Small Mammal Inventory and Monitoring Protocol in Riparian Habitats of City of Boulder Open Space Mountain Parks

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Open Space Mountain Parks--Small Mammal Inventory And Monitoring-2001

Introduction

Open Space Mountain Parks (OSMP) requested a baseline inventory of small mammal species in six selected riparian habitats of BMP and development of a protocol for monitoring small mammal communities in those habitats. Overstory and understory composition have been described for many of these sites by OSMP personnel. Avian species inventories are being conducted by researchers at the University of Colorado, Boulder and riparian monitoring points have been established at some of 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, weed control and eradication or human use of the areas.

When we complete this work we will have completed surveys of; Anemone Ridge, a transect running north up from Boulder Canyon near Elephant Rock, Gregory Canyon (cross sections), Gregory Creek, Long Canyon, Panther Canyon, Lost Gulch (along Chapman Road), Aspen Canyon, upper, middle and lower Bear Canyon, Enchanted Mesa, Coyote Gulch (the hillside and the creek), Skunk Canyon (the hillsides and the creek), the south facing hillside of Koehler Mesa and Shadow Canyon (Ruggles, et al 1999, 2000). This information should give the park fairly comprehensive information for considering the effects on small mammal communities when making management decisions.

Study sites (2001)

Trapping was carried out on 6 sites selected by BMP (Figure 1). All sites included riparian habitat. We trapped a segment of Bear Creek west of the Flatirons and above 7000 feet, Long and Panther Canyons up to 7200 feet, Aspen Canyon to 7400 feet and the gulch along Chapman Road that intersects with Lost Gulch to 6700 feet. At the foothills plains interface we trapped Shadow Canyon and Skunk Canyon. With the exception of the Chapman Road gulch which had only a few pools, there was water in all of the drainages this year in contrast to 2000 (Ruggles et al 2000). A table of UTMs for all sites trapped in OSMP in 1999, 2000 and 2001 (Table 10) is included in this report. The table also includes a list of species found at each site.

Schedule

Shadow Canyon was trapped from June 4 - June 8. This is an important bear feeding area from mid-July through entry into hibernation and is densely vegetated thus we chose to trap this site first to avoid conflicts with bears. Long and Panther Canyons were trapped the week of 11 June - 16 June. Aspen Canyon was trapped from 25 June - 29 June. We were in Middle Bear Canyon (below the Green Mountain-Westridge Trail) from 16 July - 20 July, Skunk Canyon from 23 July - 27 July and Chapman Road Gulch from 30 July - 3 August.

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). When sampling along the creeks our traplines were set on either side of the creek and followed the creek's course .Cross sections across canyons (Skunk Canyon, Panther Canyon, Middle Bear Canyon, Aspen Canyon and Chapman Road Gulch) consisted of linear arrays of at least 25 traps. On average we sampled 1.5km of each drainage. 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 along the line 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, weather and cover availability, and intrinsic factors such as behavioral or physiological patterns and 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 preceded by a season of trapping and then trapped during the subsequent two summers. 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 eveness 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. 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 species richness.

Species richness is a count of the number of species captured on a particular site at a given time. Relative abundance is calculated as the number of individual animals 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.

Species 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 vole, prairie vole or long-tailed vole in proportion to the occurrence of the three 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).

Effects of weather and population cycling of rodents

There was a heavy wet snow the third week of May this year accompanied by 2 nights of temperatures falling to the mid-20's. This freeze killed flowers on many of the fruit-bearing shrubs and trees (hawthorne, waxflower, wild plum, choke cherry, apple, skunk brush, golden currant, wax currant, and wayfaring tree) resulting in little fruit available to bears to meet their needs during hyperphagia. Our traplines were worked by bears at 4 of 6 sites damaging 217 traps of which about one half were not salvageable. The bears were dismantling the traps (Plates 9 & 10) and taking the bait (corn, oats and wheat coated with molasses).

In general we captured fewer animals this year in Mountain Parks then we expected. We may be seeing the results of a year (November 1999 - November 2000) of warmer and drier weather then usual along the Front Range and the wet snow and cold of late May 2001. This latter event may well have caused high mortality of spring small mammal litters and of shrews. We captured fewer mice then we have in the past and the first voles weren't captured until the end of the summer. Mice and voles, for the most part, build nests of grasses and these likely became saturated with the wet snow stressing both adults and pups. The first vole (long-tailed) we captured was the first week of August. In the past we have captured voles at every site throughout the summer. Rock mice (whose numbers seemed to track what we have captured in the past in OSMP canyons) build nests at the base of rock outcrops, in cracks in outcrops and in rock piles and thus may have avoided becoming wet.

The first shrews we captured all year were in late August. We normally capture them in small numbers throughout the summer. The late snow and cold certainly affected the shrew's food source (insects) and likely the shrews themselves. They have high metabolic rates and probably consume one to two times their body weight in food every 24 hours (Fitzgerald, et al. 1994). During the two days of mid-20 temperatures insects were likely to have been rare to unavailable.

Prebles meadow jumping mice are not as likely to have been effected by the late season snow and low temperatures as they are hibernators and by the third week of May they had just begun to emerge from hibernation (Meaney, Ruggles, et al 2001). Males precede females by several weeks so a significant proportion of the population was probably still hibernating. Jumping mice also have a propensity to enter a state of dormancy when stressed by either adverse weather conditions or food shortage thus avoiding immediate adverse conditions (Meaney, Ruggles, et al. 20001, Whitaker 1972).

Even if we assume that the capture rates this year reflect a negative change in population size, the smaller capture rates could be explained by a low point in population cycles. Deer mouse abundance varies in 3-5 year fluctuations and harvest mice have pronounced fluctuations in abundance (Wilson 1999). Prairie vole cyclic population peaks appear to vary from 2-4 years (Wilson 1999) and meadow vole populations cycle every 2-5 years (Krebs 1974). We may be in the low cycle for many small mammal populations or the combination of drought - which could result in smaller populations due to low availability and or low quality food - followed by wet snow and cold temperatures - which could have resulted in high mortality for young animals as well as adults - could have resulted in very few animals being available to trap.

Results (see Figure 1 for a map of transect locations, see Table 8 for capture rates, species abundance, species diversity across all sites and all years.)

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1. Shadow Canyon

1320 trap nights and a capture rate of 2%
relative abundance: 1.4
species richness: 3
species diversity: 0.17

Description:: (Plate 1).We sampled 1.6km of Shadow Canyon from west of the Mesa Trail down the Towhee Trail almost to South Boulder Creek. This is a foothills riparian system, between 5715 ft to 6398 ft in elevation. West of the Mesa Trail the canyon narrows and becomes steep. It is east-facing, has wet soils (mosses are common) and is shaded most of the time. Vegetation is dense and varied. Trees and shrubs include Rocky Mountain maple, roses and raspberries. Forbs include bedstraw, cow parsnip, waterleaf, wild mint, stinging nettle, and violets. There are also dense stands of horsetails and bracken fern. As the stream flows out of the foothills into the plains it widens, the banks become less steep and

exposure to the sun increases. Along the creek the vegetation is dense and consists largely of cottonwood, chokecherry, willows, snowberry, dogbane, and waterleaf.

The upland areas are a foothills scrub habitat similar to what is found on the south slope of Koehler Mesa and the east slope of Coyote Gulch. They are dominated by a variety of grasses including big bluestem, Canada wild rye, cheatgrass and sedges that are interspersed with large patches of shrubs, largely skunk brush. Also found are Oregon grape, prickly pear cactus, yucca, prairie sage, cinquefoil, ragweed and hound's tongue. Ponderosa pines are at the top of the slopes. There was water flowing in the creek during the week we trapped Shadow Canyon. There is a trail that runs parallel to the creek the entire length of the section we trapped and the upper portion runs through an old homestead. The house is still present as are a great variety of introduced plant species (cultivated and weedy). Relatively few people use this trail (Towhee) and dogs must be leashed.

