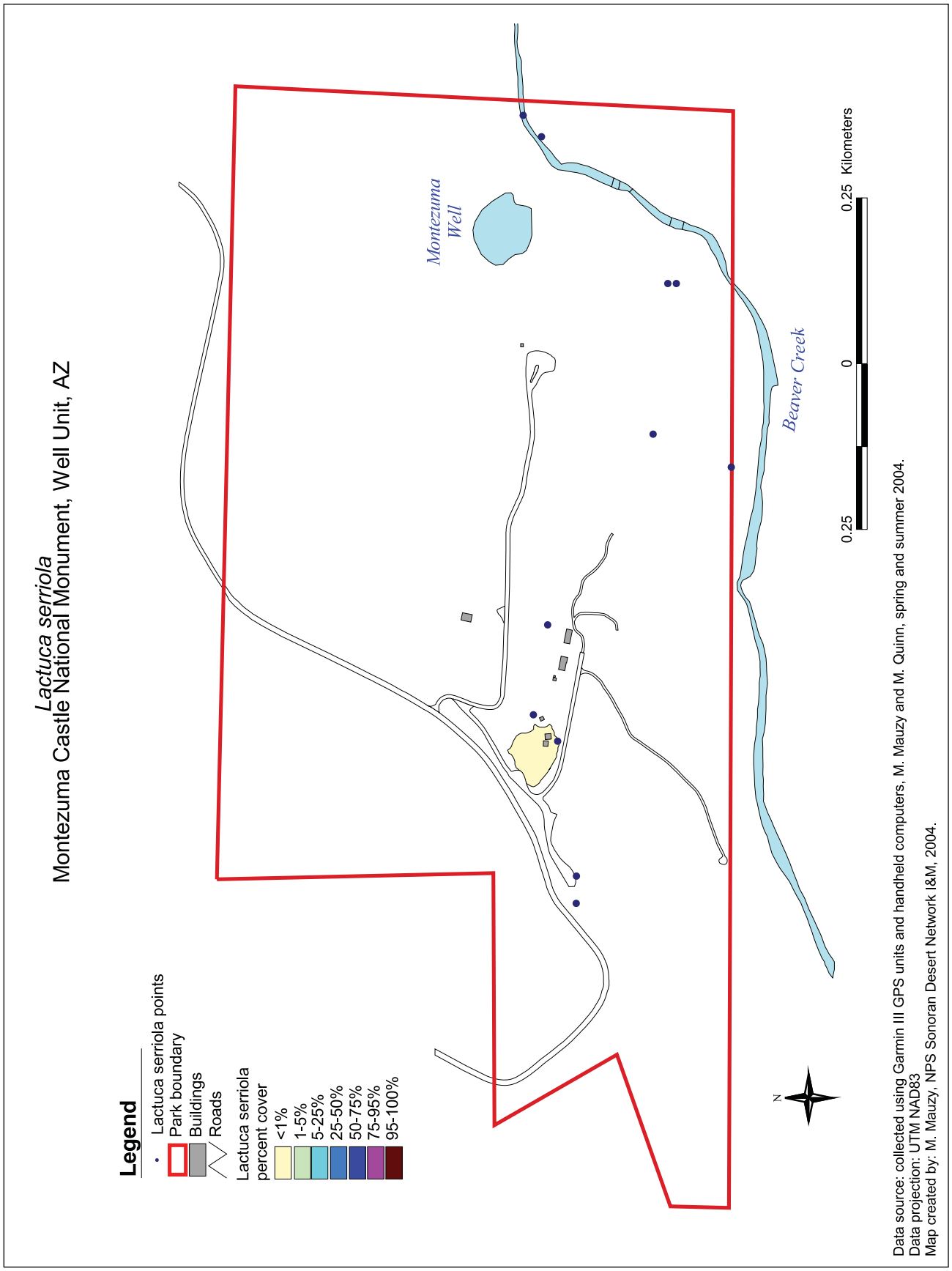
Erodium cicutarium
Montezuma Castle National Monument, Well Unit, AZ

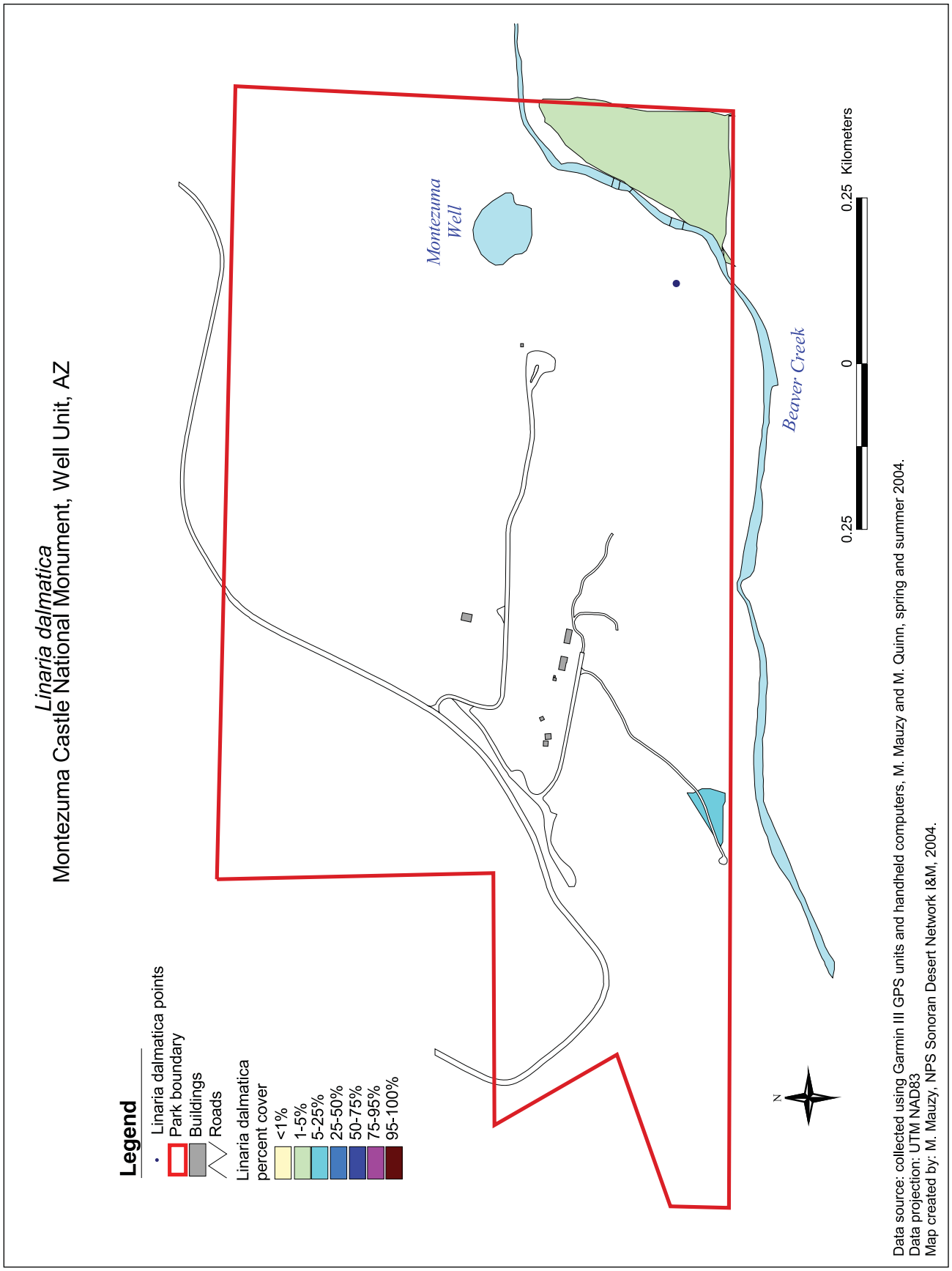


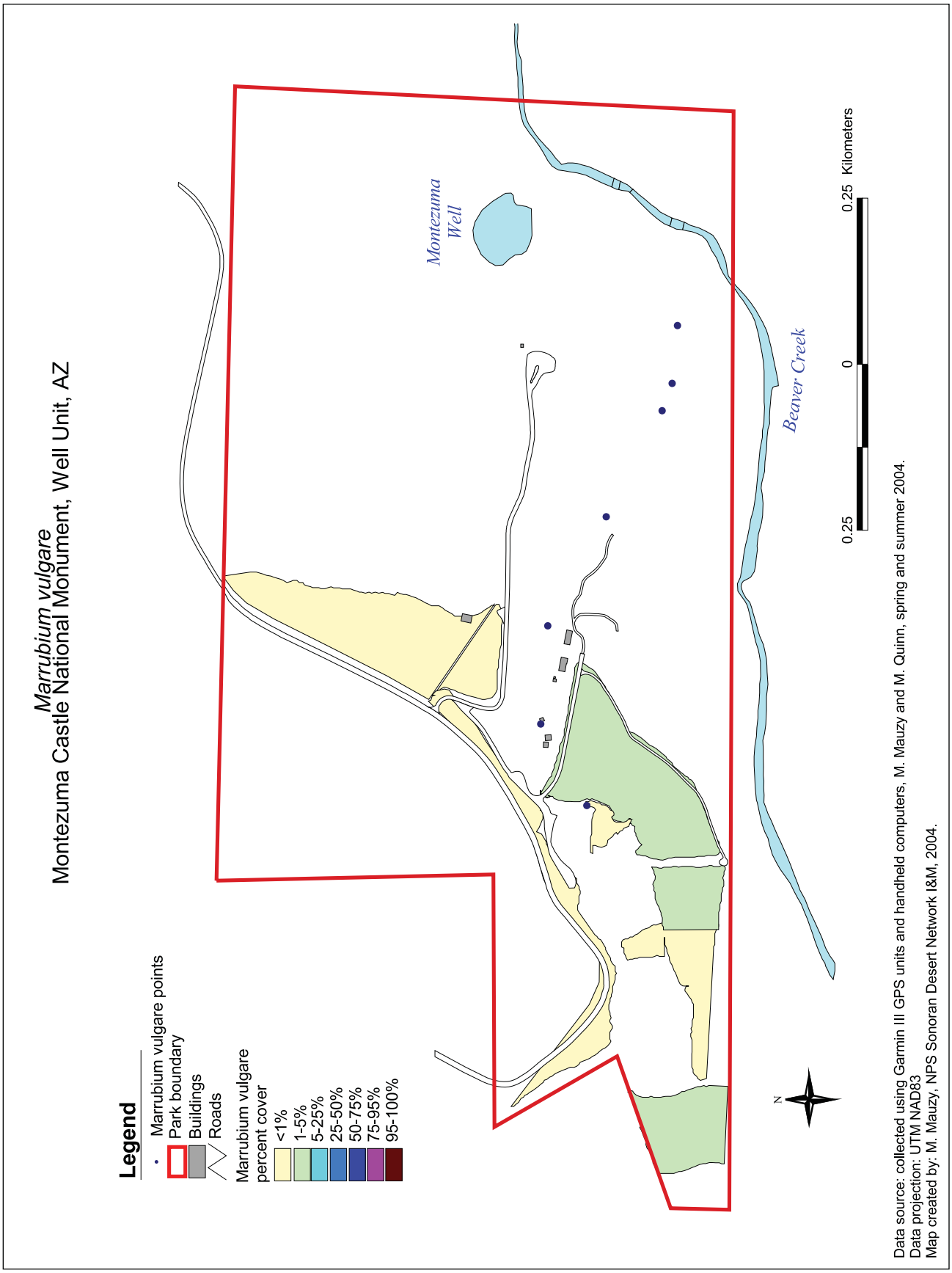
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

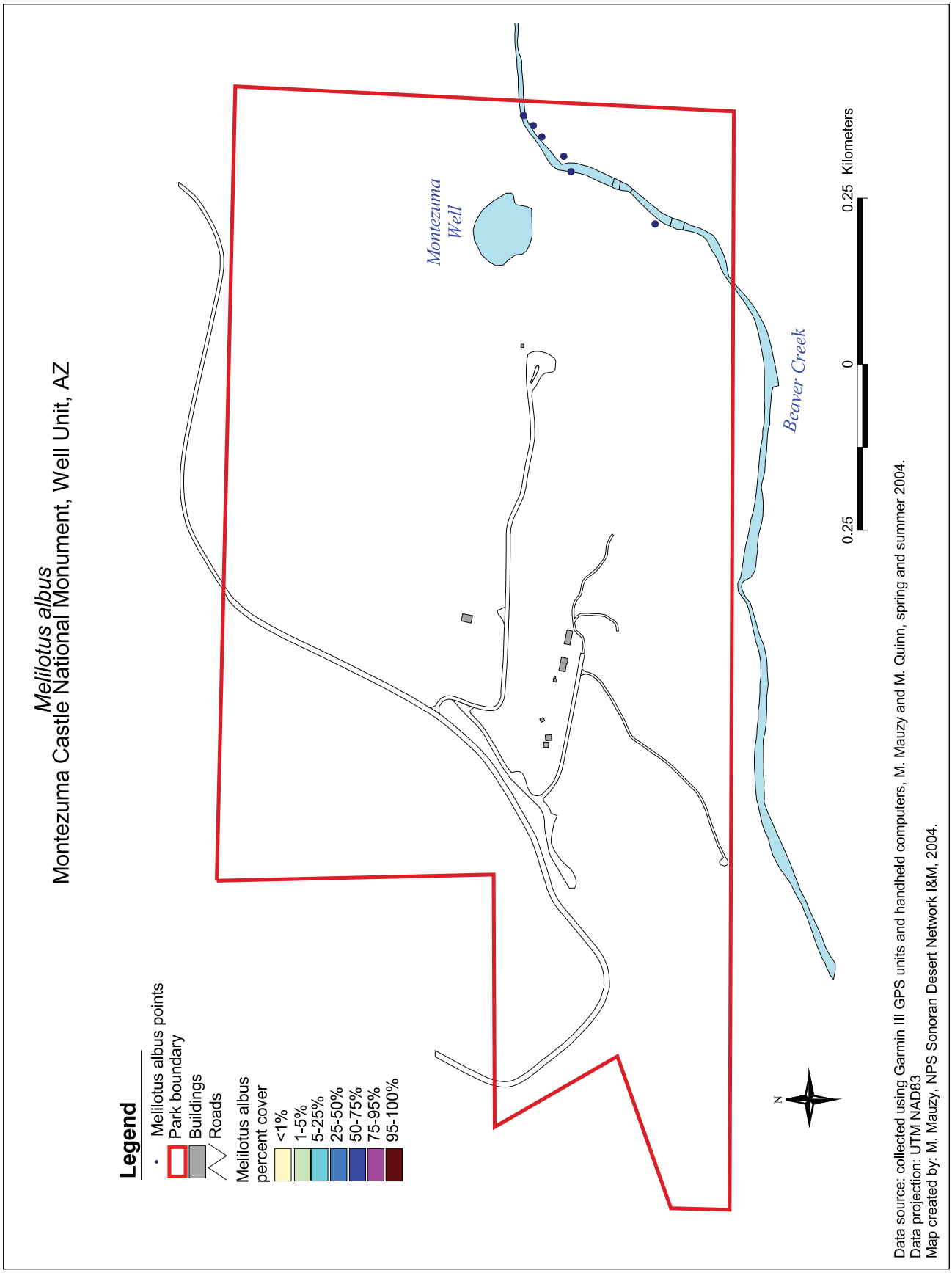

Heterotheca subaxillaris
Montezuma Castle National Monument, Well Unit, AZ
Legend
Heterotheca subaxillaris points
Park boundary
Buildings
Roads
Heterotheca subaxillaris
percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
N
0.25
0
0.25 Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

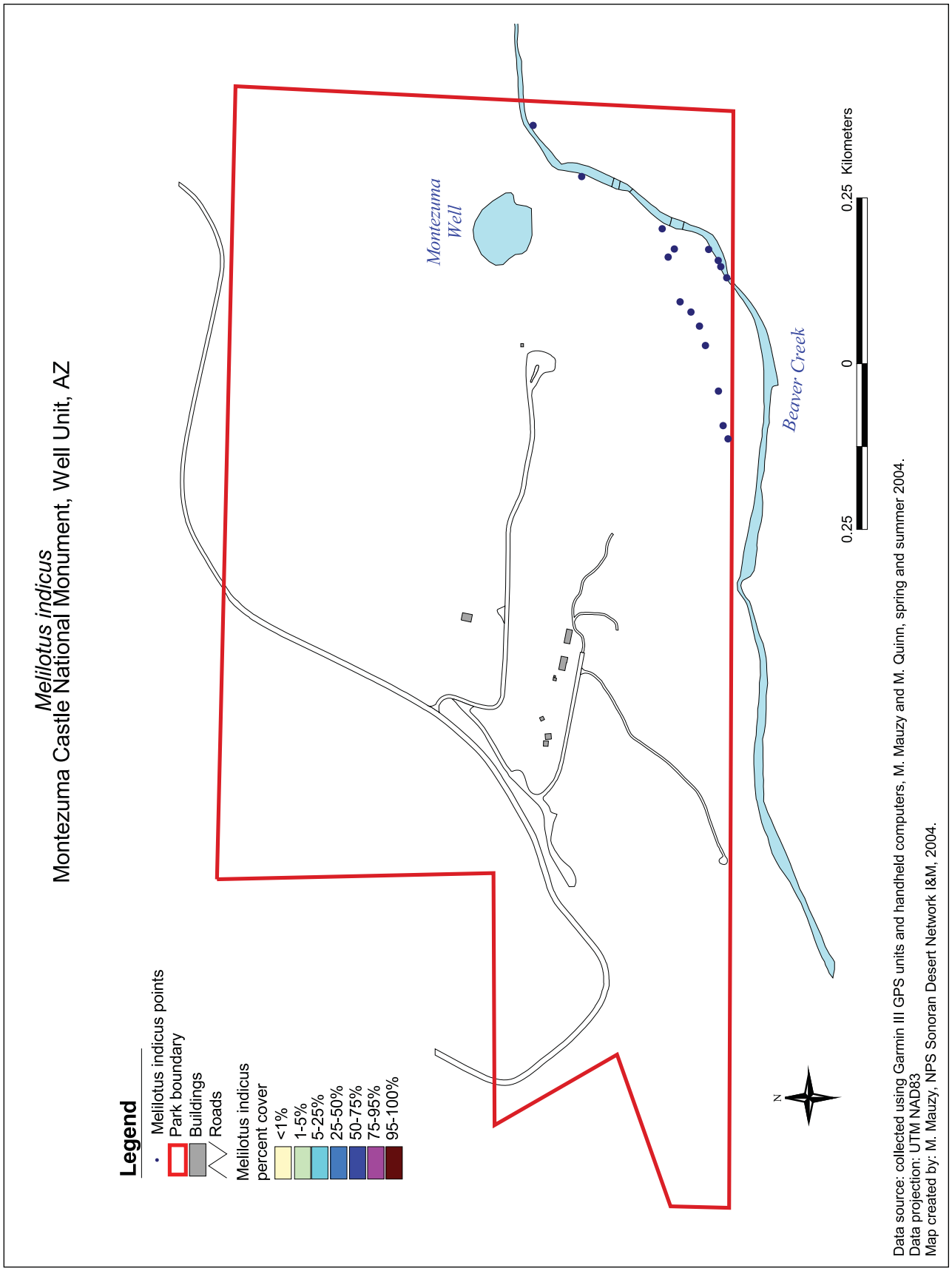

Hordeum spp.
Montezuma Castle National Monument, Well Unit, AZ
Legend
Hordeum spp. points
Park boundary
Buildings
Roads
Hordeum spp. percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
N
0.25
0
0.25
Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

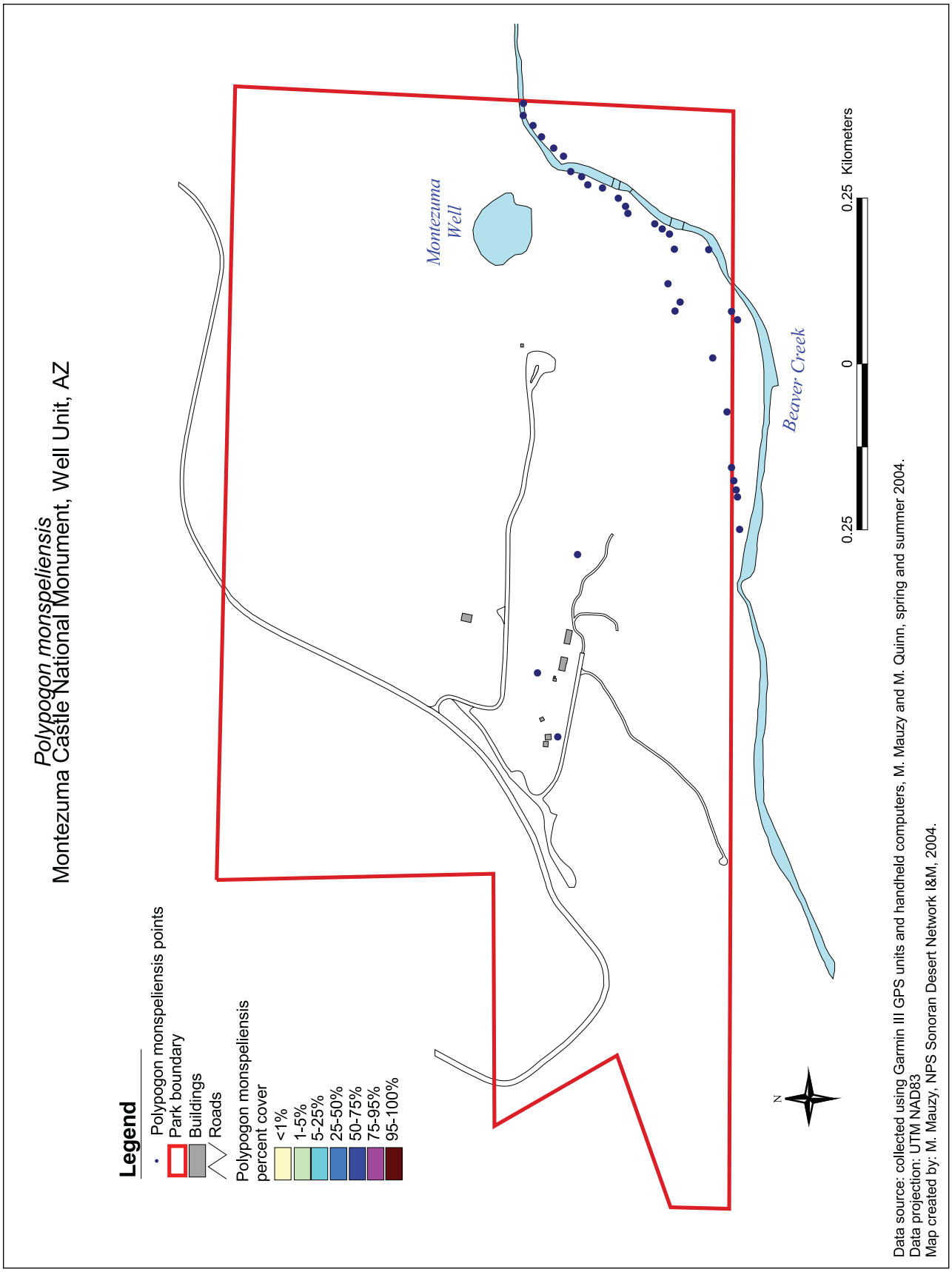

Lactuca serriola
Montezuma Castle National Monument, Well Unit, AZ
Legend
Lactuca serriola points
Park boundary
Buildings
Roads
Lactuca serriola
percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma
Well
Beaver Creek
N
0.25
0
0.25
Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

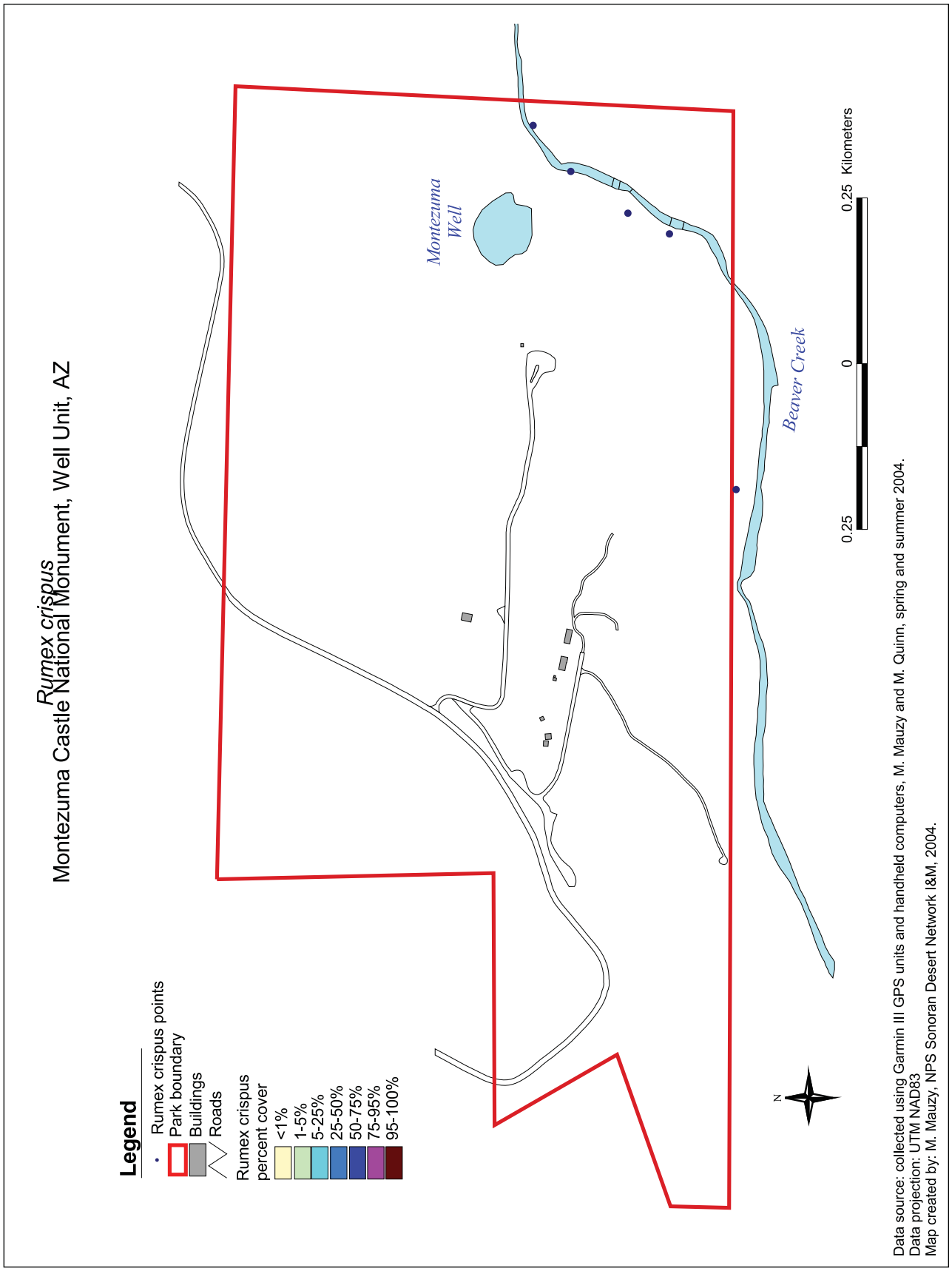

Linaria dalmatica
Montezuma Castle National Monument, Well Unit, AZ
Legend
Linaria dalmatica points
Park boundary
Buildings
Roads
Linaria dalmatica percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
N
0.25
0
0.25 Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

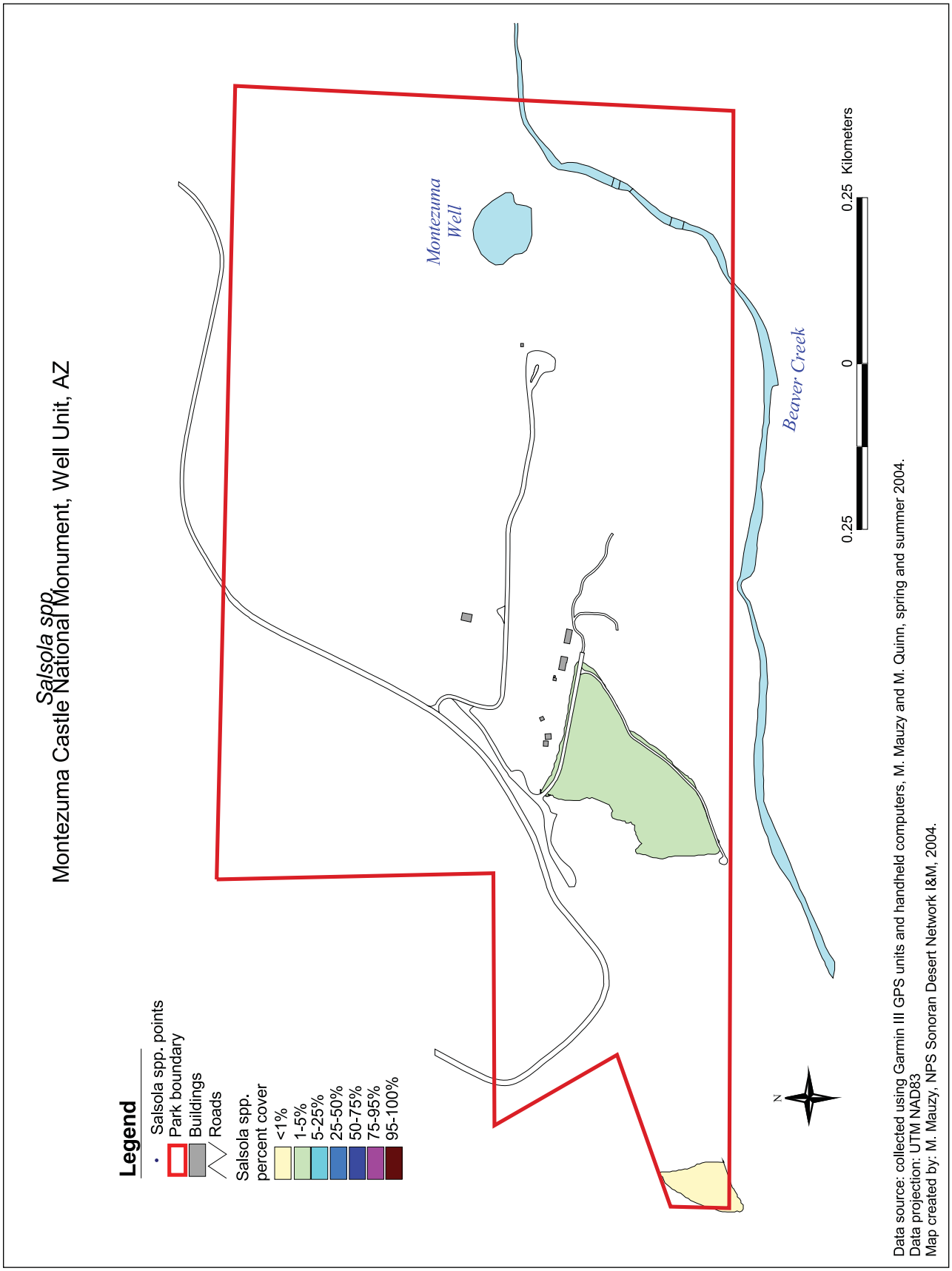

Marrubium vulgare
Montezuma Castle National Monument, Well Unit, AZ
Legend
Marrubium vulgare points
Park boundary
Buildings
Roads
Marrubium vulgare percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
N
0.25
0
0.25 Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

