A GENERAL HERPETOFAUNA ASSESSMENT AND MAPPING OF HIBERNACULA AT RABBIT MOUNTAIN OPEN SPACE

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ENVIRONMENTAL SERVICES

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A General Herpetofauna Assessment and Mapping of Hibernacula at Rabbit Mountain Open Space

Prepared for:

Boulder County Parks and Open Space

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Executive Summary

Rabbit Mountain Open Space is a centerpiece of ecological diversity recognized for its largely intact and high quality foothills natural communities, mountain mahogany shrublands, and Piedmont grassland communities. Its herpetofaunal component, however, has yet to be systematically investigated. Information on the herpetofauna on the property is needed to better inform management practices for the Rabbit Mountain Open Space Management Plan, which is currently undergoing an update over the 1986 version.

The goal of this project was to provide an account of all reptile and amphibian species occurring on Rabbit Mountain, with emphasis on locating species of state and county concern, and identification of areas of critical habitat. Field survey work by Adaptation personnel and expert volunteers, began March 28, 2015, and continued to September 25, 2015 using visual encounter surveys and turning of surface objects. Search effort implemented was 491 hours search time over approximately 656 miles foot/vehicle travel.

Results of the survey confirm that there are at least three species of amphibian (Western Tiger Salamander, Woodhouse's Toad, Boreal Chorus Frog), one species of lizard (Prairie Lizard), and for the Front Range, a remarkably large assemblage of at least nine snake species (Eastern Yellow-bellied Racer, Milksnake, Bullsnake, Plains Black-headed Snake, Terrestrial Gartersnake, Plains Gartersnake, Common Gartersnake, Lined Snake, Prairie Rattlesnake). Two amphibian species and three snake species are Boulder County Species of Special Concern. The Colorado Natural Heritage Program tracks the Common Gartersnake and Lined snake as sensitive species and ranks them as G5 S3 and "watchlisted", G5 S3, respectively. Both species are uncommon in the state and Boulder County. This new location for the Lined Snake stands as the northernmost known location for the species in the state. One particular survey site was exceptional in that it yielded eight of the nine snake species documented on the property.

The results of the survey will be provided to the BCPOS in GIS format.

Acknowledgments

We thank Boulder County Parks and Open Space for providing funding for this study. This work would not have been possible without the help of the many volunteers who participated in the surveys: Anthony Bottagaro, Tom Bottagaro, Mike Currie, Nicole Elizabeth, Ben Fisher, Carissa Fisher, Jackson Green, Jeff Green, Jenni Green, William Green, Sean Hutcheson, Tavion Hutcheson, Jay Hutchins, Katie Irwin, Cam Johnson, Hunter Johnson, Melissa Johnson, Linda Koch, Sam Koch, Karen Green, Zach Green, Brandon Green, Ian Jessup, Wendy McMullen, Sean McMullen, Hayley Urbanek, Ryan Urbanek, Lisa Visnosky, Nicole Weprin, Cole Wild, and Heather Wild.

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INTRODUCTION

Boulder County's Rabbit Mountain planning area, located in north central Boulder County at an elevation of 5400 to 6060 ft., is a 4,793-acre aggregate of 21 parcels forming one of the most ecologically diverse and native-dominated open space properties in the county. Its B1 ranking for "Outstanding Biodiversity Significance" by the Colorado Natural Heritage Program (CNHP) is shared by only two other areas in the county. The B1 ranking derives from the presence of at least four globally critically imperiled to globally imperiled (G1-G2) element occurrences that are in excellent or good (A- or B-ranked) condition, including foothills natural communities, mountain mahogany shrublands, and Piedmont grassland communities (Neid *et al.* 2009). The 2015 Boulder County Comprehensive Plan designates Rabbit Mountain as Critical Wildlife Habitat, containing Significant Natural Communities (Foothills Ponderosa Pine Scrub Woodland), a Rare Plant Area, and an Environmental Conservation Area.

This diversity derives largely from Rabbit Mountain's position at the southern terminus of a major series of north-south trending hogbacks funneled down by the Denver Basin landscape such that they span a relatively short distance from west to east. Rabbit Mountain's geographic position within this relatively steep transitional zone together with multiple sedimentary bedrock layers of the hogbacks results in an extensive mosaic of piedmont grassland, foothill shrubland, and ponderosa pine savanna habitat. Sizable Black-tailed prairie dog (*Cynomys ludovicianus*) towns, which may increase animal diversity (Lomolino and Smith 2004; Shipley and Reading 2006), occur throughout these grasslands. There are a number of small intermittent streams, natural springs, and seeps, providing aquatic and riparian habitat, and St. Vrain Supply Canal, provides an additional water source. Despite this diversity of habitat and its documented ecological value, no extensive surveys for reptiles and amphibians have been conducted on the property.

The main objective of this survey was to detect as many of the reptile and amphibian species that could occur on Rabbit Mountain Open Space as possible within a single season study. A secondary

objective was to identify winter hibernacula of snakes. It is further intended that information from this study be used in the update of the Rabbit Mountain Open Space Management Plan, which is currently in progress. The current plan, which dates to 1984, contains no information or management recommendations for reptiles and amphibians, but recognizes the need for surveys.

METHODS

General

This study was designed to detect as many species of reptile and amphibian species on the property as possible. Locations of individuals of species we detected are not necessarily indicative of a specie's entire range on the property. Species location data provided here are intended to serve as the basis for planning future species-targeted surveys.

Survey Methods

We conducted searches for reptiles and amphibians during day and nightime hours using techniques recommended for rapid and/or comprehensive assessment (Graeter et al. 2013). These species-specific survey techniques included visual encounter surveys conducted on foot and driving roads, turning surface objects, and listening for calls of anurans. Parcels in the southeastern area of the property are under seasonal closure, so surveys there were not conducted until after the July 15, 2015 opening date. Daytime surveys were conducted in spring and late summer when daytime temperatures were preferable to elicit surface activity of herpetofauna; nightime searches were conducted mid season when daytime temperatures became too hot for surface activity. Surveys began March 28, 2015 and were conducted every 1-2 weeks until September 25, 2015. A total of 27 surveys were conducted. Data on incidental herpetofauna observed beyond the September 25, 2015 end date are included on species maps and

electronic files only. The number of surveyors present varied by date, ranging from 2–12, and averaging 5–9 (Figure 1). During surveys, surveyors walked 25-100 m apart looking for herpetofauna and turning surface objects under which that herpetofauna were likely to be found, which on Rabbit Mountain was primarily flat rocks. Care was taken to return surface objects to their original positions. Herpetofauna were captured by hand, geographic coordinates at point of capture recorded with a Garmin 62s series Global Positioning System (GPS), photographed, and then released at point of capture. We also recorded geographic locations for any reptile hibernacula or amphibian breeding sites (as indicated by calling males or observations of amplexus) we encountered.

Figure 1. Representative group of enthusiastic volunteers discussing the day's finds on on Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

On each survey, 1-3 persons carried a GPS (Garmin 62s series) and collected track logs documenting their individual search paths. These tracks were used to document the general areas searched (general because there were always more surveyors present than GPS's employed, and surveyors walked apart) and estimate total distances traveled per survey (average kilometers walked multiplied by number of surveyors present). Some tracks include searches conducted while driving on roads.

ArcGIS 10.3.1 software was used to display spatial data. Global Information System data for all herpetofaunal locations are provided as electronic files in NAD 1983 HARN State Plane Colorado North (horizontal projected coordinate system). Taxonomy herein follows Crother (2012). This work was conducted under Colorado Parks and Wildlife Scientific Collection permit #15HP993 issued to J. Ehrenberger.

