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Small Mammal Inventory and Monitoring
OSMP Studies 4248

Study



Ruggles, Anne, et al

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**Small Mammal Inventory
and
Monitoring Protocol
in Selected Habitats Of
Boulder Mountain Parks**

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Boulder Mountain Parks--Small Mammal Inventory And Monitoring

Introduction

Boulder Mountain Parks (BMP) requested a baseline inventory of small mammal species in eight selected habitats of the park and development of a protocol for monitoring small mammal communities in those habitats. Overstory and understory composition have been described for most of these sites by BMP personnel. Avian species inventories are being conducted at the same sites. This information, in conjunction with information on small mammal species composition and relative densities, can be used to evaluate the effects of controlled burns, forest prescriptions or human use of these areas.

Study sites

Trapping was carried out on 10 sites selected by BMP (Figures 1 and 2). Most of these sites corresponded to forest inventory and understory sites established by BMP. The Enchanted Mesa, north and south, Anemone Ridge and Anemone south slope sites are all Ponderosa pine woodland sites with shallow, dry soils and few shrubs. The Coyote Gulch and Skunk Canyon sites are foothills shrub with little tree overstory and well-developed shrubs. Coyote Gulch Creek and Gregory Creek are both riparian sites; the former ephemeral and the latter perennial. Gregory Canyon north-facing site is a mixed conifer woodland and Gregory Canyon, south-facing combines elements of foothills-shrub and exposed rock habitats.

Schedule

The northmost Enchanted Mesa site (SM-2¹) and the Coyote Gulch foothills scrub site (SM-1) were trapped during the week of July 12-July 16. The southmost Enchanted Mesa burn site (SM-3) and Skunk Canyon (SM-4) sites were trapped July 19-July 23. The two Boulder Canyon (SM-5, stand 1-9, Anemone south slope point above Boulder Creek) and (SM-6, Stand 1-4 on Anemone Ridge) sites were trapped July 26-July 30 and the Gregory Canyon (SM-7, south-facing slope and SM-8, north-facing slope) sites were trapped September 21 - September 24. Additionally we sampled the drainages in Coyote Gulch and Gregory Creek in lower Gregory Canyon for Preble's Meadow Jumping Mouse.

¹ Site identifiers were assigned by BMP staff. Stand identifiers refer to Forest Stand Inventory sites which are a data layer in the park's GIS.

Methods

We followed recommendations of the National Biological Survey and National Museum of Natural History for standard field methods for qualitative and quantitative sampling of biological diversity (Wilson et. al. 1996). We sampled approximately 0.75 ha. at each site for 4 nights. Seventy five traps were arranged in two transects with traps 5m apart and transects 20m apart within each habitat type yielding 600 trap nights per habitat. The sites were selected by BMP and had previously been sampled for vegetation and avian inventories. The two drainage sites were trapped using 50 traps, 5m apart along the drainage for 4 nights or 200 trap nights. Standard mammalogical procedures, using Sherman live traps for small mammal trapping and following guidelines approved by the Animal Care and Use Committee of the American Society of Mammalogists (1998) were followed. Polyester batting and bait (a sweet feed mix of oats and corn) were placed in each trap and traps were set at night, checked in the early morning and closed during the day. Traps were placed away from trails and in as inconspicuous a manner as possible. Survey tape was placed at every fifth trap and was removed at the end of the trapping period.

This methodology specifically targets small nocturnal, surface-dwelling mammals and may not reflect the presence of diurnal ground squirrels, tree squirrels, shrews or pocket gophers. However, as these animals or evidence of their presence were observed, the information was collected and incorporated into the results.

These initial surveys provide the basis of a baseline inventory of each site. However, small mammal populations undergo cyclic shifts in numbers and reproduction (Krebs 1973) which are governed by both extrinsic factors such as food and cover availability, and intrinsic factors such as behavioral or physiological patterns which involve delayed or over-compensating density-dependence (Begon 1986). A more thorough inventory would include several years of sampling to obtain a picture of the magnitude of these cyclic oscillations. Understanding the amplitude and periodicity of the changes will help minimize the possibility of confusing the impact of management practices or human use with normal cycling of small mammal populations (Genoways 1979).

Management actions should be followed by trapping using this protocol, during the subsequent summer season and for two summers thereafter. Ideally the trapping should occur at the same time of summer as the baseline trapping as this will increase the likelihood of obtaining equal observability from session to session. If several years have

ensued since the original baseline trapping a new baseline may need to be established prior to engaging in management action.

Species Richness, Relative Abundance and Diversity

Describing species diversity has been a central theme in ecology since its inception as a science. Measures of diversity are viewed as indicators of the wellbeing of ecological systems (Margurran 1988). Species diversity, as we apply it, can be thought of as the number of species and their evenness or the relative abundance of each species in a given habitat. This can be compared within a habitat over time as a monitoring tool whether the habitat is altered stochastically or by design or it can be compared across habitats. It is an appropriate measure here as the stability of a system is thought to improve with increasing diversity (May 1984, Pimm 1984).

Species diversity is measured using indices of abundance and an assessment of species richness. Species richness is a simple count of the number of different species captured on a particular site at a given time. Relative abundance is calculated as the number of individuals captured per 100 trap nights. This index assumes a constant trap effort and that changes in captures of animals over time represent changes in abundance provided capture probabilities also remain constant over time (Wilson 1996). This latter assumption is probably violated with small mammals as small mammal populations fluctuate over time (Blaustein 1980), though not in an identical manner across species in the same year. If capture periods occur at the same time of year, under the same or similar moon conditions (Clarke 1983) and for the same number of trap nights, such an index may be useful, in conjunction with other indices, in comparing the same site over time or comparing across sites.

Diversity was calculated using the Shannon diversity index as described by Zar (1996):

$$H' = - \sum p_i \log p_i$$

where p_i is the proportion of the total number of individuals represented by species i . Unidentified voles were assigned as either meadow or prairie vole in proportion to the occurrence of the two species in that sample. In this equation, H indicates the degree of "uncertainty" that exists within the community; a large H means there are more species present and a small H reflects fewer species. Thus when $H = 0$ there is no uncertainty about the species of an individual in the community as there is only one species. This index also incorporates a measure of the relative abundance of a species within a community.

Thus for any given number of species, H will be greatest if all species are equally abundant (Wilson and Bossert 1971).

Results (see Figures 1 and 2 for maps of transect locations)

1. SM-2 Enchanted Mesa-N--corresponds to Stand 5-5 in the "Low Elevation Forest Stands, south"

species richness: 2

relative abundance: 1.83

species diversity: 0.13

Description: The northmost Enchanted Mesa site runs from plot 5-5-1 through 5-5-5 and is a Ponderosa Pine woodland (plate 1). The understory is composed primarily of graminoids (sun sedge, Canada bluegrass, brome) and forbs (cinquefoil, low penstemon, salsify and prickly pear cactus). There are few shrubs present and understory plants are sparsely distributed. There are stones and cobbles on the surface as well as a few large boulders and logs. A significant portion of the surface is bare.

Captures: Only 11 animals, with 3 recaptures, were captured here; 10 deer mice and one rock mouse (Table 1). There is sparse cover for small mammals and those captured sought cover at the base of large rocks, logs or the few shrubs present. Armstrong (1982) captured only deer mice in Ponderosa pine woodlands in BMP.

miscellaneous observations: We saw an Abert's squirrel one morning while checking traps as well as deer pellets and coyote scats.

Management recommendations: This site is not home to an abundance or a variety of mice. However it is of great importance to Abert's squirrels and a number of bird species including the forest hawks. The Ponderosa pine woodlands should be managed with these species in mind.

2. SM-3 Enchanted Mesa-S (burn)--corresponds to Stand 5-3 in the "Low Elevation Forest Stands, south"

species richness: 3

abundance: 1.50

species diversity: 0.40

Description:: The southmost Enchanted Mesa site includes plots 5-3-1 and 5-3-5. This is a Ponderosa Pine woodland (plate 1) with an understory dominated by orchard grass. There are a few skunkbush and Oregon grape shrubs scattered about. Stones and cobbles are on the surface and there are some fallen logs. This site was burned the spring of 1999.

Captures:: Nine animals, with 5 recaptures, were captured; 5 deer mice, 3 rock mice and 1 prairie vole (Table 2). Captured animals were in traps set adjacent to shrubs or boulders.

Miscellaneous observations:: A sharp-shinned hawk flew low over us and called whenever we came to the south end of the transects. The remains of a sharp-shinned or Cooper's hawk chick were located about midway down the westmost transect and is being taken to the Denver Museum of Natural History for identification. We also heard and saw a number of western wood pewees. Several of our traps were picked up and moved, probably by a coyote, and we saw mule deer while checking traps.