Captures: Nineteen animals were captured with six recaptures. (Table 1) Deer mice accounted for 85% of the capture. We captured and recaught one Mexican woodrat (Plate 11) and one rock mouse. These latter two species are typical of the Chihuahuan faunal assemblage; a group with a common center of origin and geographic distribution on the Mexican Plateau (Armstrong and Freeman 1982). Other similar Front Range canyons (Gregory Canyon, Skunk Canyon, and lower Bear Canyon) yielded much higher species richness in 2000 (5, 4 and 6 respectively) in fewer trap nights (200 for Gregory, 880 for Skunk, 1000 for lower Bear and 1320 for Shadow). Overall number of animals captured was also lower then expected. Because we set traps very near sources of water, the effects of the warmer and drier than average weather along the Front Range in 2000 might not be expected to have a huge impact on capture rates. However, many species of rodents using riparian areas also use parts of the environment which are outside of the effects of the surface water table and thus dry conditions could have adversely effected their use of these areas.

Miscellaneous observations: Several mule deer were present daily as we checked and set traps and coyotes were present each morning. We also observed a rock squirrel near the stone wall at the lower end of the transect. This is a canyon which provides feeding habitat for black bears from mid-summer through the fall. There are a large number of fruit-bearing shrubs, many hidden and secluded stretches of the riparian suitable for day beds and probably water available in pools through the summer and fall.

Shadow Canyon (on either side of Mesa Trail), appears to have good jumping mouse habitat along most of its length. It has a diverse plant community and structure which includes well-developed shrub, grass and forb layers. These attributes have been found to be important components of Preble's habitat. (Clippinger 2001). The Shadow Canyon creek drains into South Boulder Creek which is occupied by Preble's meadow jumping mice both upstream (Aspen Canyon-Harmon Gulch) and downstream of the confluence. We trapped Shadow Canyon the first week of June when Preble's are just beginning to emerge from hibernation in this area (Meaney, Ruggles, et al 2001). In early June, the Preble's population consists primarily of males as females emerge up to two weeks later then males. The combination of severe weather just prior to our trapping effort, the drier then normal conditions of 2000, early trapping date and very nice habitat in the canyon, lead us to believe that the results from trapping this past June (2001) are not representative of the species richness, abundance or diversity of the small mammal community in Shadow Canyon. With a relatively wet summer and thus lush vegetation we would expect to find at least plains harvest mice, prairie voles and meadow voles and perhaps Preble's meadow jumping mice.

Management recommendations: This area should be managed to maintain the shrub communities on the hill sides and preclude succession to a Ponderosa pine dominated flora. OSMP is doing an excellent job of managing canyon use to minimize negative interactions between bears and humans. Given the importance of the low elevation canyons with well-developed riparian areas and high density of fruit-bearing shrubs, OSMP staff might consider closing this canyon to public use during the period of bear hyperphagia, especially during years of low fruit production. Access to the trail going up-canyon to South Boulder Creek is available along the Mesa trail and up Fern Canyon.

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2. Long & Panther Canyons

1068 trap nights and a 0.6% capture rate

species richness: 3

abundance: 0.6

species diversity: 0.38

Description: We set 267 traps Long Creek (Plates 2 & 3) and Panther Creek (Plate 3) (≈1500 meters) the second week in June. There was water in both creeks. There are two riparian monitoring points and a bird point along the transects. The Riparian Point in Long

Canyon is 2000PC 700 and the one in Panther Canyon is PC400UL. The Bird Point in Long Canyon is from Cruz' Lab and is labeled GrCa08. Long Canyon is the northernmost canyon system in Mountain Parks and has four tributary canyons. Vegetation is highly diverse and well-developed structurally. Several Eastern Woodland species occur here; paper birch, beaked hazelnut, wood lily, and raspberry. It is the latter which comprises much of the shrub layer. Trees and shrubs also included aspen, willows, alder, snowberry and the dense understory included bracken fern, cow parsnip, sweet cicely, horsetails, shooting star and violets.

captures: Six animals were captured with no recaptures. (Table 2). Deer mice comprised two thirds of the capture. We also captured 1 Mexican wood rat and 1 Preble's meadow jumping mouse (Plate 12). The jumping mouse was a 20 gr. female with nipples visible through her hair. This latter trait indicates she was likely pregnant. In 2000 we captured 14 animals, ten of them deer mice, 2 long-tailed voles and a masked shrew. Thus combining years we have captured 5 species of small mammal in the Long Canyon-Panther Canyon complex: masked shrew, deer mouse, rock mouse, long-tailed vole and Preble's meadow jumping mouse (at the confluence of Long and Panther Canyons). Armstrong (1982) predicted that red-backed voles and meadow voles would also be found in Long Canyon. Its rich and complex flora would be expected to support a greater density of small animals than we found.

Miscellaneous observations: We had a bear work the trapline the first night. It mangled 46 traps. Initially it ripped the traps open to get at the grain. By the end of the line it had figured out how to open the door on the traps and was just opening them and removing the grain. Last year we had a bear working the trapline in both Long and Gregory Canyons. This bear activity is probably indicative of the importance of Panther, Long and Gregory Canyons both as a movement corridor and feeding area for bears in the Front Range near Boulder. We also had a raccoon work part of the trapline in Long Canyon. There was an active marmot den at the base of a rock outcrop up Panther Canyon (we found fresh scats and heard the marmot whistle) and we saw a long-tailed weasel moving up Long Canyon just south of the confluence of Panther and Long Creeks. We found the remains of a cougar killed deer just below a rock outcrop up Panther Canyon. Pine siskins and chipping sparrows were relatively abundant while we were in the canyons.

Management recommendations: Panther Canyon, Long Canyon and Gregory Canyon comprise a corridor across the Front Range from the plains into the high country. Bears use

this corridor, feeding on the fruits from the dense and diverse shrub community from mid-summer to denning. Due to the dense vegetation in the riparian corridor it likely also provides abundant daybed sites for bears. Deer, coyotes, foxes, birds and occasional elk also use the canyons. Long and Panther Canyons are also an extension of a corridor along Chapman Road Gulch up from Boulder Canyon and likely, in aggregate, provides a movement corridor from Boulder Canyon into the foothills. These canyons should all be managed to protect their value as movement corridors for large mammals and feeding areas for bears during hyperphagia.

There is a trail that runs from Flagstaff Road just beyond Chautauqua Park up Gregory Canyon and through Long Canyon. Use is much higher along Gregory Canyon than it is along Long Canyon and there is essentially no recreational use of Panther Canyon as there is no trail into the canyon and the canyon is obscured by dense vegetation and its narrow entrance. Despite the popularity of these canyons for recreation and their long use (this area was homesteaded early 1900s) they continue to support a diverse and abundant wildlife. We have captured Preble's meadow jumping mice in both Gregory and Long Canyons. Management should continue to separate recreationists and bears through education, warnings and use restrictions if warranted.

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3. Aspen Canyon
1025 trap nights and a 4% capture rate
species richness: 6
abundance: 4.1
species diversity: 0.72

Description: (Plate 4) South of Long and Panther Canyons and of Bear Canyon and draining from the west side of Bear Peak is Aspen Canyon. It flows into Harmon Gulch which flows into Woods Gulch and then into South Boulder Creek. Aspen Canyon is accessed from a private road (Bison Road) and has no trails consequently it gets very little human use. This is a deeply shaded, north facing canyon which stays cooler and moister longer then other canyons in the Front Range. This is reflected in the plant community which includes aspen, wintergreen, twisted stalk and twinflower. Trees and shrubs include Rocky mountain maple, willow, nine-bark, alder, bush honeysuckle, Oregon grape, chokecherry and Boulder raspberry. The understory includes lovage, arnica, horsetails, bracken, cow parsnip, shooting star, violets, dog bane, madder, geranium, beebalm, larkspur, bluebells, sulphur flower and wood lilies.

We sampled ≈ 1500m by setting 200 traps along the creek in Aspen Canyon and 50 traps running downgradient from Aspen Canyon along Harmon Gulch. There was water in both.

Captures: We only captured 8 animals with 2 recaptures (Table 3). Despite the low capture (1% capture rate) we had 4 species; deer mouse, rock mouse, red squirrel and 1 Preble's meadow jumping mouse. The jumping mouse was a 19 gm female with nipples visible. She was pregnant. Deer mice represented 75% of the capture.

Miscellaneous Observatoins: We had a bear work this trapline the last night. It damaged 88 traps. We also saw a blue grouse on the trap line.