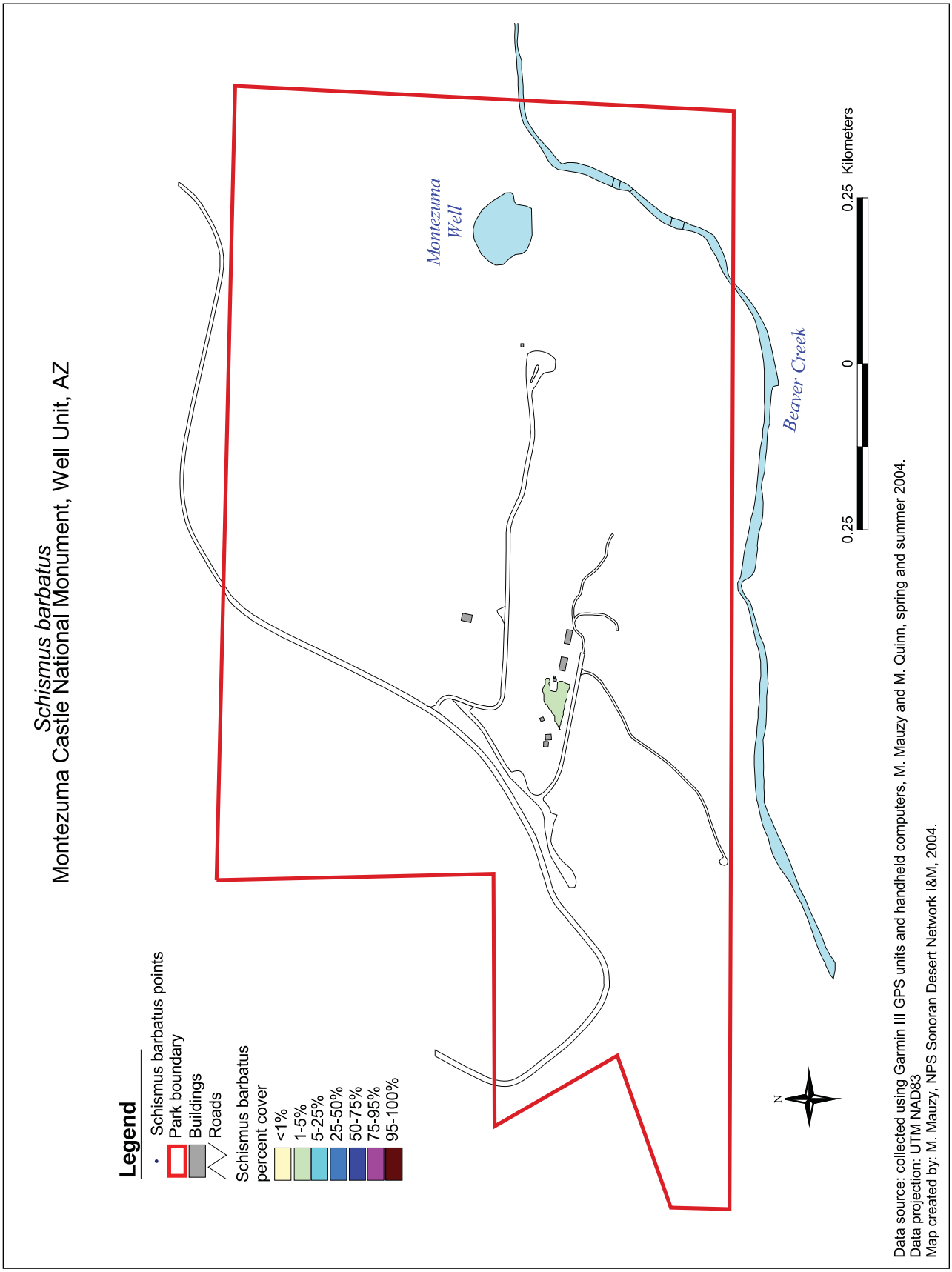

Melilotus albus
Montezuma Castle National Monument, Well Unit, AZ
Legend
Melilotus albus points
Park boundary
Buildings
Roads
Melilotus albus
percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma
Well
Beaver Creek
N
0.25
0
0.25
Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

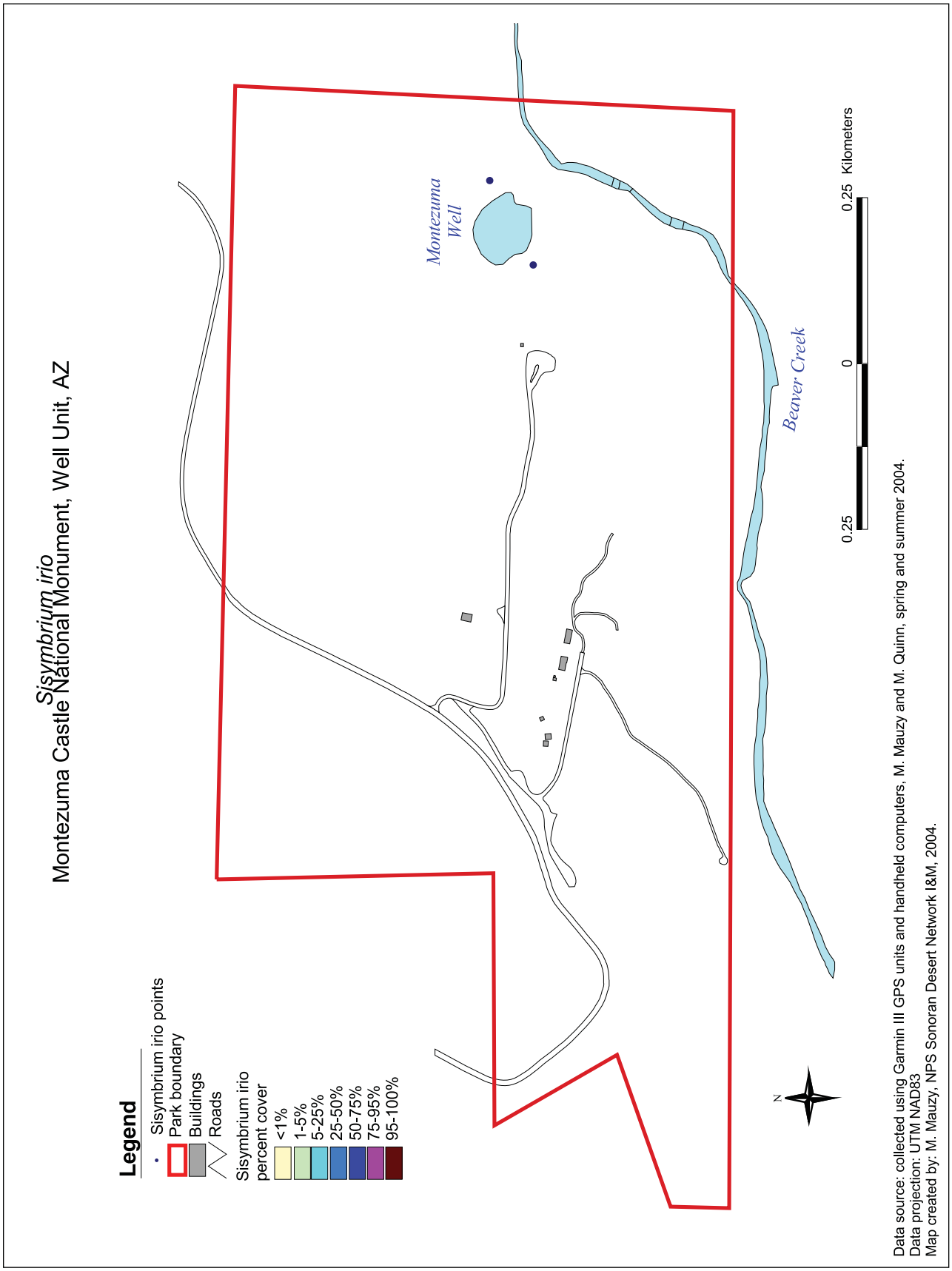

Melilotus indicus
Montezuma Castle National Monument, Well Unit, AZ
Legend
Melilotus indicus points
Park boundary
Buildings
Roads
Melilotus indicus
percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma
Well
Beaver Creek
N
0.25
0
0.25 Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

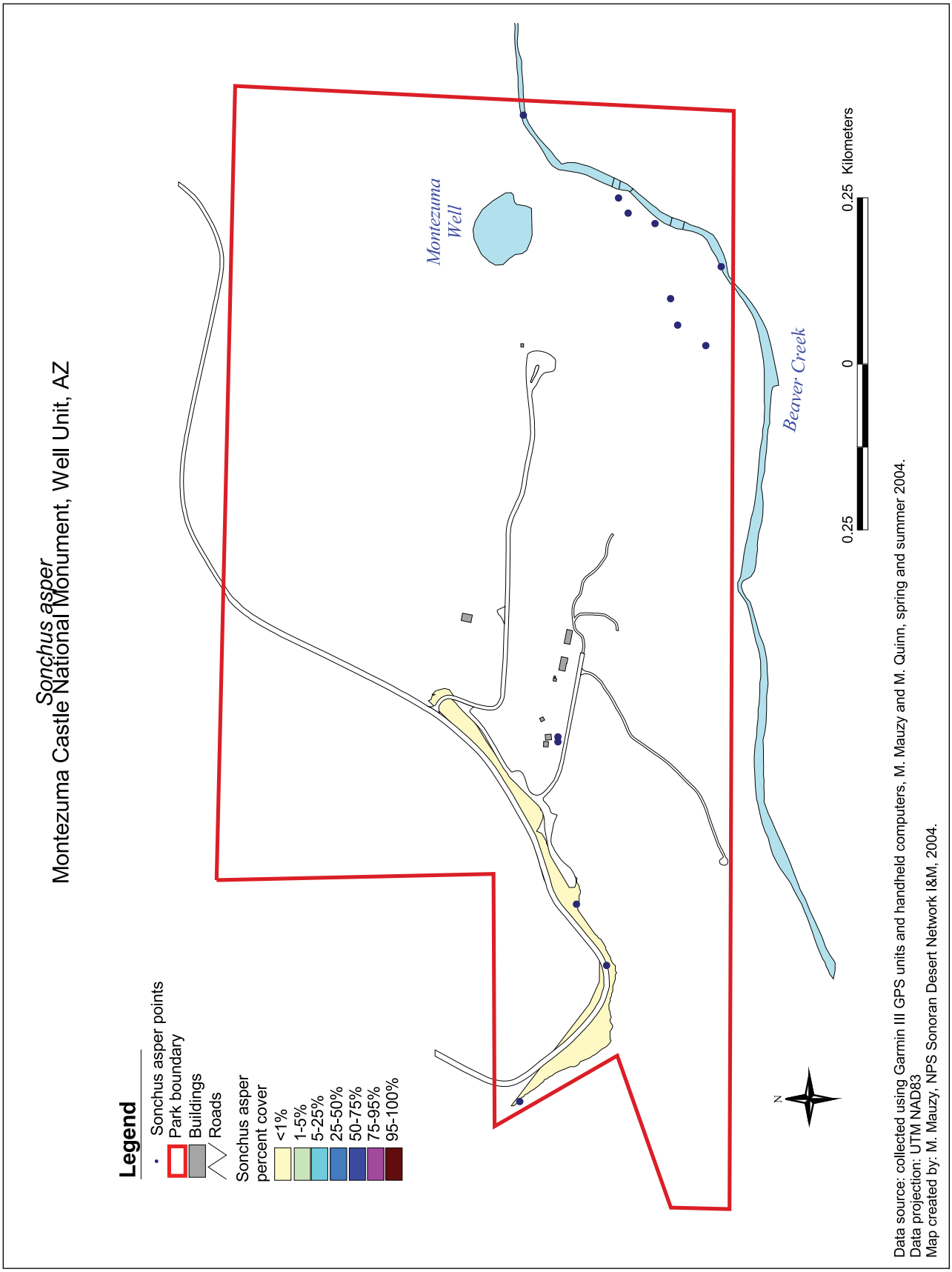

Polypogon monspeliensis
Montezuma Castle National Monument, Well Unit, AZ
Legend
Polypogon monspeliensis points
Park boundary
Buildings
Roads
Polypogon monspeliensis
percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

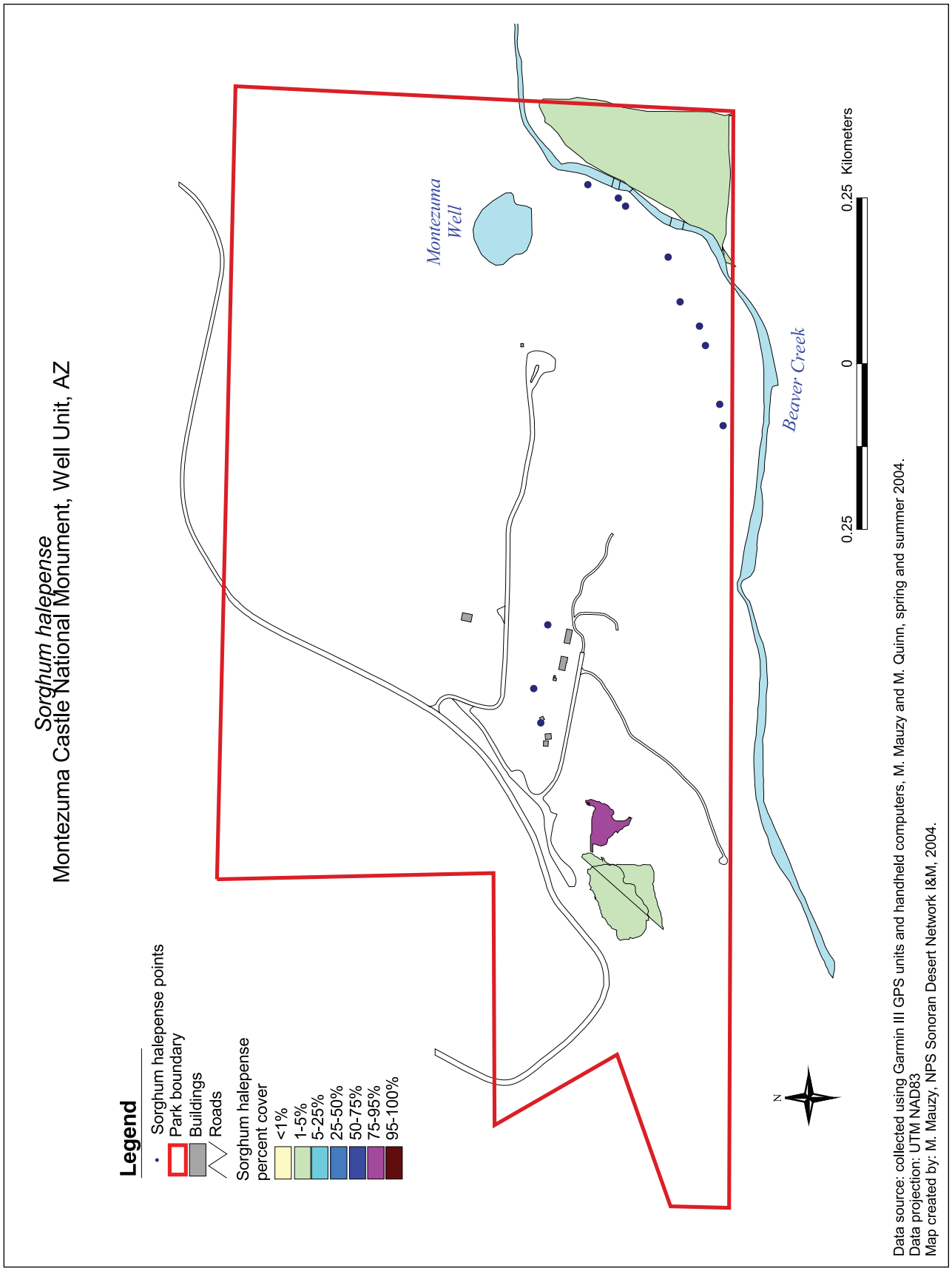

Rumex crispus
Montezuma Castle National Monument, Well Unit, AZ
Legend
Rumex crispus points
Park boundary
Buildings
Roads
Rumex crispus
percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma
Well
Beaver Creek
N
0.25
0
0.25
Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

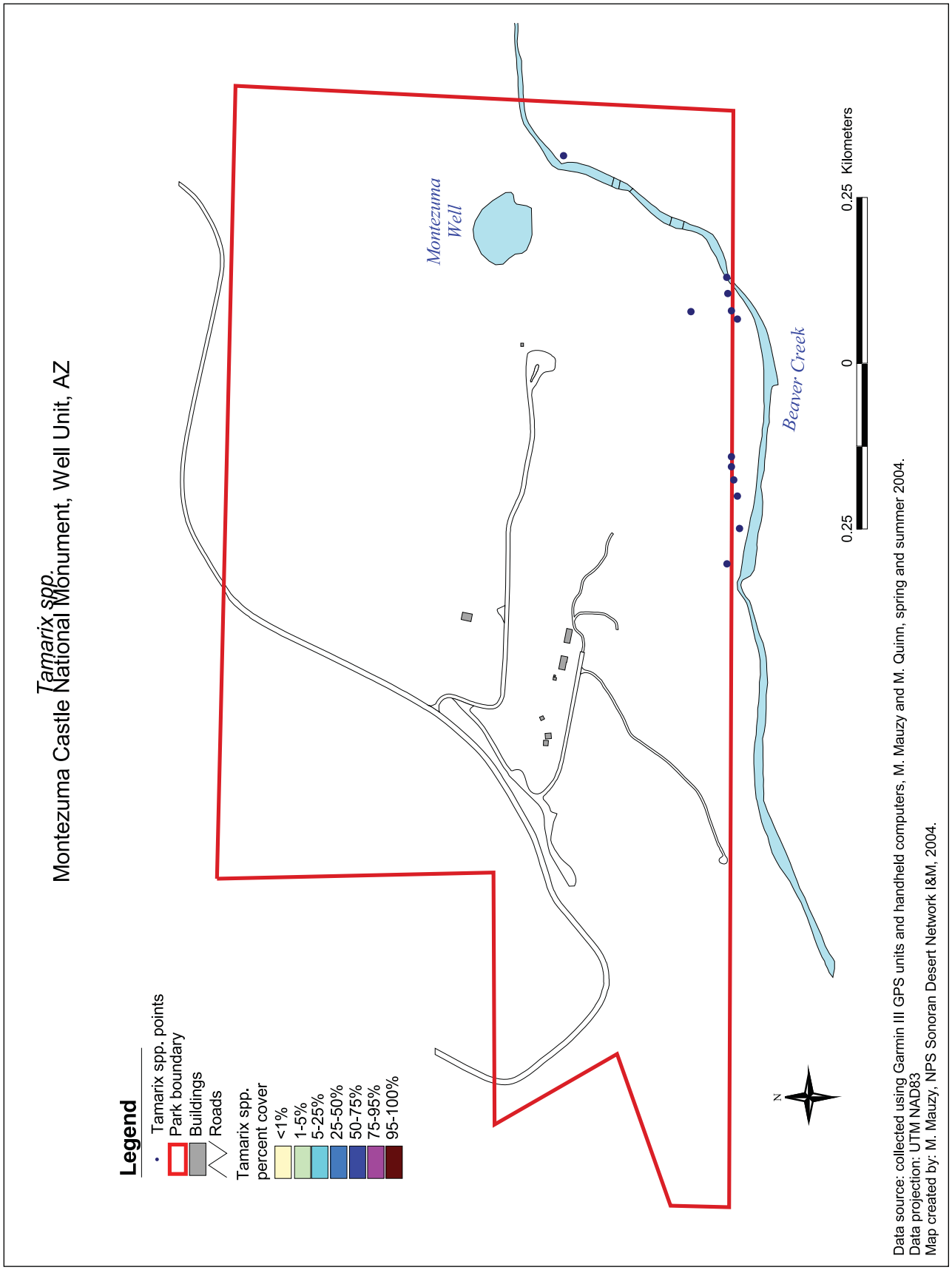

Salsola spp.
Montezuma Castle National Monument, Well Unit, AZ
Legend
Salsola spp. points
Park boundary
Buildings
Roads
Salsola spp. percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
N
0.25
0
0.25 Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

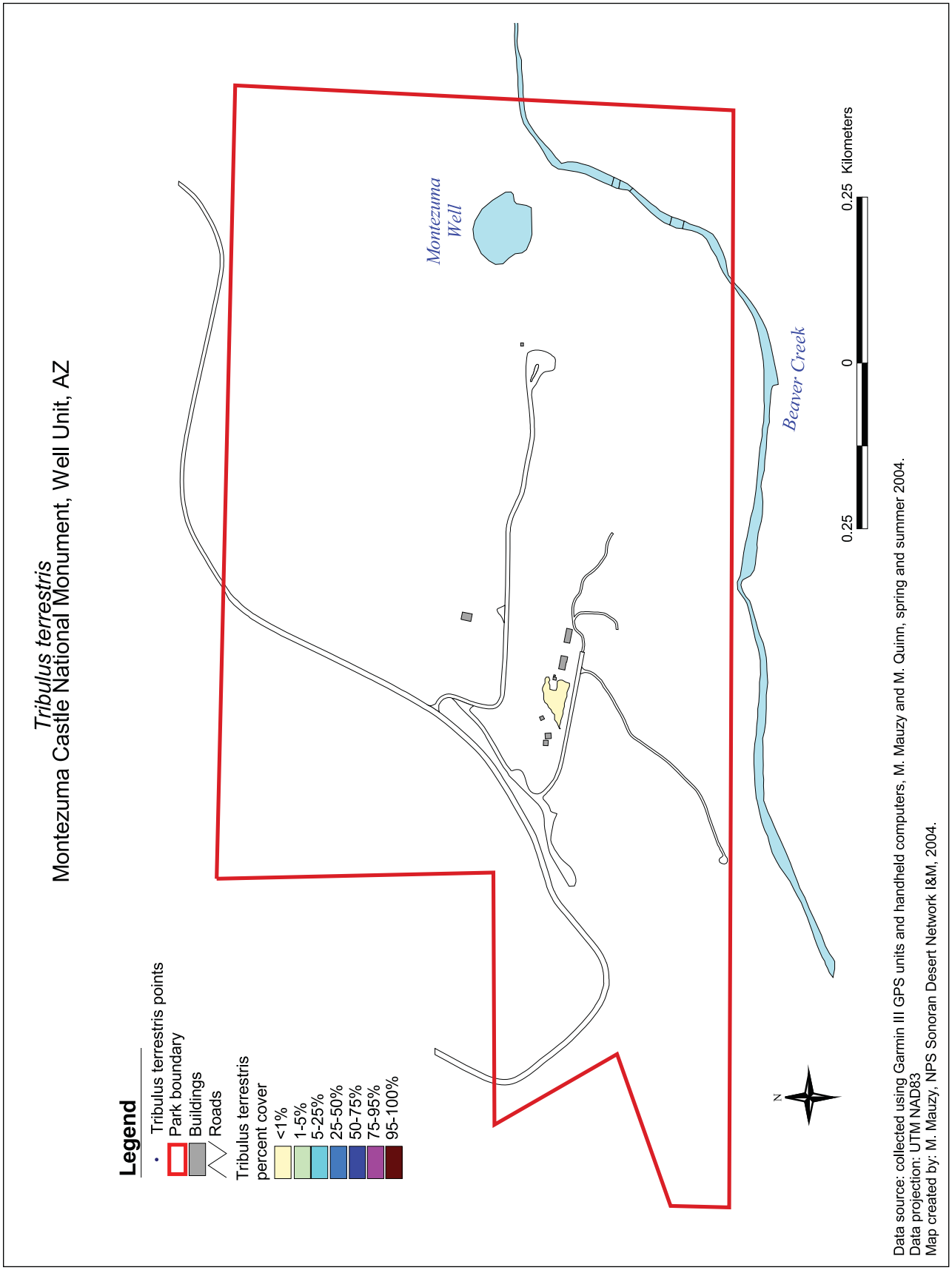

Schismus barbatus
Montezuma Castle National Monument, Well Unit, AZ
Legend
Schismus barbatus points
Park boundary
Buildings
Roads
Schismus barbatus
percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma
Well
Beaver Creek
N
0.25
0
0.25 Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

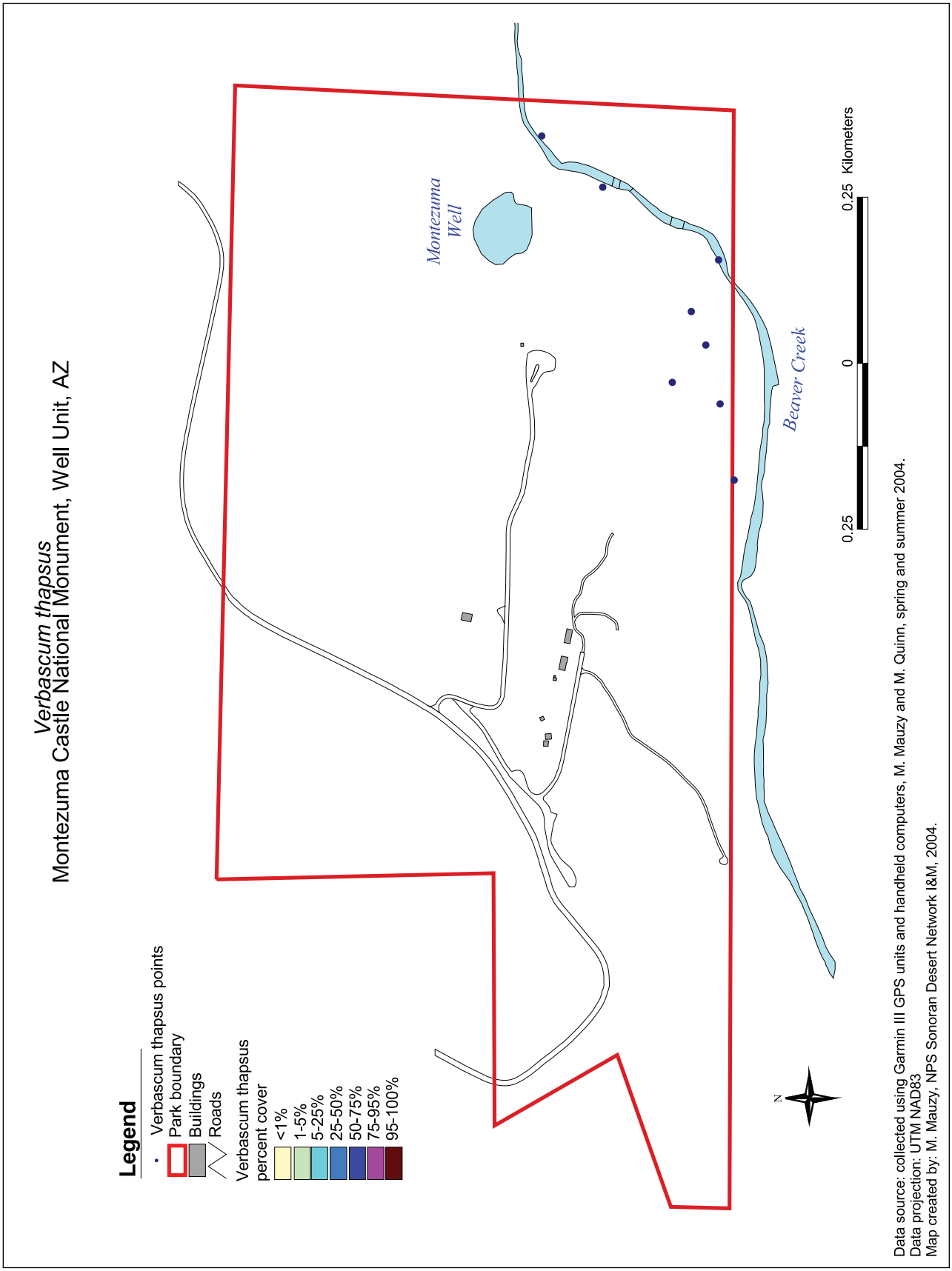

Sisymbrium irio
Montezuma Castle National Monument, Well Unit, AZ
Legend
Sisymbrium irio points
Park boundary
Buildings
Roads
Sisymbrium irio
percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma
Well
Beaver Creek
N
0.25
0
0.25 Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