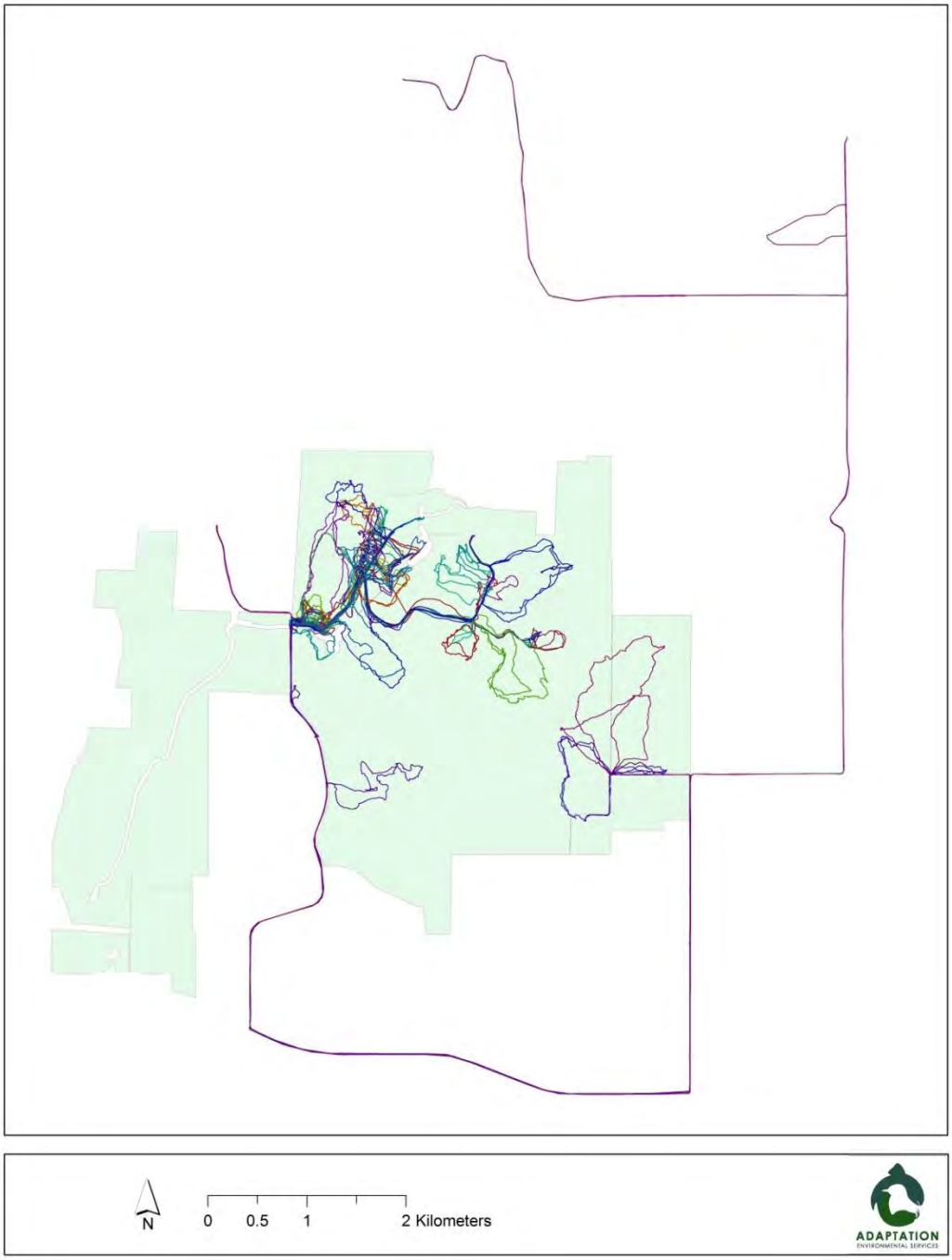

Figure 2. Global Positioning System track logs by visitation date indicating areas surveyed on Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado. Different colored lines indicate different survey dates. Twenty seven surveys were conducted between March 28, 2015 and September 25, 2015. On each survey date one to three surveyors collected individual track logs. However, there were always additional surveyors present. Surveys were therefore always conducted at a greater level of coverage than indicated by tracks shown here (see Methods).

RESULTS

Overall Findings

We documented a total of three species of amphibian (Western Tiger Salamander, Woodhouse's Toad, and Boreal Chorus Frog), one species of lizard (Prairie Lizard), and nine species of snakes (Eastern Yellow-bellied Racer, Milksnake, Bullsnake, Plains Black-headed Snake, Terrestrial Gartersnake, Plains Gartersnake, Common Gartersnake, Lined Snake, and Prairie Rattlesnake). Most individuals were observed as they were moving in the open (Table 1). Although this metric is dominated by Woodhouse's Toads which were the most commonly observed species and always observed while foraging, it was still the most common type of encounter and the greatest number of species were observed this way. However, species that were uncommon and secretive were only observed by turning cover objects.

Species Observed

Western Tiger Salamander

Figure 3. Western Tiger Salamander (*Ambystoma mavortium*), Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

We did not observe breeding sites for this species on the property although they likely exist. Larvae of this species are capable of metamorphosing at low elevation sites on the property and therefore do not require a deep water body to overwinter; ephemeral ponds and other small water sources likely suffice. The five individuals we registered, four of which were juveniles, were all found within mouths of prairie dog burrows on the west side of the property. This is a common species in Colorado and Boulder County (Hammerson 1999) and probably occurs throughout the lower elevations of the property. In Boulder

county the Western Tiger Salamander is a lower tier Species of Special Concern (Criterion 9). To protect this species, we do not provide an observation location map here.

Woodhouse's Toad

Figure 4. Woodhouse's Toad (*Anaxyrus woodhousii*), Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

This species was the most commonly encountered species on the property (n = 65), with most individuals observed in drainages and on roads. Most individuals were found in early evening after they had emerged from daytime retreats to forage for food. Individuals may be attracted to roads where insect food is more visible than in vegetated surroundings. The first individual was not found until May 14, 2015 and the last on September 12, 2015. We registered two aquatic sites on the west side of the property where this

species was observed breeding relatively late in the season (7/18/15 and 8/27/15). Recent metamorphs of at least two age classes were observed on both the west and east sides of the property. This species is likely found on every part of the property, but particularly near water sources. Tadpoles and metamorphs may be an important food source for the three garter snake species found on the property. This is a common species in Colorado and Boulder County (Hammerson 1999).