Management Recommendations: Aspen Canyon is unique in the area; vegetation is more typical of an area at a higher elevation then 7265 ft at the top of the canyon. Not only does the canyon provide habitat for rare and unusual plants but it also supports Preble's meadow jumping mice. Since access is highly limited the most imminent threat to this canyon is weeds. HOWEVER the adjacent property owner to the north has taken an interest in the canyon and surrounding area and is working hard to remove and control weeds along the road and on his property. He was delighted to learn that there were jumping mice in the canyon.

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4. Middle Bear Creek
1120 trap nights and a 4.5% capture rate
species richness: 3
abundance: 2.5
species diversity: 0.43

Description:: (Plates 5 & 6). We sampled 1400m of the Bear Creek drainage downstream of the Bear Creek-West Ridge Trail. Traplines were set along the creek and up two ephemeral drainages which feed into creek. About one half of the transect paralleled the trail. The creek here is more canyon-like then is the upstream portion, with a narrow stream corridor and steep walls. There was water flowing in the creek while we were working in early June. There are patches of open riparian woodland characterized by stands of aspen and spruce with a shrub layer of raspberry, rose and snowberry and understory of grasses and herbs. Portions of the stream corridor are more closed and are characterized by alder, rocky mountain maple, cottonwood and boxelder. The shrub layer throughout consists of

alder, maple, willow, raspberry chokecherry, ninebark and snowberry. The understory consists of horsetails, lovage, bee balm, violets and meadow rue. In places, under the aspen, the understory consists solely of bracken.

Captures:: We captured 28 animals with 23 recaptures. (Table 4). The capture rate was 4.5%, we captured 3 species including Preble's meadow jumping mice. Jumping mice constituted 21.6% of the capture (Table 5).Deer mice and rock mice comprised 58% and 21% of the capture respectively. Two of the jumping mice (both pregnant females) moved fairly long distances during the trapping session. One moved 340m between 17 July and 19 June. She remained near the 19 June capture site on recapture June 20. During this move she gained weight from 21g on first capture to 26g on last capture. The second female moved 315m between 18 June and 19 June and remained near the 19 June capture site on recapture 20 June. She was captured every night and gained weight from 23g on first capture to 29g on last capture. Both of these females were pregnant.

We trapped (1080 trap nights) part of this portion of the stream in 2000 in addition to a section further upstream. Last year we also captured; long-tailed voles, meadow voles and masked shrew. There have been no changes to either use or management of the upper and middle Bear Creek areas. We believe the difference in species richness (6 species in 2000 and 3 species in 2001) can most likely be attributed to the weather and/or cycling factors discussed above.

Miscellaneous observations:: We found a cougar-killed fawn carcass in one of the ephemeral drainages feeding into the creek and bear scats with deer hair in them nearby. We also encounter a striped skunk, a blue grouse and deer on the transect.

Management recommendations: OSMP should continue to manage this area as it has with consideration for maintaining the vegetative structural diversity of the stream corridor especially the shrub layer. The dense patches of raspberry probably provide daybed sites for jumping mice (and other mice) and the open meadows provide forage.

Bear Canyon is the only canyon providing an easy movement corridor through Mountain Parks from the plains into the mountains. A trail traces the route and is used by deer, bears, coyotes, foxes and cougars as well as people. The dense vegetation along the creek provides excellent feeding and daybed habitat for large and small mammals alike. Management should continue to maintain this corridor in a condition attractive to the large

mammals and to try to minimize displacement of wildlife and introduction of non-native plant species.

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5. Skunk Canyon

1100 trap nights and a 5% capture rate

species richness: 3

abundance: 3.3

species diversity: 0.37

Description:: (Plate 7). We trapped the creek corridor below the point at which the Mesa Trail crosses Skunk Canyon. We also ran two cross sections which began at the Mesa Trail and ran east to the hogback above the canyon and a line along the hogback from the water tank north. In total we sampled 1.4km in the Skunk Canyon area.

The plant community, especially the shrub layer, is so dense that few people ever venture into this portion of the riparian area. The stream flows during the spring and early summer but seems to be dry by July with the exception of a few pools in very shaded areas. This is one of the most intensively used areas by black bears in the park (Berry 1996) which is likely due to the fruit-bearing shrub community that dominates this segment of the canyon. Hawthorn, chokecherry, wild plum, wayfaring-tree, skunkbrush, waxflower, snowberry and poison ivy dominate the shrub community. There are also willow, rose and alder. The tree layer consists primarily of rocky mountain maple, boxelder and apple. The understory consists of a dense layer of a variety of grasses and herbs including bee balm, yarrow, meadow rue, purple asters and violets. As one moves up from the wet soils of the riparian zone the plant community changes character abruptly to a ponderosa pine dominated community. This segment of the creek appears to be excellent Preble's meadow jumping mouse habitat with the dense shrub layer and adjacent grasslands but we have not captured any in two years of trapping.

Captures: Thirty six animals were captured with 18 recaptures; 20 rock mice, 14 deer mice and two least chipmunks (Table 6). In 2000 we captured meadow voles, long-tailed voles, deer mice and masked shrews in Skunk Canyon. (Armstrong (1982) also captured long-tailed voles in the plains riparian in Mountain Parks). With two years of trapping we have found 6 species of small mammal in Skunk Canyon.

One rock mouse, a lactating female, moved 190m between captures overnight and returned to the original capture site the third night. Over a period of 2 trap nights an adult male rock mouse moved 80m.

Miscellaneous observations:: A bear worked our trapline in Skunk Canyon also, though this one only mauled 6 traps. We regularly encountered deer along the trap line and in addition to the mauled traps found several fresh bear scats. We encountered 4 eastern fence lizards (*Sceloporus undulatus*) along the trapline on the hogback. They had wavy lines on their dorsum thus, following Hammerson (1986), they should be subspecies *erythrocheilus*. Catbirds (*Dumetella carolinenisis*) were calling while we were working in the creek.

Management recommendations: This site is home, despite a period of drought (2000) and a late season, heavy wet snowfall accompanied by below freezing temperatures and of low overall capture, to a variety of small mammals. It is also of great importance to bears and a variety of nesting bird species. There is no trail along this stretch of the creek and Mountain Parks has done an excellent job of managing use by recreationists. We would recommend that the Park consider seasonal requirements along the Skunk Canyon trail for dogs to be on leash coinciding with the period of heaviest use by bears and humans. This will help minimize negative interactions between bears and humans in this popular hiking area.

This area should be managed to maintain the structural diversity of the riparian corridor and to perpetuate the adjacent grasslands. This combination of attributes appears to be important not only to a diverse small mammal community but also to deer, bear, coyotes and cougars.

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6. Chapman Road (Lost gulch)
860 trap nights and 1.6% capture rate
species richness: 4
abundance: 0.9
species diversity: 1.08

Description:: (Plate 8). We trapped the drainage which begins at the picnic tables at the Five-Corners parking area on Flagstaff Mountain. Our trap line intersected the drainage that parallels Chapman Road below the city carcass dump and extended downsteam to the private property. Altogether we sampled ≈ 1.07km of the drainage.

This is a relatively narrow drainage; the sides rise fairly steeply to ponderosa pine dominated uplands on the more south-facing slopes and a Douglas fir dominated upland on the more north-facing slopes. The drainage is so narrow that it is shaded for much of the day. Willows are largely absent and are replaced by birch, alder, maple and beaked hazelnut. Other shrubs found include: nine-bark, red osier dogwood, rose and raspberry (both in dense thickets), chokecherry and snowberry. The dominant tree in the drainage is boxelder though due to the steepness of the sides conifers shade much of the drainage. Beebalm, larkspur, yarrow, star Solomon seal, violets, cow parsnip, meadow rue, dogbane, harebells, spiderwort, brook saxifrage, and nettle compose the understory.

Captures: Only eight animals were captured (with 6 recaptures) though they represented 4 species (Table 7). The resulting species diversity is very high as the eveness of capture was extraordinary. Of the 8 animals 1 was a long-tailed vole, 2 were Mexican woodrats, 2 were deer mice and 3 were rock mice. One deer mouse moved 90m in 24 hours.