3. SM-1 Coyote Gulch, east-facing hillside

species richness: 5

abundance: 7.50

species diversity: 0.51

Description: These transects parallel the transects of SM-2 but are located downslope in Coyote Gulch and are representative of foothills scrub habitat (Plate 2). They run north to south on the east-facing slope of the gulch. The transects start at an ephemeral drainage and cross another. Both drainages cut downslope from the mesa to the creek in the canyon bottom. The southern end of the transect is in a wet, north-facing cul de sac. The slope is dominated by skunkbush, chokecherry, rose, snowberry, yucca, poison ivy, yellow salsify, hound's tongue, cutleaf fleabane, beebalm, sedges and grasses. Shrubs were most dense along the ephemeral drainages. Vegetation typical of moist soils including big bluestem and narrow-leaved milkweed, were dominant at the south end of the transects along the wet, north-facing slope. A few Ponderosa pine trees were scattered along the hillside.

Captures: Forty five percent of the traps were located adjacent to shrubs and all captures were made in these traps. Forty five animals with 18 recaptures (Table 3) were captured

representing 5 species. Deer mice represented almost one half of all captures. Three of these species, the rock mouse, the Mexican woodrat and the western harvest mouse are considered by Armstrong and Freeman (1982) to be a part of the Chihuahuan faunal assemblage (a group with a common center of origin and geographic distribution on the Mexican Plateau).

Miscellaneous observations: Several mule deer were present daily as we checked and set traps. An active coyote den was located on the west-facing slope of the gulch. Given the large number of animals trapped and the nearby water this would be a good site to rear pups. We found these areas to contain among the highest small mammal abundance, species richness and diversity of all the areas sampled. Armstrong (1982) also found the foothills scrub to have the highest trapping success in terms of number of animals and of the number of species found.

Management recommendations: This area should be managed to maintain the shrub communities and thus the varied Chihuahuan faunal assemblage found and preclude succession to a Ponderosa pine dominated flora.

4. SM-4 Skunk Canyon, south-facing slope

species richness: 5

abundance: 7.16

species diversity: 0.60

Description: This site corresponds to the Colorado State Forest Service point, CSFS 23, and runs from east to west on the south-facing slope of lower Skunk Canyon just above the trail. It is a foothills scrub habitat (Plate 2) and is dominated by dense copses of skunkbush as well as Oregon grape, big bluestem, Canada wild rye, cheatgrass, sedges, prickly pear cactus, yucca, prairie sage, ragweed and hound's tongue. There are a few Ponderosa pine trees and several spines of boulders running from the top of the slope down and crossing both transects. There are not the well-developed ephemeral drainages found in Coyote Gulch and in general this site appears to be drier than Coyote Gulch.

Captures: Forty three animals with 27 recaptures were captured (Table 4). Five species were represented with prairie voles and deer mice equally abundant at 14 individuals each and Mexican woodrats (7 individuals) and rock mice (6 individuals) also fairly abundant. The woodrats were found in traps near or in the spines of rocky outcrops. Approximately

40% of traps were located adjacent to shrubs or boulders. With the exception of the prairie voles, animals were captured in traps located near the shrubs or in the rocks. This site had the highest species diversity of all sites.

Miscellaneous observations: Mule deer walked on several traps, flattening them and were seen on the site in early morning. Coyote scats were also found.

Management recommendations: As with Coyote Gulch, this area should be managed to maintain the foothills shrub habitat. This seems to be an especially important site for both woodrats and rock mice. BMP should continue to discourage the establishment of social trails which can lead to erosion on the steep slopes where these animals are found.

5. Coyote Creek (Coyote Gulch drainage)

species richness: 5

abundance: 8.00

species diversity: 0.58

Description: One line of 50 traps was set in the creek bottom. This is a riparian habitat with deeply incised banks located at the bottom of Coyote Gulch (Plate 3) and was dry at the time of trapping. It consists largely of a dense overstory of hawthorne and chokecherry and the creek bed in deep shade. There were few grasses and forbs in the channel. The channel also had several piles of boulders. Once above the channel however there is the rich flora of the foothills scrub of Coyote gulch.

Captures: Sixteen individuals (Table 5) with 4 recaptures were captured at this site. The most abundant species was the deer mouse with 6 individuals. The next most abundant species was the meadow vole with 5 captures. Also captured were 2 rock mice (in the boulders), 1 prairie vole and 1 Mexican woodrat.

Miscellaneous observations: There was a pair of catbirds with fledglings feeding in the hawthorne on several mornings while we were checking traps. Deer pellets, coyote and bear scats were found in the creek bottom.

6. SM-5 Boulder Canyon, south-facing hillside

species richness: 3

relative abundance: 1.00

species diversity: 0.47

Description: This site is located just above the trail which runs along Boulder Creek in Boulder Canyon and corresponds to Stand 1-9 of the Low Elevation Forest Stands. The site is south-facing, very steep and bordered on three sides with outcrops of large boulders. On the east side is a small ephemeral drainage which has very different floral species composition and density than the rest of the site. The traplines were arranged in 4 transects of 35 traps each running from the canyon bottom to the top of the ridge, with transects 10m apart and traps 5m apart. This arrangement sampled almost 0.75 ha. One transect ran up the drainage and the other 3 were in the Ponderosa Pine woodland.

The site (Plate 4) is dominated by Ponderosa pines, Oregon grape, yucca, mahonia, waxflower, sedges, Canada wild rye, needle -and-thread grass, Canada bluegrass, prairie sage, sulphur flower and golden aster. Shrubs are few, widely distributed and those that are present have been severely browsed by deer. The drainage portion of the site is dominated by plants requiring more moisture than is present in the rest of the site and include: box elder, wild plum, large stands of false solomon seal, big bluestem, horsetails, poison ivy, milkweed and smooth brome.

Captures: Six individuals were captured (Table 6) with 2 recaptures. The captures were evenly distributed among rock mice, western harvest mice and golden-mantled ground squirrels. The rock mice and golden-mantled ground squirrels were found in and near the rock outcrops and the harvest mice were found in the ephemeral drainage.

Management recommendations: Most of this site has slopes of >18% and is dominated by rock outcrop which consist of exposed bedrock, mixed granite, sandstone, shale and limestone and shallow soils (USDA 1975). Little can be done to enhance this site's ability to support small mammals other than to make sure the outcrops continue to be available to ground squirrels and rock mice by continuing to discourage the establishment of social trails which can lead to erosion on the steep slopes and degradation of the ephemeral drainage.

7. SM-6 Boulder Canyon, Anemone Ridge

species richness: 1

relative abundance: 0.50

species diversity: 0.00

Description: This site corresponds to Stand 1-4 of the "Low Elevation Forest Stands, north" and runs parallel to and above the Aqueduct trail. The 3 transects of 50 traps each ran west to east along the hillside (Plate 4). Transects were 20m apart and traps were 5m apart; thus 1.5ha were sampled.

This is a southwest-facing Ponderosa Pine woodland above Boulder Canyon and is dominated by Ponderosa pines with little understory. Shrubs are sparsely distributed and include Oregon grape, yucca and prickly pear cactus. Graminoids include needle-and-thread grass and other short grasses. Forbs include prairie sage and sulphur flower. The ground is littered with rocks. The soils (Jugot-Rock outcrop complex, 9-55% slopes (USDA 1975)) consist of 50% gravely sandy loam and 30% rock outcrop. Runoff is high and water retention low as the soils are shallow to bedrock. There is little cover available to small mammals at this site.

Captures: Captures (Table 7) consisted of 3 deer mice. This site had the lowest richness, abundance and diversity of any of the sampled sites.

Miscellaneous observations: On the way up to the site we passed through a well-developed ephemeral drainage and daily saw deer, cottontail rabbits, Lazuli buntings, Lincoln sparrows and mixed flocks of nuthatches and black-capped chickadees in the drainage.

Management recommendations: Due to the low ability of the soils to hold water there are few, very sparsely distributed shrubs and thus little cover for small mammals. There is likely little that can be done to enhance this site for small mammals. However, we would recommend working to discourage the establishment of social trails in the ephemeral drainage that connects this site to Boulder Canyon. Had we trapped this drainage we would likely have found fairly high species diversity and relative abundance.

8. SM-7 Gregory Canyon, south-facing hillside (Crown Rock)

species richness: 6

relative abundance: 5.00

species diversity: 0.59

Description: Two transects were established running across Gregory Canyon from just below Crown Rock down into the canyon and up the north-facing slope toward Saddle Rock (see map with Preble's Field Survey Form). The south-facing slope rises steeply from the creek to Crown Rock and is covered with a few sparsely distributed Ponderosa pine trees with an understory of skunkbush in widely spaced clumps, yucca, big bluestem and, further upslope, short grasses. The top third of the south-facing transects consists largely of rock outcrops (Plate 5).

Captures: Thirty individuals were captured about half of which were deer mice. Deer mice were found at shrubs and five other species were captured. Least chipmunks and rock mice were the most abundant. Armstrong (1982) also captured a large number of rock mice in Gregory Canyon. A western harvest mouse and meadow vole were found toward the creek end of these transects and prairie voles were found among the short grasses. Chipmunks and rock mice were found almost exclusively in the rocks. This high diversity is probably due to the abundance of both food and cover at this site.

Management recommendations: This area should be managed to minimize loss of shrubs to encroachment by Ponderosa pine trees or by the establishment of social trails.