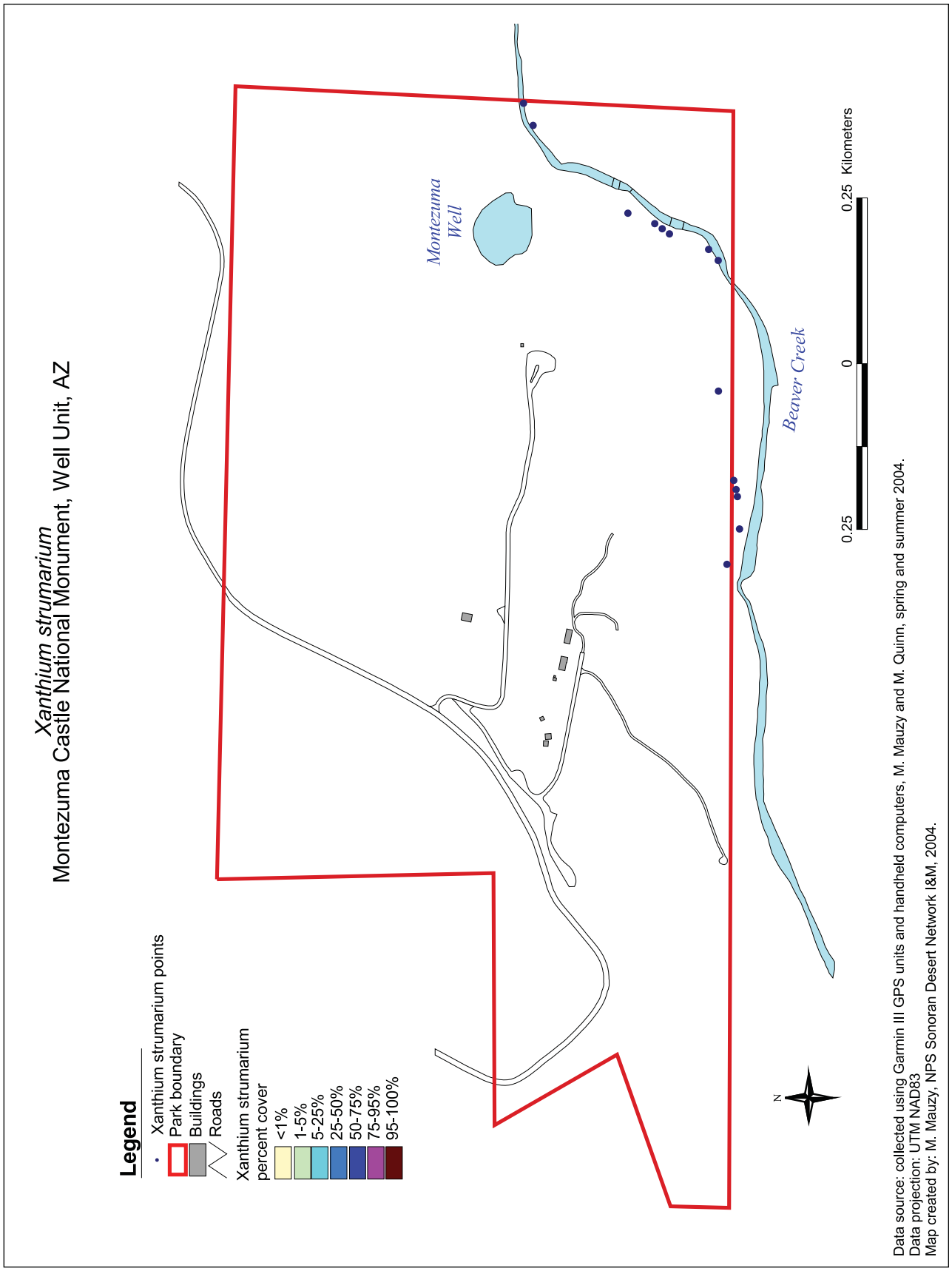

Sonchus asper
Montezuma Castle National Monument, Well Unit, AZ
Legend
Sonchus asper points
Park boundary
Buildings
Roads
Sonchus asper percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
N
0.25
0
0.25 Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

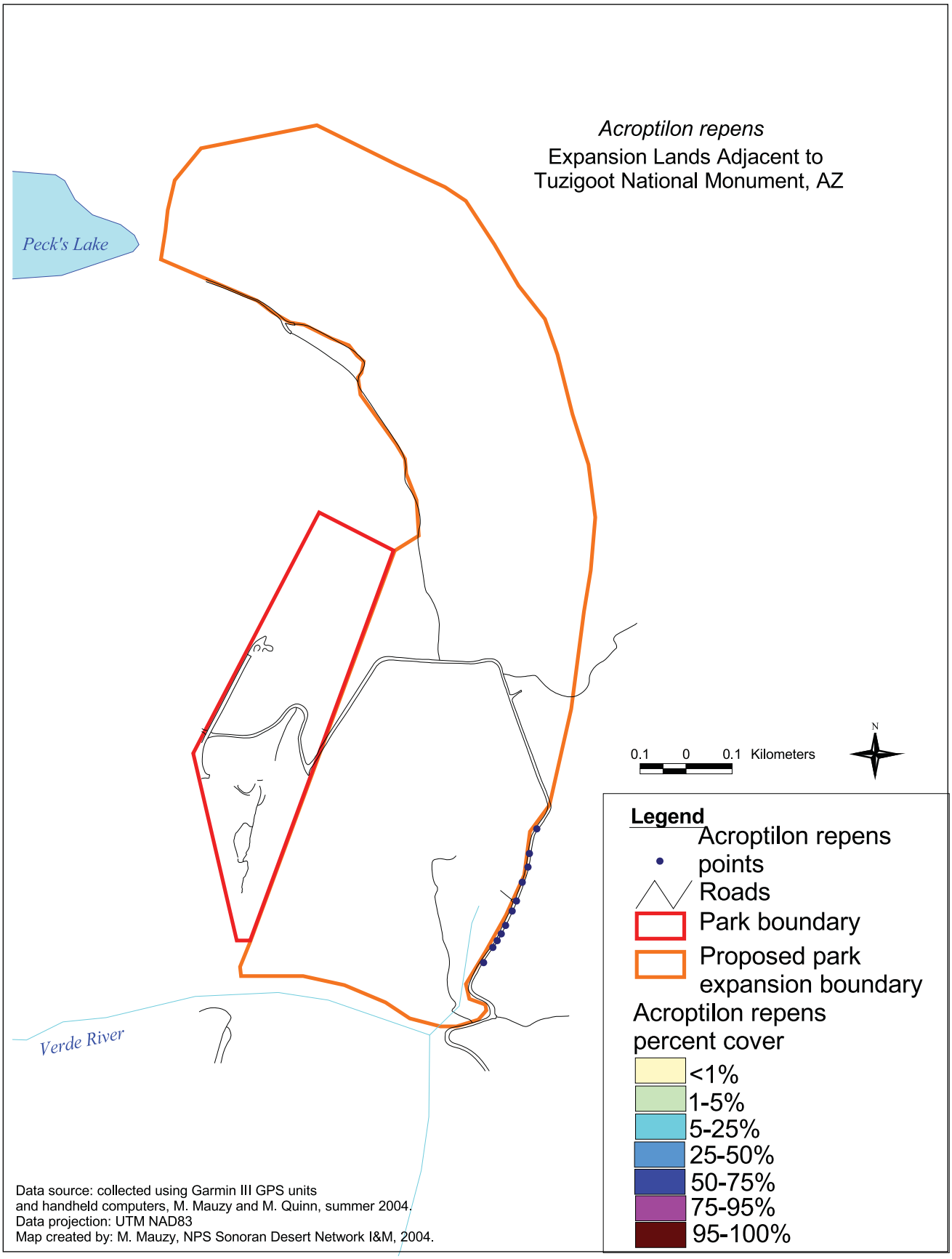

Sorghum halepense
Montezuma Castle National Monument, Well Unit, AZ
Legend
Sorghum halepense points
Park boundary
Buildings
Roads
Sorghum halepense
percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma
Well
Beaver Creek
0.25
0
0.25 Kilometers
N
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

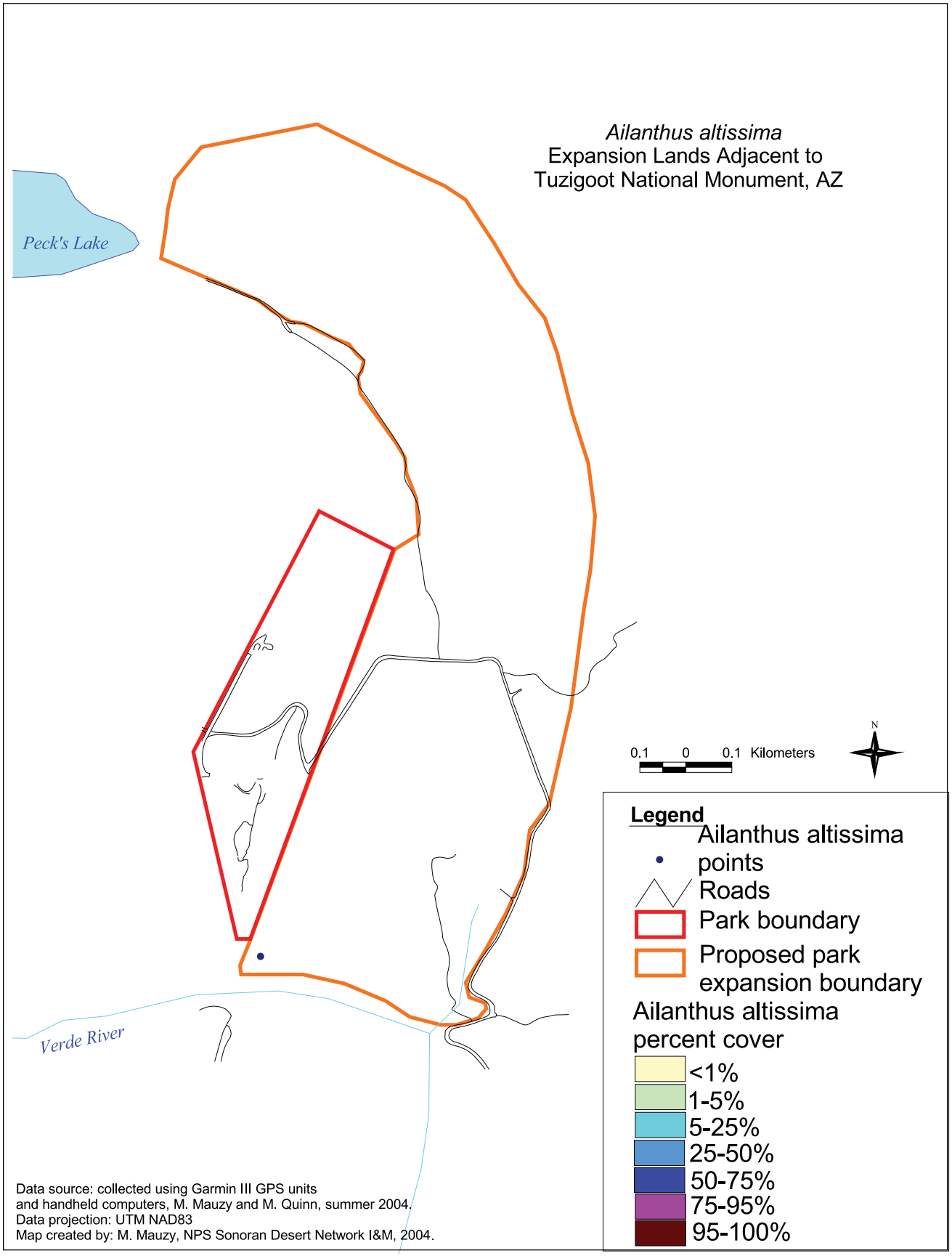

Tamarix spp.
Montezuma Castle National Monument, Well Unit, AZ
Legend
Tamarix spp. points
Park boundary
Buildings
Roads
Tamarix spp. percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
N
0.25
0
0.25 Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

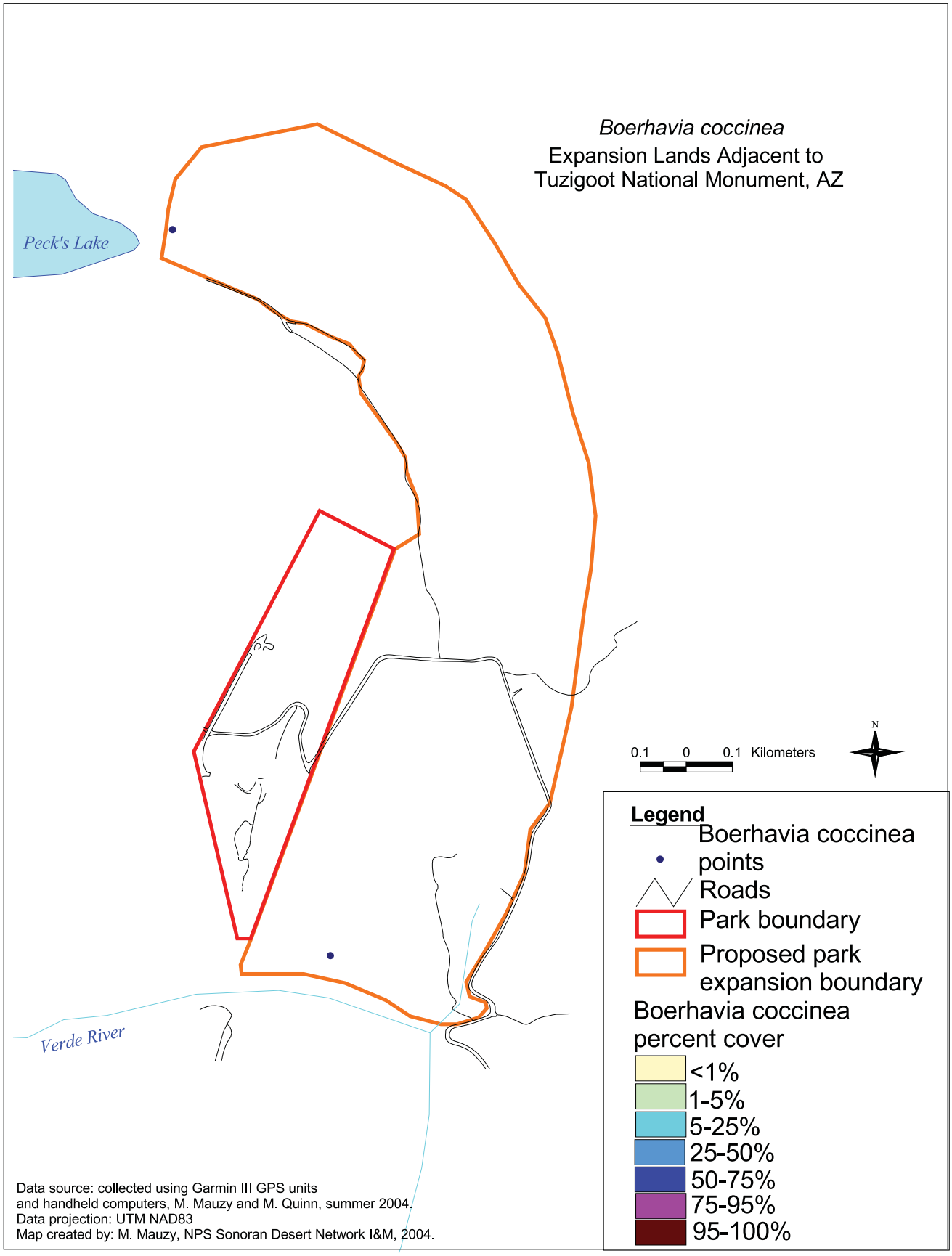

Tribulus terrestris
Montezuma Castle National Monument, Well Unit, AZ
Legend
Tribulus terrestris points
Park boundary
Buildings
Roads
Tribulus terrestris percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma Well
Beaver Creek
N
0.25
0
0.25 Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

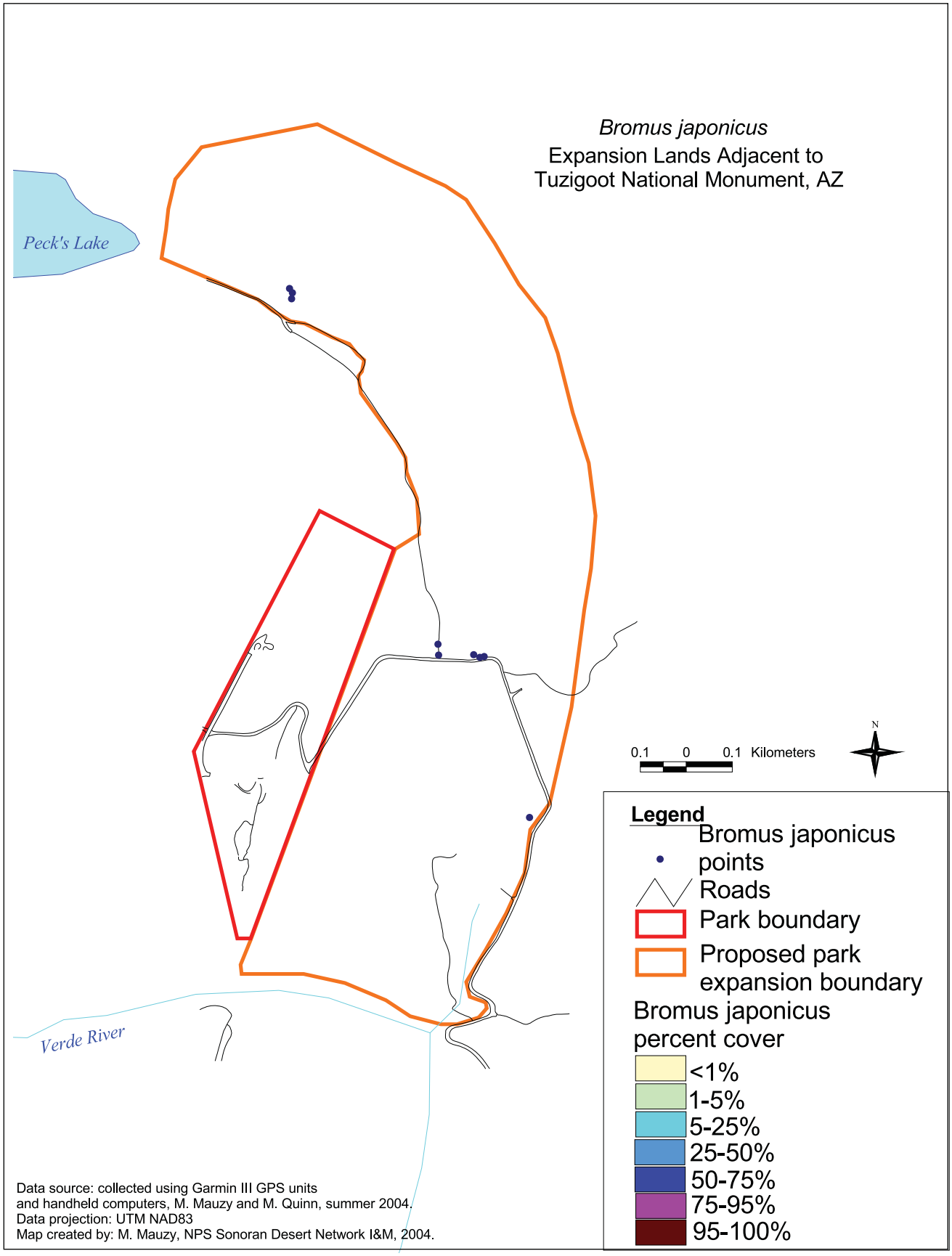

Verbascum thapsus
Montezuma Castle National Monument, Well Unit, AZ
Legend
Verbascum thapsus points
Park boundary
Buildings
Roads
Verbascum thapsus
percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma
Well
Beaver Creek
N
0.25
0
0.25 Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

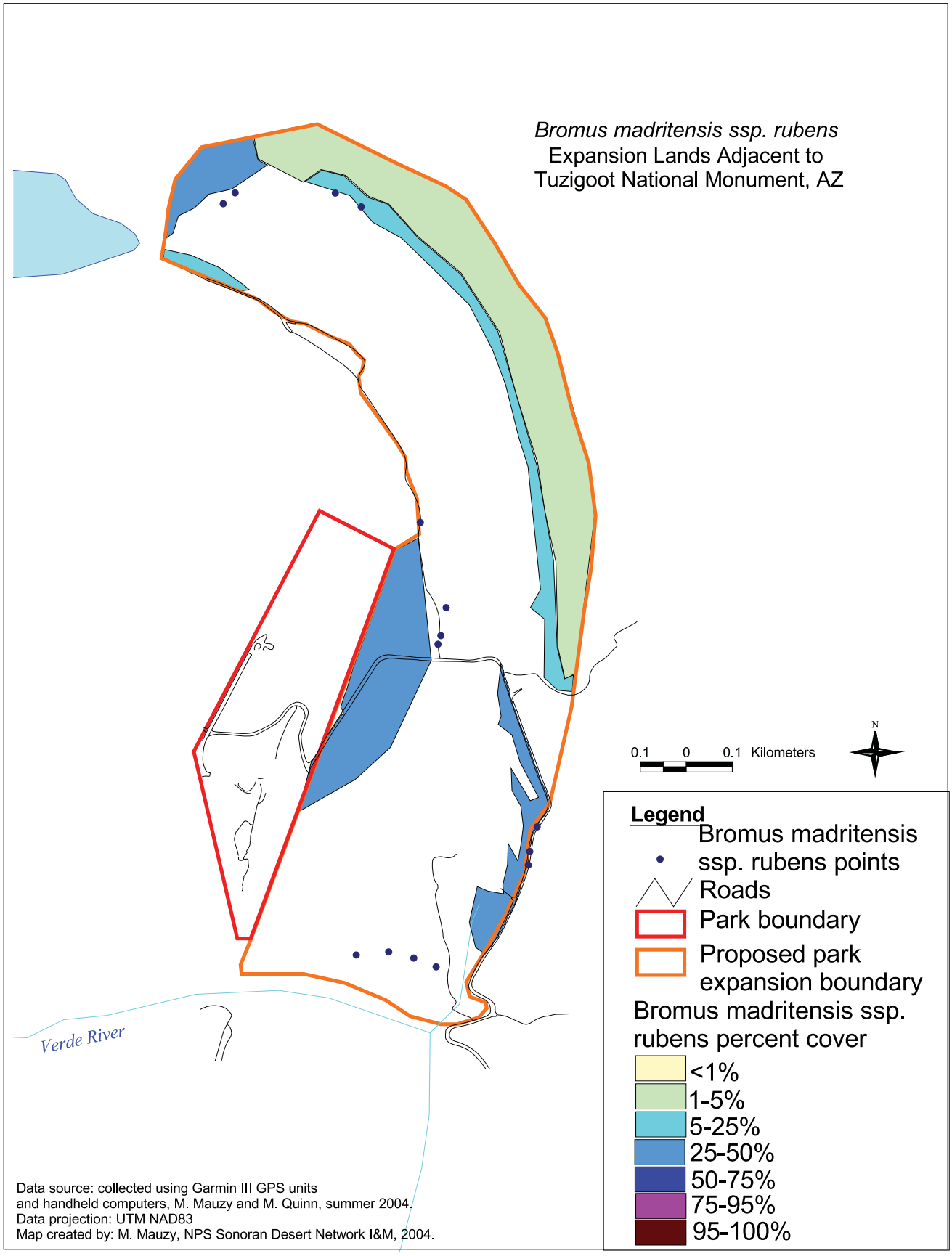

Xanthium strumarium
Montezuma Castle National Monument, Well Unit, AZ
Legend
Xanthium strumarium points
Park boundary
Buildings
Roads
Xanthium strumarium
percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Montezuma
Well
Beaver Creek
N
0.25
0
0.25 Kilometers
Data source: collected using Garmin III GPS units and handheld computers, M. Mauzy and M. Quinn, spring and summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

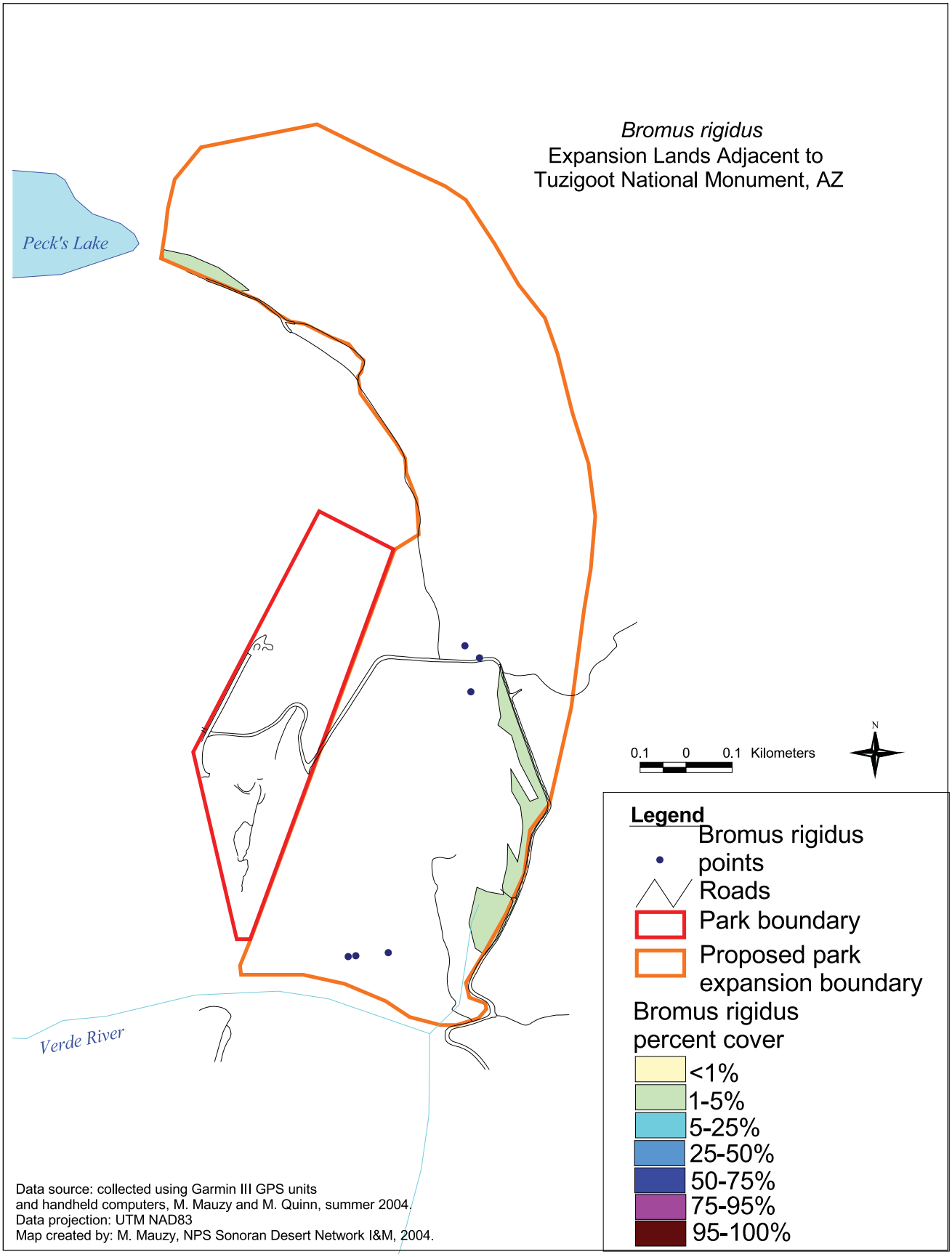

Acroptilon repens
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Acroptilon repens points
Roads
Park boundary
Proposed park expansion boundary
Acroptilon repens percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

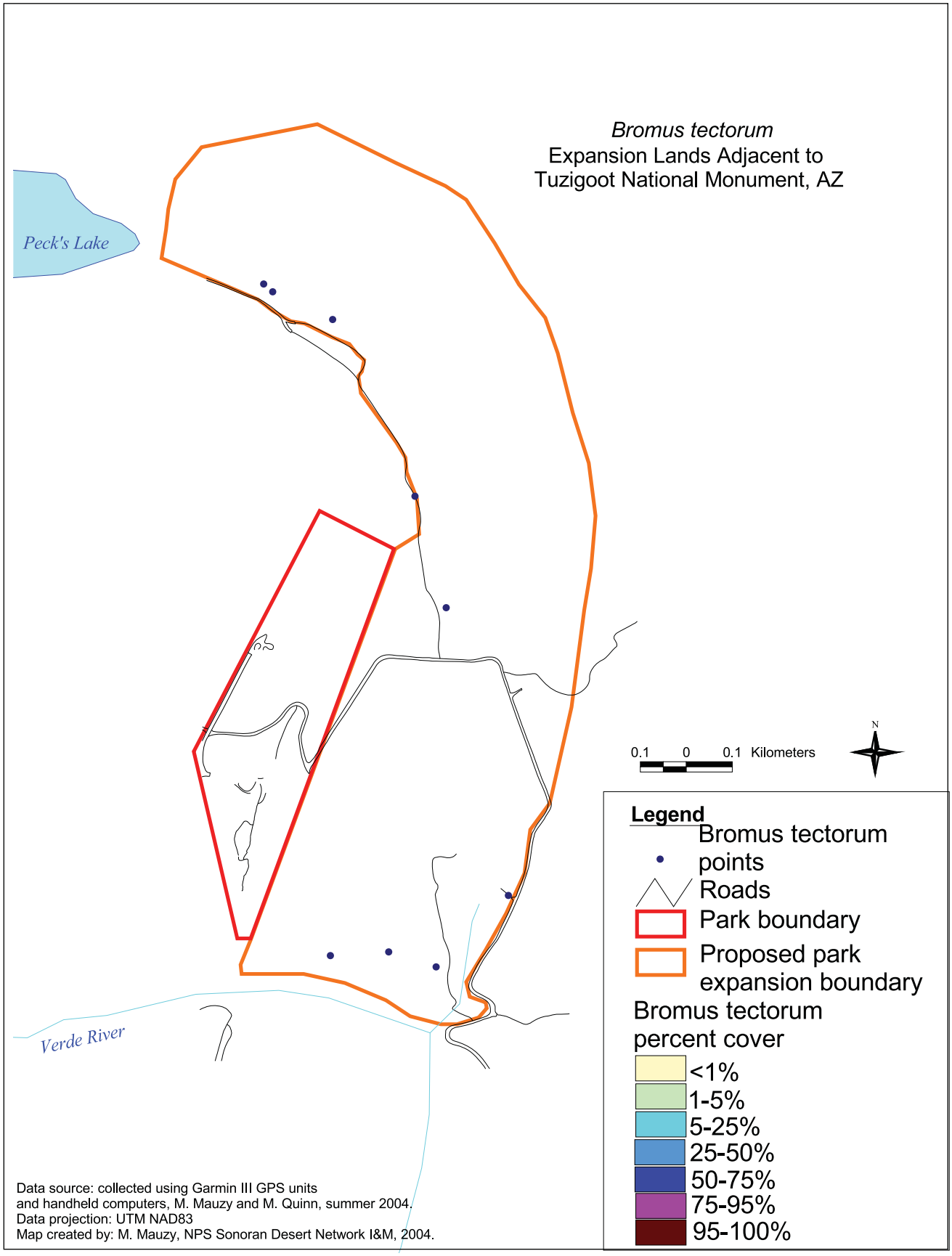

Ailanthus altissima
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Ailanthus altissima points
Roads
Park boundary
Proposed park expansion boundary
Ailanthus altissima percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