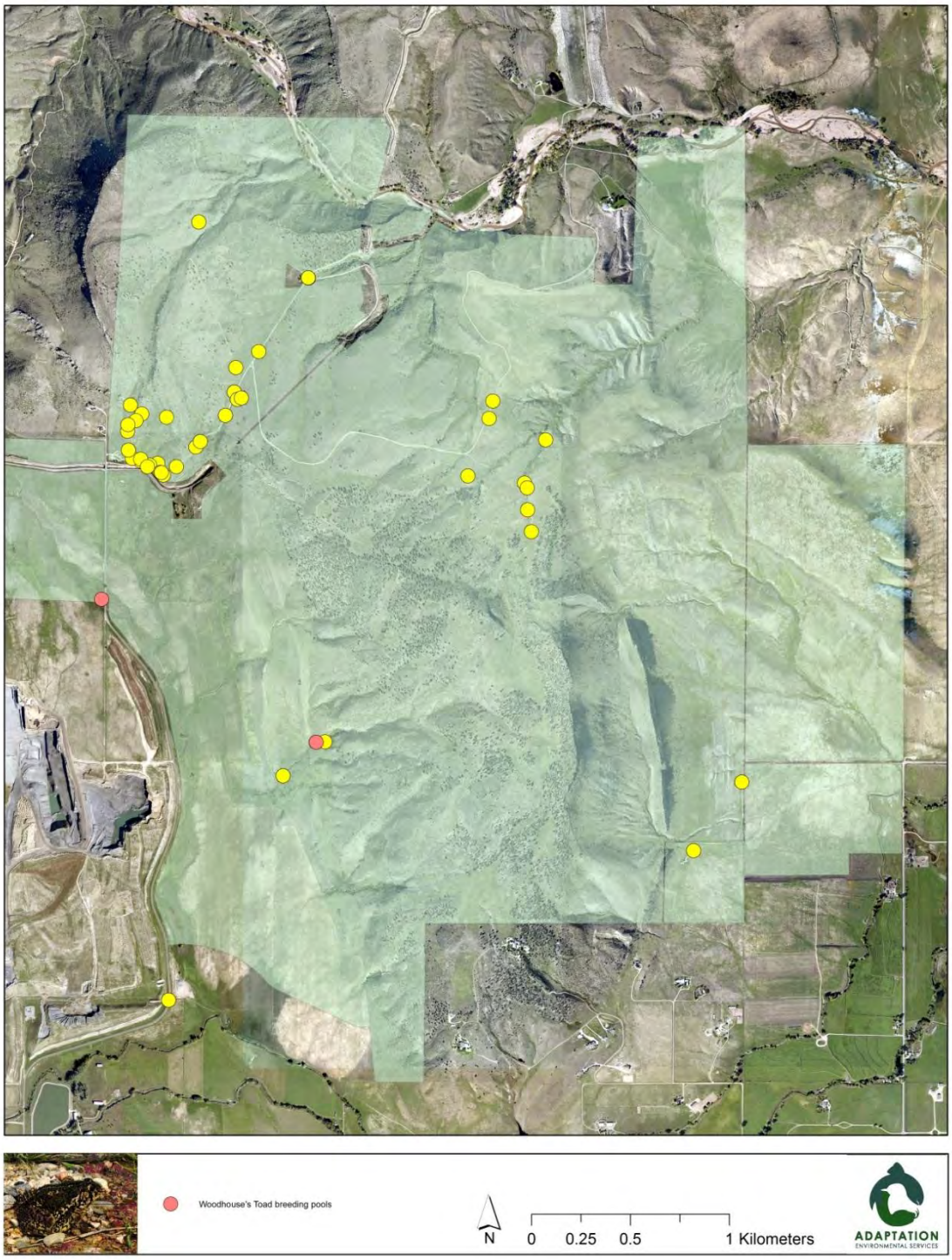

Figure 5. Locations of Woodhouse's Toads (*Anaxyrus woodhousii*) observed on Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado (Yellow-filled circles). Red-filled circles indicate locations of aquatic breeding sites.

Boreal Chorus Frog

Figure 6. Boreal Chorus Frog (Pseudacris maculata), Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

We registered four observations for Boreal Chorus Frogs (formerly recognized as Western Chorus Frog, *Pseudacris triseriata*) between April 17, 2015 and May 27, 2015 and all were calling individuals in ephemeral streams on the west side of the property. One adult was observed in an ephemeral stream on the east side of the property on September 4, 2015. This species is common in Colorado and in Boulder County (Hammerson 1999), but is a Species of Special Concern in Boulder County (Criterion 9). To protect this species, we do not provide an observation location map here.

Prairie Lizard

Figure 7. Prairie Lizard (Sceloporus consobrinus), Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

Despite the rocky habitat on many parts of Rabbit Mountain, we observed only seven individuals. Locations were widely dispersed throughout the property but tended to be in upland areas. The common habitat feature at each location were large rock outcroppings. We never observed this species on the ground in the more prairie-like habitats of the lower parts of the property. This is a common species in Colorado and Boulder County (Hammerson 1999). It is likely more common than we observed, but focused surveys in suitable habitat are needed to evaluate this supposition.

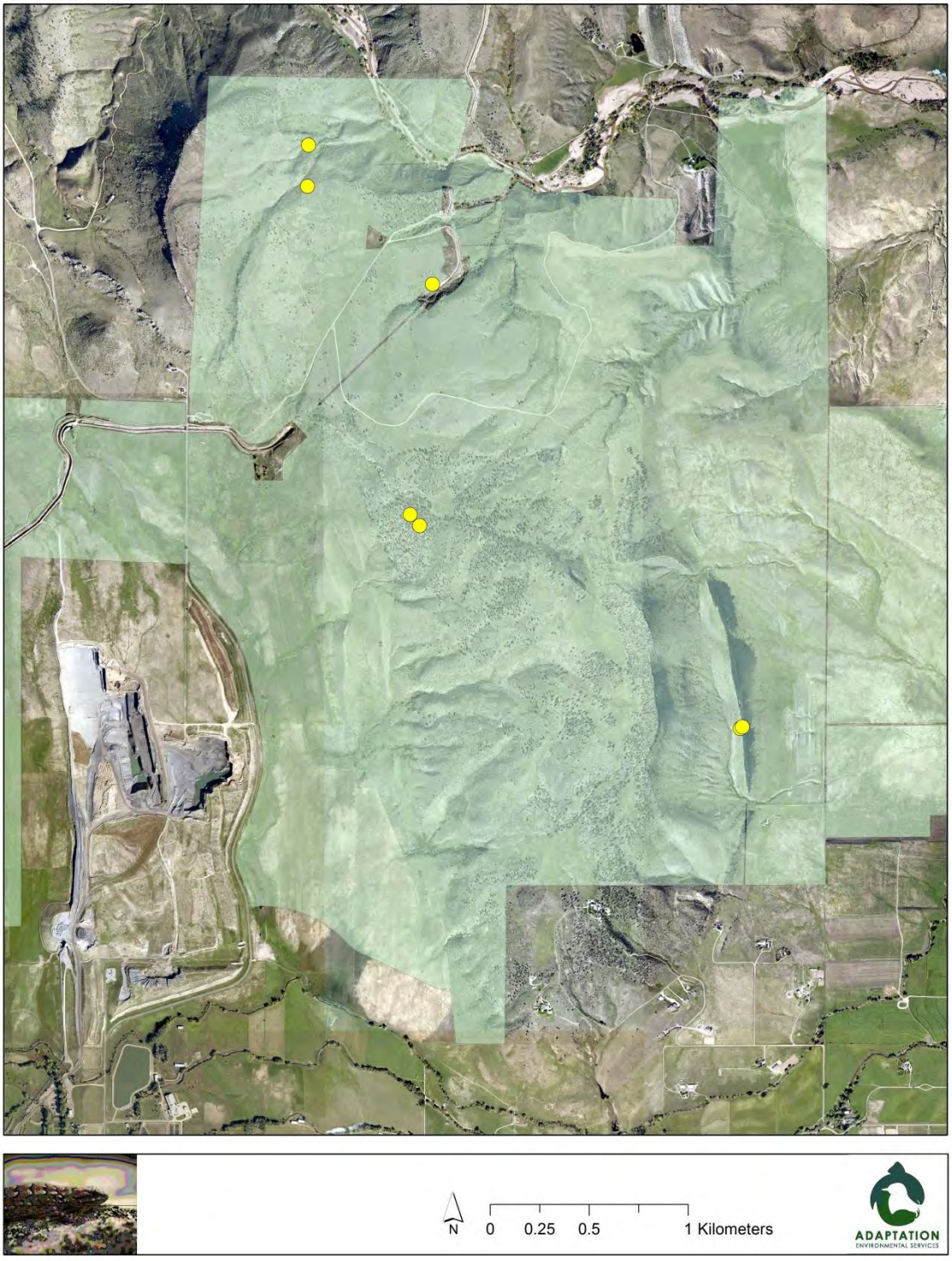

Figure 8. Locations of Prairie Lizards (*Sceloporus consobrinus*) observed on Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

Eastern Yellow-bellied Racer

Figure 9. Eastern Yellow-bellied Racer (*Coluber constrictor*) Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

The Eastern Yellow-bellied Racer is a diurnal species that inhabits a wide diversity of habitats in Colorado and takes a wide variety of vertebrate and invertebrate prey. In accordance this was the second most common snake species found (n = 15), although we found it only on the western side of the property. This is a common species in Colorado and Boulder County (Hammerson 1999) and it almost certainly occurs throughout the entire Rabbit Mountain property.