9. SM-8 Gregory Canyon, north-facing hillside (Saddle Rock)

species richness: 3

relative abundance: 3.00

species diversity: 0.11

Description: Two transects were established running across Gregory Canyon from just below Crown Rock down into the canyon and up the north-facing slope toward Saddle Rock (see map with Preble's Field Survey Form). The north-facing slope consisted of a mixed coniferous forest (Ponderosa pine and Douglas fir) on a fairly steep slope with a sparse understory of grasses and Oregon grape (Plate 5). Rocks, deadfall and bare ground comprised most of the understory. There was evidence of sheet-water runoff on this slope with dirt and needles piled on the uphill side of logs and rocks.

Captures: Three species comprising 18 individuals and 12 recaptures were captured on the transects of the north-facing slope. Deer mice were the most abundant species with 14 individuals. Also captured were 3 rock mice, at rock outcrops, and 1 prairie vole. This site has very low richness, abundance and diversity though we trapped more species than did Armstrong (1982) who only captured deer mice. There is very little cover or food available on these transects.

Miscellaneous observations: Red squirrels were seen and heard and their middens were apparent on these transects. Mixed flocks of chickadees and nuthatches were heard on this site.

Management recommendations: Due to the slope aspect, the high degree of water runoff and dense canopy, this site will likely not support many shrubs and thus few mice, rats or voles. However, it appears to be suitable for red squirrels.

10. Lower Gregory Creek to confluence with Greenman Creek

species richness: 5

relative abundance: 8.50

species diversity: 0.52

Description: Fifty traps were set along Gregory Creek (see FWS Preble's Field Survey Form) from just above the confluence with Greenman Creek downstream toward the parking lot. This montane riparian corridor is very well-developed (see plant list with Preble's Field Survey Form) with a tree layer that includes white oak, crack willow, green ash, apple and cottonwoods. Dominant shrubs include chokecherry, wild plum, buckthorn, sumac, bluestem willow, snowberry and poison ivy; graminoids include orchard grass, Canada wild-rye, switchgrass and bluegrass and forbs include dogbane, smooth aster, horsetail, wild lettuce and beebalm (see plant list with the Preble's Field Survey Form, App. C).

Captures: Seventeen individuals and 17 recaptures were captured. These included 5 species; 10 deer mice, 2 meadow voles, 3 rock mice (all at the base of a large boulder), 1 long-tailed vole in the grass plot near the confluence of Greenman and Gregory creeks and one Preble's meadow jumping mouse. Armstrong (1982) had his greatest trapping success (number of animals and species captured) in the Gregory Canyon riparian corridor.

The Preble's meadow jumping mouse was captured twice and was permanently marked with a Passive Integrated Transponder (PIT) tag. Her tag number is: 410B6D5318. These are electromagnetic, glass-encased tags that are inserted under the skin of the back between the scapulae. Tags are read with a hand-held scanner having an exciter frequency of 125kHz. The animal, a female, was first captured downstream in an area dominated by poison ivy, horsetail and green ash seedlings with an overstory of crack willow. She weighed 24g. At this time of year this weight would indicate that she was a young of the year. She was captured two days later upstream in an area dominated by chokecherry, shrub willow and a dense understory of grasses and forbs. On recapture she weighed 27g and was likely close to being ready for hibernation.

Preble's meadow jumping mouse: Preble's meadow jumping mouse was listed as threatened under the Endangered Species Act by the U.S. Fish and Wildlife Service on May 13, 1998 (63FR26517). It is a rare subspecies of meadow jumping mouse whose distribution is limited to portions of Colorado and Wyoming. It is known, historically, from eight counties along the South Platte River drainage (Armstrong 1972, Warren 1942) and once had a wider distribution in the tallgrass prairie across the eastern plains of Colorado and Wyoming (Fitzgerald et al. 1994). While its current distribution and status in Colorado are under investigation, there have been a number of successful trapping efforts in Larimer, Weld, Boulder, Jefferson, Douglas, Elbert and El Paso counties in the past few years. This is the first report of Preble's meadow jumping mouse in Gregory Canyon though Armstrong (1982) hypothesized the presence of the western jumping mouse in Long Canyon.

The preferred habitat of Preble's meadow jumping mice consists of drainages with well-developed vegetation characterized by high plant species diversity, including grass, forb and shrub (especially willow) species, and structural diversity (Bakeman 1997). Such areas include feeding areas composed of grasslands and riparian areas with heavy ground cover of grasses and sedges (Tester et al. 1993); day nests in dense riparian shrub understory (Tanya Shenk, personal communication); hibernation sites in dense upland shrubs (Rob Schorr personal communication, Tom Ryon, personal communication); and movement corridors in riparian corridors with cover (Bakeman 1997, Choate et al. 1991, Tester et al. 1993).

Miscellaneous observations: Black bear scats were found in the riparian corridor as were deer pellets and coyote scats.

Management recommendations: This stream represents excellent jumping mouse habitat though there are threats to this mouse at this site. The greatest long-term threat comes from the presence of a large number of crack willows and green ash, both non-native species. Both have an ability to reproduce rapidly (the willow via vegetative reproduction from broken branches and the ash from wind-spread seeds). There are already a very large number of ash seedlings in places near the first jumping mouse capture site. Both trees shade out understory plants reducing the complex structure preferred by jumping mice and needed by them for both food and cover. We recommend that BMP continue to maintain the integrity of the creek corridor by continuing to discourage the establishment of social trails which cross or access the creek.

Summary and recommendations for monitoring

Of the sites sampled the riparian and foothills shrub exhibited the highest small mammal species richness, abundance and diversity. Due to the presence of water, the riparian areas support a high diversity and abundance of plant species which results in more varied and abundant food sources available to small mammals (seeds, fruits, leaves and invertebrates). They also provide a more complex vegetative structure which provides relatively more cover. In one riparian site, Gregory Creek, we found Preble's Meadow Jumping Mice, listed as threatened on the Endangered Species List.

The foothills shrub also provides relatively more vegetative complexity and thus more varied and abundant food and shelter for small mammals. The foothills-shrub community includes small mammal species unique to that habitat and dependent on the shrub component of the habitat. This is a habitat that is uncommon and that supports species that are part of the Chihuahuan faunal assemblage

The Ponderosa Pine woodlands are the least diverse of the sites sampled. These sites are dry, have a relatively dense canopy and shallow soils thus there is less diversity of plant species and structure and therefore less food and shelter available to support a variety of small mammals. The Ponderosa pine woodlands, however, are important to Abert's squirrels and many bird species and should be managed to maintain these species.

We recommend that BMP monitor riparian and foothills-shrub habitats as both support rich diverse and unique small mammal communities. For general monitoring we recommend trapping using the protocol described above once every three years. This may be frequent enough to begin to understand the amplitude and frequency of population cycles. If management action is anticipated for a foothills-shrub or riparian site BMP should try to trap the year before the action and each year for three years following the action. In foothills-shrub habitats Management actions should be directed toward maintaining the integrity of the shrubs. Management in riparian areas should be directed to maintaining diverse plant communities and high quality water. Monitoring allows the park to detect changes in species composition and relative abundance of small mammals and thus a chance to take action if negative changes are detected.

In analyzing the species captured and where they were captured, one is struck by the importance of the diversity of cover types found on the Boulder Mountain Parks properties. Maintaining this diversity will maintain the diversity of rodents which reside on the land.

Acknowledgments

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Table 1. Species Richness, Relative Abundance and Species Diversity, Boulder Mountain Parks, Colorado 1999.

Site	Species richness	Relative Abundance	Species Diversity
SM-2 (E-Mesa, N)	2	1.83	0.13
SM-3 (E-Mesa, S)	3	1.50	0.40
SM-1 (Coyote Gulch)	5	7.50	0.51
SM-4 (Skunk Canyon)	5	7.16	0.64
Coyote Creek	5	8.00	0.57
SM-5 (Anemone Hill)	3	1.00	0.47
SM-6 (Anemone Ridge)	1	0.50	0.00
SM-7 (Gregory Canyon, S)	6	5.00	0.58
SM-8 (Gregory Canyon, N)	3	3.00	0.13
lower Gregory Creek	5	8.50	0.52

Table 2. Total Small Mammal Captures at Enchanted Mesa, north (SM-2), Boulder Mountain Parks, Boulder, Colorado, 1999.

Species	Adult		Subadult		Juvenile		Total		unknown	Total All
	Male	Female	Male	Female	Male	Female	Male	Female		
<i>Microtus ochrogaster</i> Prairie Vole	0	0	0	0	0	0	0	0	0	0
<i>Microtus pennsylvanicus</i> Meadow Vole	0	0	0	0	0	0	0	0	0	0
<i>Microtus spp</i> Microtus spp.	0	0	0	0	0	0	0	0	0	0
<i>Neotoma mexicana</i> Mexican Woodrat	0	0	0	0	0	0	0	0	0	0
<i>Peromyscus maniculatus</i> Deer Mouse	3	3	1	2	1	0	5	5	0	10 (3) ¹
<i>Peromyscus nasutus</i> Rock Mouse	0	1	0	0	0	0	0	1	0	1
<i>Reithrodontomys megalotis</i> Western Harvest Mouse	0	0	0	0	0	0	0	0	0	0
<i>Zapus hudsonius preblei</i> Preble's Meadow Jumping Mouse	0	0	0	0	0	0	0	0	0	0
Total										11 (3)

All values based on 600 trap-nights.