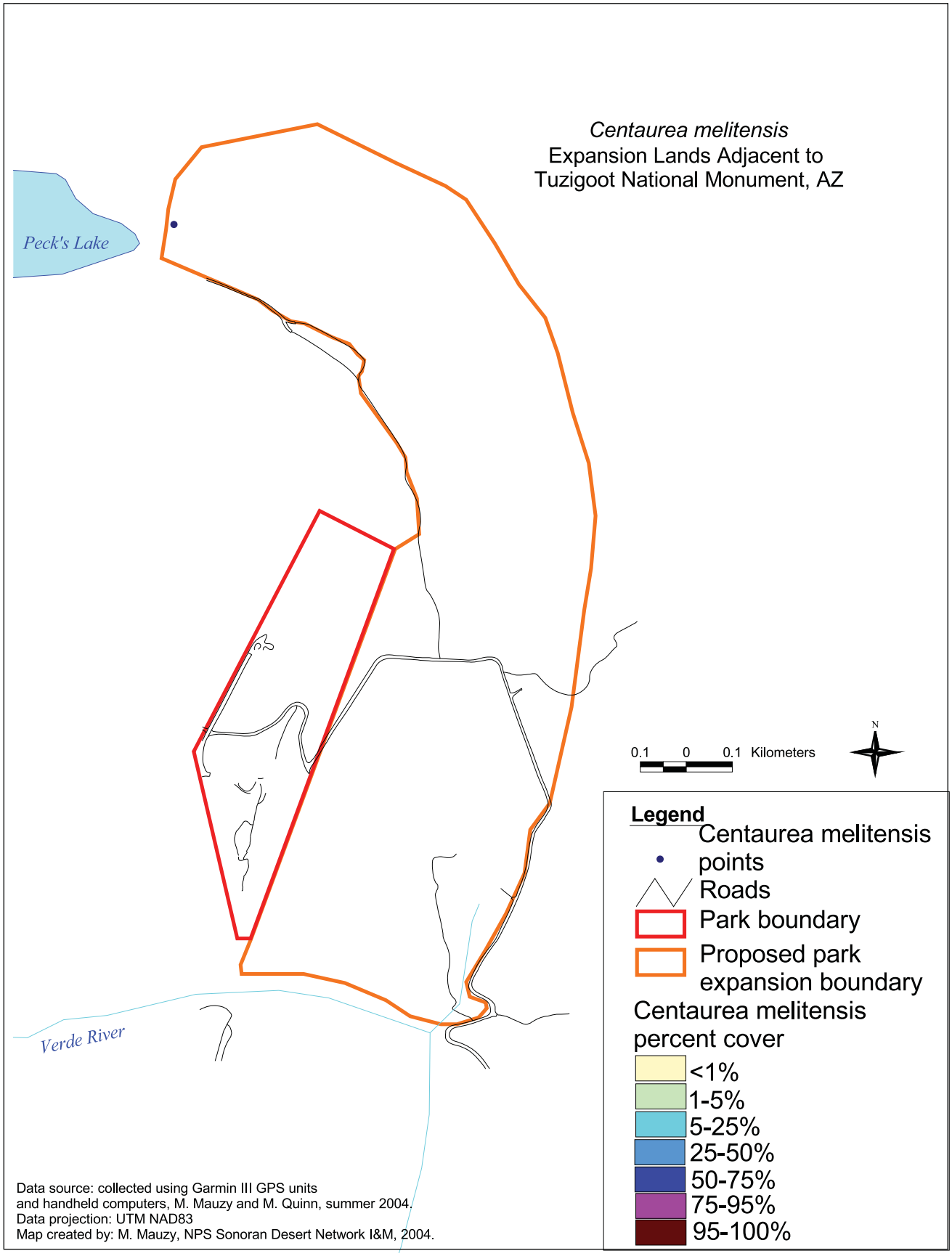

Boerhavia coccinea
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Boerhavia coccinea points
Roads
Park boundary
Proposed park expansion boundary
Boerhavia coccinea percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

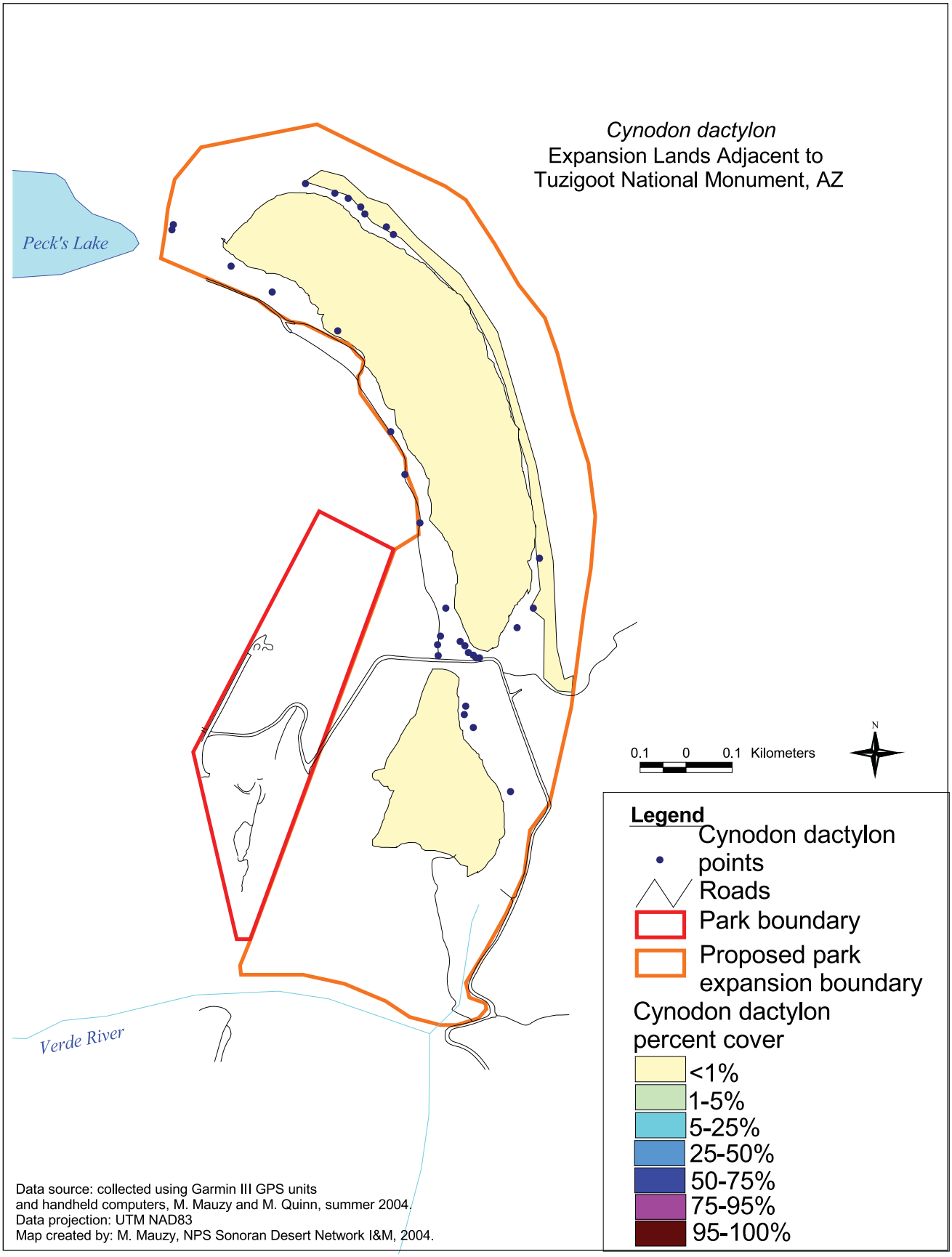

Bromus japonicus
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Bromus japonicus points
Roads
Park boundary
Proposed park expansion boundary
Bromus japonicus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

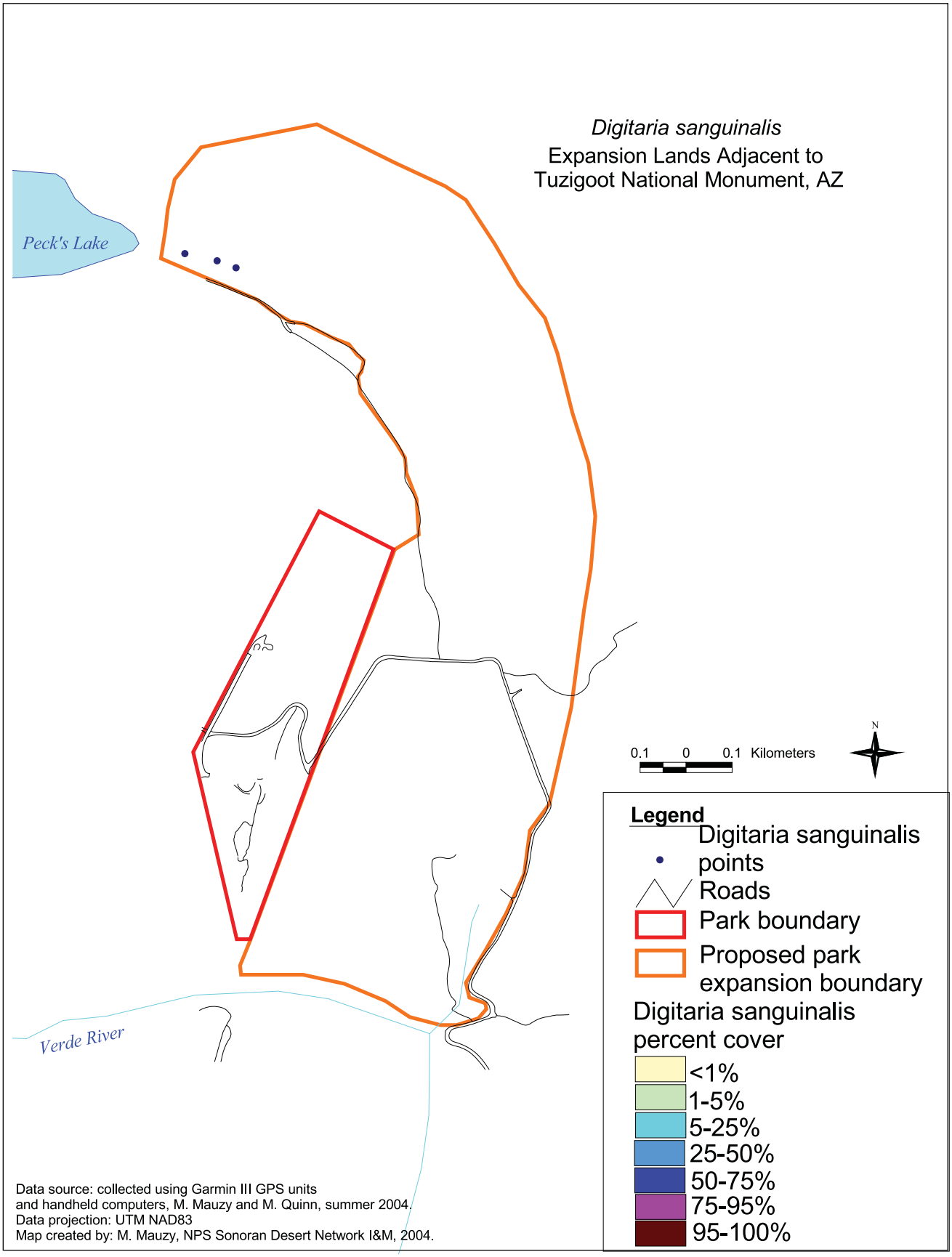

Bromus madritensis ssp. rubens
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
0.1 0 0.1 Kilometers
N
Legend
Bromus madritensis ssp. rubens points
Roads
Park boundary
Proposed park expansion boundary
Bromus madritensis ssp. rubens percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Verde River
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

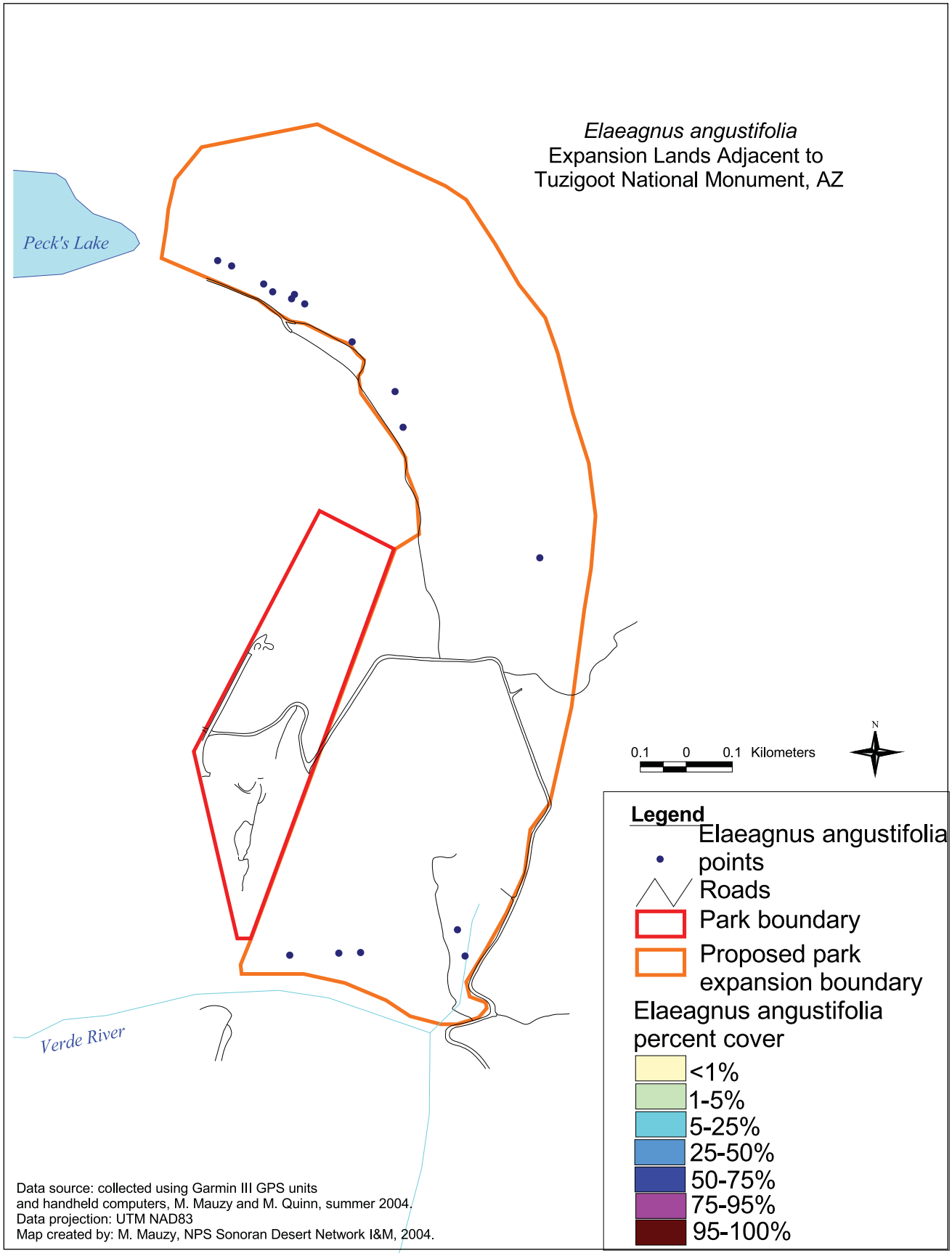

Bromus rigidus
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Bromus rigidus points
Roads
Park boundary
Proposed park expansion boundary
Bromus rigidus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

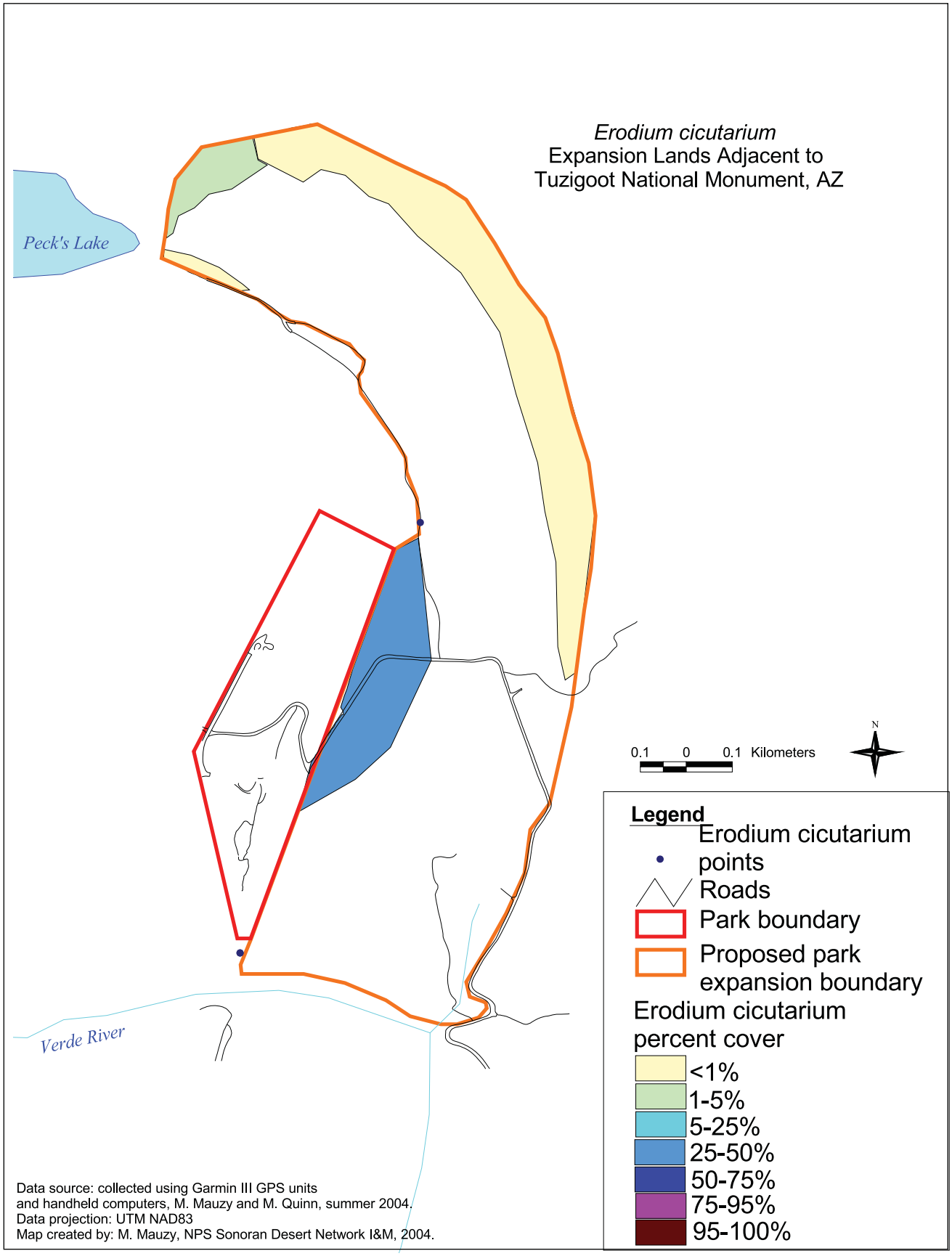

Bromus tectorum
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Bromus tectorum points
Roads
Park boundary
Proposed park expansion boundary
Bromus tectorum percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

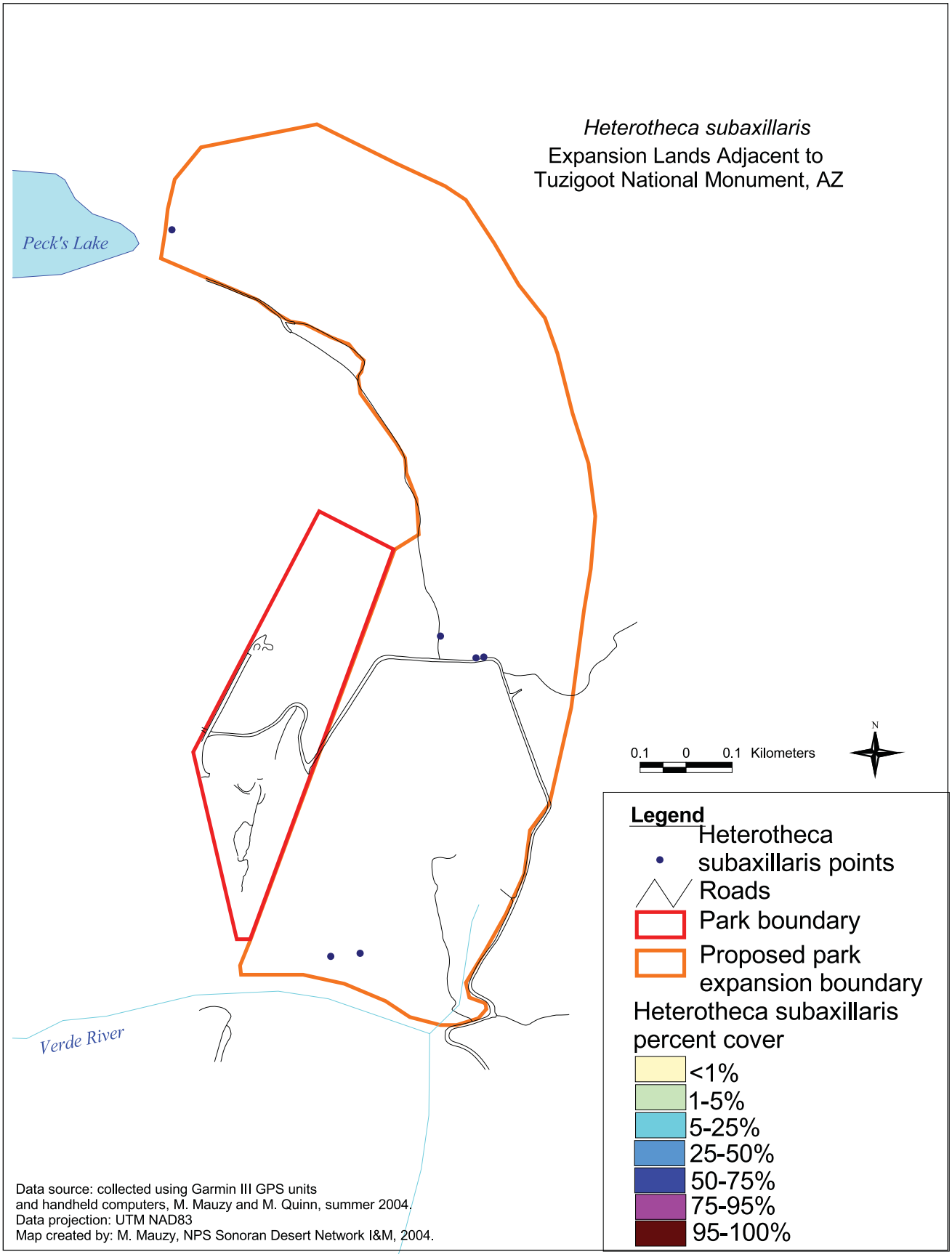

Centaurea melitensis
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Centaurea melitensis points
Roads
Park boundary
Proposed park expansion boundary
Centaurea melitensis percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

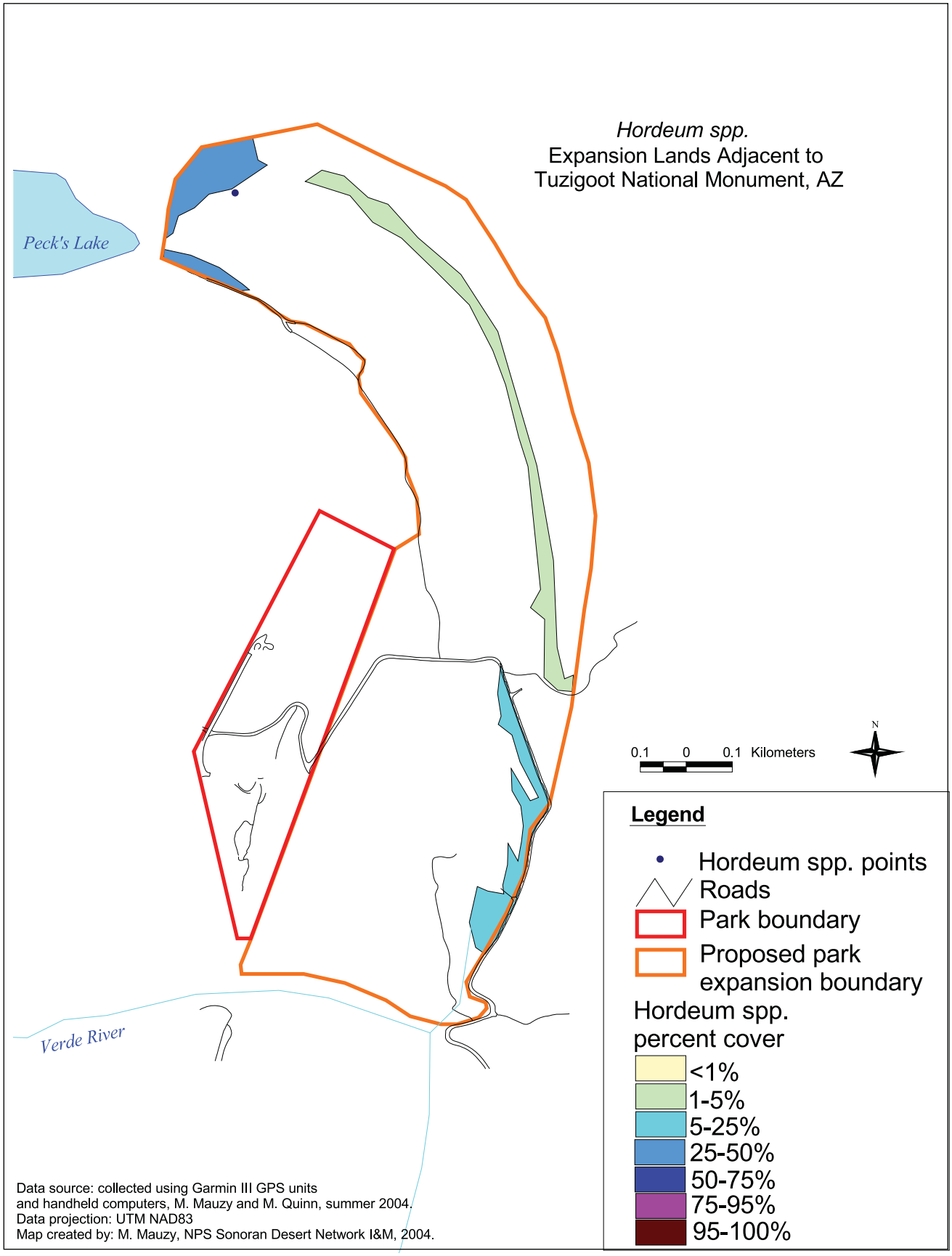

Cynodon dactylon
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Cynodon dactylon points
Roads
Park boundary
Proposed park expansion boundary
Cynodon dactylon percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

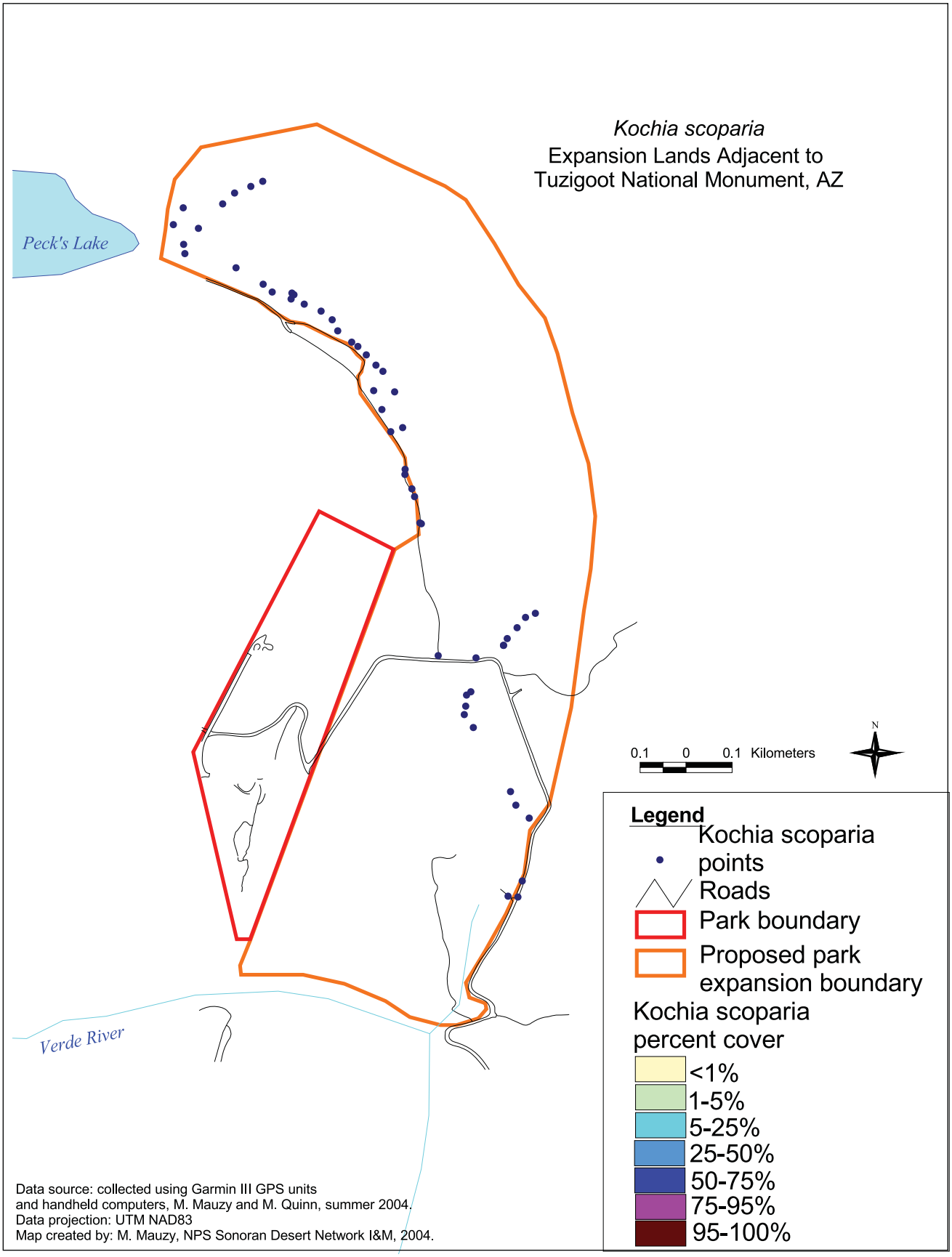

Digitaria sanguinalis
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Digitaria sanguinalis points
Roads
Park boundary
Proposed park expansion boundary
Digitaria sanguinalis percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