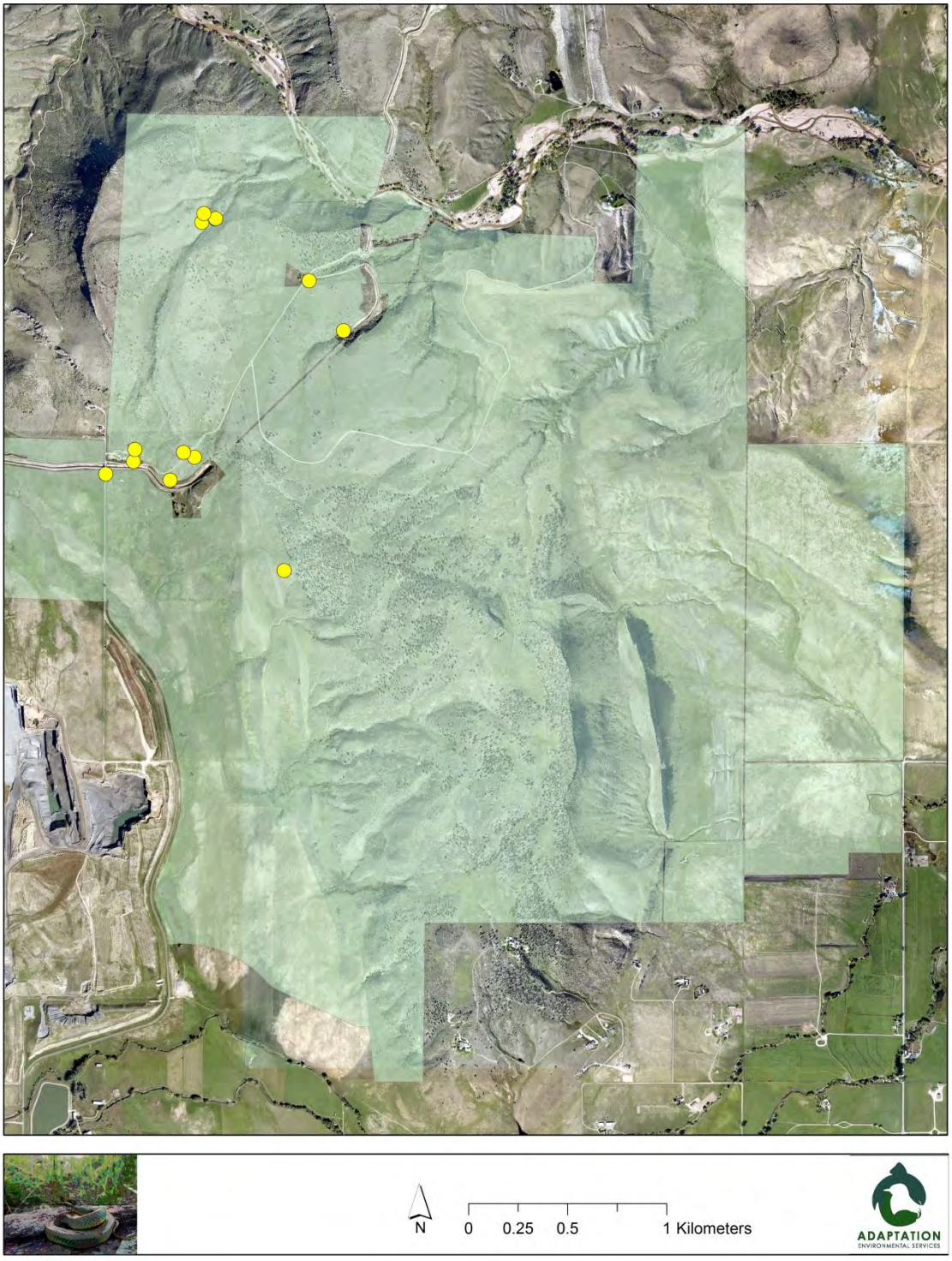

Figure 10. Locations of Eastern Yellow-bellied Racers (*Coluber constrictor*) observed on Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

Milk Snake

Figure 11. Milk Snake (*Lampropeltis triangulum*) Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

As anticipated, we registered this species on the property, but it was infrequently encountered (n = 3), which is generally the case over much of the range of this species in Colorado. Two individuals were found under flat stones and the other was foraging on the surface near dusk. In Colorado this species occurs in a wide variety of habitats from shortgrass prairie to open stands of Ponderosa pine and thus likely occurs throughout the property. The Milk Snake is considered rare In Boulder County and is thus classified as a mid-tier Species of Special Concern (Criteria, 4, 9). To protect this species, we do not provide an observation location map here.

Bullsnake

Figure 12. Bullsnake (*Pituophis catenifer*) Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

We encountered relatively few individuals of this species (n = 7), despite its widespread distribution and commonality in many areas of the state. Like the Eastern Yellow-bellied Racer, this species occurs in a wide variety of habitats in Boulder County, from shortgrass prairie up into to stands of Ponderosa pine in the foothills. It too, likely occurs throughout the property, but apparently in lesser numbers than the Eastern Yellow-bellied Racer. It is primarily diurnal and is easily observed when present.

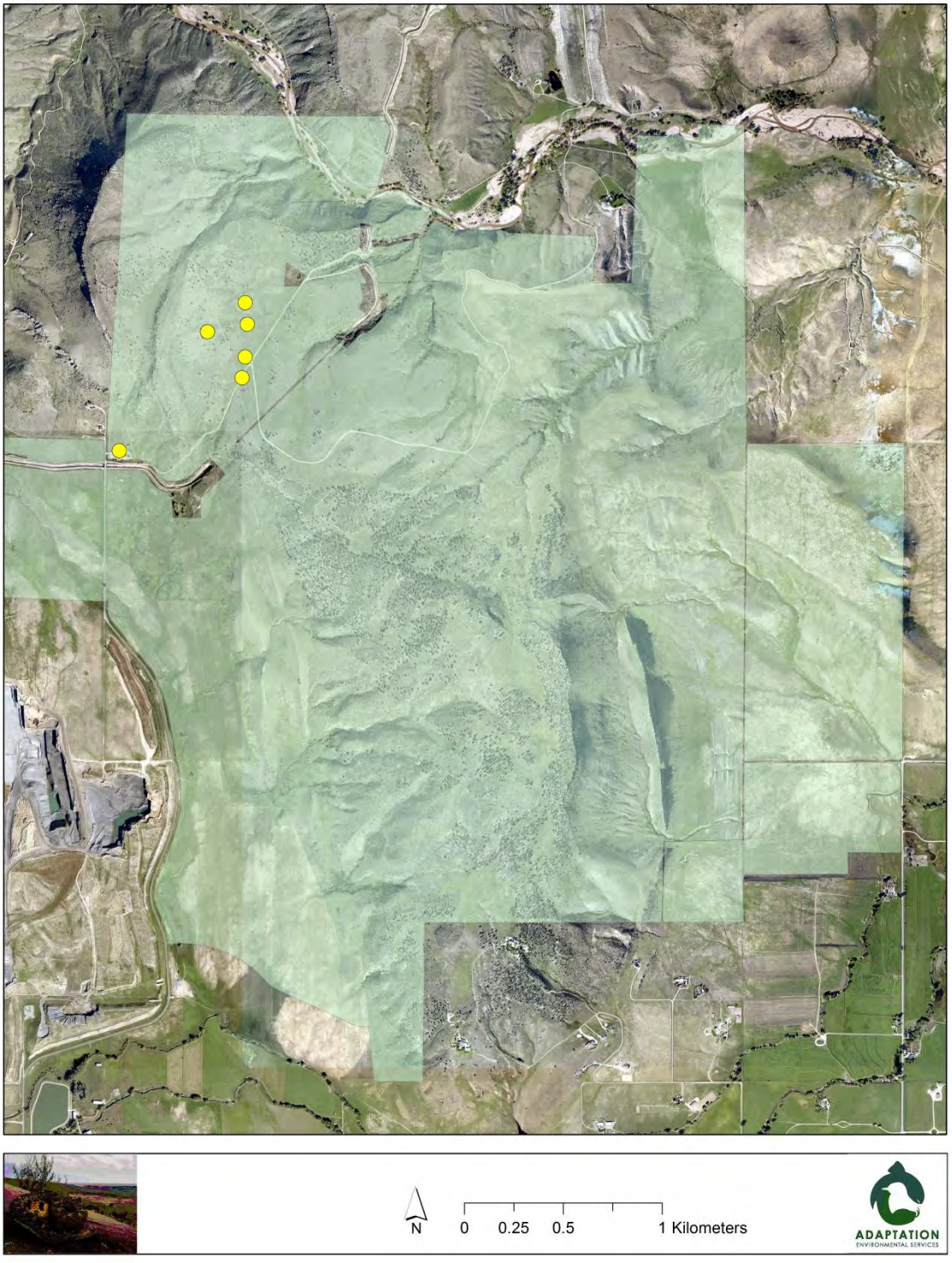

Figure 13. Locations of Bullsnakes (*Pituophis catenifer*) observed on Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

Plains Black-headed Snake

Figure 14. Plains Black-headed Snakes (*Tantilla nigriceps*) Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

This small secretive species is represented by relatively few records in Colorado, although in some places where it occurs it can be locally abundant. Our finding of five individuals under flat rocks on one small hillside is consistent with this phenomenon. We also found one individual on the eastern side of the property on a relatively cool northeast-facing rocky slope which suggests they may be found in many other parts of the property where favorable moist microhabitat beneath surface cover is found. In eastern Colorado it occurs in plains grasslands up into the foothills. The last individual we encountered was on June 24, 2015, relatively early in the field season, likely because they retreat belowground after the soil beneath surface objects dries and daytime temperatures become too hot. It is probably surface-active

again in fall provided ample precipitation. Targeted surveys for this species at other areas of the property during the appropriate temperature-precipitation windows are needed to determine its distribution and status throughout the property. To protect this species, we do not provide an observation location map here.