¹ values in parantheses indicate recaptures

Table 3. Total Small Mammal Captures at Enchanted Mesa south, (SM-3), Boulder Mountain Parks, Boulder, Colorado, 1999.

Species	Adult		Subadult		Juvenile		Total		Total All
	Male	Female	Male	Female	Male	Female	Male	Female	
<i>Microtus ochrogaster</i> Prairie Vole	1	0	0	0	0	0	1	0	1
<i>Microtus pennsylvanicus</i> Meadow Vole	0	0	0	0	0	0	0	0	0
<i>Mus musculus</i> House Mouse	0	0	0	0	0	0	0	0	0
<i>Neotoma mexicana</i> Mexican Woodrat	0	0	0	0	0	0	0	0	0
<i>Peromyscus maniculatus</i> Deer Mouse	2	1	2	0	0	0	4	1	5 (2) ¹
<i>Peromyscus nasutus</i> Rock Mouse	1	2	0	0	0	0	1	2	3 (3)
<i>Reithrodontomys megalotis</i> Western Harvest Mouse	0	0	0	0	0	0	0	0	0
<i>Zapus hudsonius preblei</i> Preble's Meadow Jumping Mouse	0	0	0	0	0	0	0	0	0
Total									9 (5)

All values based on 600 trap-nights.

¹ values in parantheses indicate recaptures



Plate 1. SM-2 -- Enchanted Mesa, North



Plate 1, SM-3 -- Enchanted Mesa, South



Plate 2. SM-1 -- Coyote Gulch, east-facing slope

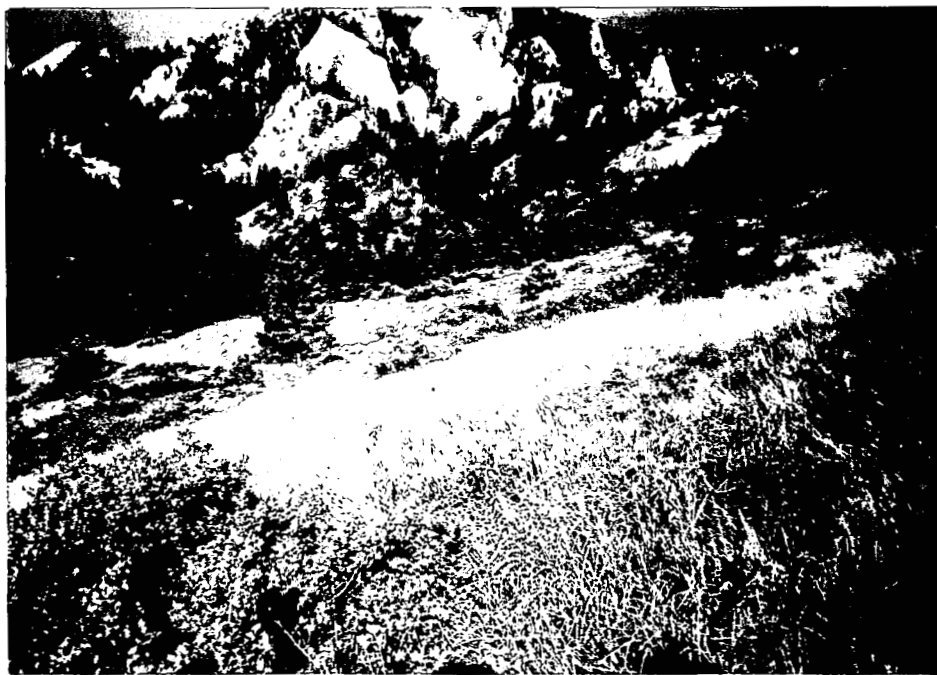


Plate 2. SM-4 -- Skunk Canyon, south-facing slope



Plate 3. Coyote Creek



Plate 3. Gregory Creek



Plate 4. SM-6 -- Anemone Ridge

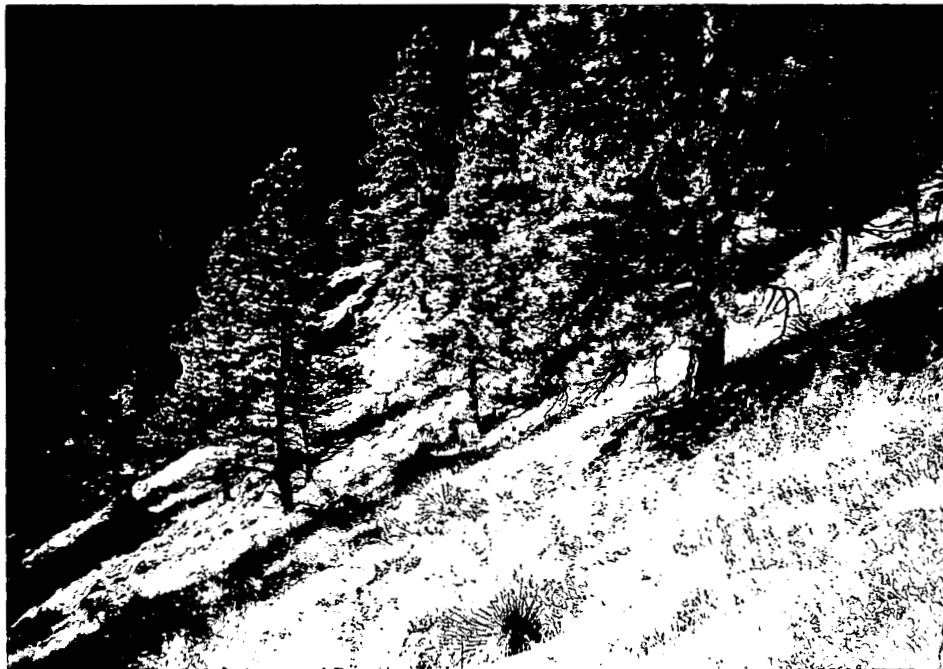


Plate 4. SM-7 -- Anemone Hill (Boulder Canyon, south-facing slope)



Plate 5. SM-7 -- Gregory Canyon, south-facing slope (upper portion)



Plate 5. SM-8 -- Gregory Canyon, north-facing slope



Plate 5. SM-7 -- Gregory Canyon, south-facing slope (lower portion)

Small mammal captures in BMP: Species' habitat descriptions

The species captured during this study are small, nocturnal rodents. Insectivores such as shrews were occasionally taken, as were diurnal rodents, but these were more as an accidental capture than by design. A description of the general habitat affiliations for each species found in this study is listed below. Included also are habitat descriptions of a few species we expected to capture but failed to trap in this study. These accounts were compiled from Armstrong (1972), Fitzgerald et al. (1996), and other sources cited specifically in each description. In analyzing these species habitat associations collectively, one is struck by the importance of maintaining a diversity of cover types found on the Boulder Mountain Parks properties.

1. Deer mouse (*Peromyscus maniculatus*)

Deer mice range across most of North America excepting the southeastern United States. It was trapped at all of the sites in this study, and is generally the most abundant species across many habitats, including plains grasslands up to rocky cliffs though they are most often found in areas with vegetative cover. The vegetation that they require is also highly variable; they may be found in areas with nearly bare ground to dense grasslands, brush, or forests. The deer mouse will not actively dig its own burrows, so it takes advantage of small burrows of other species or finds small crevices and spaces between rocks for its nests. Materials such as feathers, hair, dry grass, and other plants will be found in nesting materials. Cold temperatures and low food availability may lead to short-term torpor and aggregate nesting, but the species does not hibernate. The deer mouse will eat a wide variety of plant seeds, insects, and fungi (King 1968) which contributes to the ability of these mice to use a great number of different kinds of habitats. Their numbers relative to habitat specialists (such as the rock mouse) may be low in some habitats, but they are found in every habitat type we trapped in Boulder Mountain Parks.

2. Northern Rock Mouse (*Peromyscus nasutus*)

Although similar in appearance to deer mice, the northern rock mouse has long ears, with whitish to silver gray venter, and a tail slightly longer than the head and body. They live in rocky canyons, cliffs, and hogbacks that provide numerous cracks, fissures, and overhanging ledges in montane shrubland. The animals use crevices and burrows under ledges or rock outcrops often devoid of vegetative cover and were always captured at such locations in this study. These habitats are most often found on sunny, south-facing slopes such as those found in the Gregory Canyon and Boulder Canyon sites. Armstrong (1982, 1996) considers this species as a representative of a Chihuahuan faunal element extending

north from Mexico through New Mexico, with a thin extension thorough the Front Range foothills of Colorado. The importance of protecting its habitat from trail (especially social trail) generated erosion on steep slopes must be of concern in Boulder Mountain Parks.

3. Western Harvest Mouse (*Reithrodontomys megalotis*)

Primarily found in the plains east of the foothills, the western harvest mouse may be found in riparian areas reaching into Front Range canyons. It occurs in riparian communities, weedy disturbed areas, margins of wetlands, and relatively dense, tall stands of grasses. In BMP we trapped it in Coyote Gulch in the wet cul-de-sac (SM-1), in the ephemeral drainage on the south-facing slope in Boulder Canyon (SM-5) and in Gregory Canyon on the south-facing slope in the grasses above the creek (SM-7). Its diet consists mostly of the seeds of grasses and forbs. Insects are also frequently eaten. They may undergo torpor in cold periods, and nest in small depressions in the ground or above the ground in clumps of grass, low shrubs, and weeds. One would expect to find this species only near the small streams running down towards the plains in Boulder Mountain Parks; and they were only found at such locations in this study.