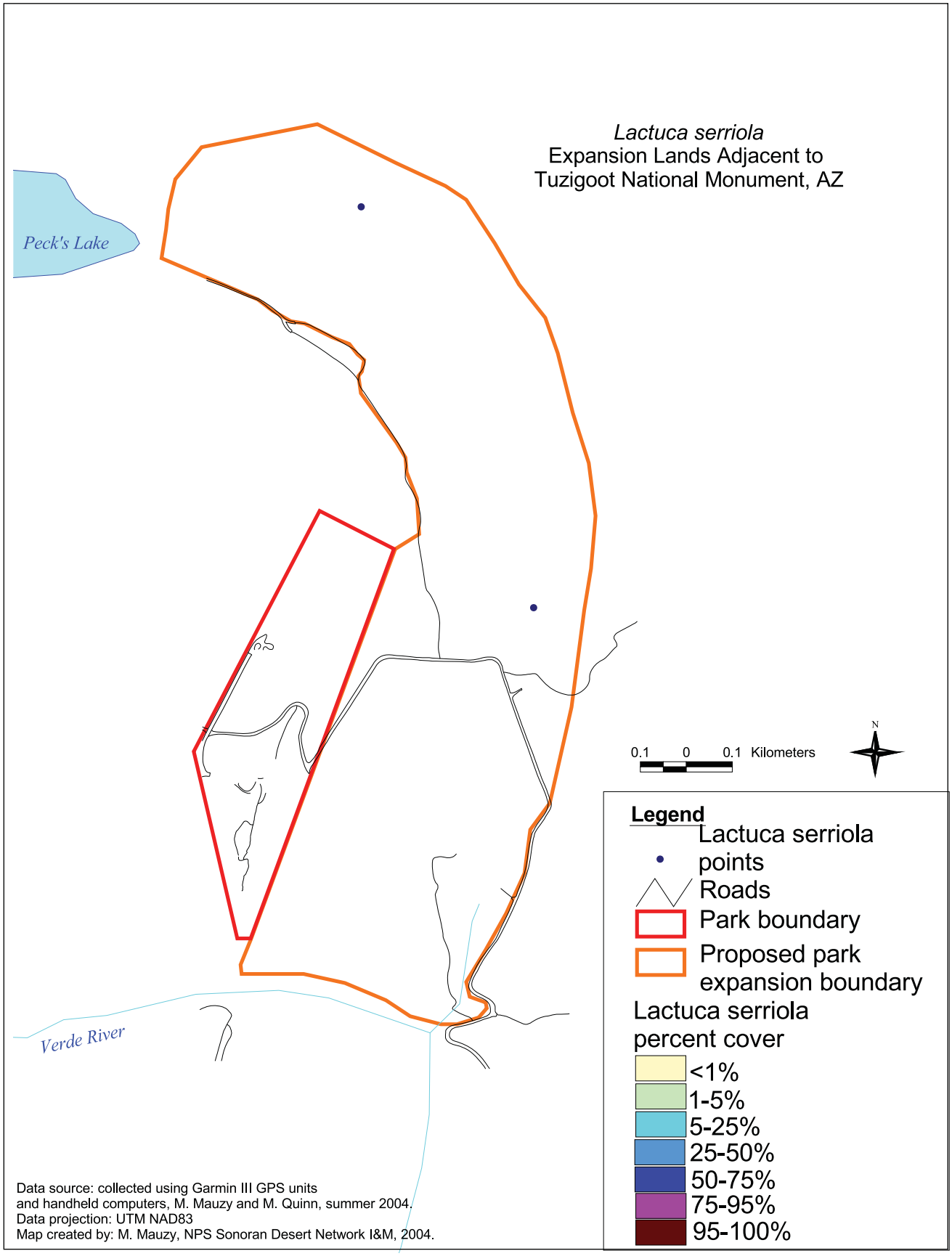

Elaeagnus angustifolia
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Elaeagnus angustifolia points
Roads
Park boundary
Proposed park expansion boundary
Elaeagnus angustifolia percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

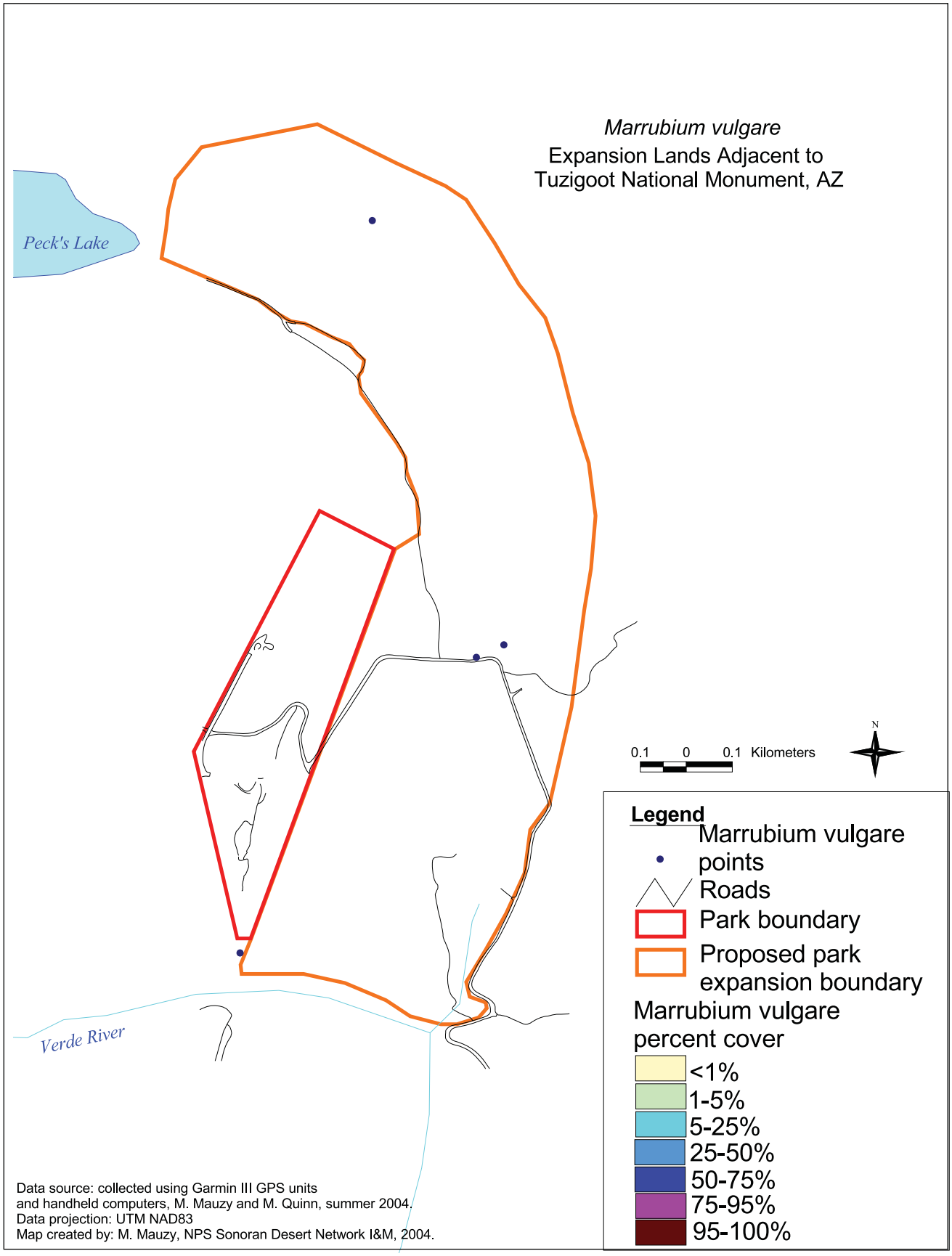

Erodium cicutarium
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Erodium cicutarium points
Roads
Park boundary
Proposed park expansion boundary
Erodium cicutarium percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

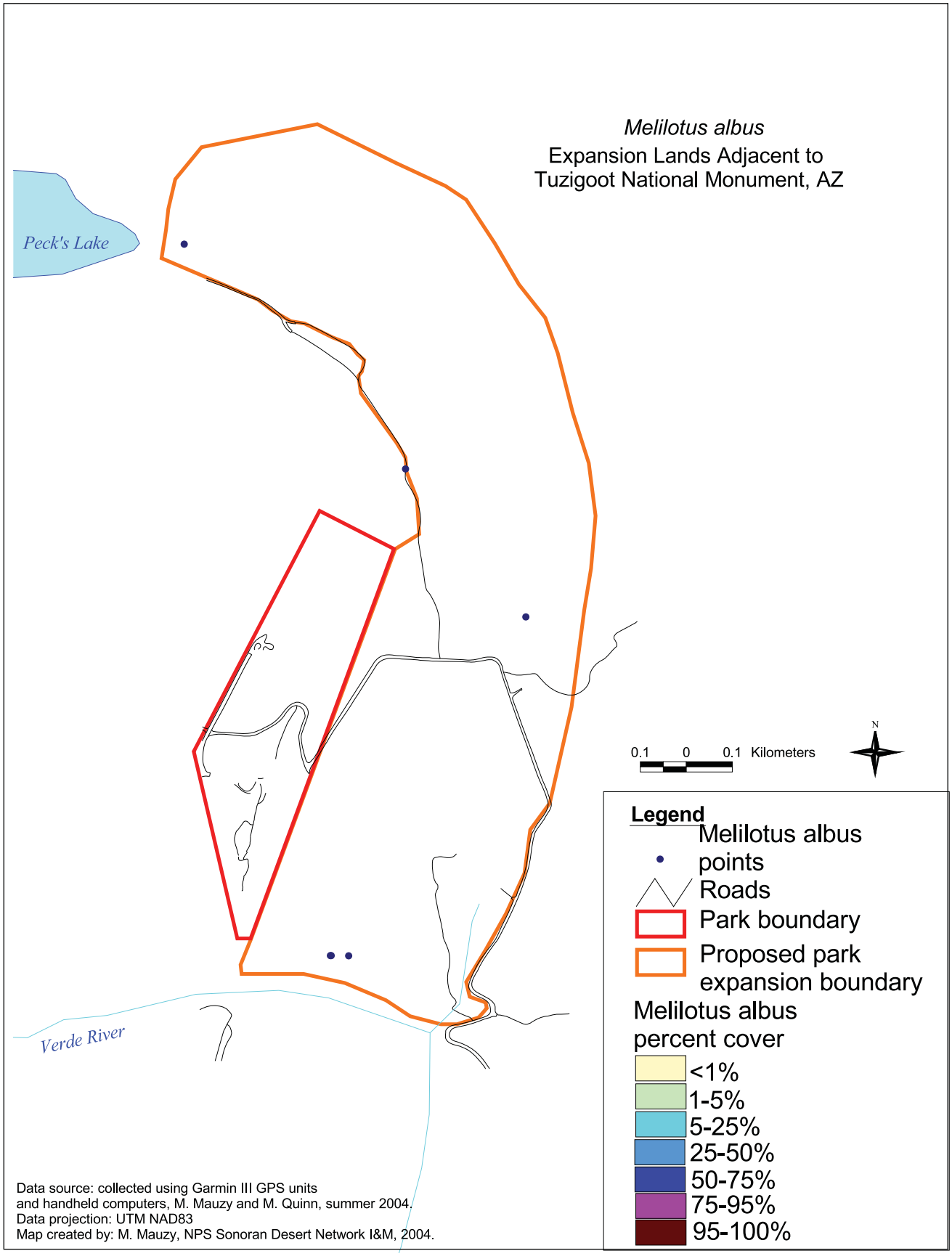

Heterotheca subaxillaris
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Heterotheca subaxillaris points
Roads
Park boundary
Proposed park expansion boundary
Heterotheca subaxillaris percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

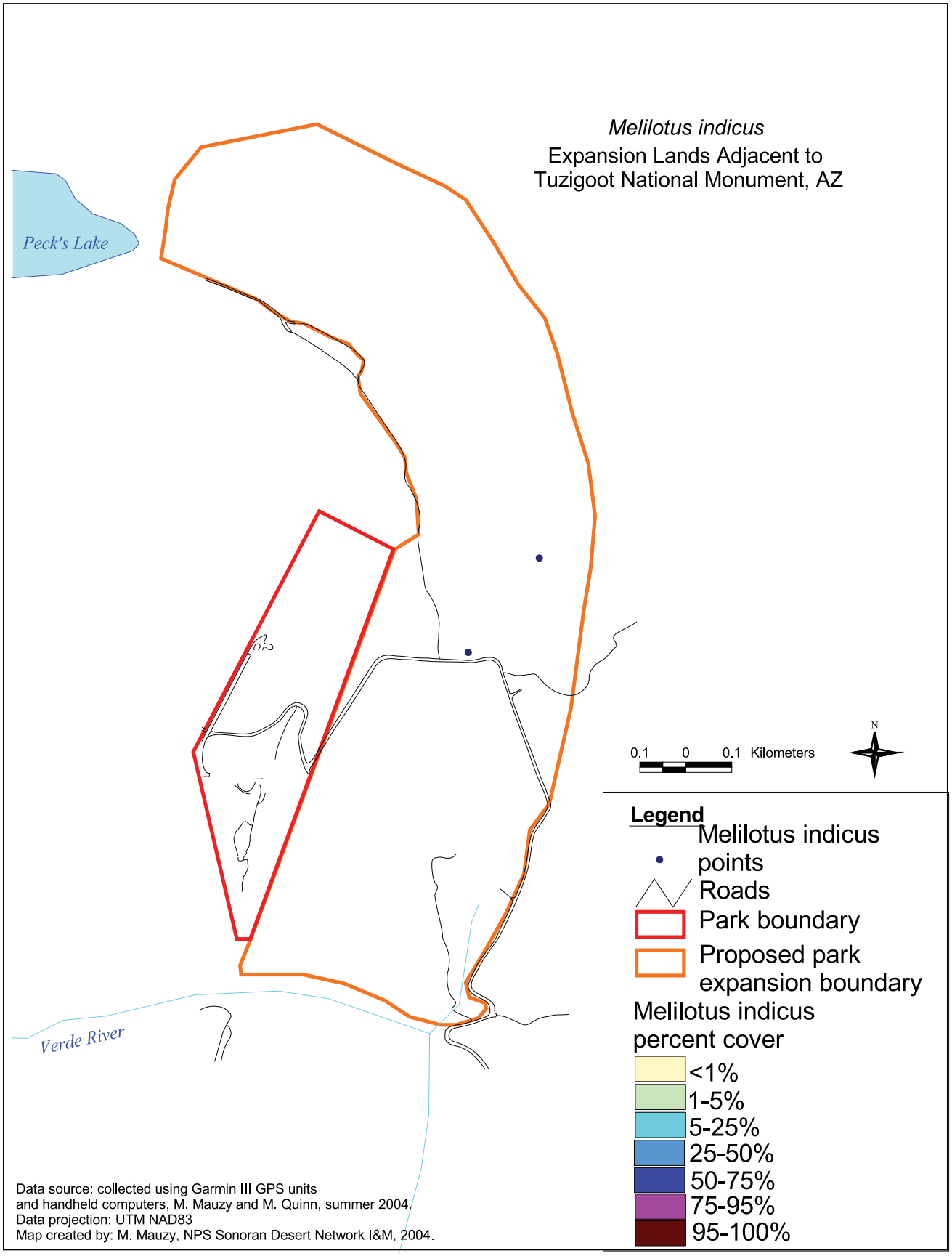

Hordeum spp.
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Hordeum spp. points
Roads
Park boundary
Proposed park expansion boundary
Hordeum spp. percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

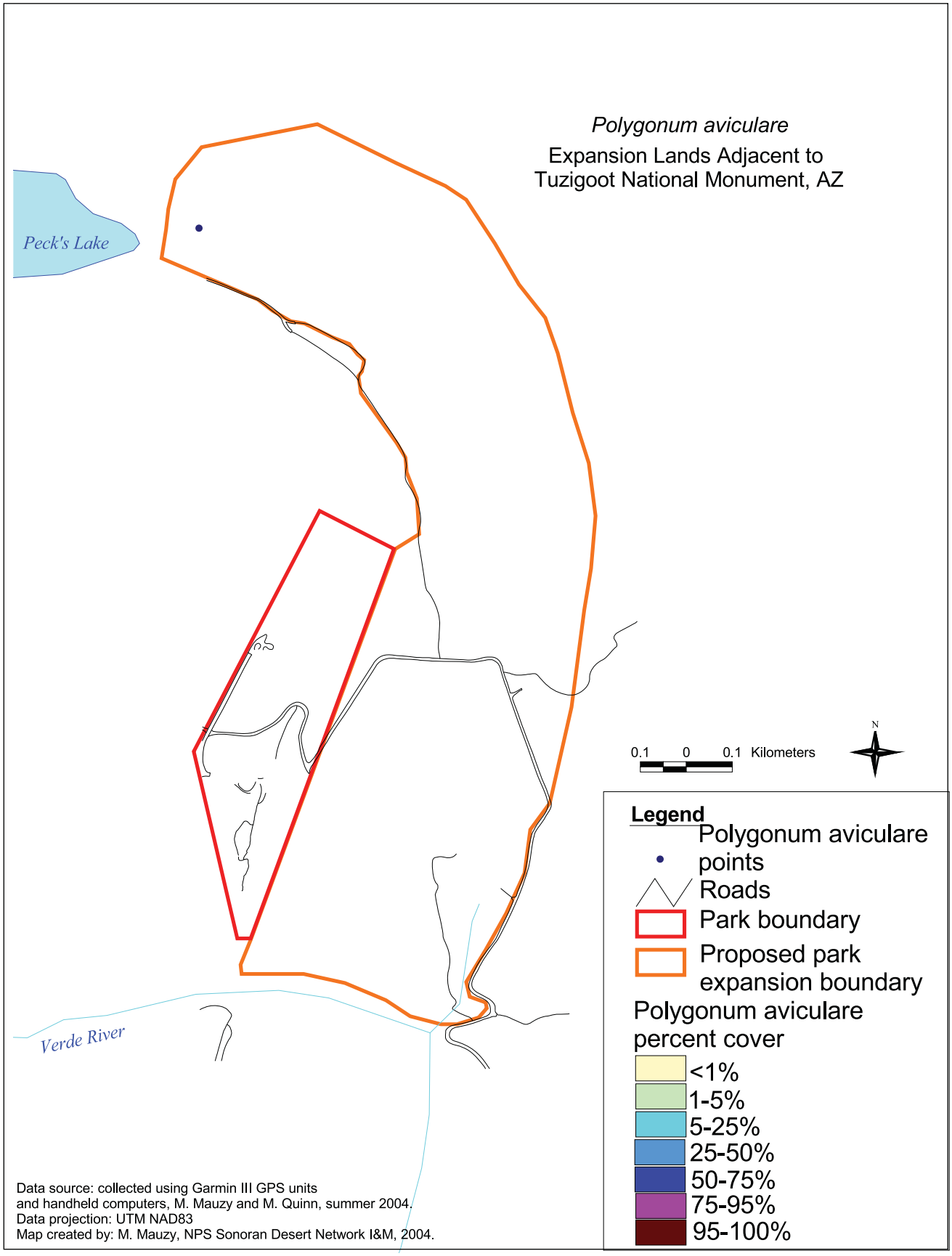

Kochia scoparia
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Kochia scoparia points
Roads
Park boundary
Proposed park expansion boundary
Kochia scoparia percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

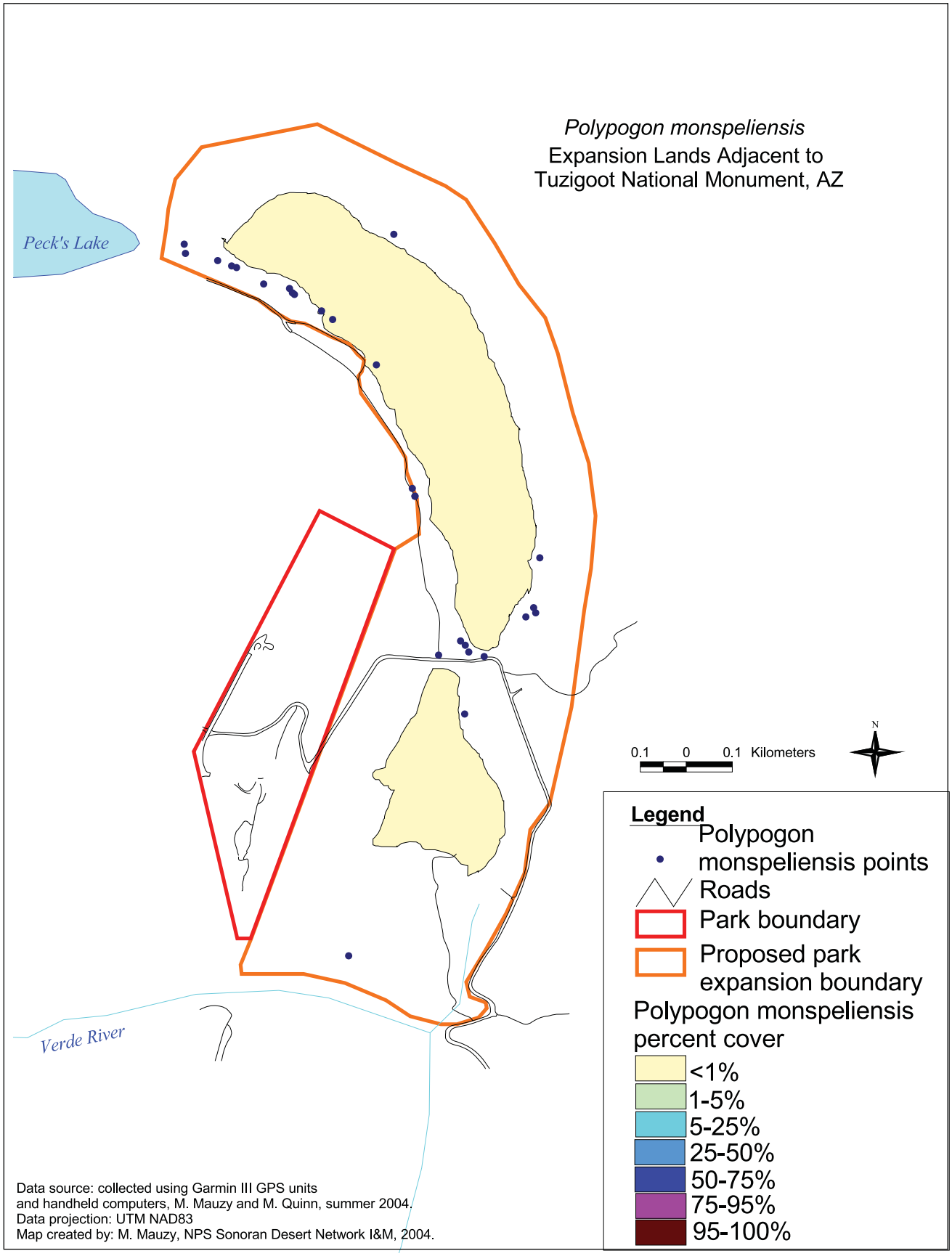

Lactuca serriola
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Lactuca serriola points
Roads
Park boundary
Proposed park expansion boundary
Lactuca serriola percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

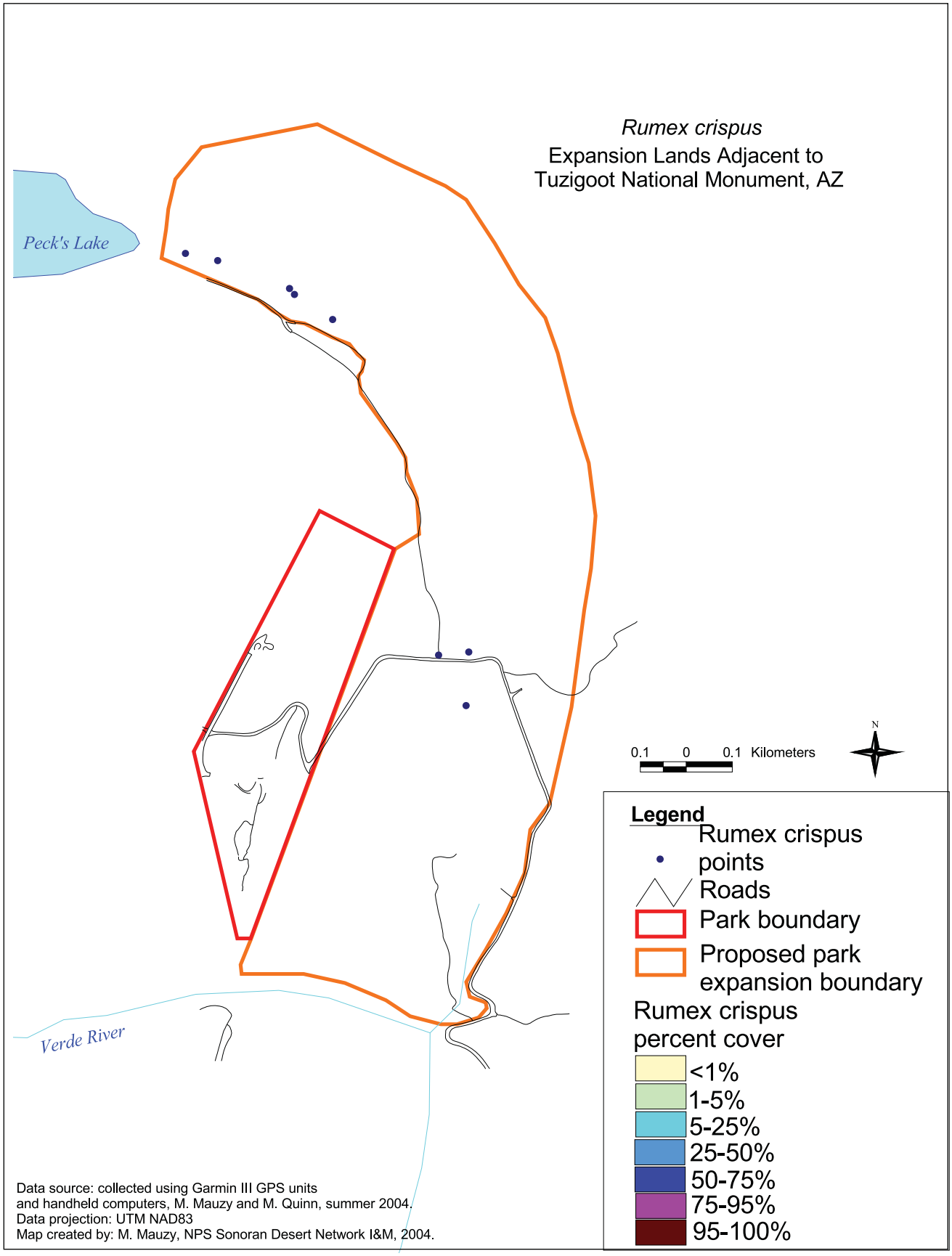

Marrubium vulgare
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Marrubium vulgare points
Roads
Park boundary
Proposed park expansion boundary
Marrubium vulgare percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