Miscellaneous observations:: A bear mangled 77 traps along this line over the course of two nights. We found a fresh bear scat (Plate 13) the second morning. It was relatively small both in diameter and in volume--probably deposited by a yearling bear. The scat contained a few chokecherry seeds, Oregon grape seeds and deer hair. It had the consistency and color of a scat containing meat, probably obtained from scavenging at the carcass dump upstream. We also encountered (sign or observation) red squirrels, cottontails (probably eastern), raccoons, deer, striped skunk, fox, cougar and coyotes in the drainage. This is probably reflective of the value of this drainage as a movement corridor from Boulder Canyon into the foothills and to canyons further south (Gregory and Long). There were still a few pools of water along the drainage when we trapped here in late July and early August. These may be important areas for bats as they were adjacent to rocky outcrops.

Management recommendations:
There were a large number of tires in the creekbed left from when this was an actively used road. Aesthetically it would be nice to remove them and since Chapman Road parallels the creek for most of its length it wouldn't be too difficult to do so. The prime importance of the creek corridor (which includes the road) is as a corridor for movement of wildlife from Boulder Canyon up to Gregory and Long Canyons and into the foothills. Since there are few other routs of movement with so little human use this is probably an important corridor to maintain. It appears that human use is relatively low. We only met a few people during

the week we worked on this site. To help ensure the integrity and continued existence of this important wildlife corridor OSMP should try to purchase at least the development rights to the private property down gradient of the OSMP land along Chapman Road.

Summary and recommendations for monitoring

Of the sites sampled in 1999, 2000 and 2001 the riparian and foothills shrub habitats exhibited the highest small mammal species richness, abundance and diversity (Table 8). This echoes the findings of Armstrong (1982) who also found the greatest species richness and trapping success (a rough index of relative density) in the foothills and montane riparian and foothills-shrub ecosystems.

Riparian: Due to the presence of water, the riparian areas support a high species richness 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. The riparian in OSMP is dominated by cottonwoods, willow, maple, alder, birch, snowberry, horsetails and sedges. These areas also provide movement corridors for large mammals across the Front Range.

We found well-established Preble's Meadow Jumping Mouse populations (listed as threatened under the Endangered Species Act on May 13, 1998 (63 FR 26517)) all along Bear Creek both east and west of the Flatirons. We also captured Preble's meadow jumping mice in Gregory Canyon, Long Canyon and Aspen Canyon. Each of these appeared to be a well-established population as we either captured adults and subadults or pregnant females.

Foothills shrub: The foothills shrub also provides relatively more vegetative complexity then other ecosystems in OSMP and thus more varied and abundant food and shelter for small mammals. These ecosystems are dominated, in OSMP, by skunkbrush, wax currant, wild rose, choke cherry, needle-and-thread grass, blue gramma grass, western wheat grass and side-oats gramma. Topographically the foothills shrub in OSMP is characterized by rocky, well-drained soils and is associated with limestone hogbacks. The foothills-shrub community includes small mammal species unique to that habitat and dependent on the shrub and rocky outcrop components of the habitat. It is a habitat that is uncommon and that supports rock squirrels, plains harvest mouse, rock mouse, Mexican wood rat and gray fox--species that are part of the Chihuahuan faunal assemblage (Armstrong 1972).

Abert's squirrels, a ponderosa pine forest obligate is another member of the Chihuahuan faunal assemblage found in OSMP.

Ponderosa-Pine Woodland: The Ponderosa Pine parklands are the least diverse (in terms of small mammals) of the sites sampled. These sites are dry (most moisture coming as snow), have shallow, well-drained soils and occupy south-facing slopes. There is less diversity of plant species and structure and therefore less food and shelter available to support a variety of small mammals. Dominant plants other then the pine include wax currant, sulphur flower and kinnikinnik. Most resident mammals depend on cones, cambium and stems of the ponderosa pine or fruits of the wax currant and kinnikinnik for food or insects found in association with ponderosa pine. The Ponderosa pine woodlands are important to Abert's squirrels and many bird species and should be managed to maintain these species.

Abert's Squirrels: Abert squirrels are ecologically dependent on ponderosa pine for food, shelter and reproduction (nests are located in ponderosa pine trees and are only constructed by pregnant females though maintained and used by both sexes (Keith 1965)). Fox squirrels move up onto Enchanted Mesa during the summer but retreat to the homes east of the park and in Chautauqua during the winter. This may give them a competitive advantage over Abert's squirrels which are dependent on the ponderosa pine ecosystem on Enchanted Mesa. Abert's Squirrels do not benefit from the winter supplemental feeding available to fox squirrels. Due to the potential of competition by this non-native species we recommend monitoring of Abert's squirrels on Enchanted Mesa using the work of previous researchers as a baseline (Farentinos 1972, Halloran 1993, Havlick 1984, Slobe 1994). Several population estimates have been made of the Abert squirrels on Enchanted Mesa. Farentinos (1979) estimated an annual population of 24 squirrels in 1971 and Halloran (1994) estimated a population of 17 adults from May 1989 through October 1991. Slobe (1994) reported observing 13 different Abert squirrels.

Monitoring: Monitoring will enable the park to evaluate the effect of habitat manipulations such as forest thinning and controlled burns, trail placement, and increasing human use on small mammal communities. We recommend that OSMP especially 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. Management in riparian areas should be

directed to maintaining diverse plant communities and high quality water. In foothills-shrub habitats management actions should be directed toward maintaining the integrity of the shrubs and discouraging encroachment by ponderosa pine. If management action is anticipated for a foothills-shrub or riparian site OSMP should try to trap the year before the action and each year for three years following the action. With this information managers should be able to evaluate the effects of the management action and recreational use on small mammal populations.

It is important and heartening to note that one indicator of deterioration of a wild system is, to date, missing. In three years we have not captured any house mice though we did not work in the area closest to humans; the Bluebell Creek area. Other species indicative of increasing human influence on a system are found in BMP; fox squirrels (see Abert's squirrels above) and raccoons (throughout the region raccoons are a common prey species of cougars).

In analyzing the species captured and where they were captured, one is struck by the importance of the diversity of ecosystem types found on the OSMP properties. This mosaic reflects the extraordinary topographic diversity of the plains-mountain interface managed by OSMP. OSMP has done an excellent job in maintaining the diversity of ecosystems upon which the diversity of wildlife is dependent. But as use of these areas increases deterioration is likely to increase unless OSMP continues to have city support for monitoring the effects of increased use and consequent management actions needed to manage use and rehabilitate impacted areas.

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Table 1. Total individual captures of small mammals in Shadow Canyon, OSMP, Boulder, Colorado. 5-8, June 2001.

Species	Adult Male	Adult Female	Subadult Male	Subadult Female	Juvenile Male	Juvenile Female	Total Male	Total Female	Total Unknown	Total All
Neatoma mexicana Mexican Woodrat	0	1	0	0	0	0	0	1	0	1 (1)
Peromyscus maniculatus Deer Mouse	4	4	5	2	1	1	10	7	0	17 (4)
Peromyscus nasutus Rock Mouse	0	0	0	1	0	0	0	1	0	1 (1)
	Total									19 (6)

All values based on 1320 trap-nights.
98% of traps available.
[1] values in parentheses ( ) indicate recaptures

Table 2. Total individual captures of small mammals in Long and Panther Canyons, OSMP, Boulder, Colorado. 11-15 June 2001.

Species	Adult Male	Adult Female	Subadult Male	Subadult Female	Juvenile Male	Juvenile Female	Total Male	Total Female	Total Unknown	Total All
Neatoma mexicana Mexican Woodrat	0	0	1	0	0	0	1	0	0	1
Peromyscus maniculatus Deer Mouse	2	1	0	0	1	0	3	1	0	4
Zapus hudsonius preblei Preble's Meadow Jumping Mouse	0	1[1]	0	0	0	0	0	1	0	1
	Total									6

All values based on 1068 trap-nights.
90% of traps available.
[1]20g female with nipples visible through her hair

Table 3. Total individual captures of small mammals in Aspen Canyon, OSMP, Boulder, Colorado. 25-28 June 2001.

Species	Adult Male	Adult Female	Subadult Male	Subadult Female	Juvenile Male	Juvenile Female	Total Male	Total Female	Total Unknown	Total All
Peromyscus maniculatus Deer Mouse	0	2	0	2	0	0	0	4	1	5 (1)[1]
Peromyscus nasutus Rock Mouse	0	0	1	0	0	0	1	0	0	1 (1)
Tamiasciurus hudsonius Red Squirrel	0	1	0	0	0	0	0	1	0	1
Zapus hudsonius preblei Preble's Meadow Jumping Mouse	0	1[2]	0	0	0	0	0	1	0	1
	Total									8 (2)

All values based on 1004 trap-nights.
88.5% available
[1] values in parentheses ( ) indicate recaptures
[2] 19g pregnant female (nipples visible)

Table 4. Total individual captures of small mammals on Middle Bear Creek, OSMP, Boulder Colorado. 17-20 July 2001.