Terrestrial Gartersnake

Figure 15. Terrestrial Gartersnake (*Thamnophis elegans*), Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

We registered seven individuals of this common and wide-ranging species. This was the most commonly observed Gartersnake species on the property. As expected, all individuals were found in the close vicinity of water. Most were found in the close vicinity of the St. Vrain Supply Canal near the visitors'

parking lot. This species occurs at higher elevations that any other Gartersnake (or snake) species in Colorado and it is therefore expected in all parts and elevations of Rabbit Mountain, even in areas where there is no standing water. Although they take a wide range of vertebrate and invertebrate prey, we would expect them to be present in greater numbers where amphibians are breeding, as larvae and metamorphs of all three amphibian species recorded here are readily taken.

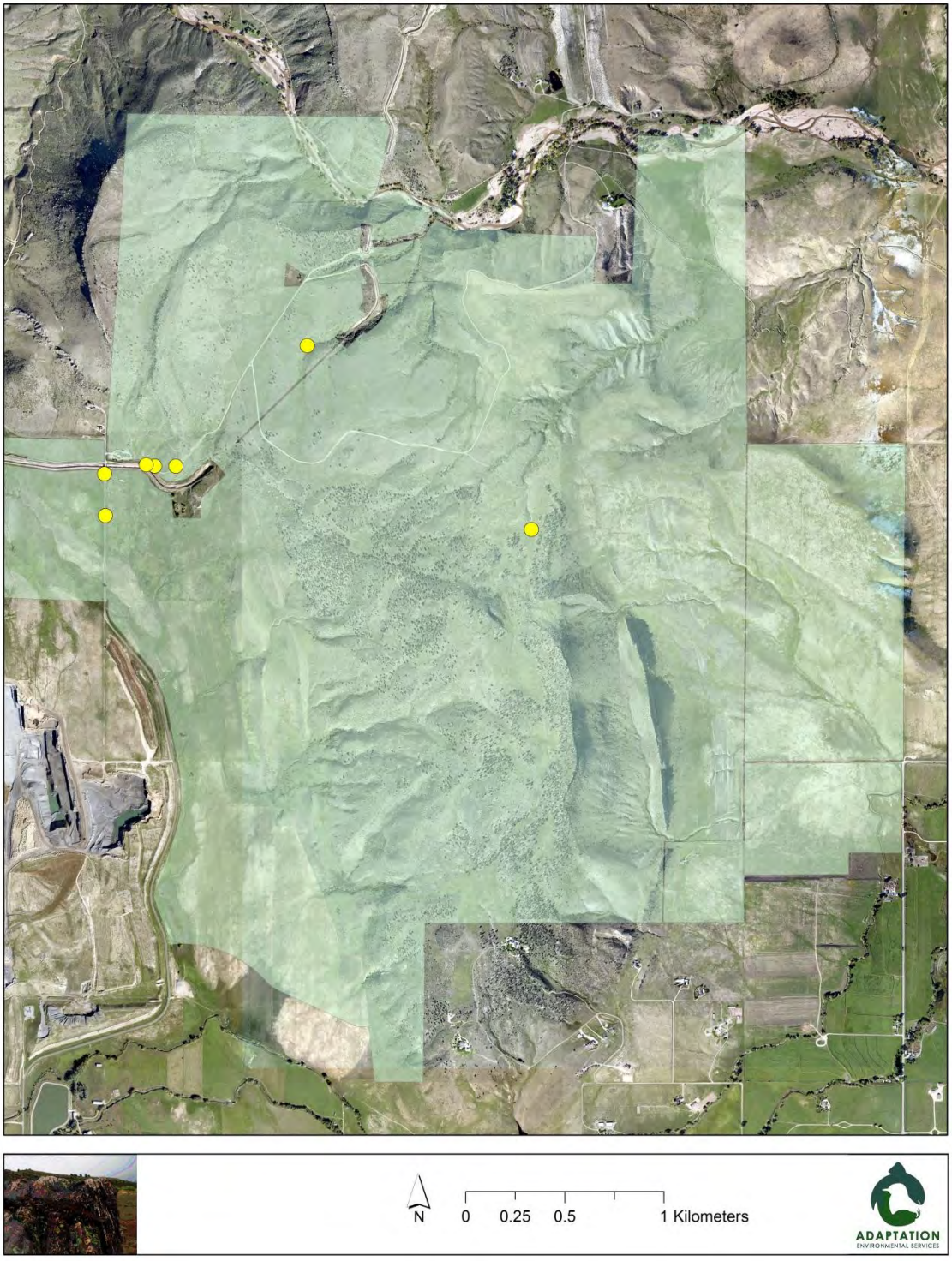

Figure 16. Locations of Terrestrial Gartersnakes (*Thamnophis elegans*) observed on Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

Plains Gartersnake

Figure 17. Plains Gartersnake (*Thamnophis radix*), Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

All four of the individuals we found were in or near standing water, which is consistent trait of this species. Two of the individuals were encountered foraging in a pond containing Woodhouse's Toad tadpoles and metamorphs. Although they consume a wide variety of vertebrate and invertebrate prey, amphibians form a major component of the diet. All individuals we registered were found in lower areas of the property. Aquatic habitat at low elevations of the property where amphibians breed should be maintained in as good as condition as possible, for this and the other two Gartersnake species, as well as the three documented species of amphibians. This species is well-documented within Boulder County and throughout eastern Colorado.

Figure 18. Locations of Plains Gartersnakes (*Thamnophis radix*) observed on Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

Common Gartersnake

Figure 19. Common Gartersnake (*Thamnophis sirtalis*), Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

We were surprised to find two individuals of this now infrequently seen species. Although this is one of the most widely ranging species in North America, it enters Colorado only through a narrow riverine corridor in the north central part of the state with a range terminus near Denver. Although there are a number of records for this species in Boulder County, it is thought to be declining (Hammerson 1999). CNHP considerers it to be uncommon in the county. The Colorado Natural Heritage Program tracks the Common Gartersnake as a sensitive species with a G5 S3 ranking. It is an upper tier Species of Special Concern in Boulder County (Criteria, 2, 3). A potential reason for this apparent decline is that in Colorado this species of Gartersnake is restricted to aquatic habitats along the floodplains of streams and these areas

are more and more becoming impacted by human activities. Not only were we surprised to find this species, it was remarkable that we found it so far from permanent water. The two individuals we encountered were on the northern end of the property in an upland area near an intermittent stream/riparian corridor connecting to the Little Thompson River 0.64 km to the east. This area is on a relatively open steep and rock-strewn slope. Both individuals were found beneath flat stones. Targeted surveys should be conducted for this species throughout this drainage and along the Rabbit Mountain side of the Little Thompson River. To protect this species, we do not provide an observation location map here.

Lined Snake

Figure 20. Lined Snake (*Tropidoclonion lineatum*), Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

The core of the Lined Snake's range is the Great Plain Region but there are disjunct populations to the east and particularly to the west. It is often times common at sites where it exists, including disturbed sites and around human habitation. There are few records for this species in Boulder County. CNHP ranks it "watchlisted" (S3S4). Boulder County considers it a Species of Special Concern (SSC) by their two lowest SSC criteria: "9. Species whose populations in the County may be currently secure, but are vulnerable to imminent threats affecting their populations either directly or indirectly" and "10. Species of undetermined status which require further research and/or monitoring." We found a total of nine individuals between May 14, 2015 and July 3, 2015, all in the same small area of one southwest-facing hillside. All seven of the individuals we documented were found beneath flat rocks when soil beneath was moist. It likely occurs in other places on the property and targeted searches should be conducted at the appropriate times of year to fully determine its distribution. To protect this species, we do not provide an observation location map here.