4. Mexican Woodrat (*Neotoma mexicana*)

These woodrats are associated with rocky slopes and cliffs in montane forests and montane shrublands. Their diet consists mainly of leaves, with occasional cones and flowers/buds; the species taken consist of a very wide variety of shrubs and pines. It caches a great amount of this material in the fall for winter use. They are active year-round. They will not build dens away from rocky areas, as rock shelter is essential. Both horizontal and vertical crevices will do, as will seasonally occupied buildings, mine tunnels and houses and structures constructed by other species of woodrats. Their dens are typically built of sticks, twigs, and leaf cuttings, with bark, sage and yucca lining the nest. Like other woodrats, this is a "packrat" that collects many other materials including feces to add to the walls of the den. In areas of sympatry with bushy tailed woodrats (possible in Gregory Canyon and Boulder Canyon sites), Mexican woodrats tend to use the crevices closer to ground level, while bushy tailed woodrats cons¹truct dens further up a cliff face. In areas without bushy tailed woodrats, the Mexican woodrat will use the entire cliff.

5. Bushy-tailed Woodrat*² (*Neotoma cinerea*)

² Species denoted by an asterisk (*) were not captured but could be expected to be found in BMP.

Though not found in this study, this woodrat is also a packrat found in the upper cliffs of the montane up into the lower alpine zone. It has a bushy tail, larger ears, and furred hind feet which differentiates it from the Mexican woodrat. It was reported from Gregory Canyon (Armstrong 1982). They may inhabit montane and subalpine Douglas fir, ponderosa pine, and aspen forests up into alpine talus (including areas around old mining camps and diggings). In the lower elevation canyon country it may be found in rimrock and rock outcrops, usually at the top of montane cliffs. In addition to the foods used by Mexican woodrats, bushy tailed woodrats also take conifer needles in their diet. They will also collect human refuse such as bright objects and old rags and put them in their den.

6. House mice* (*Mus musculus*)

House mice are often a sign of human habitation and /or disturbance. They are superficially similar to harvest mice, but lack their grooved incisors, and exhibit a very distinctive odor due to anal gland secretions. Their ability to reproduce combined with an active territoriality may displace small native rodents. They are very opportunistic and varied in their diet. House mice were not found on Boulder Mountain Parks areas surveyed in this report, but care should be taken to restrict its damage to native rodent populations.

7. Meadow vole (*Microtus pennsylvanicus*)

With the widest distribution of any species of *Microtus*, the meadow vole is invariably associated with moist habitats. It requires moist to wet meadows, bogs, or wetlands along riparian corridors, with lush cover of grasses, forbs, rushes, or sedges. Their food is green plant material from grasses or forbs; in the winter dried grass and herbaceous matter, bark, twigs and buds are eaten. Meadow voles are active all year round, day or night depending on the season. They swim well and use surface or burrow nests. They are often sympatric with meadow jumping mice in riparian corridors of the Colorado piedmont, as they were in Gregory Canyon. The prairie vole displaces it in drier habitats on the plains and foothills, and long-tailed and montane voles may displace it in drier montane to subalpine habitats.

8. Long-tailed vole (*Microtus longicaudus*)

Very similar to the meadow vole, this species has a much longer tail and a brown or reddish-brown dorsal color. They are also found in marshy areas to dry grassy areas adjacent to water, but more often in upper montane and aspen woodlands. They have a wide habitat tolerance, but will not be found in local sympatry with other voles since they are poor competitors for resources in these habitats. These voles would be found in the

are poor competitors for resources in these habitats. These voles would be found in the higher reaches of foothill streams or on the west facing slopes of the foothills. We captured one at the confluence of Gregory and Greenman creeks.

9. Prairie Vole (*Microtus ochrogaster*)

This species is also similar to the meadow vole, but tends to be slightly smaller with a shorter tail, and buffy ventral color. It tends to be found in plains upland swales, grassy areas, edges of irrigation ditches and fence rows, and wooded riparian habitat. Prairie voles may also occupy the grassy understory of shrublands in foothill canyons. Their food habits concur with those of other voles, but they may construct more elaborate burrow systems than their congeners. They are also active at all times of day and the year, but may be more active in the summer at dusk or night. Prairie voles were only expected to be found in the riparian and grassland corridors leading into the foothills, and this was the case in our study.

10. Golden-mantled Ground Squirrel (*Spermophilus lateralis*)

The golden-mantled ground squirrel was only found at one site sampled in 1999, the south-facing slope in Boulder Canyon. They are usually found in open woodlands and forest-edge communities. They tend to be crepuscular and feed on sagebrush leaves, the vegetation of forbs and a variety of seeds and insects. This ground squirrel hibernates, usually among rocks.

11. Least Chipmunk (*Tamias minimus*)

The least chipmunk was found on the south-facing slope of Gregory Canyon. Like the golden-mantled ground squirrel it prefers relatively open, sunny sites with close proximity to cover. They feed on a variety of fruits, flowers, seeds, leaves, stems and insects depending on availability. They are a diurnal species becoming dormant in winter. Dens are complex burrows among the rocks.

12. Meadow Jumping Mouse (*Zapus hudsonius (preblei)*)

See the description in the text of the main report.

13. Western Jumping Mouse* (*Zapus princeps*)

This jumping mouse is very similar in coloration to the meadow jumping mouse, but tends to be larger in size with various dental and skeletal differences. The western jumping mouse inhabits higher elevations in Colorado, from about 6000 feet in northern Colorado

to the subalpine streams and meadows to 12,000 ft. It is most abundant in streamside alder, willow, and aspen stands with a well developed understory of forbs and grasses. Individuals also occur in bogs and marshes in the subalpine. Like the meadow jumping mouse, the western jumping mouse may hibernate (for up to nine months), and is insectivorous and grainivorous. While the species was not caught in this study, a study which includes a sampling of the proper habitat in higher elevation Boulder Mountain Parks might reveal populations close to sympatry, which would be interesting. The previous closest record of western jumping mouse to meadow jumping mice was within six miles of Gregory Canyon up in Gold Hill. Current studies by the Colorado Division of Wildlife may reveal sympatric populations of the two species in Larimer County, Colorado, but results of studies completed to this point are inconclusive.

Scientific Names

Mammals

<i>Canis latrans</i>	coyote
<i>Microtus ochragaster</i>	prairie vole
<i>M. pennsylvanicus</i>	meadow vole
<i>M. longicaudis</i>	long-tailed vole
<i>Neotoma mexicana</i>	Mexican woodrat
<i>Odocoileus hemionus</i>	mule deer
<i>Peromyscus maniculatus</i>	deer mouse
<i>P. nasutus</i>	rock mouse
<i>Reithrodontomys megalotis</i>	western harvest mouse
<i>Sciurus aberti</i>	Abert's squirrel
<i>Spermophilus lateralis</i>	golden-mantled ground squirrel
<i>Tamias minimus</i>	least chipmunk
<i>Tamiasciurus hudsonicus</i>	red squirrel
<i>Ursus americanus</i>	American black bear
<i>Zapus hudsonius</i>	Preble's meadow jumping mouse
<i>Zapus princeps</i>	western jumping mouse

Birds

<i>Accipiter cooperi</i>	Cooper's hawk
<i>A. striatus</i>	sharp-shinned hawk
<i>Dumetella carolinensis</i>	catbird
<i>Melospiza lincolnii</i>	Lincoln's sparrow
<i>Passerina amoena</i>	lazuli bunting
<i>Poecile atricapillus</i>	black-capped chickadee
<i>Sitta spp.</i>	nuthatches

Trees

<i>Acer negundo</i>	box elder
<i>Pinus ponderosa</i>	Ponderosa pine
<i>Pseudotsuga menziesii</i>	Douglas fir

Shrubs

<i>Equisetum arvense</i>	horsetail
<i>Crateagus erythropoda</i>	hawthorne
<i>Jamesia americana</i>	waxflower
<i>Mahonia repens</i>	Oregon grape
<i>Opuntia macrorhiza</i>	prickly pear cactus
<i>Potentilla sp</i>	cinquefoil
<i>Prunus americana</i>	American plum
<i>Prunus virginiana</i>	chokecherry
<i>Rhus trilobata</i>	skunkbush
<i>Rosa woodsii</i>	wild rose
<i>Symphoricarpus occidentalis</i>	snowberry
<i>Toxicodendron rydbergii</i>	poison ivy
<i>Yucca glauca</i>	yucca

Graminoids

Andropogon gerardii
Bromus inermis
Bromus sp.
Bromus tectorum
Carex sp.
Dactylis glomerata
Elymus canadensis
Poa compressa
stipa sp.

big blue stem
smooth brome
brome sp.
cheatgrass
sedge sp.
orchard grass
Canada wild rye
Canada bluegrass
needle grass sp.