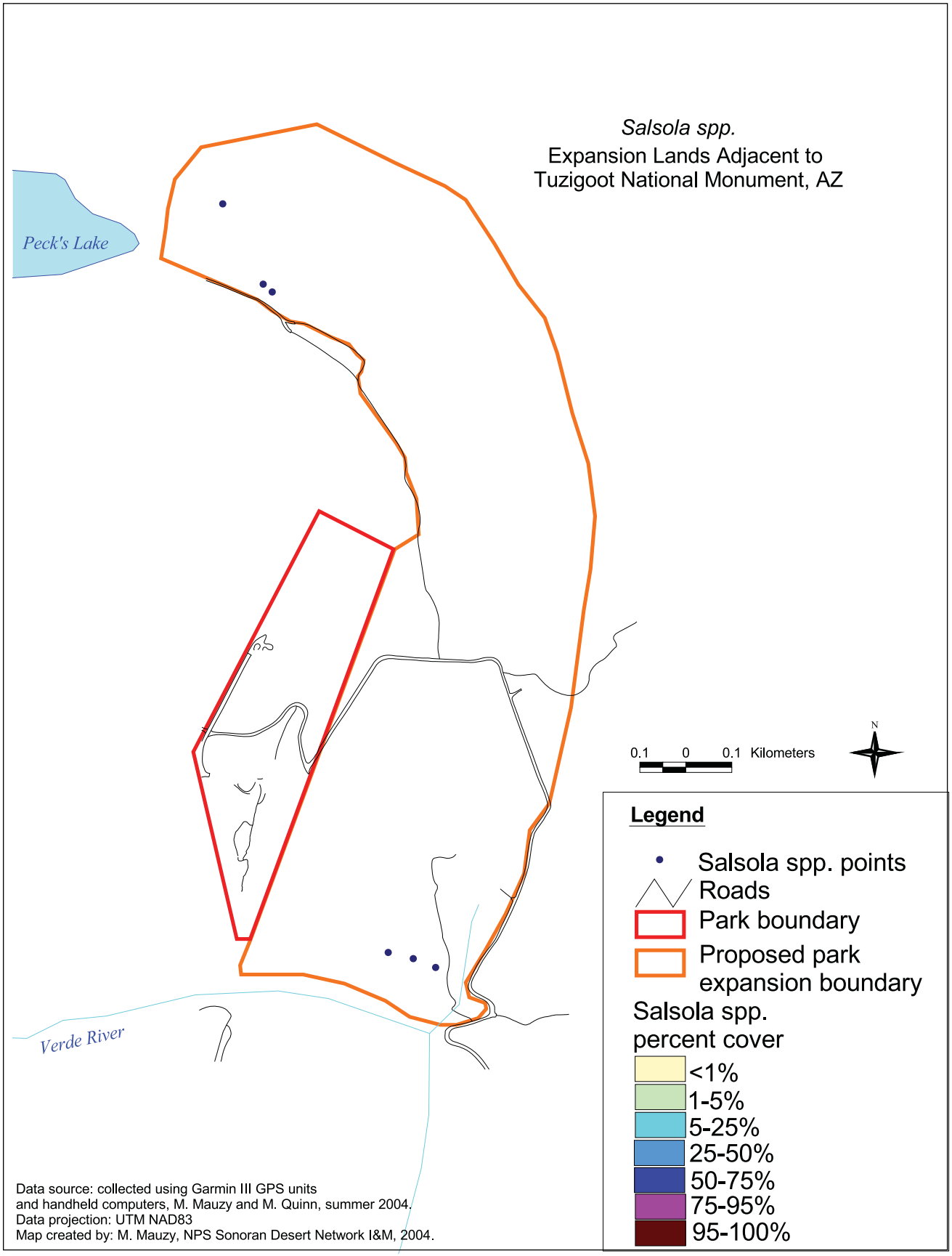

Melilotus albus
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Melilotus albus points
Roads
Park boundary
Proposed park expansion boundary
Melilotus albus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

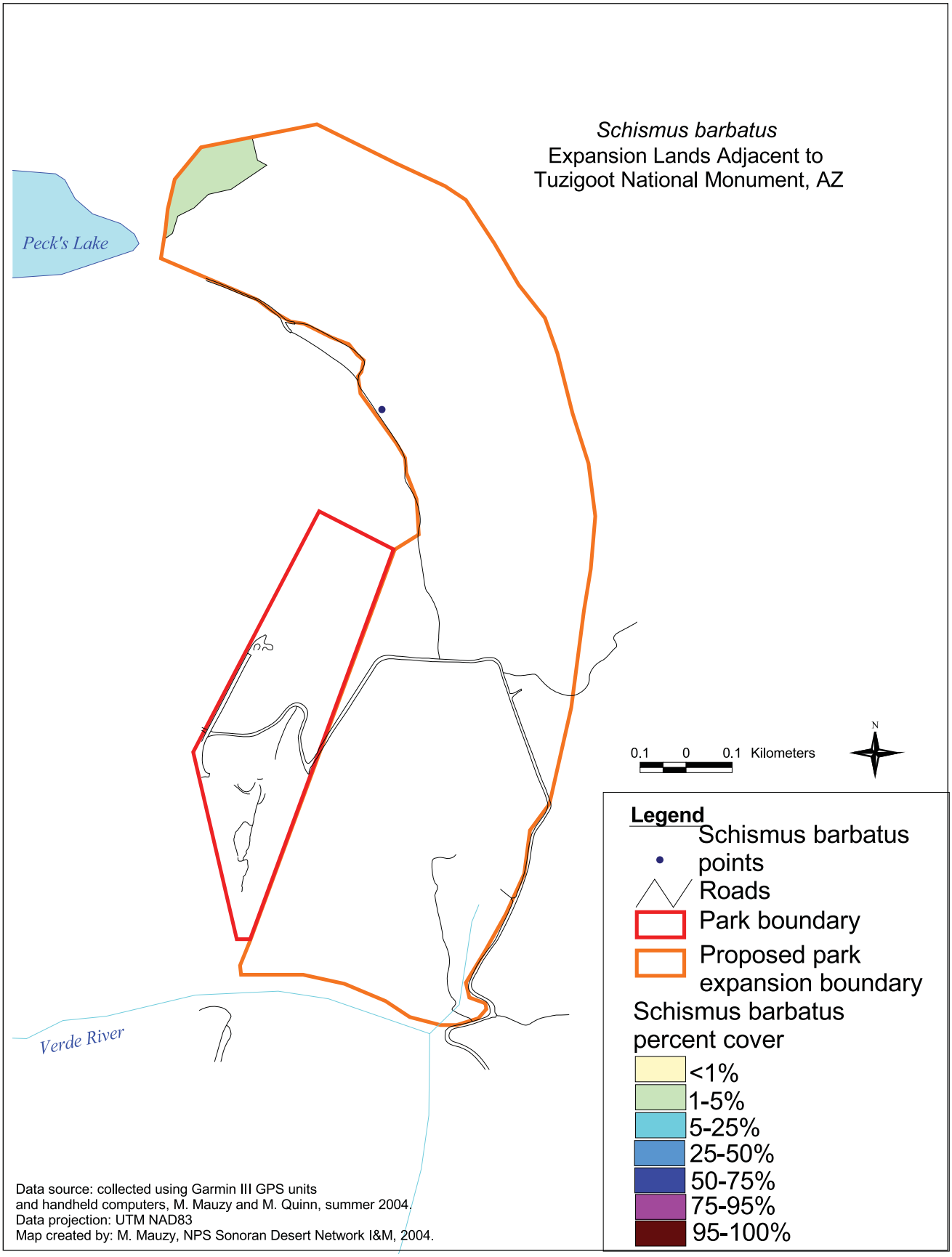

Melilotus indicus
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Melilotus indicus points
Roads
Park boundary
Proposed park expansion boundary
Melilotus indicus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

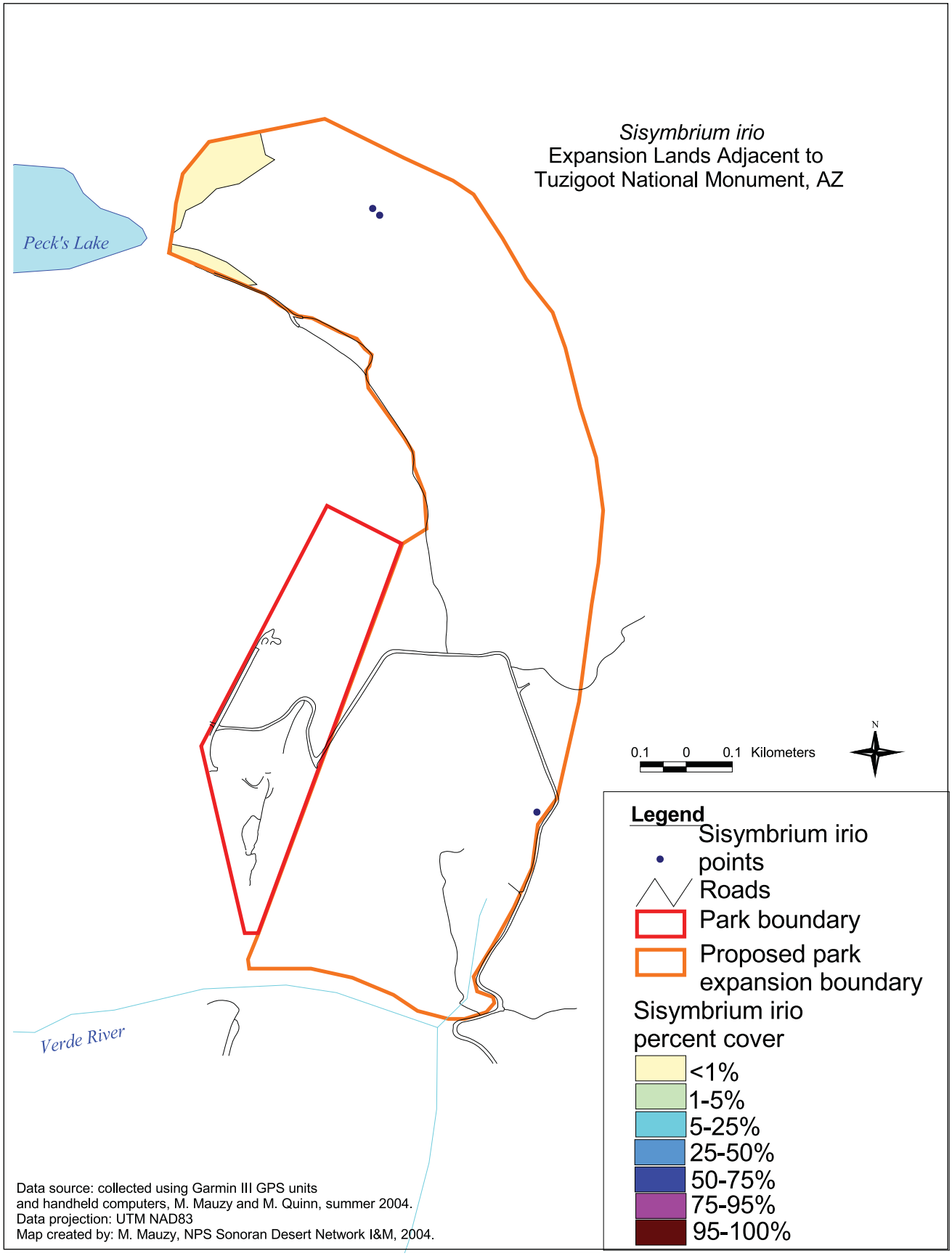

Polygonum aviculare
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Polygonum aviculare points
Roads
Park boundary
Proposed park expansion boundary
Polygonum aviculare percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

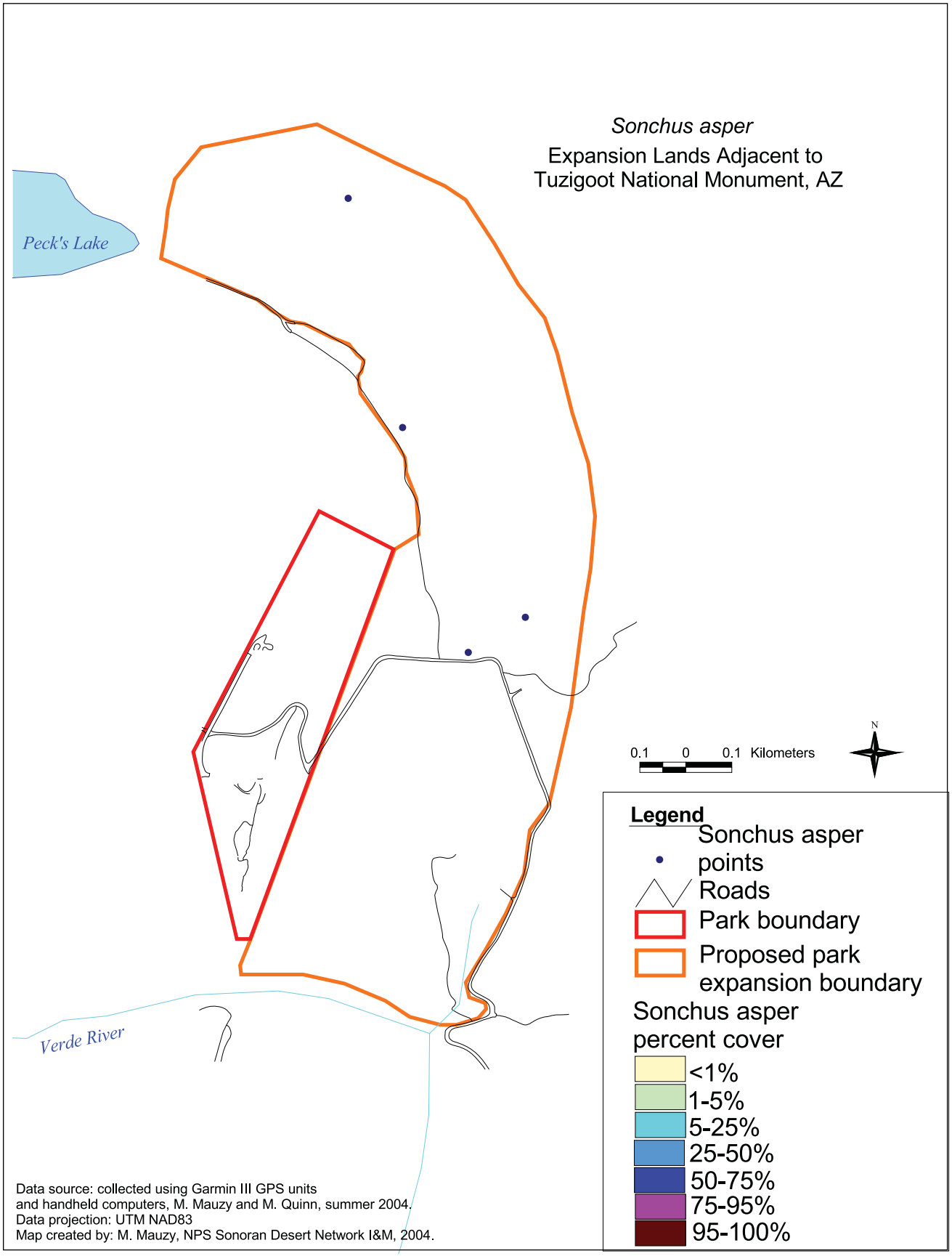

Polypogon monspeliensis
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Polypogon monspeliensis points
Roads
Park boundary
Proposed park expansion boundary
Polypogon monspeliensis percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

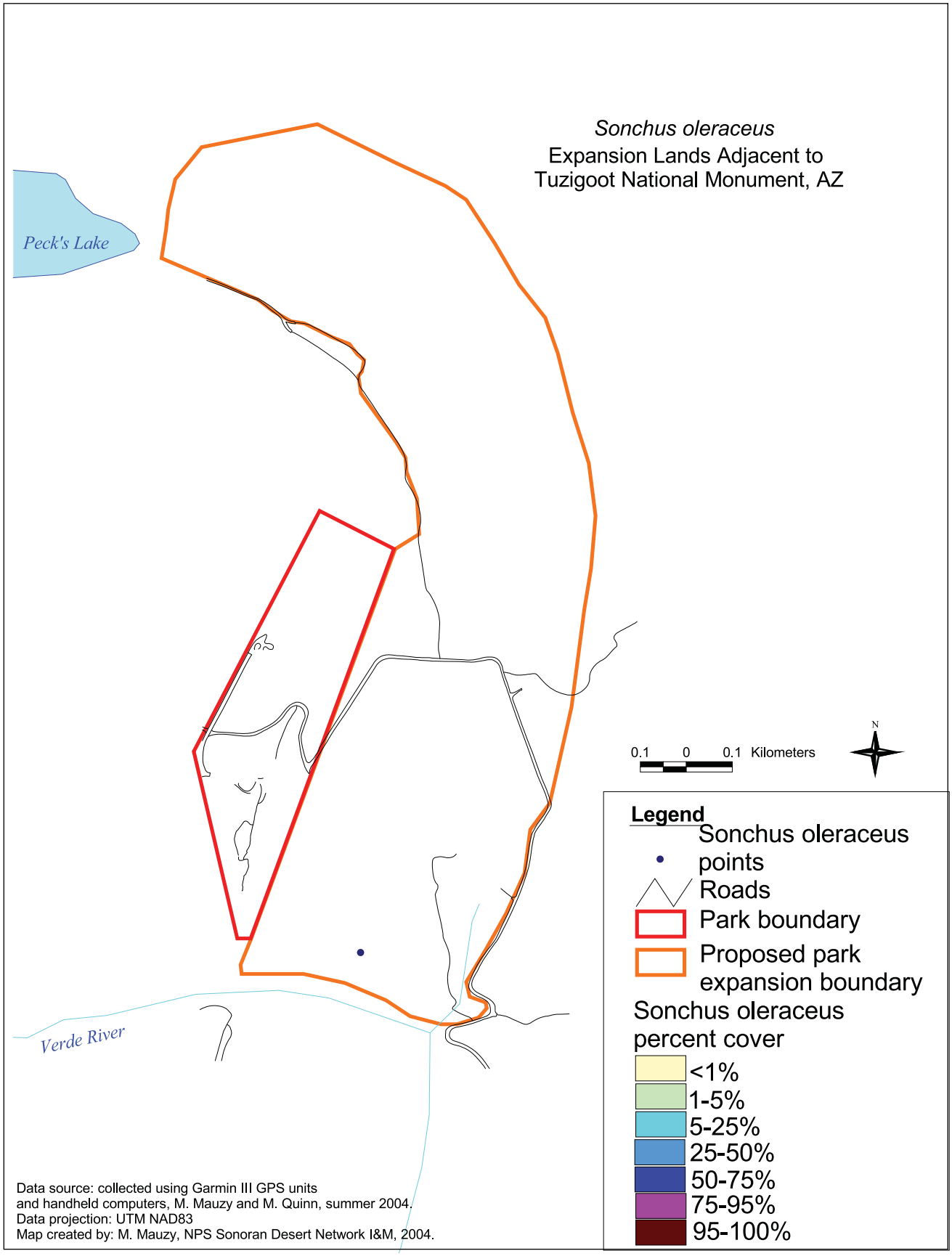

Rumex crispus
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Rumex crispus points
Roads
Park boundary
Proposed park expansion boundary
Rumex crispus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

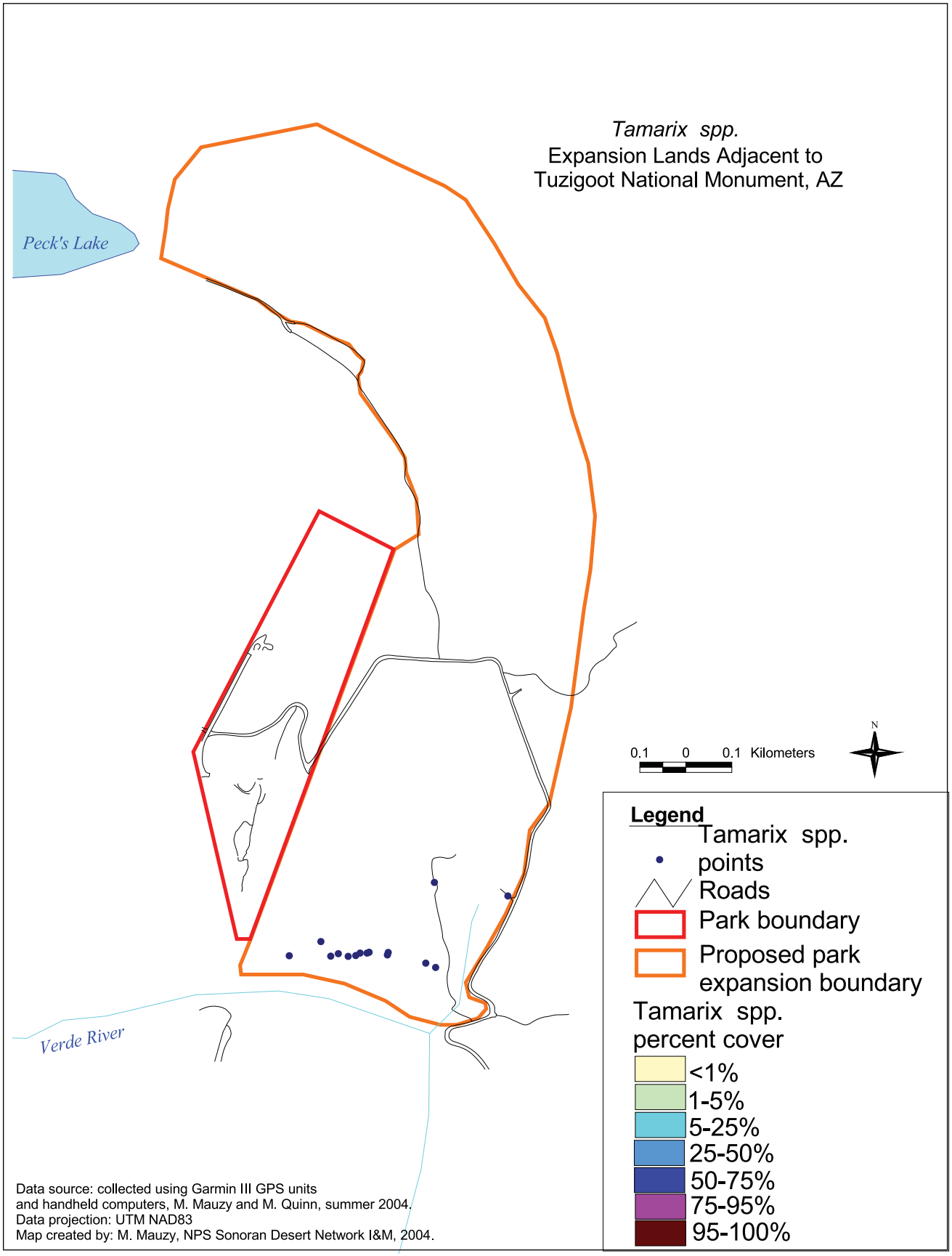

Salsola spp.
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Salsola spp. points
Roads
Park boundary
Proposed park expansion boundary
Salsola spp. percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

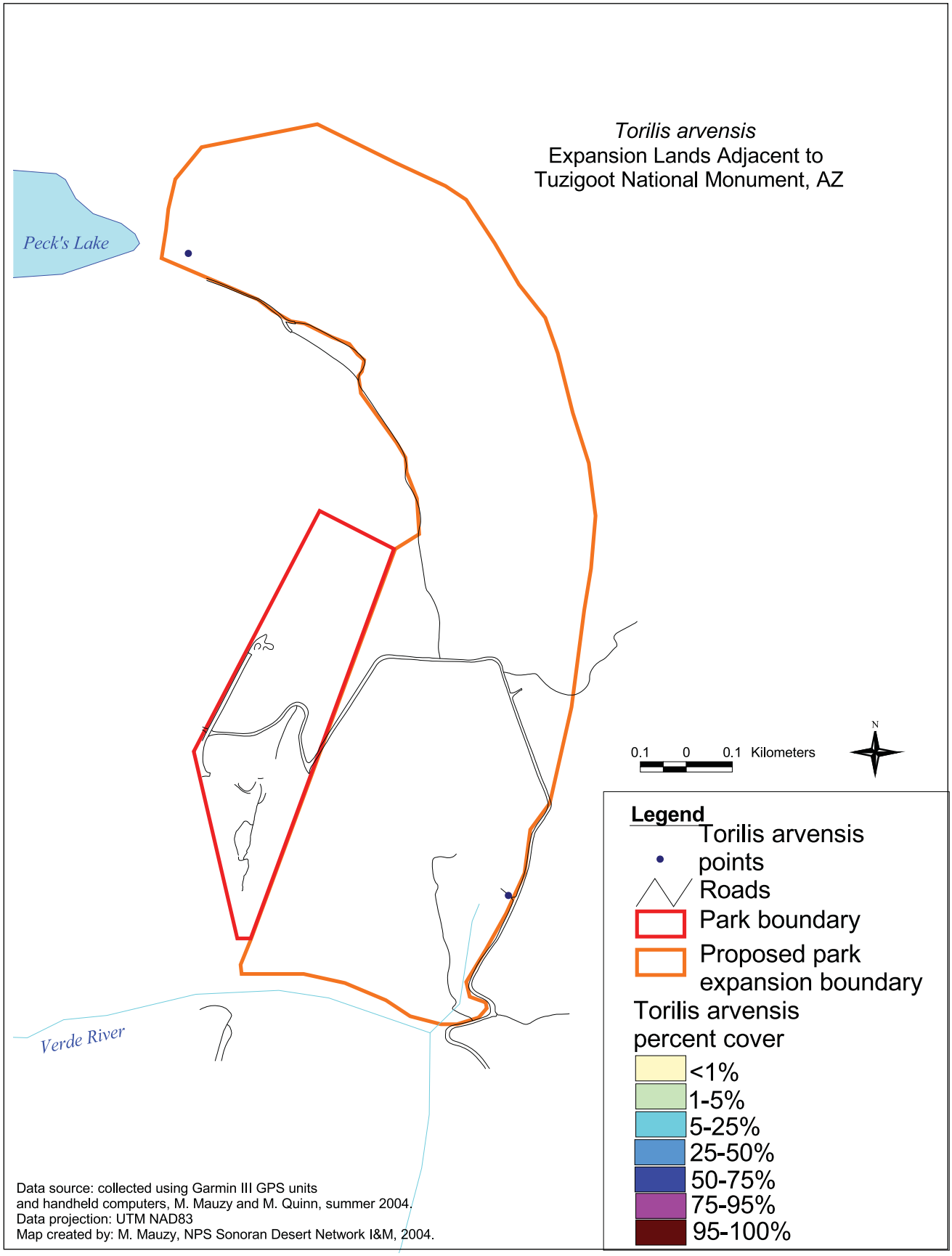

Schismus barbatus
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Schismus barbatus points
Roads
Park boundary
Proposed park expansion boundary
Schismus barbatus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

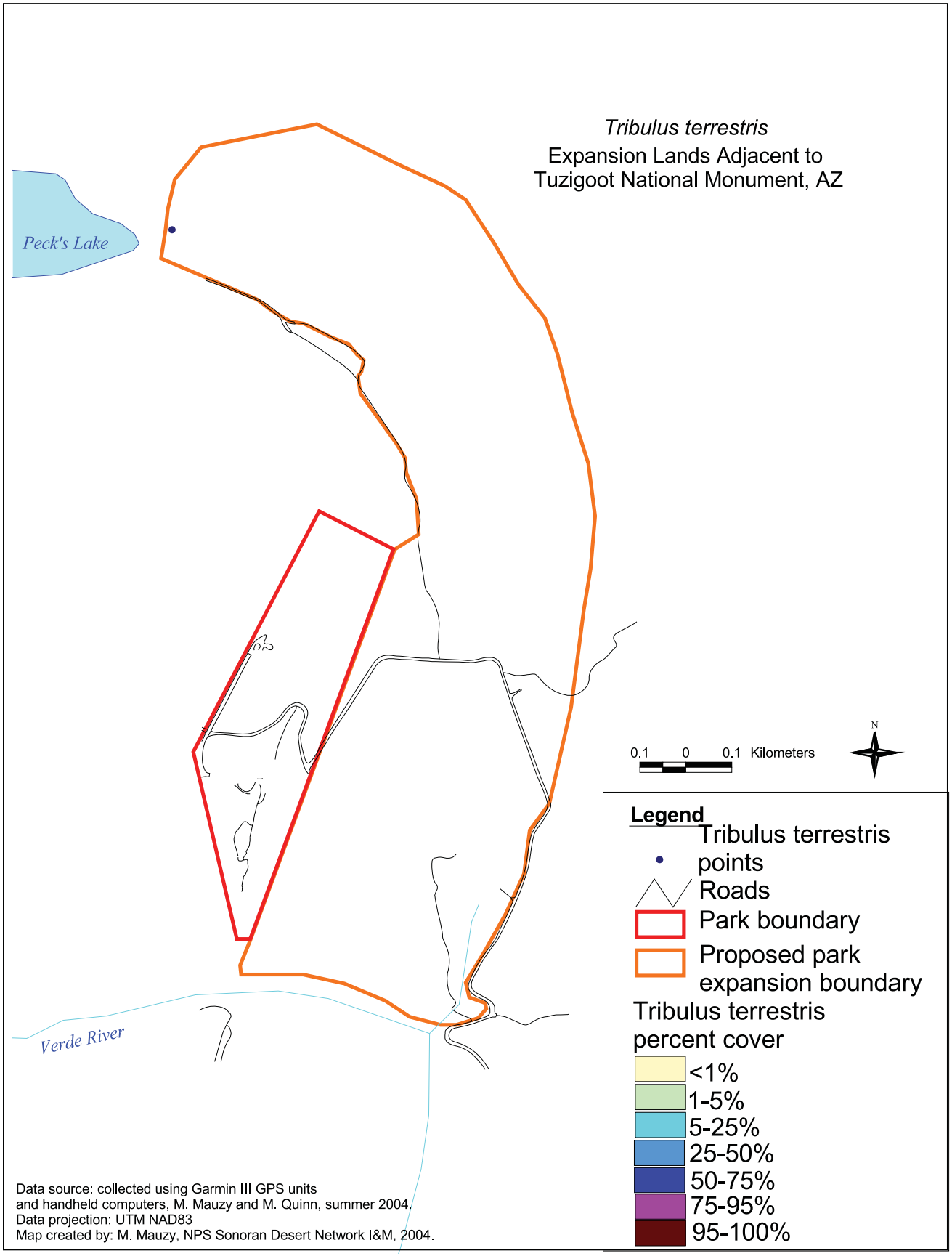

Sisymbrium irio
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Sisymbrium irio points
Roads
Park boundary
Proposed park expansion boundary
Sisymbrium irio percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