Prairie Rattlesnake

Figure 21. Prairie Rattlesnakes (*Crotalus viridis*), Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

Historical accounts mention that Rabbit Mountain was once nicknamed "Rattlesnake Mountain" because of the presence of numerous rattlesnakes. Although the numbers of rattlesnakes are probably considerably less than what was reportedly on the property, Prairie Rattlesnakes are still routinely encountered (Rabbit Mountain Management Plan 1984). Indeed, we found Prairie Rattlesnakes to be by far the most common snake species on the property (n = 36), constituting 46% of the total number of snakes found. We encountered them on both day and night searches in all terrestrial habitats including rocky upland hillsides, grasslands, and prairie dog towns. They were generally encountered while they were basking or moving about; only two were found beneath cover objects. One small female was pregnant at time of

capture. This individual, to which we dermally attached a small radio transmitter, moved to beneath a large flat rock (~3.5x3.5 ft. square, 1.5 ft. thick) where she resided for about eight days before she was observed there together with her neonates on August 25, 2015. Female Prairie Rattlesnakes are known to use the same individual rookeries for birthing year after year (Graves and Duvall 1993). One likely hibernaculum was located near the reintroduced prairie dog colony on the Motley parcel on the northwest end of the reintroduced prairie dogs colony. On April 30, 2015 we observed two adult Prairie Rattlesnakes basking near the entrance of a prairie dog burrow. This species has been documented in Colorado as using prairie dog burrows for hibernacula (Shipley et al. 2013). Prairie Rattlesnakes found on trails and roads within the property were usually found near dusk when air temperatures were decreasing and surface temperatures were still warm enough to elicit basking (i.e., resting on trail or road). This is essentially the same time of day when visitors are most likely to be using trails (i.e., visitors wait for daytime temperature to decrease before venturing forth). This is the main reason why visitors at Rabbit Mountain so often encounter this species.

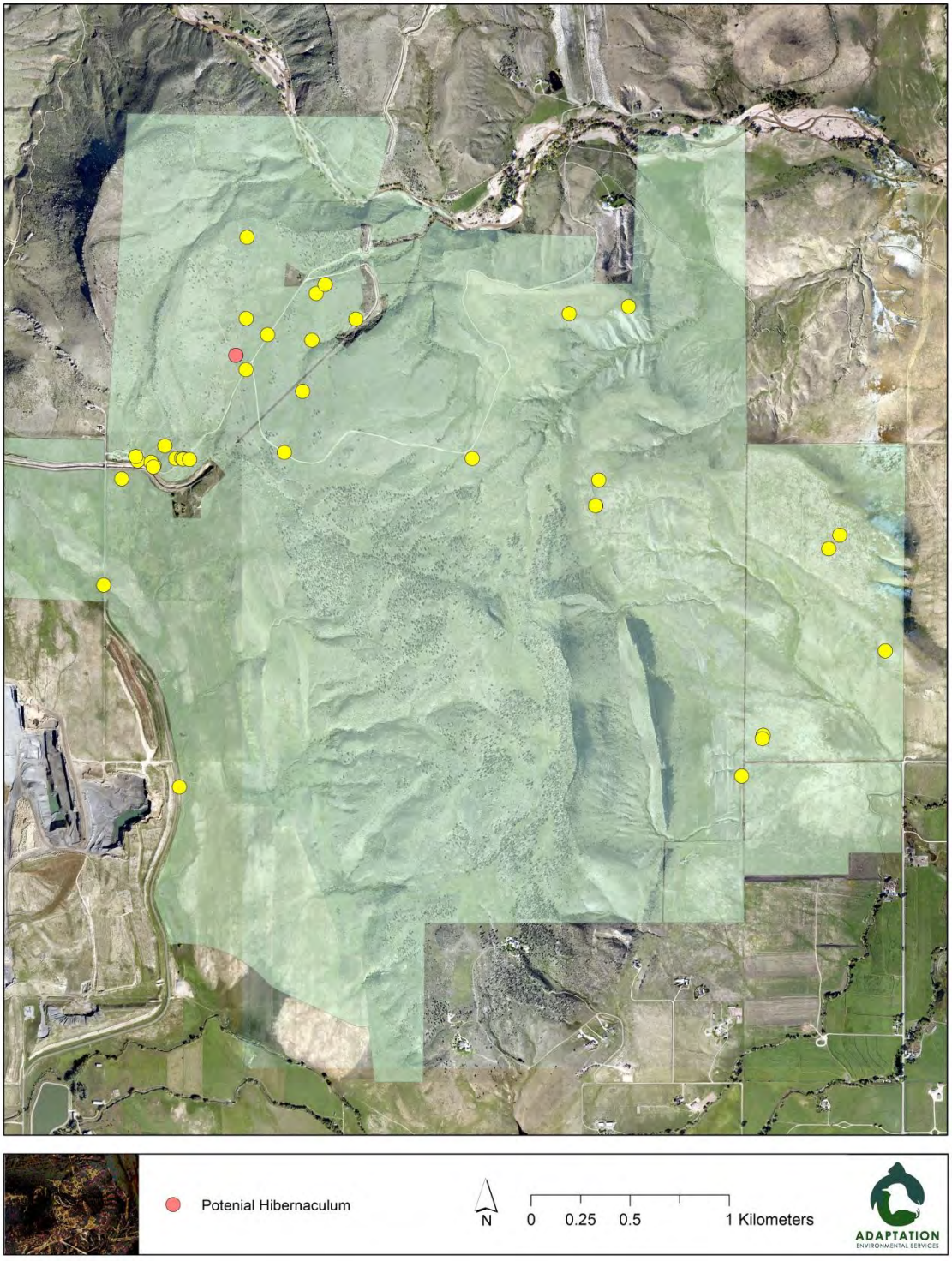

Figure 22. Locations of Prairie Rattlesnakes (*Crotalus viridis*) observed on Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

Survey Effort

A typical site visit averaged 18 person hours with an average total walking/driving distance of 24 miles (Table 2). Altogether, Adaptation personel and volunteers effected a survey effort of 491 hours search time over approximately 656 miles foot/vehicle travel. The cost required detecting the numbers of species and numbers of individuals recorded in this study would have been substantial without the help of the many volunteers. Using the current monetary value of volunteer time in the state of Colorado of $25.68/h (https://www.independentsector.org/volunteer_time), yields a total project labor cost of $12,609, or for all snakes we documented, about $143 per observation (0.18 snakes per search hour). This cost per observation is no shortcoming of the methods we used, but rather an accurate reflection of the difficulty in detecting species that are difficult to observe, uncommon, and/or secretive. A similar study conducted at City of Boulder Open Space and Mountain Parks' North Boulder Grasslands yielded 0.16 snakes per hour, in part because of the lower snake species diversity there (Ehrenberger et al. 2014).

Species That May Occur On Rabbit Mountain

All native amphibian species that could potentially occur on the property were documented except the Northern Leopard Frog. This species, formerly abundant, but now scarce in Boulder County, is unlikely to occur on the property because of the lack of permanent water deep enough for overwintering, suitably sized small ephemeral ponds for breeding, and wet meadows for foraging that also contain water bodies into which that frogs can escape to avoid predation.

Six-lined Racerunners (*Aspidoscelis sexlineata*) and Greater Short-horned Lizards (*Phrynosoma hernadesi*) may inhabit the south eastern part of the property because habitat type for both species, large areas with patchy open ground, exists there. The latter species, though uncommon in Boulder County, occurs just south of Rabbit Mountain on Table Mountain (BCPOS staff observation, 2014), a U.S. Department of Commerce site, and the former species occurs in eastern Boulder County in the White

Rocks area (Livo 1997). Although we conducted targeted surveys for both species there and many hours of additional time was spent in the area radiotracking Prairie Rattlesnakes, neither species was observed. Both species are known to persist in disturbed areas, such as those having been under agricultural, as this area of Rabbit Mountain once was, so it is possible one or both species exist there. No other lizard species are expected on Rabbit Mountain, except possibly Many-lined Skink (*Eumeces multivirgatus*). This species has been recorded in Weld County close to the Boulder County Line (Hammerson (1999). Despite extensive turning of surface objects in appropriate habitat we did not observed this secretive species.