Forbs

Aesclepias sternophylla
Ambrosia sp.
Artemisia ludoviciana
Cynoglossum officianalle
Erigeron sp.
Eriogonum umbellatum
Heterotheca horrida
Monarda fistulosa
Penstemon secundiflora
Smilacina stellata
Tragopogon dubius

narrow-leaved milkweed
ragweed
prairie sage
houndstongue
fleabane
suphur flower
golden aster
beebalm
low penstemon
false Solomon's seal
salsify

Zapus hudsonius preblei, Preble's Meadow Jumping Mouse

Survey Field Data Compilation Form

Z. h. preblei found? Yes No Dates of Survey 21 Sept - 24 Sept 99

Surveyor:

Organization/Company Carron meaney

Full Name(s) Anne Ruggles, Norm Clippinger

Location:

Descriptive Site Name (creek, nearby road intersection, etc.) Gregory Creek

U.S.G.S. Quad Name Eldorado sprgs County Boulder Elevation 5500

1/4 Section(s) NW Township(s) 15 Range(s) 71W

UTM Coordinates, Zone 13 Northing 474869.98732 Easting 4427311.23061

Directions to Location Baseline Road W to Flagstaff Rd.; south onto rd. to Gregory canyon trailhead

Land Ownership City of Boulder mountain parks

Habitat:

General Habitat Description Riparian shrub

(see attached)
Dominant Plant Community site 1: crack-willow/young Green Ash, Poison Ivy, Equise
site 2: cottonwood, D. Fir, Rocky mtn maple, Dr. grape, Chokecherry, Blustery willow

Drainage Type: Perennial Stream Ephemeral Stream Pond/Lake Ditch
Other

Trapping Information:

Type of Traps Shuman Type of Bait Horse sweat seed % Available (unsprung) 94%

Number of Nights Trapped 4 Total Trapnights 200

Weather conditions prior to and during survey temps in upper 30's & lower 40's;
no precip; clear skies; little wind

Associated Animal Species (especially urban predators, rats, house mice) Microtus pennsylvanicus,
Microtus longicaudis, Peromyscus maniculatus,
P. nasutus

Sketch of surveyed area showing traplines, specific area disqualified (can be done on required U.S.G.S. map of site if appropriate)

Preble's Data:

Number of Preble's trapped or seen 1 ♀ / recapture

Distance from water (m) Sex (m/f) Evidence of repro.* Weight (grams) Marked or tagged?

Distance from water (m)	Sex (m/f)	Evidence of repro.*	Weight (grams)	Marked or tagged?
1. ~ 10 ft (3m)	F	none	24g	no
2. ~ 10 ft	F	none	27g	PIT-tag # 410 B&D 5318
3.				
4.				

(Continue on separate sheet if needed)

* Reproduction evidence for males is descended testes, for females is enlarged nipples.

Evidence of disease, predation or injury none

(Submit injury/mortality form if appropriate)

Genetic Material Obtained? Yes _____ No X Forwarded to _____

Specimen(s)? Yes _____ No X Forwarded to _____

Additional Comments:

(SUBMIT THIS FIELD DATA FORM WITH THE SURVEY REPORT)

GREGORY CANYON SITE VISIT--October 21, 1999

Scientific Name	Common Name	Site 1	Site 2	Native
Trees:				
<i>Celtis reticulata</i>	Hackberry	X		Yes
<i>Fraxinus pensylvanica</i> var. <i>lanceolata</i>	Green Ash	X		Yes
<i>Malus domestica</i>	Apple	X		No
<i>Pinus ponderosa</i> ssp. <i>scopulorum</i>	Ponderosa Pine	X	X	Yes
<i>Populus angustifolia</i>	Narrowleaf Cottonwood		X	Yes
<i>Populus deltoides</i> ssp. <i>monolifera</i>	Plains Cottonwood	X		Yes
<i>Pseudotsuga menziesii</i>	Douglas-fir		X	Yes
<i>Quercus</i> spp.	Oak	X	X	No
<i>Salix fragilis</i>	Crack Willow	X		No
<i>Sorbus scopulina</i>	Mountain-ash		X	Yes
Shrubs:				
<i>Acer glabrum</i>	Rocky Mountain Maple		X	Yes
<i>Alnus incana</i> ssp. <i>tenuifolia</i>	Alder	X		Yes
<i>Betula fontinalis</i>	River Birch	X		Yes
<i>Corylus cornuta</i>	Beaked Hazlenut	X		Yes
<i>Mahonia repens</i>	Oregon-grape	X	X	Yes
<i>Oreobatus deliciosus</i>	Boulder Raspberry	X	X	Yes
<i>Padus virginianus</i> ssp. <i>melanocarpa</i>	Chokecherry	X	X	Yes
<i>Parthenocissus vitacea</i>	Virginia Creeper	X	X	Yes
<i>Prunus americanus</i>	Wild Plum	X		Yes
<i>Rhamnus cathartica</i>	Buckthorn		X	No
<i>Rhus glabra</i>	Smooth Sumac	X		Yes
<i>Rosa woodsii</i>	Wild Rose	X	X	Yes
<i>Salix irrorata</i>	Bluestem Willow	X	X	Yes
<i>Swida sericea</i>	Red-twig Dogwood	X	X	Yes
<i>Symphoricarpos</i> sp.	Snowberry	X	X	Yes
<i>Toxicodendron rydbergii</i>	Posion Ivy	X	X	Yes
<i>Viburnum lantana</i>	Wayfaring-tree	X	X	No
<i>Vitis riparia</i>	Wild Grape		X	Yes
Graminoids:				
<i>Dactylis glomerata</i>	Orchard Grass	X		No
<i>Elymus canadensis</i>	Canada Wild-rye	X		Yes
<i>Panicum virgatum</i>	Switchgrass		X	Yes
<i>Poa compressa</i>	Canada Bluegrass		X	No
<i>Poa</i> sp.	Bluegrass	X	X	Yes
Forbs:				
<i>Agrimonia striata</i>	Agrimony	X		Yes
<i>Apocynum androsaemifolium</i>	Spreading Dog-bane	X	X	Yes
<i>Aster laevis</i>	Smooth Aster	X	X	Yes
<i>Equisetum arvense</i>	Horsetail	X		Yes
<i>Hippochaete hymenalis</i> ssp. <i>affinis</i>	Scouring-rush		X	Yes
<i>Lactuca</i> sp.	Wild Lettuce	X		Yes
<i>Monarda fistulosa</i> var. <i>menthaefolia</i>	Beebalm		X	Yes
<i>Physocarpus monogynous</i>	Rocky Mountain Ninebark		X	Yes
<i>Solidago gigantea</i>	Goldenrod	X		Yes
<i>Thermopsis divaricarpa</i>	Golden Banner		X	Yes

Gregory Canyon Trail

Crown Rock Trail

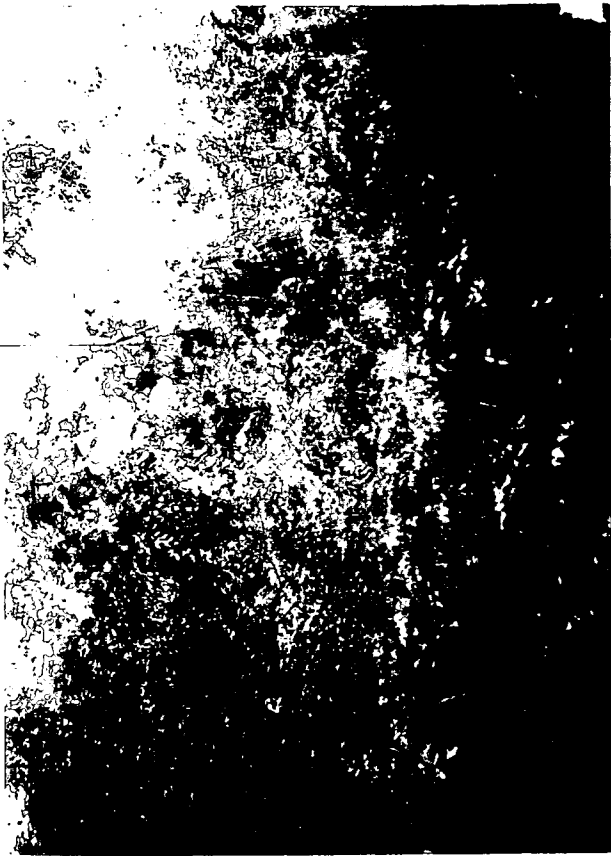
Baseline
Fogstaff Rd.