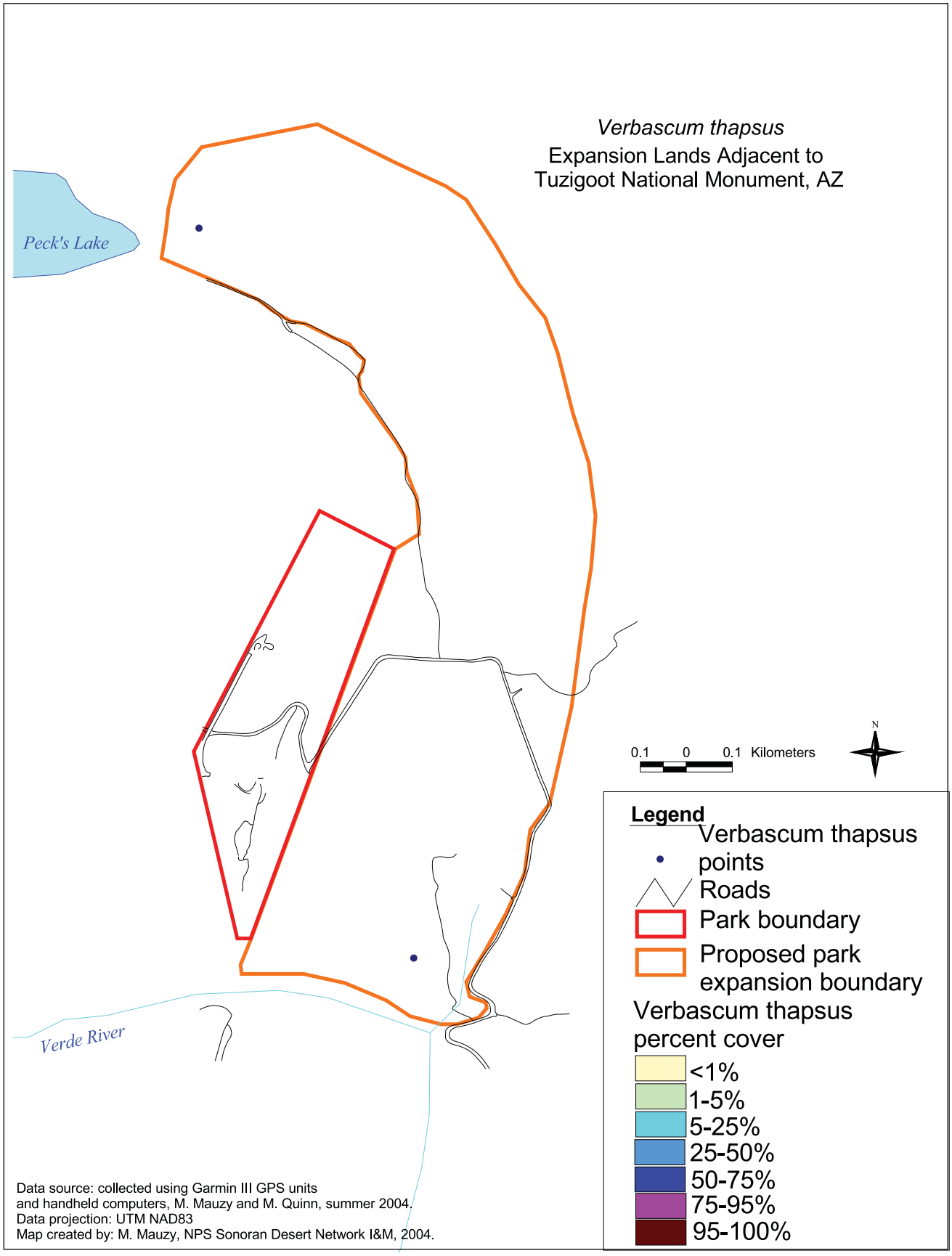

Sonchus asper
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Sonchus asper points
Roads
Park boundary
Proposed park expansion boundary
Sonchus asper percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

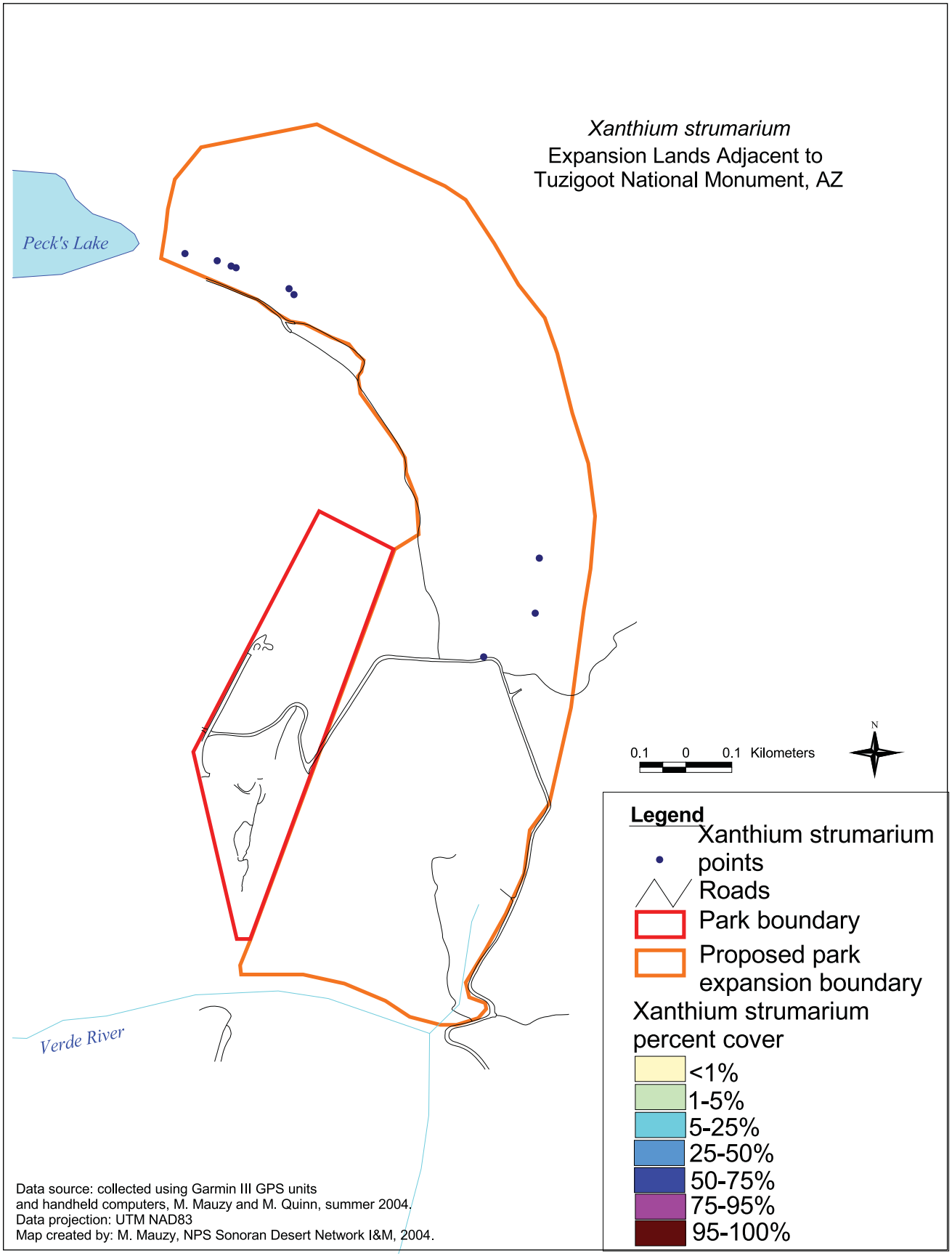

Sonchus oleraceus
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Sonchus oleraceus points
Roads
Park boundary
Proposed park expansion boundary
Sonchus oleraceus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

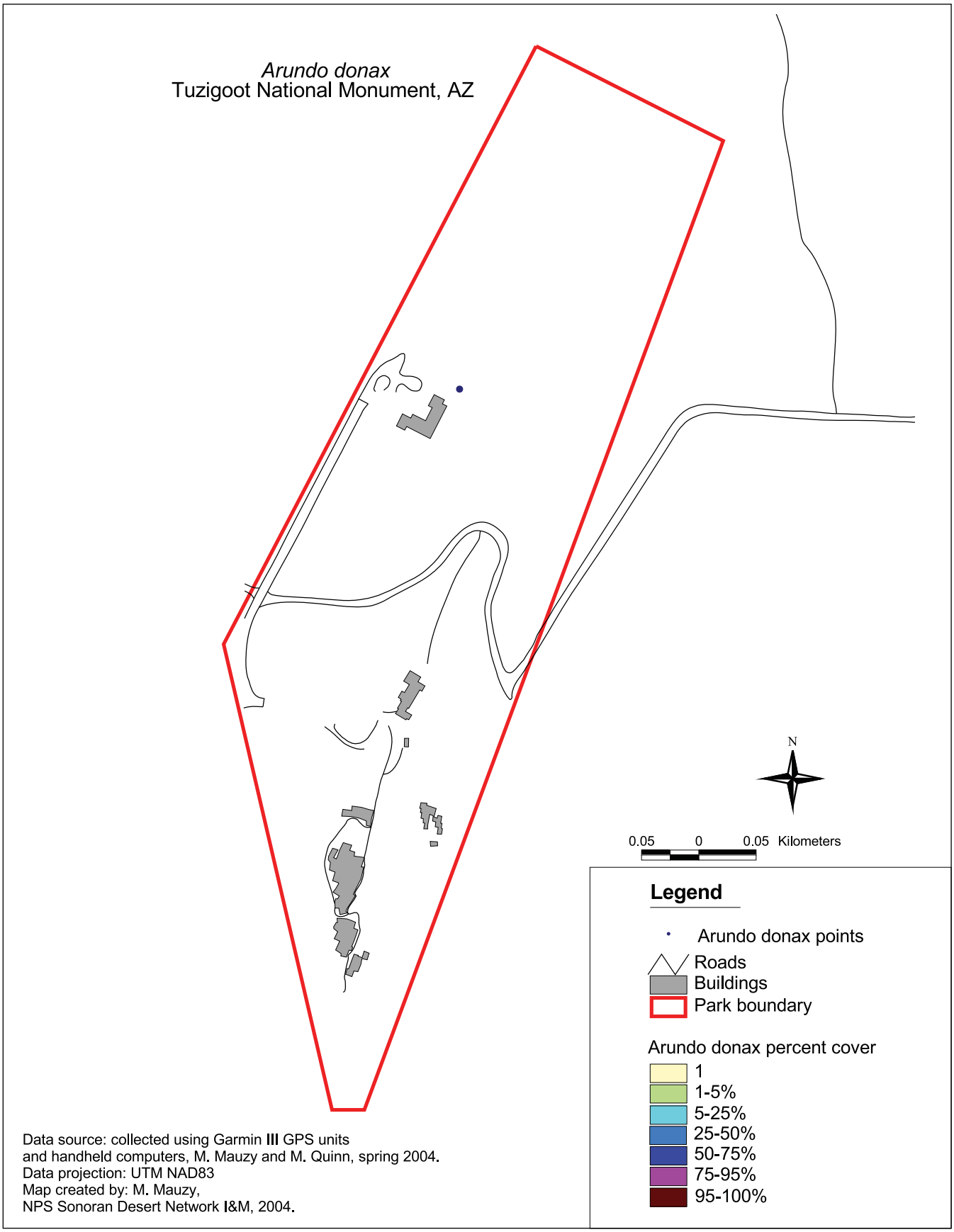

Tamarix spp.
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Tamarix spp. points
Roads
Park boundary
Proposed park expansion boundary
Tamarix spp. percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

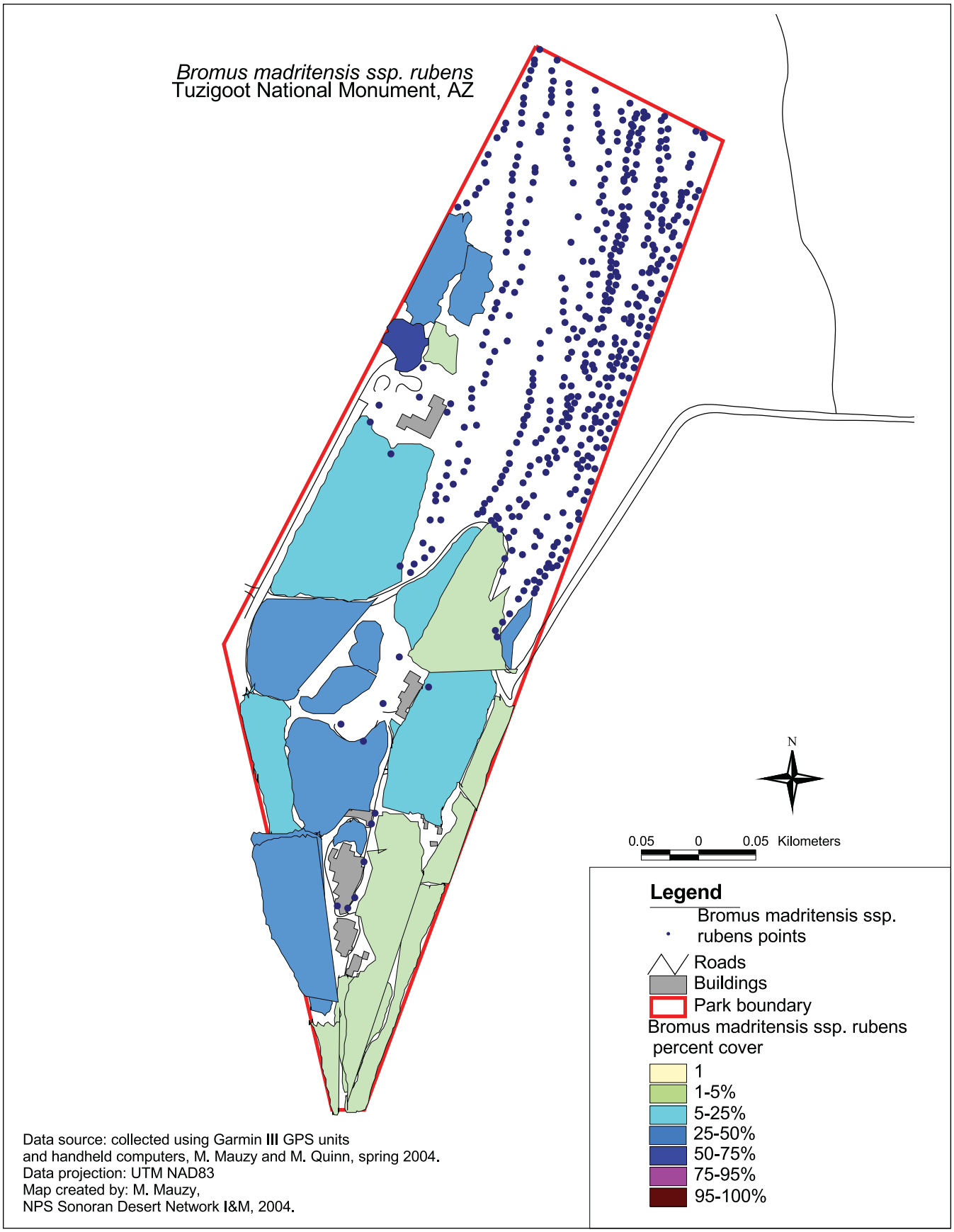

Torilis arvensis
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Torilis arvensis points
Roads
Park boundary
Proposed park expansion boundary
Torilis arvensis percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

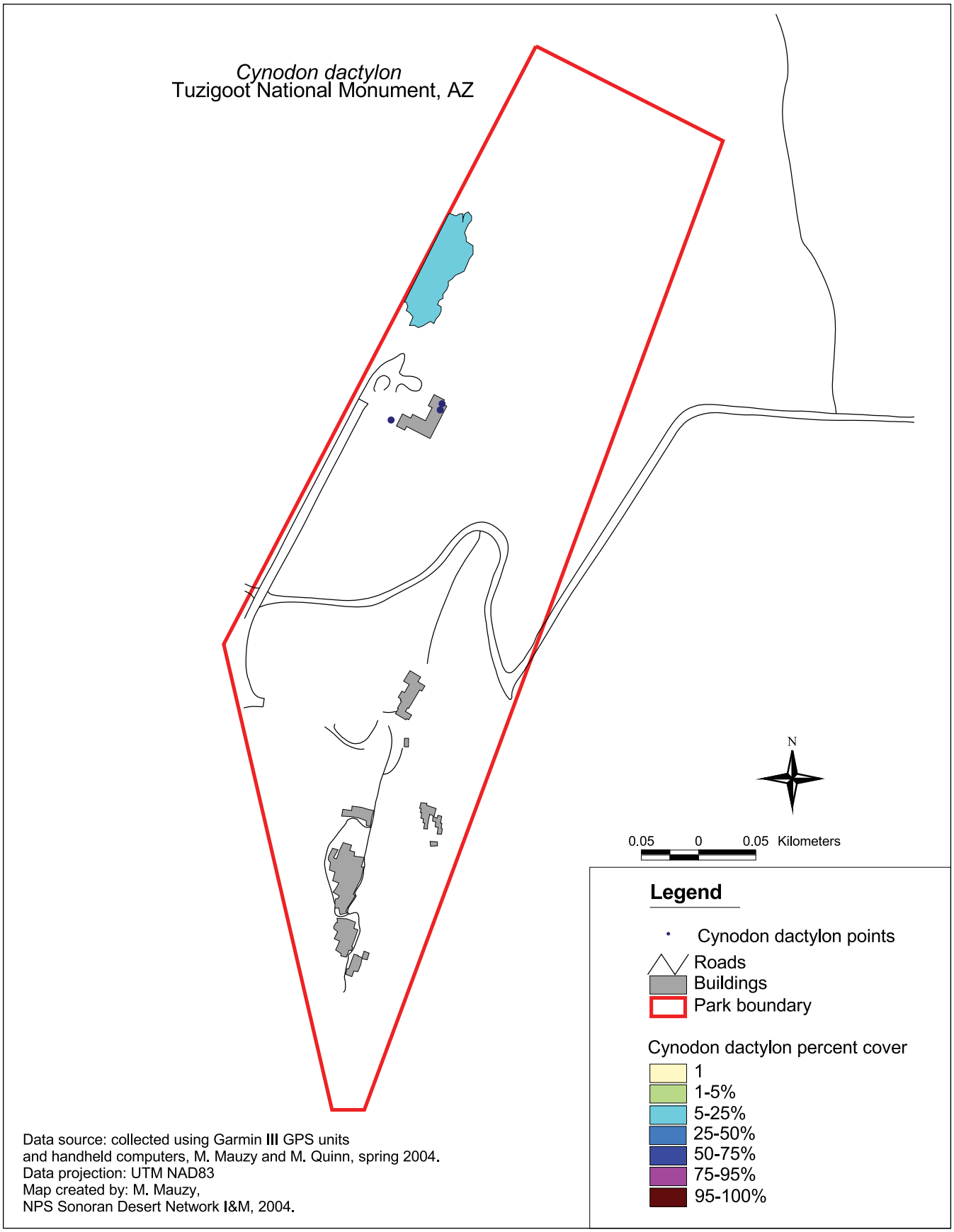

Tribulus terrestris
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Tribulus terrestris points
Roads
Park boundary
Proposed park expansion boundary
Tribulus terrestris percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

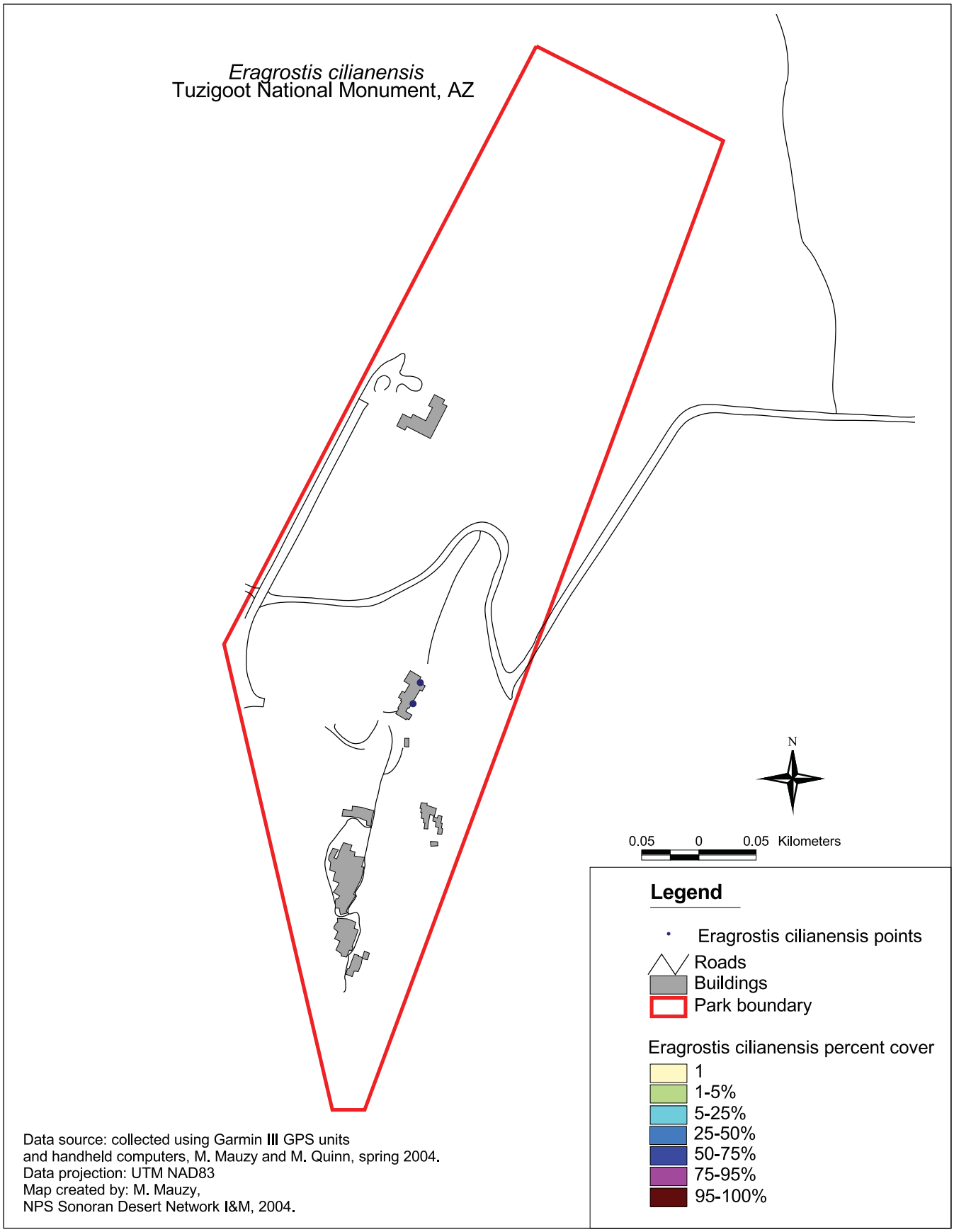

Verbascum thapsus
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Verbascum thapsus points
Roads
Park boundary
Proposed park expansion boundary
Verbascum thapsus percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

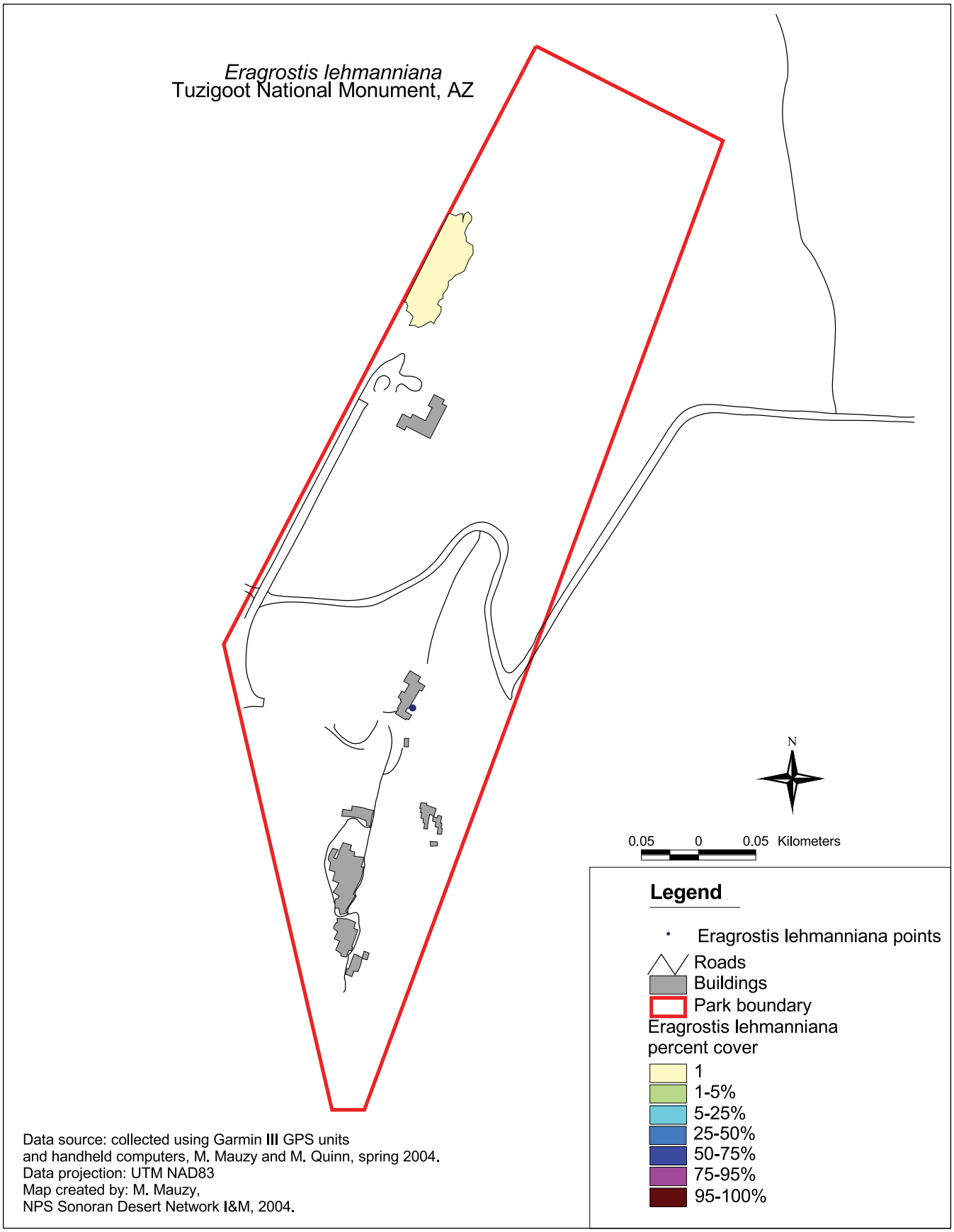

Xanthium strumarium
Expansion Lands Adjacent to
Tuzigoot National Monument, AZ
Peck's Lake
Verde River
0.1 0 0.1 Kilometers
N
Legend
Xanthium strumarium points
Roads
Park boundary
Proposed park expansion boundary
Xanthium strumarium percent cover
<1%
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, summer 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy, NPS Sonoran Desert Network I&M, 2004.

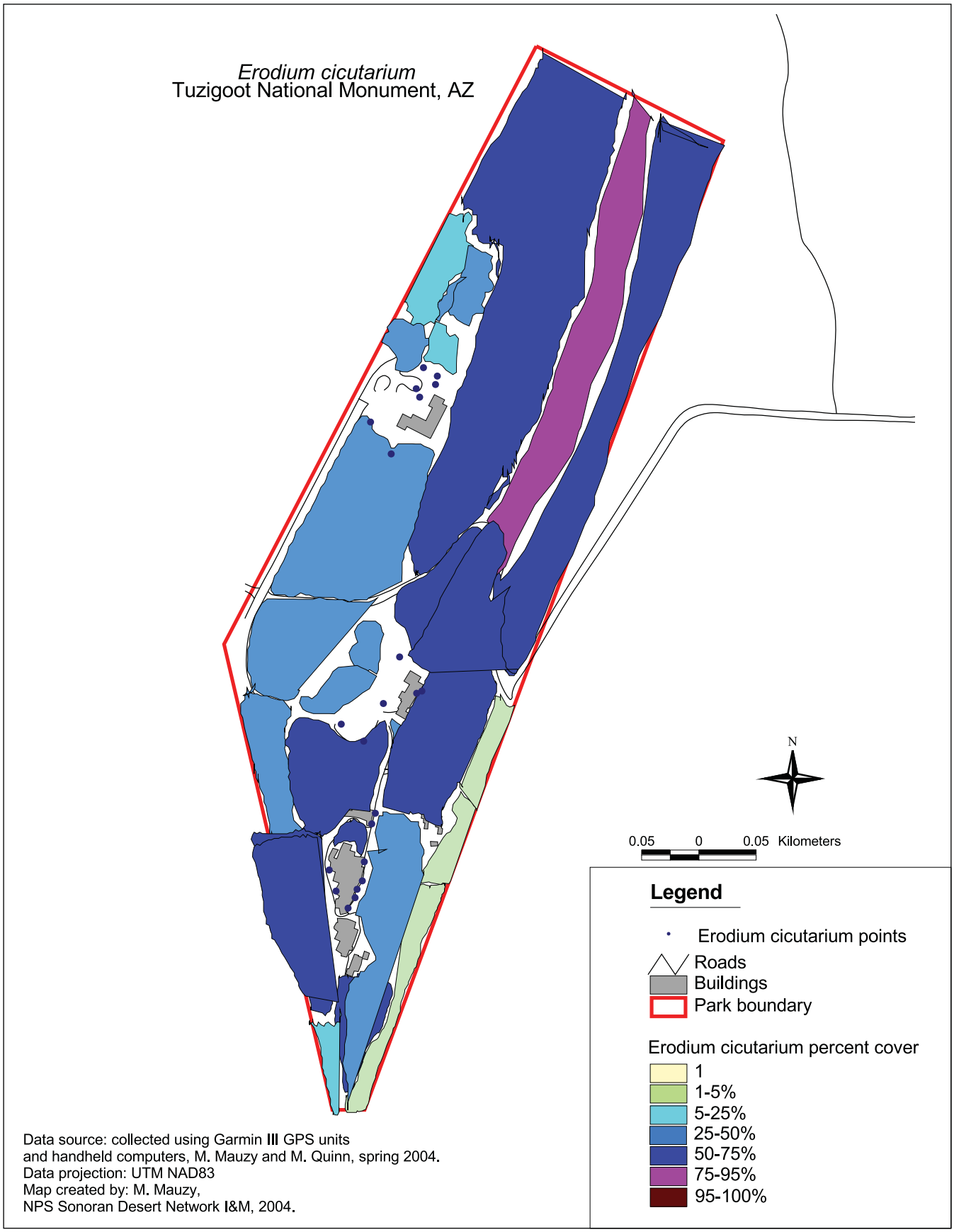

Arundo donax
Tuzigoot National Monument, AZ
N
0.05 0 0.05 Kilometers
Legend
Arundo donax points
Roads
Buildings
Park boundary
Arundo donax percent cover
1
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, spring 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy,
NPS Sonoran Desert Network I&M, 2004.