Species	Adult Male	Adult Female	Subadult Male	Subadult Female	Juvenile Male	Juvenile Female	Total Male	Total Female	Total Unknown	Total All
Peromyscus maniculatus Deer Mouse	2	2	3	4	1	2	6	8	1	15 (15)[1]
Peromyscus nasutus Rock Mouse	4	0	1	1	1	0	6	1	0	7 (3)
Zapus hudsonius preblei Preble's Meadow Jumping Mouse	2	3	0	0	0	0	2	3	1	6 (5)
	Total									28 (23)

All values based on 1120 trap-nights.
96% of traps available.
[1] values in parentheses ( ) indicate recaptures

Table 5. Captures of Prebles Meadow Jumping Mice, Middle Bear Canyon, OSMP, Boulder, Colorado. 17 - 20 July 2001

ID	17 July	18 July	19 July	20 July
pink (curve line)	female/ 21g pregnant		24g	26g
note: this animal moved 340m between 17 June and recapture 19 June and remained near the 19 June capture site on recapture 20 June.				
blue (blue line)	female/23g pregnant	25g	28g	29g
note: this animal moved 315m between initial capture on 18 June and first recapture 19 June and remained near the 19 June capture site on recapture 20 June.				
pink (orange line)		female/23g nipples showing		
orange (blue line)			male/19g reproductive	
green (blue line)			male/22g reproductive	
XXXX (junction of blue and orange lines)		Zapus seen traveling along creek		

note: all animals are adults

Table 6. Total individual captures of small mammals Skunk Canyon, OSMP, Boulder, Colorado. 23-27 July 2001.

Species	Adult Male	Adult Female	Subadult Male	Subadult Female	Juvenile Male	Juvenile Female	Total Male	Total Female	Total Unknown	Total All
Peromyscus maniculatus Deer Mouse	5	5	1	2	0	1	6	8	0	14 (3)[1]
Peromyscus nasutus Rock Mouse	7	7	4	2	0	0	11	9	20	20 (15)
Tamias minimus Least Chipmunk	2	0	0	0	0	0	2	0	0	2
	Total									36 (18)

All values based on 1100 trap-nights.
96% of traps available
[1] values in parentheses ( ) indicate recaptures

Table 7. Total individual captures of small mammals in Chapman Road/Lost Gulch, OSMP, Boulder, Colorado. 31 July - 3 August 2001.

Species	Adult Male	Adult Female	Subadult Male	Subadult Female	Juvenile Male	Juvenile Female	Total Male	Total Female	Total Unknown	Total All
Microtus longicaudis Long-tailed Vole	1	0	0	0	0	0	1	0	0	1
Neatoma mexicana Mexican Woodrat	0	2	0	0	0	0	0	2	0	2
Peromyscus maniculatus Deer Mouse	0	0	1	1	0	0	1	1	0	2 (3)[1]
Peromyscus nasutus Rock Mouse	0	0	3	0	0	0	3	0	0	3 (3)
	Total									8 (6)

All values based on 860 trap-nights.
87% of traps available.
[1] values in parentheses ( ) indicate recaptures

Table 8. Capture rates at all sites in Boulder Mountain Parks: 1999-2001

site	year	# trap nights	capture rate	# spp.	spp. abund	spp div.	% cap = zapus	# zapus & recap	notes
Enchanted Mesa N	1999	600	2%	2	1.83	0.13	na	na	PP parkland
Enchanted Mesa S	1999	600	2%	3	1.50	0.40	na	na	PP parkland
Coyote Gulch	1999	600	10%	5	7.50	0.51	na	na	shrubs
Coyote Creek	1999	200	10%	5	8.00	0.57	0	0	rip./no water
Skunk Canyon, hill	1999	600	12%	5	7.16	0.64	na	na	shrubs
Boulder Canyon, south face slope	1999	600	1%	3	1.00	0.47	na	na	open, dry
Anemone Ridge south face slope	1999	600	0.5%	1	0.50	0.00	na	na	PP parkland
Gregory Canyon south face slope	1999	600	8%	6	5.00	0.58	na	na	shrubs, rocks
Gregory Canyon north face slope	1999	600	5%	3	3.00	0.13	na	na	fir forest
Gregory Ck.	1999	200	17%	5	8.50	0.52	6%	1 (1)	water
Gregory Canyon (creek & cross section)	2000	916	5%	5	3.6	0.49	2%	1	rip./no water

site	year	# trap nights	capture rate	# spp.	spp. abund	spp div.	% cap = zapus	# zapus & recap	notes
Upper Bear (creek & cross sections)	2000	1025	4%	6	4.1	0.72	31%	13 (3)	water
Lower Bear (creek & cross sections)	2000	1000	7%	6	4.8	0.48	19%	9 (3)	water
Middle Bear (creek & cross sections)	2001	1120	4.5%	3	2.5	0.43	21.6%	6 (5)	water/(late May wet snow and hard freezes)
Skunk Canyon	2000	880	6%	4	3.6	0.15	0	0	rip./no water
Skunk Canyon (creek & cross sections)	2001	1100	5%	3	3.3	0.37	0	0	no water/ x-sec.
Long Canyon	2000	1200	1.6%	4	1.1	0.39	0	0	rip/no water
Long Canyon/Panther	2001	1068	0.6%	3	0.6	0.38	17%	1	water (late May wet snow and hard freezes)
Aspen (Creek & cross sections)	2001	1004	1%	4	1.1	0.46	10%	1	water (late May wet snow and hard freezes)
Shadow Canyon	2001	1320	2%	3	1.4	0.17	0	0	water (late May wet snow and hard freezes)
Chapman Rd. (Lost Gulch)	2001	860	1.6%	4	0.9	1.08	0	0	no water (late May wet snow and hard freezes)

Table 9. Species Lists

A. Plants

Graminoids and Ferns

wheatgrass	*Agropyron sp.*
side oats gramma	*Bouteloua curtipendula*
blue gramma	*B. gracilis*
big blue stem	*Andropogon gerardii*
smooth brome	*Bromus inermis*
cheatgrass	*Bromus tectorum*
sedge	*Carex sp.*
Canada wild rye	*Elymus canadensis*
bracken fern	*Pteridium aquilinum*
needle grass sp	*stipa comata*
western wheatgraaa	*Agropyron smithii*

Forbs

ragweed	*Ambrosia sp.*
dogbane	*Apocynum cannabinum*
yarrow	*Achillea lanulosa*
pussytoes	*Antennaria sp.*
heart-leaved arnica	*Arnica cordifo lia*
houndstongue	*Cynoglossum officianalle*
larkspur	*Delphiniumnramosum*
shooting star	*Dodecatheon pulchellum*
field horsetail	*Equisetum arvense*
suphur flower	*Eriogonum umbellatum*
bedstraw	*Galium boreale*
white geranium	*Geranium richardsonii*
cow parsnip	*Heraculum sphondylium*
waterleaf	*Hydrophyllum fendleri.*
lovage	*Ligusticum porteri*
wood lily	*Lilium philadelphicum*
twisted stalk	*Linnaea borealis*
lupine	*Lupinus sp.*
false solomon's seal	*Maianthemum amplexicaule*
star solomon seal	*Maianthemum stellata*
wild mint	*Mentha arvensii*
chiming bells	*M. lanceolata*
brook saxifragee	*Micranthes odontolonia*
beebalm	*Monarda fistulosa*
sweet cicely	*Osmorhiza chlensis*
wintergreen	*Pyrola picta*
oneside penstemon	*Penstemon unilateralis*
black-eyed susan	*Rudbeckia hirta*
twisted stalk	*Streptopus fassettii*
meadowrue	*Thalictrum fendleri*
spiderwort	*Tradescantia occidentalis*
salsify	*Tragopogon dubius*
violet	*Viola sp.*