Gregory Creek

Parking Lot



Gregory Canyon - Boulder Mtn. Pks



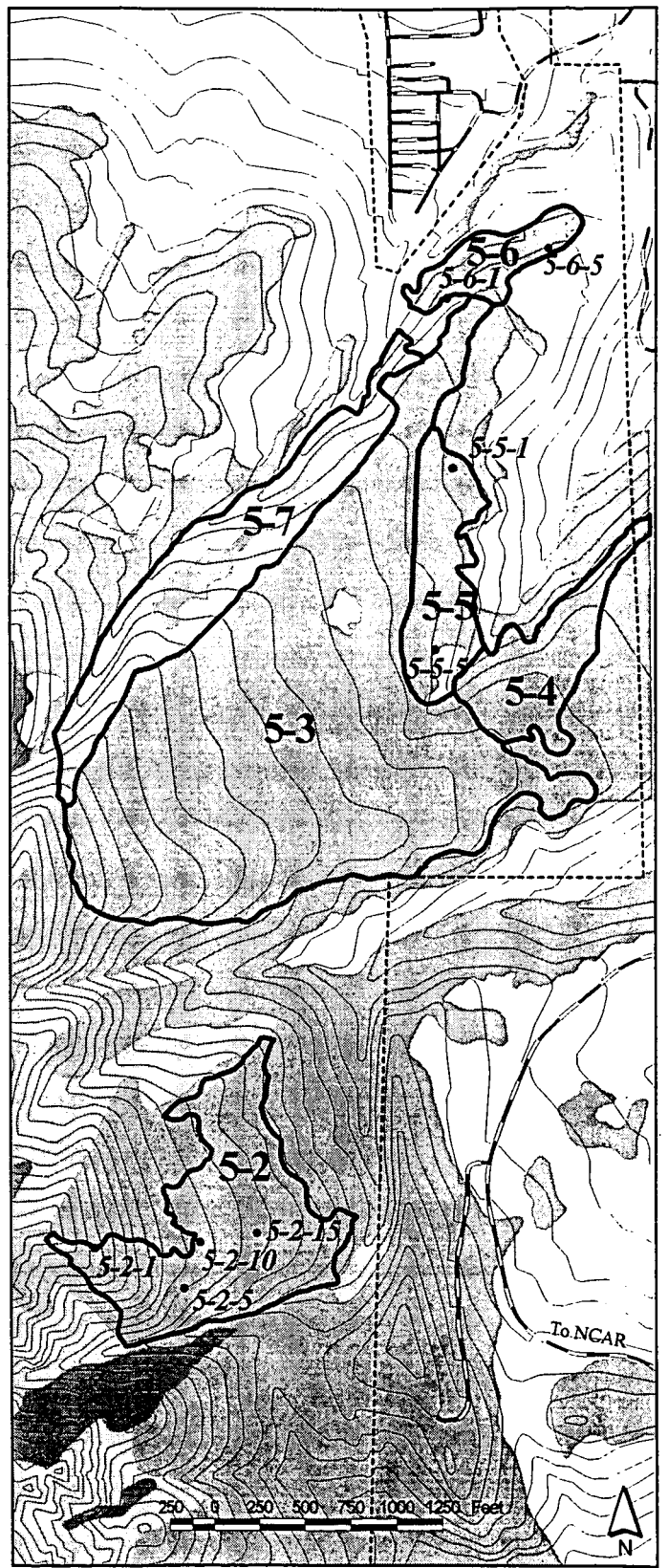
Gregory Canyon, Boulder Mountain Parks
Boulder CO

24 Sept 99 #410B6D5318

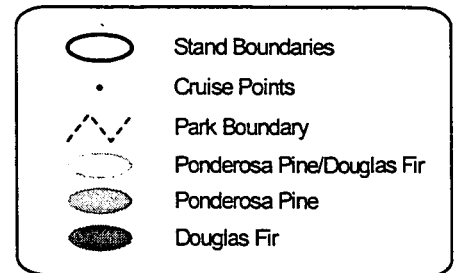
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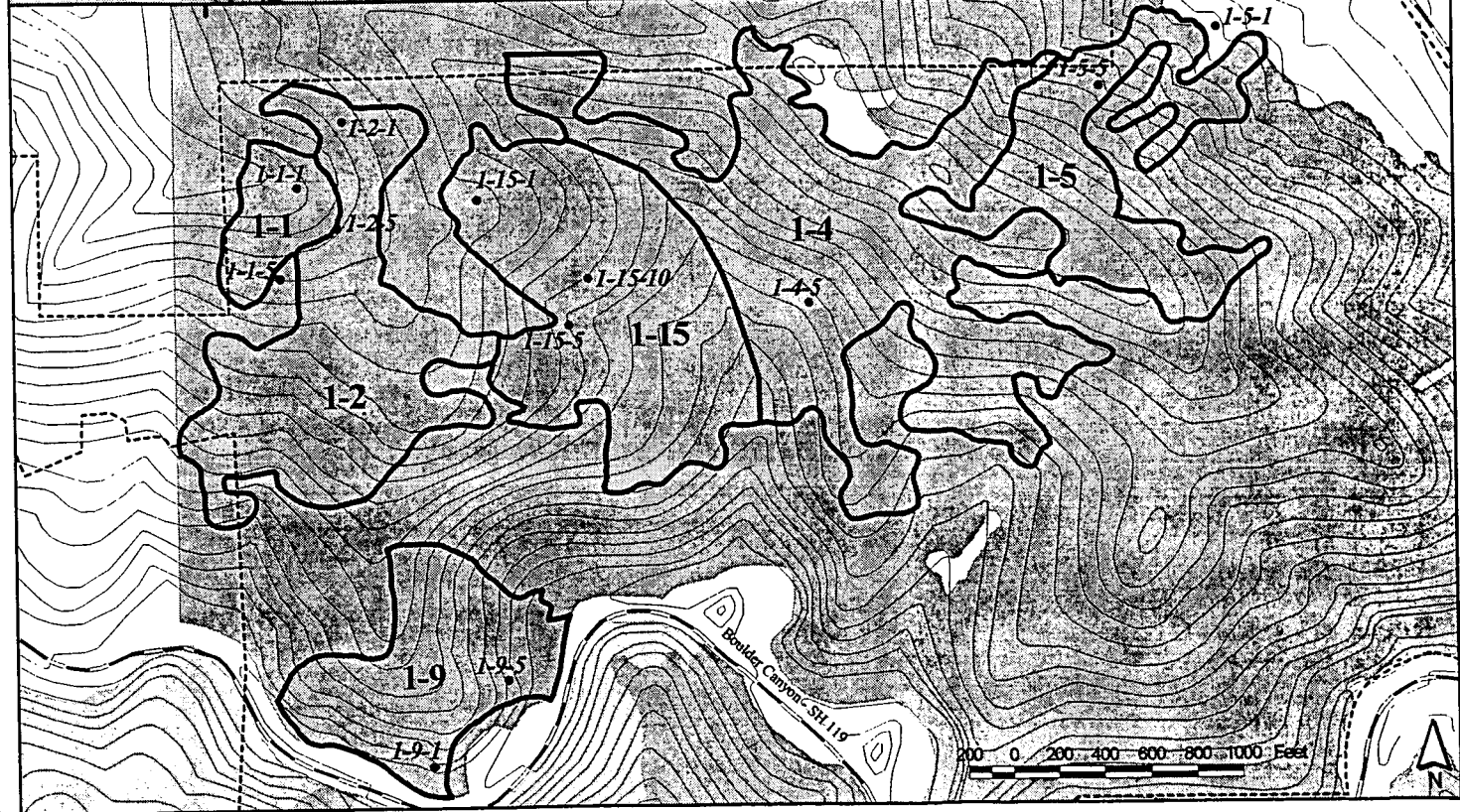
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Enchanted Mesa Low Elevation Stands





Anemone Hill Low Elevation Stands

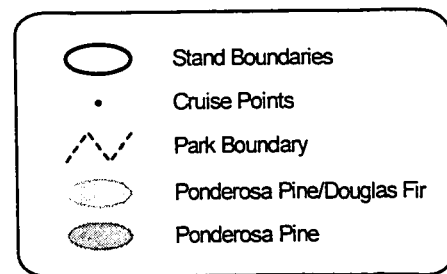


Table 4. Total Small Mammal Captures at Coyote Gulch (SM-1), Boulder Mountain Parks, Boulder, Colorado, 1999.

Species	Adult Male	Female	Subadult Male	Female	Juvenile Male	Female	Total Male	Female	unknown	Total All
<i>Microtus ochrogaster</i> Prairie Vole	2	7	2	2	0	0	4	9	0	13 (4) ¹
<i>Microtus pennsylvanicus</i> Meadow Vole	0	0	0	0	0	0	0	0	0	0
<i>Microtus spp</i> Microtus spp.	0	0	0	0	0	2	0	2	0	2
<i>Neotoma mexicana</i> Mexican Woodrat	1	0	0	0	0	0	1	0	0	1
<i>Peromyscus maniculatus</i> Deer Mouse	8	6	3	3	0	2	11	11	0	22 (10)
<i>Peromyscus nasutus</i> Rock Mouse	4	1	0	0	0	0	4	1	0	5 (4)
<i>Reithrodontomys megalotis</i> Western Harvest Mouse	2	0	0	0	0	0	2	0	0	2
<i>Zapus hudsonius preblei</i> Preble's Meadow Jumping Mouse	0	0	0	0	0	0	0	0	0	0
Total										45 (18)

All values based on 600 trap-nights.

¹ values in parantheses indicate recaptures

Table 5. Total Small Mammal Captures at Skunk Canyon (SM-4), Boulder Mountain Parks, Boulder, Colorado, 1999.