In 2008 it was remarkable to learn that a Western Hognose Snake (*Heterodon nasicus*) had been found on Rabbit Mountain (University of Colorado Museum of Natural History, Catalog Number AC-166) and then another in 2014 on road between Rabbit Mountain and Cemex properties (Cameron Young, pers comm). These occurances were remarkable because the species was previously unrecorded from Boulder County and because of the absense of sandy soils prefered by this species. We conducted one survey in this area of the property but no Western Hognose Snakes were observed. However, this species is also often found near streams, irrigation ditches, and other water sources, and there is a small semi-permanent water course paralleling the road on the Rabbit Mountain side of the road. In this area we documented numerous occurances for Woodhouse's Toad here, a preferred food of the Western Hognose Snake. Habitat on the west side of the road (Dowe Flats-CEMEX property), because it is dryer and more sparsely vegetated, appears to be better habitat for this species than that on the Rabbit Mountain side of road. Before Cemex's permit to quarry on Dowe Flats expires, habitat needs of this species should be considered in planning of any reclamation/restoration work and targeted surveys should be conducted.

Based on a possible sighting of a Smooth Greensnake (*Opheodrys vernalis*) on Rabbit Mountain by a BCPOS staff member in April 2011, we conducted targeted surveys for this species at this location and at other locations where we considered them most likely to occur, specifically along riparian drainages on the east side of the property. On each survey there were persons present with experience surveying for this species in Colorado. Although we were not able to register this species, the more vegetated drainages on the mid to lower slopes on the east side of the property and along the Little

Thompson River may harbor this species. This species can be confused with the Eastern Yellow-bellied Racer, which is also greenish in color, and documented herein as common on Rabbit Mountain.

Table 1. Species observed according to detection method on Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

	DISPOSITION WHEN ENCOUNTERED					
	Basking in Open	**Moving in Open**	**RestingUnder Natural Cover**	**Dead**	**Calling**	**Other**
SPECIES						
Western Tiger Salamander		3				
Woodhouse's Toad		62				3 breeding pools
Boreal Chorus Frog					**5**	
Prairie Lizard	6					**1 Scat**
Eastern Yellow-bellied Racer		**10**	**4**	**1****		
Milk Snake		**1**	**2**			
Bullsnake	3	**2**		**2***		
Plains Black-headed Snake			**7**			
Terrestrial Gartersnake		**8**		**3****		
Plains Gartersnake		**5**				
Red-sided Gartersnake			**2**			
Lined Snake			**9**			
Prairie Rattlesnake	18	**15**	**2**	**1****		
TOTAL	27	**106**	**26**	**7**	**5**	**4**
%	15	**61**	**15**	**4**	**3**	**2**

Notes: *in field, **on N 55th Street

Table 2. Species detections and survey effort by date on Boulder County Parks and Open Space, Rabbit Mountain, Boulder County, Colorado.

	SPECIES														
	Amphibians			Reptiles											
Survey Date	WTS	WT	BCF	PL	EYR	MS	B	PBS	TG	PG	RG	LS	PR	Miles	Hours
28-Mar-15							1						1	19.2	16.5
11-Apr-15							2							12.5	17.5
17-Apr-15	3		2											10.4	8
22-Apr-15			2										2	4.8	4
30-Apr-15							1						3	23.2	24
02-May-15													2	19.4	16
14-May-15		3				1		4				7		9.5	15
27-May-15		1	1		4		1	1			2	1	2	52.8	48
31-May-15		1			3				1				0	10.0	10
06-Jun-15		4						1						16.0	18
24-Jun-15		4						1						27.0	10
03-Jul-15		4		1		1						1		50.0	12
17-Jul-15		1		2	1					3				30.0	39
25-Jul-15		1											3	8.0	16
08-Aug-15		9											4	36.0	36
12-Aug-15		11							1	1			3	24.0	24
21-Aug-15		5				1							2	30.0	18
26-Aug-15		8											1	22.8	12.5
28-Aug-15		3			3				1				4	31.2	18
02-Sep-15		4		2										8.4	10.5
04-Sep-15		4	1						1				1	12.5	17.5
09-Sep-15				1	3									34.0	15
11-Sep-15		1			1				1				2	83.6	44
16-Sep-15							2						1	43.8	18
19-Sep-15									1				2	4.6	4
23-Sep-15													3	10.8	8
25-Sep-15									1					21.6	12
Totals	3	65	6	6	15	3	7	7	7	4	2	9	36	656.1	491.5

Notes: WTS=Western Tiger Salamander, WT=Woodhouse's Toad, BCF=Boreal Chorus Frog, PL=Prairie Lizard, EYR=Eastern Yellow-bellied Racer, MS=Milk Snake, B=Bullsnake, PBS=Plains Black-headed Snake, TG= Terrestrial Gartersnake, PG=Plains Gartersnake, RS=Red-sided Gartersnake, LS=Lined Snake, PR=Prairie Rattlesnake.

LAND MANAGEMENT RECOMMENDATIONS

Priority Areas:

Rabbit Mountain Open Space is important to biodiversity. The density of amphibian and reptile species is higher here than in most other Front Range locations. Therefore protecting the entire area, as well as specific priority areas, is paramount for conservation and ecosystem function. Although our survey was a rapid assessment of the property, we were able to identify three specific priority areas important for conservation: A) general area where Lined Snakes were found, B) general area where Common Gartersnakes were found, and C) potential/ identified hibernacula and maternity dens for Prairie Rattlesnakes. Electronic GIS data included with this report provides managers with specific locations and habitat types. Our general recommendations below offer information relevant to these specific priority areas and the entire Open Space property.

General Recommendations:

We recommend referring to Habitat Management Guidelines (HMG) provided by the Partners in Amphibian and Reptile Conservation (PARC) for information on how to best manage properties with amphibians and reptiles in mind. The HMG for the Southwest region will be published soon, however the Northwest and Midwest (2nd Ed.) versions are currently available (*and provided earlier this year to BCPOS*). Additional copies of these resources may be obtained upon request through www.parcplace.org.

Healthy prairie habitats are routinely maintained with grazing and controlled burning. These methods definitely benefit amphibians and reptiles too, but should be conducted in ways that take their requirements into consideration. During times when amphibians may be breeding, access of livestock to areas containing natural pools of water should be curtailed. If accessed, the areas may receive unusual levels of disturbance and defecation causing changes in water quality that may become uninhabitable by

some species and their larvae. Different grazing practices are recommended with respect to pasture usage and seasons, but care should be taken to avoid potential introductions and impacts from non-native and noxious weed species. Some species of noxious weeds (e.g. cheatgrass species and Russian thistle) may be particularly flammable, and while management of them through controlled burning may be practical, it also comes with risks to wildlife. One issue is that some noxious weed species may be denser than native vegetation species, and thus could burn longer, hotter, and maim or kill wildlife species not able to escape the area. Denser non-native vegetation may restrict individual mobility for some species making them more susceptible to predation, as well as restrict gene flow between populations. Application of herbicides as a means for controlling noxious weed species may also have adverse effects on amphibians, reptiles, and their food. Beyond carefully following any pesticide's label, further consideration of all wildlife and their possible activities is paramount. We observed patches of cheatgrass species routinely throughout the property, as well as patches of Russian thistle. Field bindweed was observed in abundance in northeastern sections of the property.