Shrubs

alder	*Alnus tenuifolia*
bearberry (bearberry)	*Arctostaphylos uva-vusu*
fringed sagebrush	*Artemesia frigida*
creeping Oregon grape	*Berberis repens*
water birch	*Betula occidentalis*
beaked hazlenut	*Corylus cornuta*
hawthorne	*Crateagus erythropoda*
horsetails	*Equisetum arvense*
waxflower	*Jamesia americana*
bush honeysuckle	*Loricera involucrata*
tall Oregon grape	*Mahonia repens*
prickly pear cactus	*Opuntia macrorhiza*
cinquefoil	*Potentilla sp*
American plum	*Prunus americana*
chokecherry	*Prunus virginiana*
skunkbush	*Rhus trilobata*
ninebark	*Physocarpus monogynus*
gold currant	*Ribes aureum*
wax currant	*Ribes cereum*
wild rose	*Rosa woodsii*
Boulder raspberry	*Rubus deliciosus*
raspberry	*Rubus spp.*
coyote willow	*Salix exigua*
red osier dogwood	*Swida serciea*
snowberry	*Symphoricarpus occidentalis*
wayfaring tree	*Viburnum lantana*
poison ivy	*Toxicodendron rydbergii*
yucca	*Yucca glauca*

Trees

Rocky Mountain maple	*Acer glabrum*
box elder	*Acer negundo*
paper birch	*Betula papyrifera*
Colorado blue spruce	*Picea pungens*
ponderosa pine	*Pinus ponderosa*
narrow-leaved cottonwood	*Populus angustfolia*
plains cottonwood	*P. deltoides*
aspen	*Populus tremuloides*
Douglas fir	*Pseudotsuga menziesii*
apple	*Pyrus malus*

B. Mammals

coyote	*Canis latrans*
red-backed vole	*Clethrinomys gapperi*
cougar	*Felis concolor*
marmot	*Marmota flaviventris*
striped skunk	*Mephitis mephitis*
prairie vole	*Microtus ochragaster*
meadow vole	*M. pennsylvanicus*
long-tailed vole	*M. longicaudis*
house mouse	*Mus musculus*
long-tailed weasle	*Mustela frenata*
Mexican woodrat	*Neotoma mexicana*

mule deer	*Odocoileus hemionus*
deer mouse	*Peramyscus maniculatus*
rock mouse	*P. nasutus*
western harvest mouse	*Reithrodontomys megalotis*
Abert's squirrel	*Sciurus aberti*
fox squirrel	*S. niger*
rock squirrel	*S. variegatus*
masked Shrew	*Sorex cinereus*
eastern cottontail	*Sylvilagus floridanus*
least chipmunk	*Tamias minimus*
red squirrel	*Tamiasciurus husdonicus*
gray fox	*Urocyon cinereoargenteus*
American black bear	*Ursus americanus*
red fox	*Vulpes vulpes*
Preble's meadow jumping mouse	*Zapus hudsonius preblei*
western jumping mouse	*Z. princeps*

C. Other

eastern fence lizards	*Sceloporus undulatus*
blue grouse	*Dendragapus obscurus*

Table 10. UTMs and species captured for all sampled sites in Boulder Mountain Parks, 1999-2001.

Site Name	UTMs	species captured	comments
Enchanted Mesa E (low elevation Forest Stand 5-5)	13S0476013E/4426443N 13S0475968E /4426581N	Pema, Pena, Scab	1999
Enchanted Mesa W (low elevation Forest Stand 5-3)	13S0476052E/4426477N 13S0476075E/4426657N	Pema, Pena, Mioc, Scab	1999 (fox squirrel)
Coyote Gulch (hillside)	13S0476064E/4426400N 13S0476145E/4426652N	Pema, Pena, Mioc, Neme, Reme	1999
Coyote Gulch	13S0476205E/4426598N 13S0476255E/4426705N	Pema, pena, Mioc, Mipe, Neme	1999
Koehler Mesa (S. hillside) (CSFS 23)	13S0475665E/4425901N 13S0475924E/4425965N	Pema, Pena, Neme, Mipe, Mioc	1999
Skunk Canyon	13S0476069E/4425934N 13S0475629E/4425243N	Pema, mioc, mipe, milo	2000, 2001
Skunk Canyon-S xs	13S0475645E/4425356N 13S0475902E/4425291N	Pema, Pena	2001
Skunk Canyon-N xs	13S0475703E/4425639N 13S0475966E/4425562N	PemaPena, Tami	2001
Lower Bear Creek (unnamed bird point)	13S0476037E/4424806N 13S0476851E/4424602N	Zahu, Pema, Pena, Mioc, Mipe, Soci	2000
Middle Bear Creek (unamed bird point)	13S0473715E/4424783N 13S0474484E/4424174N	Zahu, Pema, Pena	2001 (tahu)
Upper Bear Creek (unnamed bird point and unnamed wetland point)	13S0473229E/4425501N 13S0473571E/4424953N	Zahu, Pema, Pena, Milo, Mipe, Soci	2000 (tahu)
Shadow Canyon	13S0477583E/4421057N 13S0475900E/4421322N	Pema, Pena, Neme, Tahu	2001 (rock squirrle)
Aspen Canyon	13S0473162E/4423450N 13S0473805E/4423325N	Zahu, Pema, Pena, Tahu	2001
Chapman Rd Gulch	13S0472678E/4427927N 13S0473590E/4427355N	Pema, Pena, Neme, Milo	2001 (tahu)

Long Canyon (bird point; GrCa08-Cruz Lab; riparian point= 2000PC 700)	13S0473727E/4427177N 13S0473441E/4426461N	Zahu, Pema, Neme, Milo, Soci	2000, 2001 (long-tailed weasle)
Panther Canyon (Riparian Pt. PC400UL)	13S0473441E/4426461N 13S0473826E/4426094N	Zahu, Pema, Neme	2001 (marmot, tahul)
Gregory Canyon (unnamed bird point and riparian point--GrC2)	13S0475285E/4427289N 13S0474497E/4427325N	Zahu, Pema, Pena, Mioc, Mipe, Milo,Neme, Reme, Soci	1999, 2000
Gregory Canyon E xs	13S0474836E/4427540N 13S0474869E/4427013N	Pema,Pena, Mioc, Mipe, Reme, Tahu	1999
Gregory Canyon W xs	13S0474739E/4426871N 13S0474613E/4427782N	Pema, Pena, Neme, Tami, Tahu	2000)
Anemone Ridge (low elevation Forest Stand 1-9)	13S0473052E/4429041N 13S0473019E/4429377N	Pema	1999
Boulder Canyon-S. slope(low elevation Forest Stand 1-9)	13S0473819E/4429535N 13S0473997E/4429550N	Pena, Reme, Spla	1999

tami = Tamais minimus
spla = Spermophilus lateralis
scab = Sciurus aberti
tahu = Tamiasciurus husdonicus
reme = Reithrodontomys megalotis
pema = Peromyscus maniculatus

pena = P. nasutus
neme = Neotoma mexicana
mipe = Microtus pennsylvanicus
mioc = M. ochragaster
milo = M. longicaudis
zapus = Zapus hudsonius

soci = Sorex cinereus

Datum = NAD 27

Plate 1: Shadow Canyon

Plate 2 Long Canyon

Plate 3: Panther Canyon

Plate 4: Aspen Canyon

Plate 5: Middle Bear Canyon

Plate 6: Middle Bear

Plate 7: Skunk

Plate 8: Chapman Road Gulch

Plate 9: Bear Damaged Trap

Plate 10 Repairing Bear Damaged Traps

Plate 11: Mexican Woodrat (marked red on venter)