Species	Adult		Subadult		Juvenile		Total		unknown	Total All
	Male	Female	Male	Female	Male	Female	Male	Female		
<i>Microtus ochrogaster</i>										
Prairie Vole	5	2	3	3	1	0	9	5	0	14 (3) ¹
<i>Microtus pennsylvanicus</i>										
Meadow Vole	0	1	0	0	0	0	0	1	0	1
<i>Microtus spp</i>										
Microtus spp.	0	0	0	0	0	1	0	1	0	1
<i>Neotoma mexicana</i>										
Mexican Woodrat	0	4	1	2	0	0	1	6	0	7 (8)
<i>Peromyscus maniculatus</i>										
Deer Mouse	2	4	3	1	1	0	6	5	3	14 (8)
<i>Peromyscus nasutus</i>										
Rock Mouse	3	2	0	1	0	0	3	3	0	6 (7)
<i>Reithrodontomys megalotis</i>										
Western Harvest Mouse	0	0	0	0	0	0	0	0	0	0
<i>Zapus hudsonius preblei</i>										
Preble's Meadow Jumping Mouse	0	0	0	0	0	0	0	0	0	0
Total										43 (27)

All values based on 600 trap-nights.

¹ values in parantheses indicate recaptures

Table 6. Total Small Mammal Captures at Coyote Creek, Boulder Mountain Parks, Boulder, Colorado, 1999.

Species	Adult Male	Female	Subadult Male	Female	Juvenile Male	Female	Total Male	Female	unknown	Total All
<i>Microtus ochrogaster</i> Prairie Vole	0	0	1	0	0	0	1	0	0	1
<i>Microtus pennsylvanicus</i> Meadow Vole	2	0	1	1	1	0	4	1	0	5
<i>Microtus spp</i> Microtus spp.	0	0	0	0	1	0	1	0	0	1
<i>Neotoma mexicana</i> Mexican Woodrat	1	0	0	0	0	0	1	0	0	1
<i>Peromyscus maniculatus</i> Deer Mouse	3	1	0	2	0	0	3	3	0	6 (4) ¹
<i>Peromyscus nasutus</i> Rock Mouse	2	0	0	0	0	0	2	0	0	2
<i>Reithrodontomys megalotis</i> Western Harvest Mouse	0	0	0	0	0	0	0	0	0	0
<i>Zapus hudsonius preblei</i> Preble's Meadow Jumping Mouse	0	0	0	0	0	0	0	0	0	0
Total										16 (4)

All values based on 200 trap-nights.

¹ values in parantheses indicate recaptures

Table 7. Total Boulder Canyon, south-facing slope (SM-5), Boulder Mountain Parks, Boulder, Colorado, 1999.

Species	Adult Male	Female	Subadult Male	Female	Juvenile Male	Female	Total Male	Female	unknown	Total All
<i>Microtus ochrogaster</i> Prairie Vole	0	0	0	0	0	0	0	0	0	0
<i>Microtus pennsylvanicus</i> Meadow Vole	0	0	0	0	0	0	0	0	0	0
<i>Neotoma mexicana</i> Mexican Woodrat	0	0	0	0	0	0	0	0	0	0
<i>Peromyscus maniculatus</i> Deer Mouse	0	0	0	0	0	0	0	0	0	0
<i>Peromyscus nasutus</i> Rock Mouse	1	1	0	0	0	0	1	1	0	2 (1)
<i>Reithrodontomys megalotis</i> Western Harvest Mouse	2	0	0	0	0	0	2	0	0	2 (1)
<i>Spermophilus lateralis</i> Golden-mantled Ground Squirrel	1	1	0	0	0	0	1	1	0	2
<i>Zapus hudsonius preblei</i> Preble's Meadow Jumping Mouse	0	0	0	0	0	0	0	0	0	0
Total										6 (1)

All values based on 600 trap-nights.

Table 8. Total Small Mammal Captures at Anemone Ridge SM-6, Boulder Mountain Parks, Boulder, Colorado, 1999.

Species	Adult Male	Female	Subadult Male	Female	Juvenile Male	Female	Total Male	Female	unknown	Total All
<i>Microtus ochrogaster</i> Prairie Vole	0	0	0	0	0	0	0	0	0	0
<i>Microtus pennsylvanicus</i> Meadow Vole	0	0	0	0	0	0	0	0	0	0
<i>Microtus spp</i> Microtus spp.	0	0	0	0	0	0	0	0	0	0
<i>Neotoma mexicana</i> Mexican Woodrat	0	0	0	0	0	0	1	0	0	0
<i>Peromyscus maniculatus</i> Deer Mouse	3	0	0	0	0	0	3	0	0	3
<i>Peromyscus nasutus</i> Rock Mouse	0	0	0	0	0	0	0	0	0	0
<i>Reithrodontomys megalotis</i> Western Harvest Mouse	0	0	0	0	0	0	0	0	0	0
<i>Zapus hudsonius preblei</i> Preble's Meadow Jumping Mouse	0	0	0	0	0	0	0	0	0	0
Total										3

All values based on 600 trap-nights.

¹ values in parentheses indicate recaptures

Table 9. Total Small Mammal Captures at Gregory Canyon, south-facing slope (SM-7), Boulder Mountain Parks, Boulder, Colorado, 1999.

Species	Adult		Subadult		Juvenile		Total		unknown	Total All
	Male	Female	Male	Female	Male	Female	Male	Female		
<i>Microtus ochrogaster</i> Prairie Vole	1	1	0	0	0	0	1	1	0	2
<i>Microtus pennsylvanicus</i> Meadow Vole	0	0	0	1	0	0	0	1	0	1
<i>Neotoma mexicana</i> Mexican Woodrat	0	0	0	0	0	0	0	0	0	0
<i>Peromyscus maniculatus</i> Deer Mouse	5	2	1	4	0	0	6	6	2	14 (9) ¹
<i>Peromyscus nasutus</i> Rock Mouse	1	2	0	0	0	1	1	3	1	5 (6)
<i>Reithrodontomys megalotis</i> Western Harvest Mouse	0	1	0	0	0	0	0	1	0	1 (1)
<i>Tamiasciurus minimus</i> Least Chipmunk	3	3	0	0	0	0	3	3	1	7 (1)
<i>Zapus hudsonius preblei</i> Preble's Meadow Jumping Mouse	0	0	0	0	0	0	0	0	0	0
Total										30 (17)

All values based on 600 trap-nights.

¹ values in parantheses indicate recaptures

Table 10. Total Small Mammal Captures at Gregory Canyon, north-facing slope (SM-8), Boulder Mountain Parks, Boulder, Colorado, 1999.

Species	Adult		Subadult		Juvenile		Total		unknown	Total All
	Male	Female	Male	Female	Male	Female	Male	Female		
<i>Microtus ochrogaster</i> Prairie Vole	0	1	0	0	0	0	0	1	0	1
<i>Microtus pennsylvanicus</i> Meadow Vole	0	0	0	0	0	0	0	0	0	0
<i>Neotoma mexicana</i> Mexican Woodrat	0	0	0	0	0	0	0	0	0	0
<i>Peromyscus maniculatus</i> Deer Mouse	1	1	4	3	0	1	5	5	4	14 (10) ¹
<i>Peromyscus nasutus</i> Rock Mouse	0	1	2	0	0	0	2	1	0	3 (2)
<i>Reithrodontomys megalotis</i> Western Harvest Mouse	0	0	0	0	0	0	0	0	0	0
<i>Tamisciurus minimus</i> Least Chipmunk	0	0	0	0	0	0	0	0	0	0
<i>Zapus hudsonius preblei</i> Preble's Meadow Jumping Mouse	0	0	0	0	0	0	0	0	0	0
Total										18 (12)

All values based on 600 trap-nights.

¹ values in parantheses indicate recaptures

Table 11. Total Small Mammal Captures at lower Gregory Creek, Boulder Mountain Parks, Boulder, Colorado, 1999.

Species	Adult		Subadult		Juvenile		Total		unknown	Total All
	Male	Female	Male	Female	Male	Female	Male	Female		
<i>Microtus ochrogaster</i> Prairie Vole	0	0	0	0	0	0	0	0	0	0
<i>Microtus pennsylvanicus</i> Meadow Vole	0	1	1	0	0	0	1	1	0	2
<i>Microtus longicaudus</i> Long-tailed Vole	0	0	1	0	0	0	1	1	0	1
<i>Neotoma mexicana</i> Mexican Woodrat	0	0	0	0	0	0	0	0	0	0
<i>Peromyscus maniculatus</i> Deer Mouse	1	3	1	2	0	2	2	7	1	10 (12) ¹
<i>Peromyscus nasutus</i> Rock Mouse	1	1	0	1	0	0	2	1	0	3 (4)
<i>Reithrodontomys megalotis</i> Western Harvest Mouse	0	0	0	0	0	0	0	0	0	0
<i>Tamiasciurus minimus</i> Least Chipmunk	0	0	0	0	0	0	0	0	0	0
<i>Zapus hudsonius preblei</i> Preble's Meadow Jumping Mouse	0	1	0	0	0	0	0	1	0	1 (1)
Total										17 (17)

All values based on 200 trap-nights.

¹ values in parantheses indicate recaptures