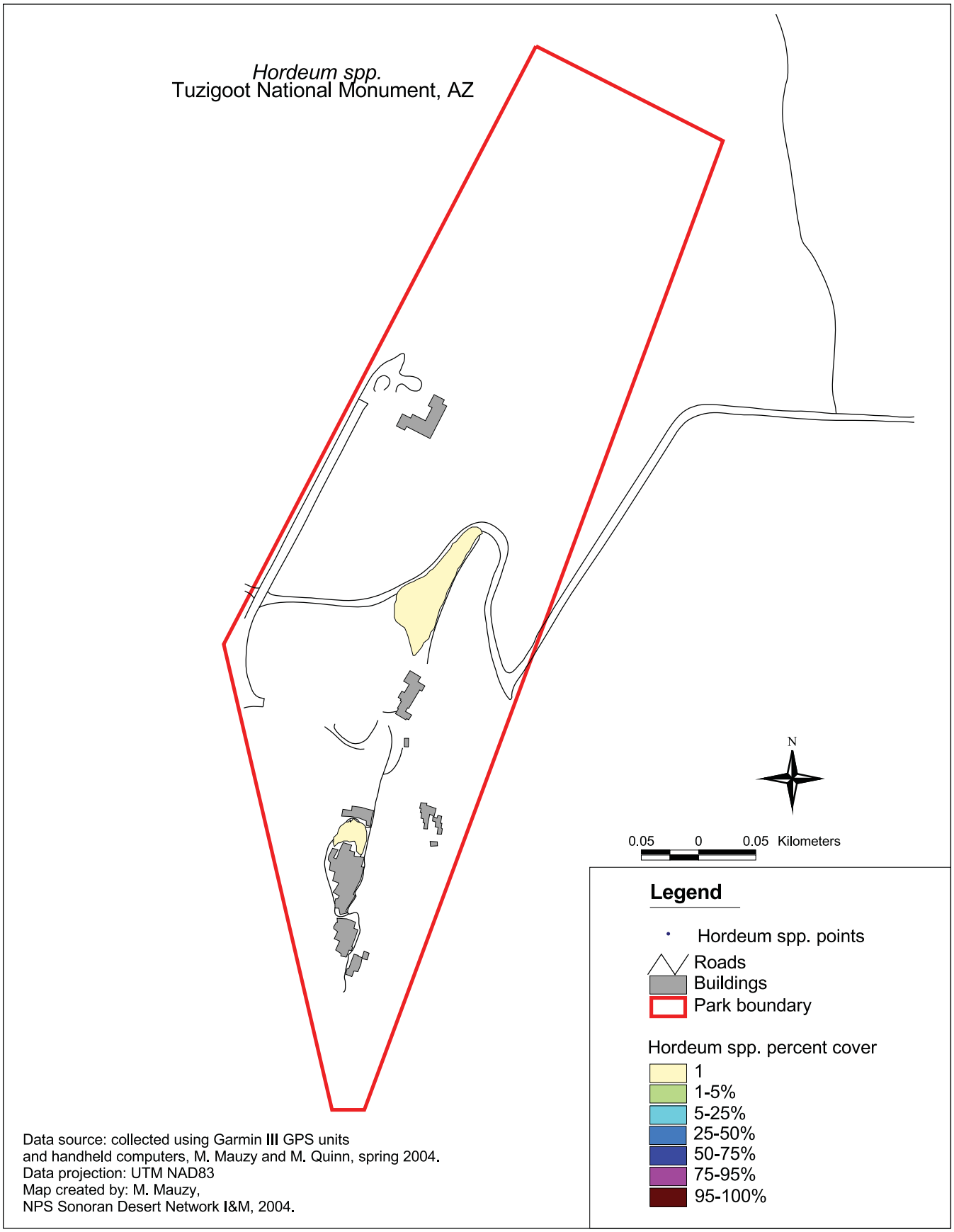

Bromus madritensis ssp. rubens
Tuzigoot National Monument, AZ
N
0.05 0 0.05 Kilometers
Legend
Bromus madritensis ssp. rubens points
Roads
Buildings
Park boundary
Bromus madritensis ssp. rubens percent cover
1
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, spring 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy,
NPS Sonoran Desert Network I&M, 2004.

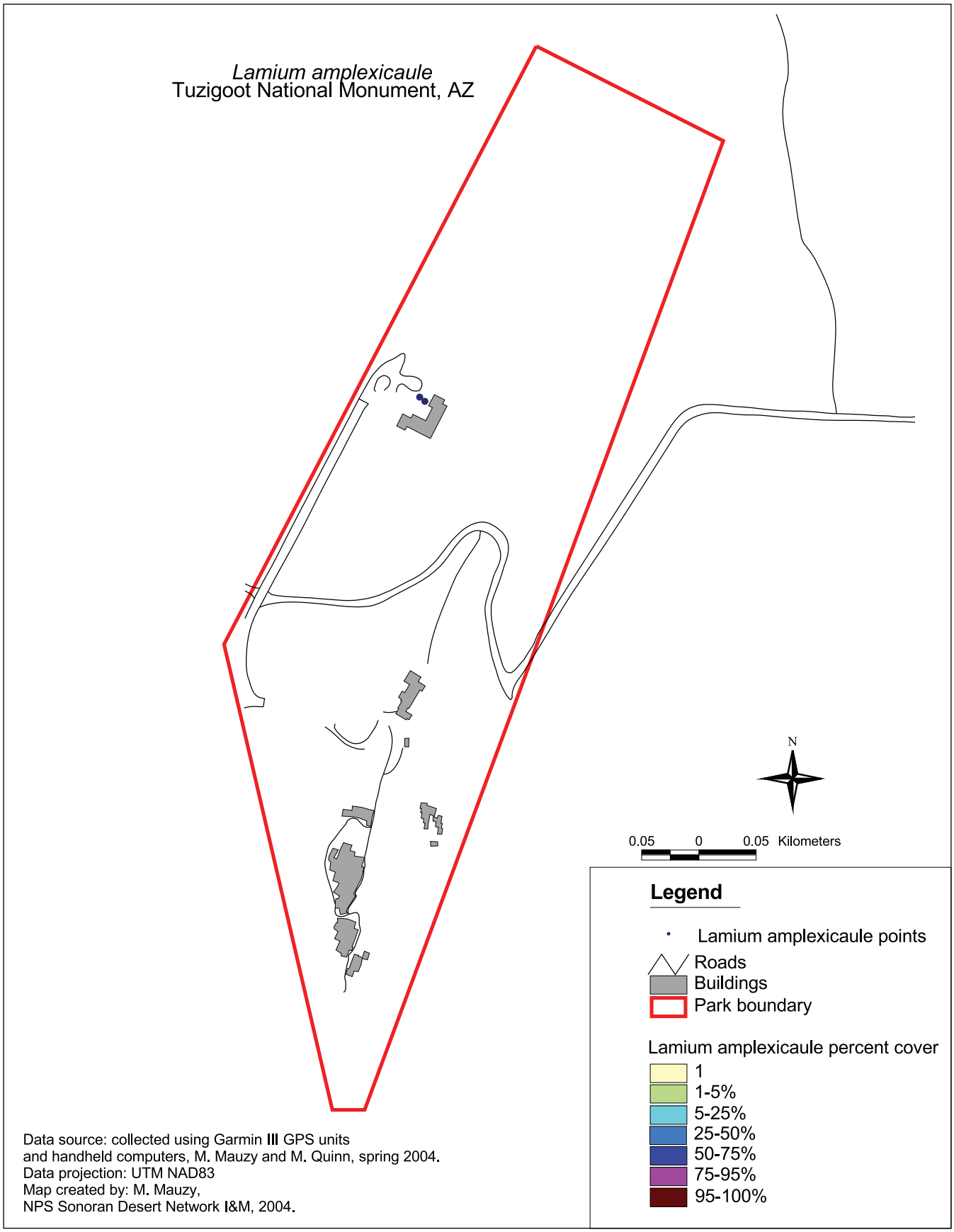

Cynodon dactylon
Tuzigoot National Monument, AZ
N
0.05 0 0.05 Kilometers
Legend
Cynodon dactylon points
Roads
Buildings
Park boundary
Cynodon dactylon percent cover
1
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, spring 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy,
NPS Sonoran Desert Network I&M, 2004.

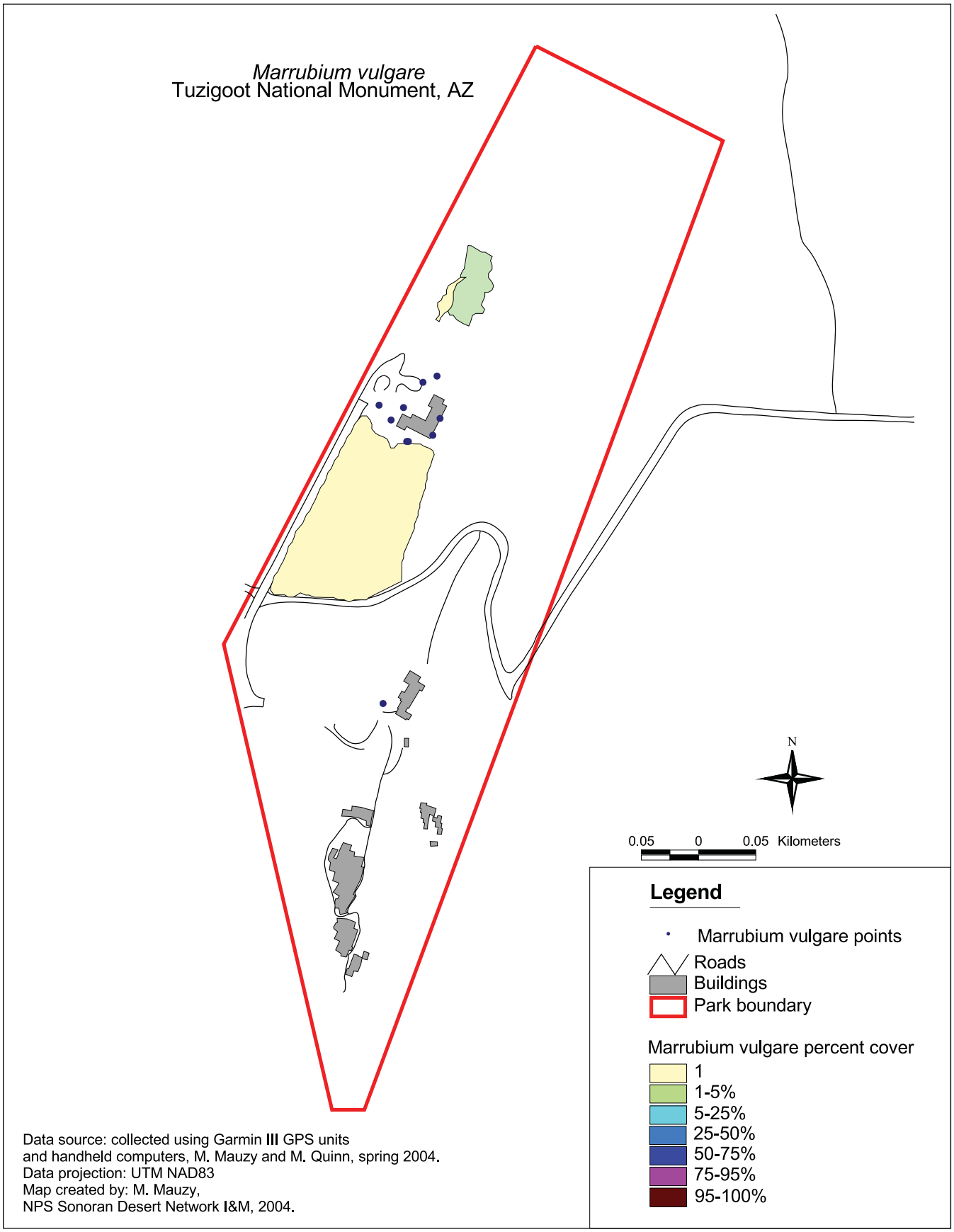

Eragrostis cilianensis
Tuzigoot National Monument, AZ
N
0.05 0 0.05 Kilometers
Legend
Eragrostis cilianensis points
Roads
Buildings
Park boundary
Eragrostis cilianensis percent cover
1
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, spring 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy,
NPS Sonoran Desert Network I&M, 2004.

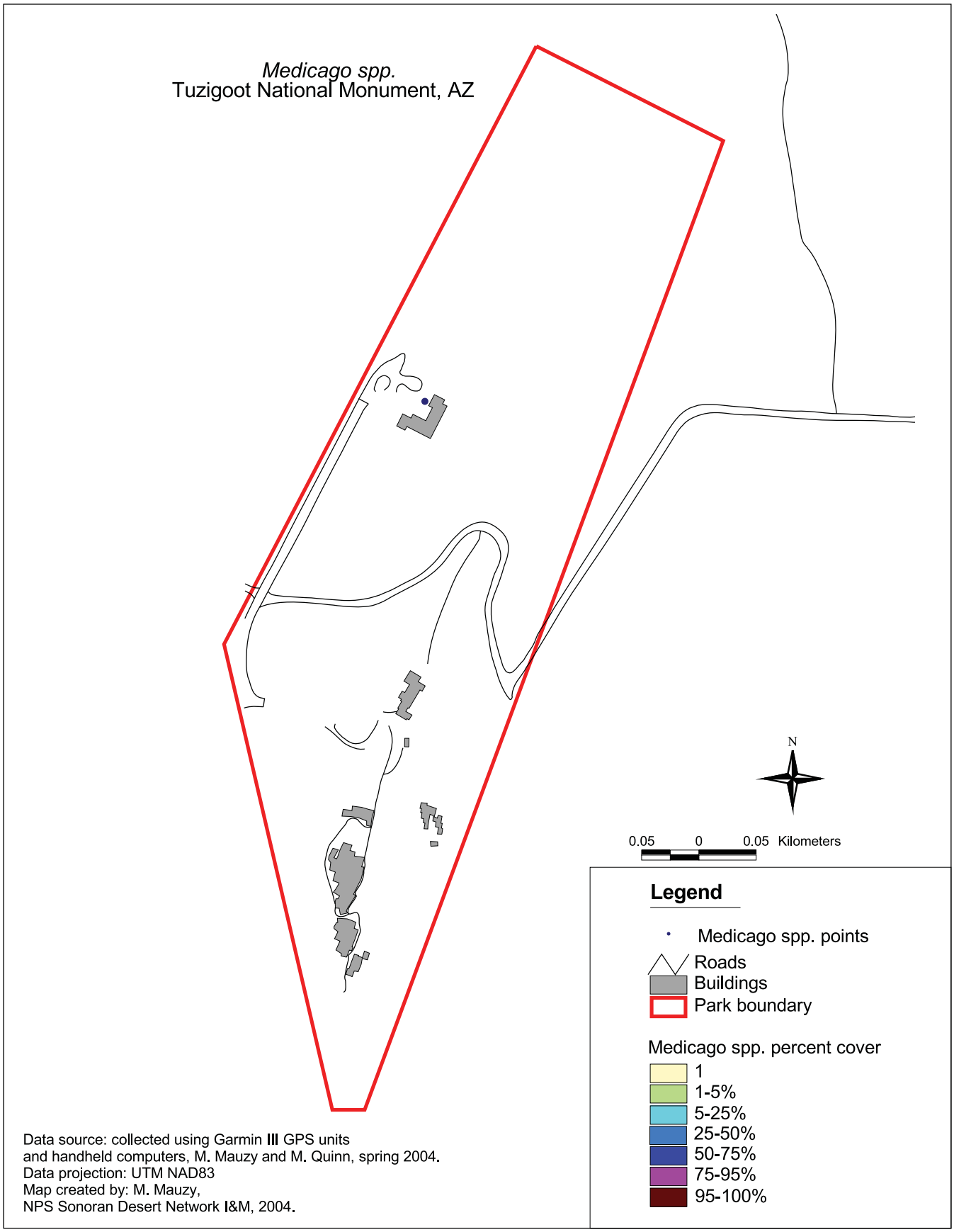

Eragrostis lehmanniana
Tuzigoot National Monument, AZ
N
0.05 0 0.05 Kilometers
Legend
Eragrostis lehmanniana points
Roads
Buildings
Park boundary
Eragrostis lehmanniana
percent cover
1
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, spring 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy,
NPS Sonoran Desert Network I&M, 2004.

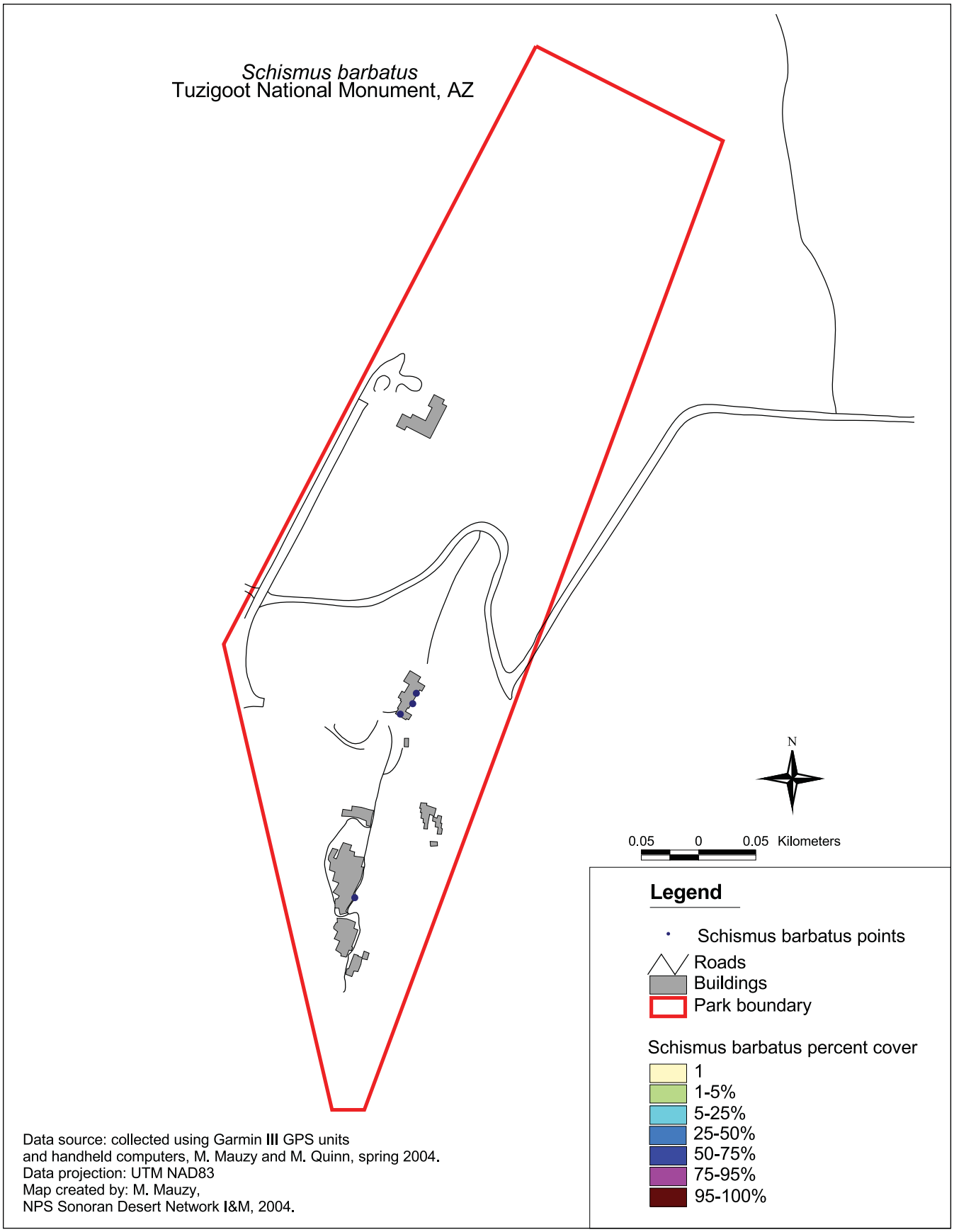

Erodium cicutarium
Tuzigoot National Monument, AZ
N
0.05 0 0.05 Kilometers
Legend
Erodium cicutarium points
Roads
Buildings
Park boundary
Erodium cicutarium percent cover
1
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, spring 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy,
NPS Sonoran Desert Network I&M, 2004.

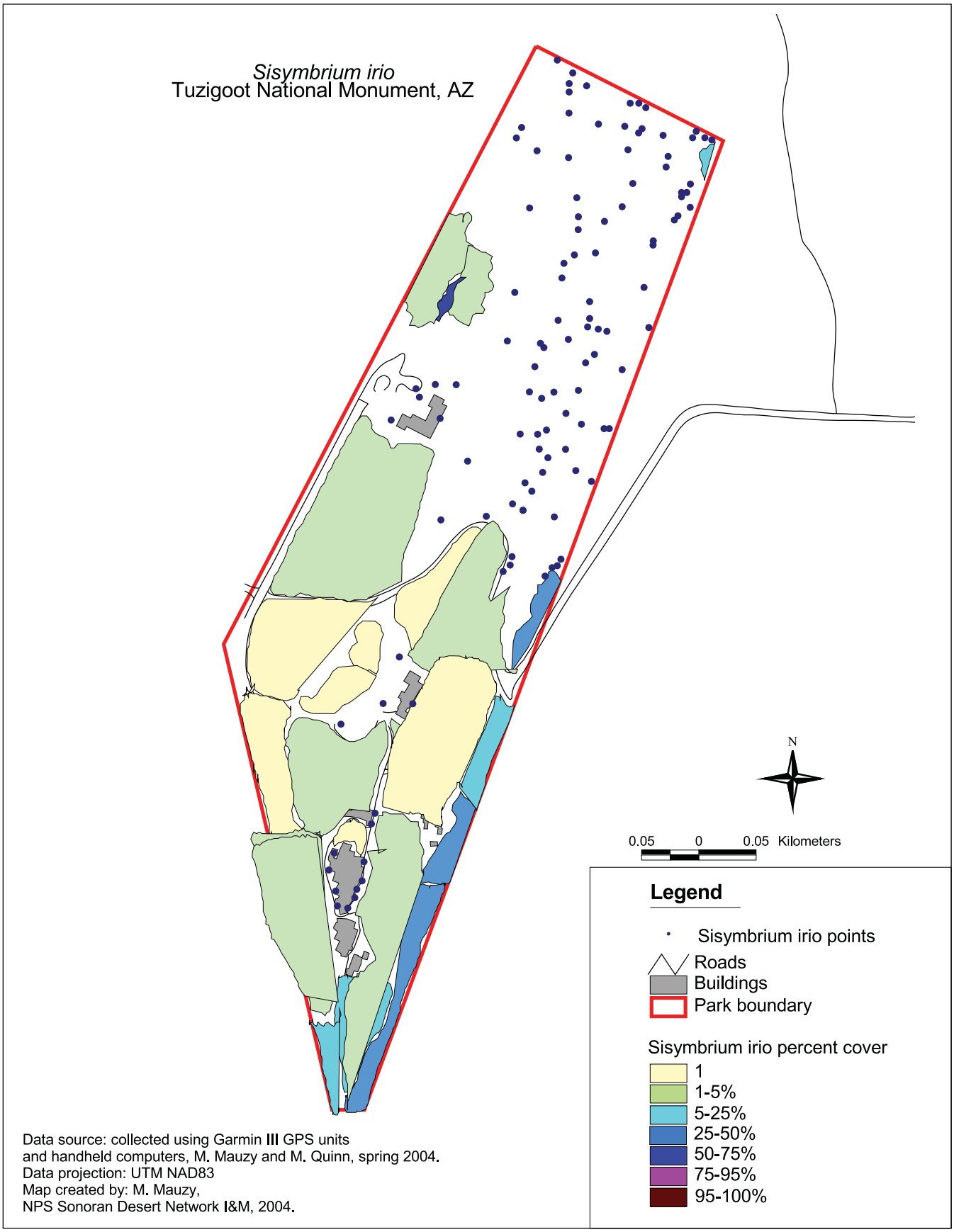

Hordeum spp.
Tuzigoot National Monument, AZ
N
0.05 0 0.05 Kilometers
Legend
Hordeum spp. points
Roads
Buildings
Park boundary
Hordeum spp. percent cover
1
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, spring 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy,
NPS Sonoran Desert Network I&M, 2004.

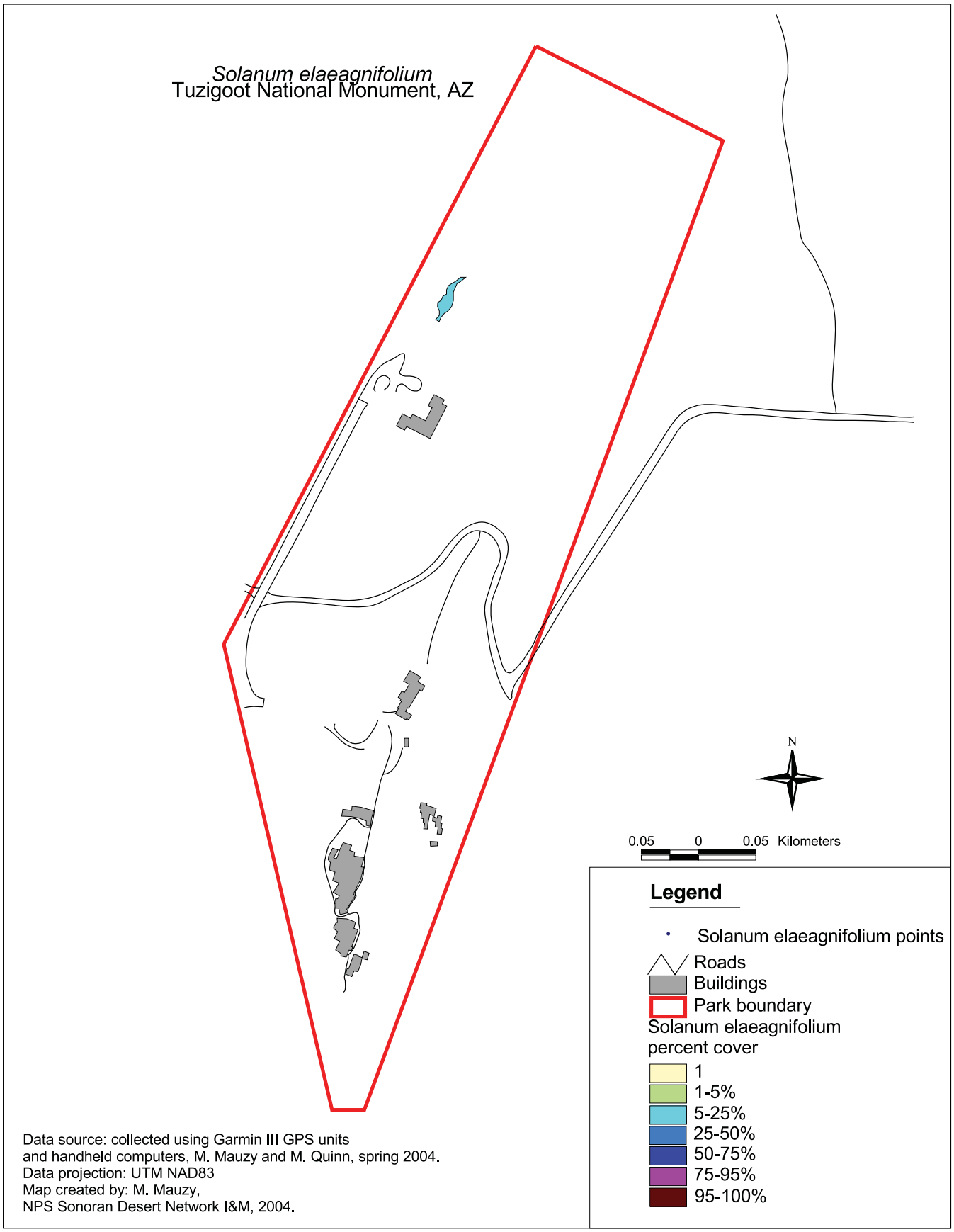

Lamium amplexicaule
Tuzigoot National Monument, AZ
N
0.05 0 0.05 Kilometers
Legend
Lamium amplexicaule points
Roads
Buildings
Park boundary
Lamium amplexicaule percent cover
1
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, spring 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy,
NPS Sonoran Desert Network I&M, 2004.


Marrubium vulgare
Tuzigoot National Monument, AZ
N
0.05 0 0.05 Kilometers
Legend
Marrubium vulgare points
Roads
Buildings
Park boundary
Marrubium vulgare percent cover
1
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, spring 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy,
NPS Sonoran Desert Network I&M, 2004.


Medicago spp.
Tuzigoot National Monument, AZ
N
0.05 0 0.05 Kilometers
Legend
Medicago spp. points
Roads
Buildings
Park boundary
Medicago spp. percent cover
1
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, spring 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy,
NPS Sonoran Desert Network I&M, 2004.


Schismus barbatus
Tuzigoot National Monument, AZ
N
0.05 0 0.05 Kilometers
Legend
Schismus barbatus points
Roads
Buildings
Park boundary
Schismus barbatus percent cover
1
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, spring 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy,
NPS Sonoran Desert Network I&M, 2004.


Sisymbrium irio
Tuzigoot National Monument, AZ
N
0.05 0 0.05 Kilometers
Legend
Sisymbrium irio points
Roads
Buildings
Park boundary
Sisymbrium irio percent cover
1
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, spring 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy,
NPS Sonoran Desert Network I&M, 2004.


Solanum elaeagnifolium
Tuzigoot National Monument, AZ
N
0.05 0 0.05 Kilometers
Legend
Solanum elaeagnifolium points
Roads
Buildings
Park boundary
Solanum elaeagnifolium
percent cover
1
1-5%
5-25%
25-50%
50-75%
75-95%
95-100%
Data source: collected using Garmin III GPS units
and handheld computers, M. Mauzy and M. Quinn, spring 2004.
Data projection: UTM NAD83
Map created by: M. Mauzy,
NPS Sonoran Desert Network I&M, 2004.

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

NPS 309/100671, November 2009

National Park Service
U.S. Department of the Interior

Natural Resource Program Center
1201 Oak Ridge Drive, Suite 150
Fort Collins, Colorado 80525

www.nature.nps.gov