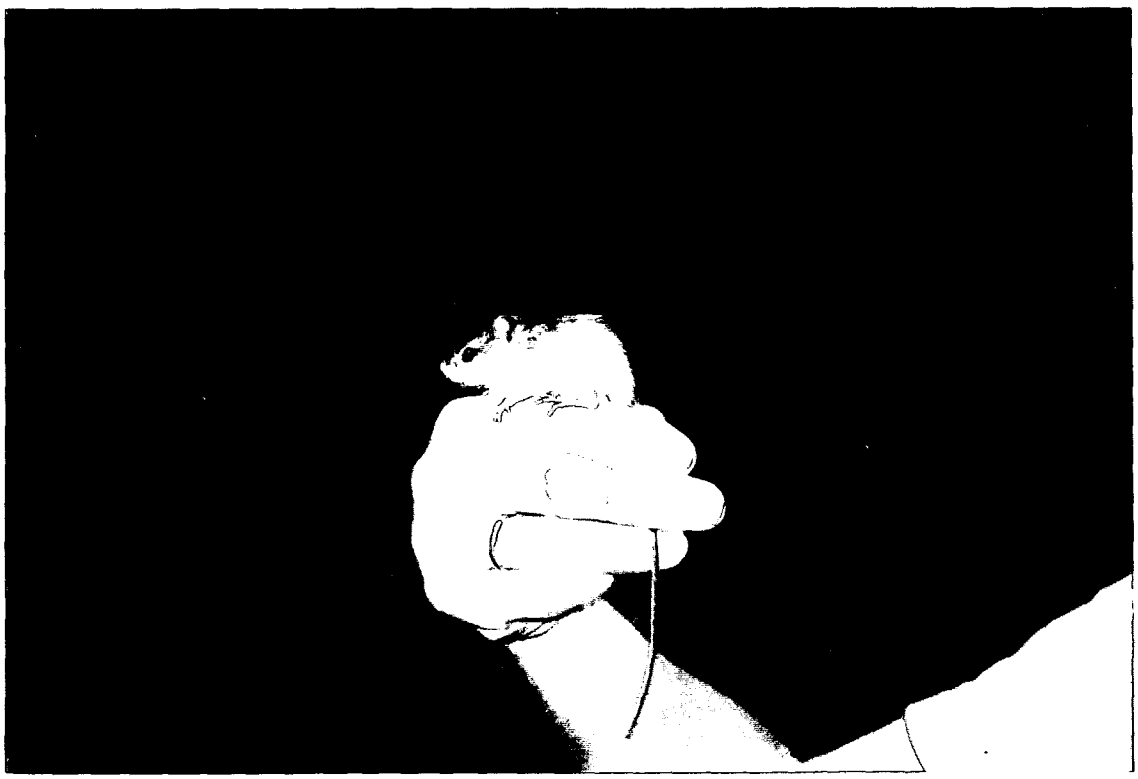

Plate 12 Preble's Meadow Jumping Mouse

Plate 13: Bear Scat

Plae 14: Wood Lily

Appendix A

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 complied from Armstrong (1972), Fitzgerald et al. (1994), 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. Masked Shrew (*Sorex cinereus*)

Although similar in size to some rodents, the evolutionary history, pointed snout, and diet of the masked shrew sets it apart in the order Insectivora. Their paws have 5 fingers (most rodents have 4), and their ears are covered and concealed by fur.

The masked shrew may be found in the same general mountain distributions as the montane shrew (*S. monticolus*), but has a slightly lighter color and is more common on the eastern side of the Continental Divide and in the lower foothills. It occurs in moist habitats within the montane and subalpine forests. It has a particularly strong affiliation with moist montane meadows and meadow-forest ecotones (Armstrong 1977). Stands of willows with a mesic under story of rank forbs are also a common area of occurrence.

This insectivore also consumes other invertebrates such as earthworms and arachnids, in amounts up to several times its 3-6 g body weight in a 24 hour period. It breeds several times a year from March to October.

2. 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.

3. 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.

4. 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, in the ephemeral drainage on the south-facing slope in Boulder Canyon 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.

5. 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 construct 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)*

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 mouse *(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.

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

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)*

The long-tailed vole is very similar in appearance to meadow voles (M. pennsylvanicus), but is relatively small bodied and has a tail greater than one-third the length of the head and body. They are most often associated with marshy to dry grassy areas adjacent to water in the mountainous parts of the state (Fitzgerald et al. 1994). Long-tailed voles are in sympatry with the meadow vole and the montane vole (*M. montanus*) throughout the central and southern Rocky Mountains, including locations in Colorado (Hoffmann and Koeppl 1985). Long-tailed voles are distributed throughout the western two thirds of Colorado. They may be poor competitors with montane and meadow voles, and so may not occur in the same microhabitats. But they have a wide ecological tolerance, and can be found from the alpine tundra, down through subalpine meadows and forests, and in montane riparian willows similar to those found our trapping sites in Boulder Mountain Parks.

As with all other arvicolines, long-tailed voles feed on green vegetation, but also include fruits and seeds in their diet. They are active both day and night, but do not make well-defined runways. Their nests of grass and stems of forbs are located underground or under surface litter. Locally high populations have been reported in the literature (up to 120 per hectare), but 10 to twenty animals are probably average for populations not undergoing large cycles (Smollen and Keller 1987).

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 congenerics. 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))*

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 (63 FR 26517). 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.

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).