All amphibian and reptile species are habitat indicators. Species sensitive to water quality include all amphibians, as well as garter snake species, which often feed on amphibians. In particular, the Common Gartersnake (*Thamnophis sirtalis*) which is uncommon in Boulder County is tied to Saint Vrain River drainages in Colorado, which demonstrates its need for intact riparian habitats (C. Henke, pers comm). Aquatic habitat on the property should be maintained in as good as condition as possible because it provides breeding sites for the three amphibians species documented and the other two garter-snake species. Less obvious habitat indicators include species like Prairie Lizards (*Sceloporus consobrinus*) which feed on insects and rely on a natural prairie vegetation matrix of bunch grasses and open ground for dispersal, foraging, and thermoregulation. We suspect this species would be negatively impacted by insecticides through a loss of food source and toxicity when affected insects are ingested. Field application of a deltamethrin-based insecticide, the active ingredient in DeltaDust®, resulted in substantial reductions in the densities of two lizard species on treated *vs*. control plots (Alexander et al.

2002). Prairie lizards on Rabbit Mountain, however, are never found within prairie dog colonies, although a number of amphibian and snakes species are. Per a natural prairie vegetation matrix, systematic grazing and controlled burning can restore and maintain a preferred landscape. The presence of common species, like Eastern Yellow-belly Racers (*Coluber constrictor*), Bullsnakes (*Pituophis catenifer*), and Prairie Rattlesnakes (*Crotalus viridis*), in conjunction with small mammal and bird communities, is indicative of a healthy system, as these species routinely prey on mammals, birds, and particularly bird eggs.

Road mortality is a concern for nearly all of the species encountered at Rabbit Mountain Open Space. Amphibians traverse roads during rain events to reach breeding pools, and for general dispersal, and during the summer, simply to thermoregulate, and hunt for prey. Reptiles certainly have learned to use roads to help thermoregulate and disperse. A number of our observations reflect this, including dead-on-road garter-snakes and actively basking/on-the-crawl Prairie Rattlesnakes. The Western Hognose Snake observation records also come from road observations.

As noted above, the recent detections of Western Hognose Snake on Dowe Flats are important because they are new county records for the state and almost certainly represent an isolated population. Prior to reclamation/restoration work on the Cemex quarry, surveys should be conducted to determine the status of this population and habitat requirements.

Open Space Safety/Outreach

Encouraging on-trail-only use at Rabbit Mountain Open Space will benefit amphibians and reptiles, and just as important, will better enable visitors to see rattlesnakes and avoid them. Similarly, controlling dogs via a leash will help them avoid snakes and promote more positive interactions between visitors and all wildlife. Results of research on these issues at the City of Boulder's Open Spaces and Mountain Parks continually reinforces these points and with nearly all wildlife. Regular mowing alongside trails will reinforce positive visual encounters with Prairie Rattlesnakes, rather than surprised and startling ones.

Equestrians routinely visit the area, and along with the entire Trailhead parking area, their staging areas, vegetation should be kept short to help horses and their riders to spot snakes. Further benefits of on-trail-only use are reduced incidence of disease transmission between dogs and wildlife (e.g. tularemia), and improved safety near areas of high use by Prairie Rattlesnakes (e.g., Black-tailed Prairie Dog towns). As we learn more about wildlife diseases (e.g. amphibian and snake fungal diseases), on-trail-only use may help prevent spread of disease by limiting our interactions.

Opportunities are plentiful at Rabbit Mountain Open Space for visitors to learn about amphibians, reptiles, how to stay safe, and how to protect this fauna. Mobile applications and online resources (e.g. social media, podcasts, and websites) are readily accessible to visitor prior to and during their time here. Additionally, a kiosk providing information about species and rattlesnake safety would help further the public's general education of amphibians and reptiles. Kiosks at the trailhead and within the picnic area are most opportunistic as these also provide outdoor shade while visitors await friends and family. We recommend installing kiosks at several other locations along trails within the property for information and shade, and particularly to reinforce what to do in any emergency. (NOTE: We recognize that during electrical and rain storms kiosks may not be the best place for visitors to seek shelter.) In particular, information on how to respond to Prairie Rattlesnake bites should be presented on-site, via mobile applications, and online. We recommend **CALL 911** as the only provided instruction for snake bites at Rabbit Mountain. Medical information is routinely revised, popular television shows may lead to confusion, and former methods of treatment may lead to further negative consequences. Other information that may be shared in this situation includes:

1. Keep the victim calm and avoid excessive activity.
2. Remove jewelry, watches, and restrictive items.
3. Maintain bite area below heart level, if possible.
4. Do NOT use a tourniquet, or other restrictive item to control spread of venom.
5. Do NOT apply ice to area.

6. Do NOT consume alcohol and/ or medications. (*Consult with your physician about epinephrine pen use.)
7. Do NOT cut bite area and/ or attempt to suck out venom.
8. Monitor victim regularly to assess condition and venom progression.
9. Pets: Utilize the above information and contact a veterinarian immediately.

We recommend staff and volunteer training routinely for general identification of and safety around amphibians and reptiles. Many behaviors of these species are predictable and positive interactions with them reinforced. General identification, rattlesnake safety, and frog/ toad call-monitoring would also be beneficial trainings to staff and volunteers.

Outreach programs for the general public and Open Space visitors are encouraged to promote the fascinating wildlife in Boulder County. To note, we consistently had positive interactions with Open Space visitors during surveys. Programs could focus on general identification and behavior of amphibians and reptiles, rattlesnakes and bullsnakes: facts and myths, and rattlesnake safety. During the fall and spring, daytime programs are recommended, as these are more active times for reptiles. Evening/ night programs could be considered for summer.

REFERENCES

Alexander, G. J., D. Horne, and S. A. Hanrahan. 2002. An evaluation of the effects of deltamethrin on two non-target lizard species in the Karoo, South Africa. Journal of Arid Environments. 50:121-133.

Ashton, K.G. 2000. Reptile Survey and Identification of Critical Areas on City of Boulder Open Space. Report. City of Boulder Open Space.

Neid, S., Lemly, J., Jeremy, J., Decker, K., and D. Culver. 2009. Survey of Critical Biological Resources in Boulder County, Colorado 2007-2008. Report. Boulder County Parks and Open Space.

Crother, B.I. (ed.). 2012. Scientific and standard English names of amphibians and reptiles of North America north of Mexico, with comments regarding confidence in our understanding. 7th ed. SSAR Herpetological Circular 39:1-92.

Ehrenberger, J., Mathies, T. and K.Urbanek. 2014. North Boulder Grasslands Snake Species Inventory: 2012–2014. Report. City of Boulder Open Space and Mountain Parks, Boulder, Colorado.

Graeter, G.J., K.A. Buhlmann, L.R. Wilkinson, and J.W. Gibbons (Eds.). 2013. Inventory and Monitoring: Recommended Techniques for Reptiles and Amphibians. Partners in Amphibian and Reptile Conservation Technical Publication IM-1, Birmingham, Alabama.

Graves, B. M., and D. Duvall. 1993. Reproduction, rookery use, and thermoregulation in free-ranging, pregnant *Crotalus v. viridis*. Journal of Herpetology, 33-41.

Hammerson, Geoffrey A. 1999. Amphibians and Reptiles in Colorado, 2nd Edition. University Press of Colorado and Colorado Division of Wildlife, Niwot, Colorado.

Livo, L. J. 1997. City of Boulder 1996 Amphibian and Reptile Survey. Report. City of Boulder Open Space.

Lomolino, M. V., and G. A. Smith. 2004. Terrestrial vertebrate communities at black-tailed prairie dog (*Cynomys ludovicianus*) towns. Biological Conservation 115:89-100.

Rabbit Mountain Management Plan. 1984. http://www.bouldercounty.org/doc/parks/rabbitmountainmplan.pdf.

Shipley, B.K., Reading, R.P., 2006. A comparison of herpetofauna and small mammal diversity on black-tailed prairie dog (*Cynomys ludovicianus*) colonies and non-colonized grasslands in Colorado. Journal of Arid Environments 66, 27–41.

Shipley, B.K., Chiszar,D.,Fitzgerald, K.T., and A.J. Saviola. 2013. Spatial ecology of Prairie rattlesnakes (*Crotalus viridis*) associated with Black-tailed prairie dog (*Cynomys ludovicianus*) colonies in Colorado. Herpetological Conservation and Biology 8:240-250.

APPENDIX A. PHOTOGRAPHS

Provided by separate flashdrive

APPENDIX B. SPECIES GUIDES

Provided by separate flashdrive