Appendix B

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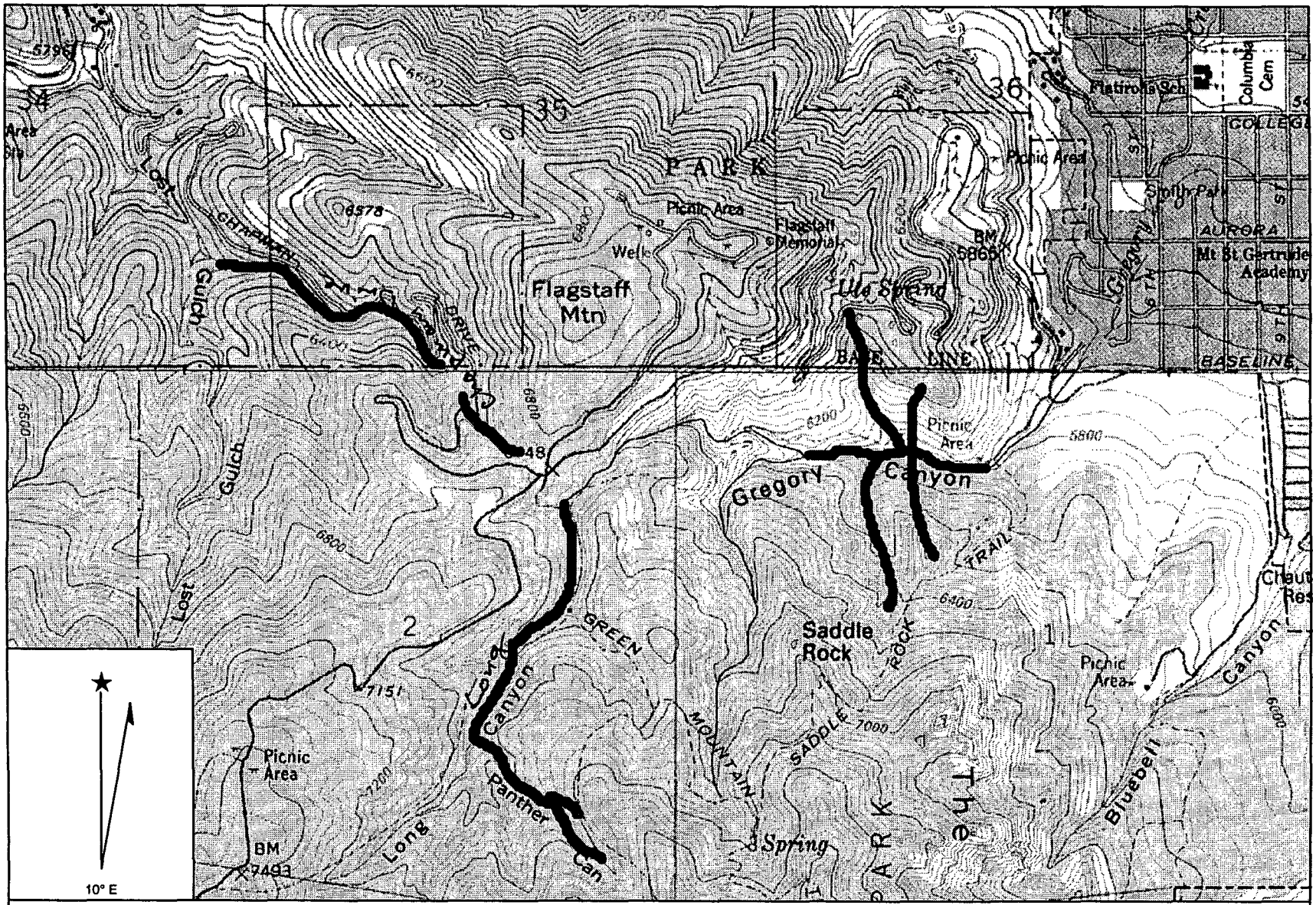
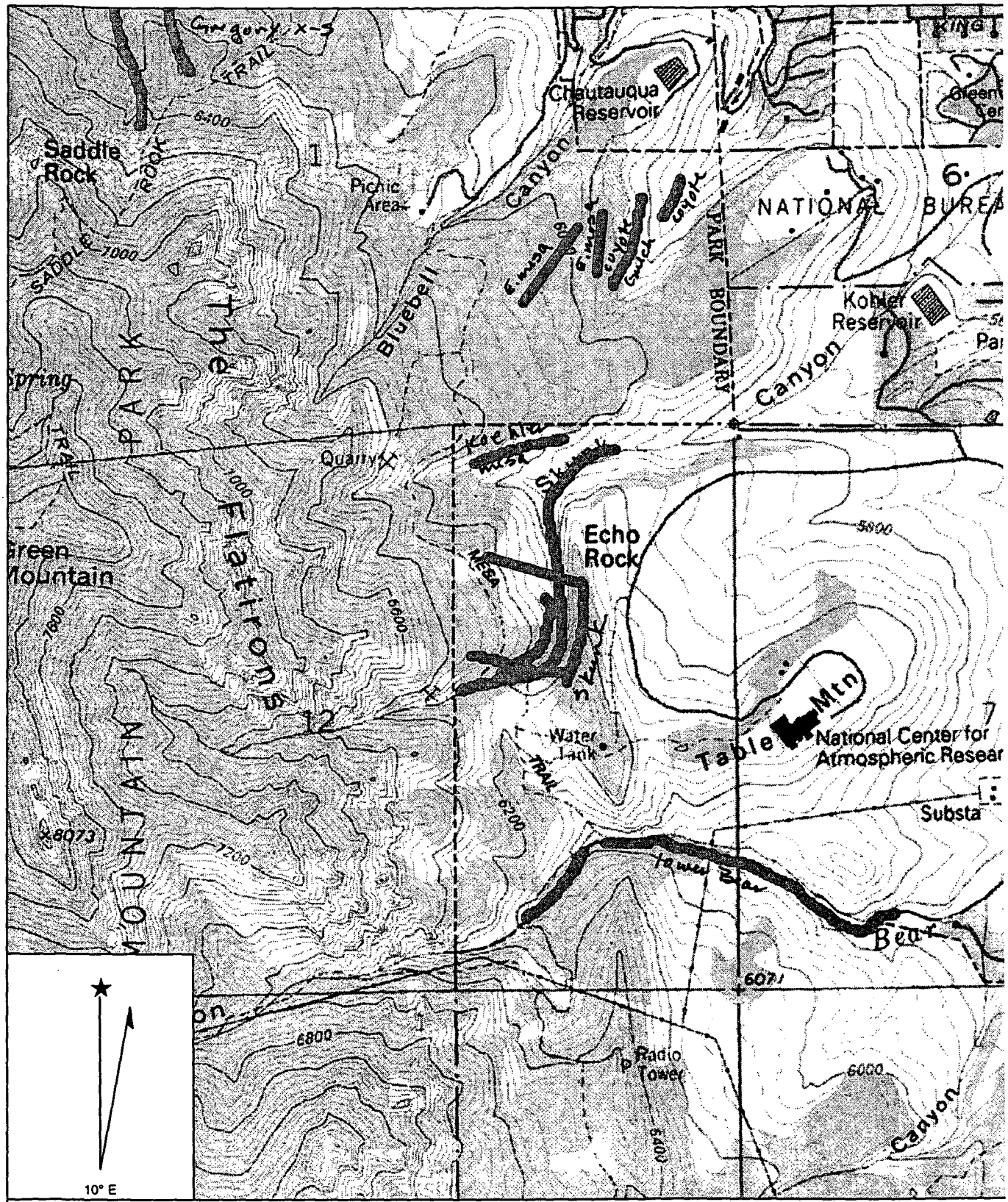


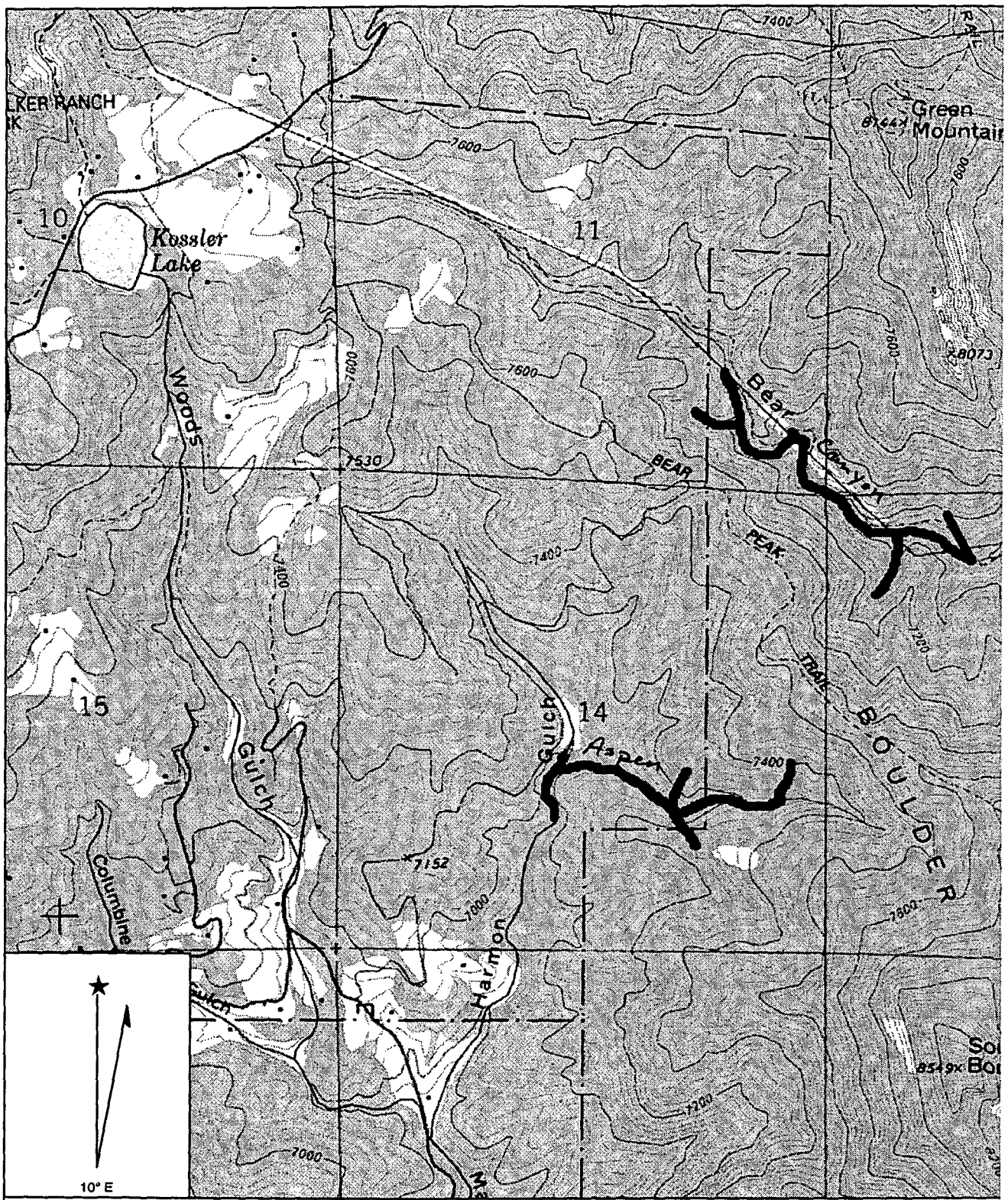
Name: ELDORADO SPRINGS
Date: 8/10/2001
Scale: 1 inch equals 1250 feet

Location: 13 474021 E 4427348 N
Caption: Long/Panther, Chapman (Lost Gulch), Gregory OSMP



Name: ELDORADO SPRINGS
Date: 8/10/2001
Scale: 1 inch equals 1142 feet

Location: 13 475761 E 4425496 N
Caption: Skunk Canyon, Koehler Mesa hillside, Enchanted Mesa, Coyote gulch, lower Bear Creek
OSMP

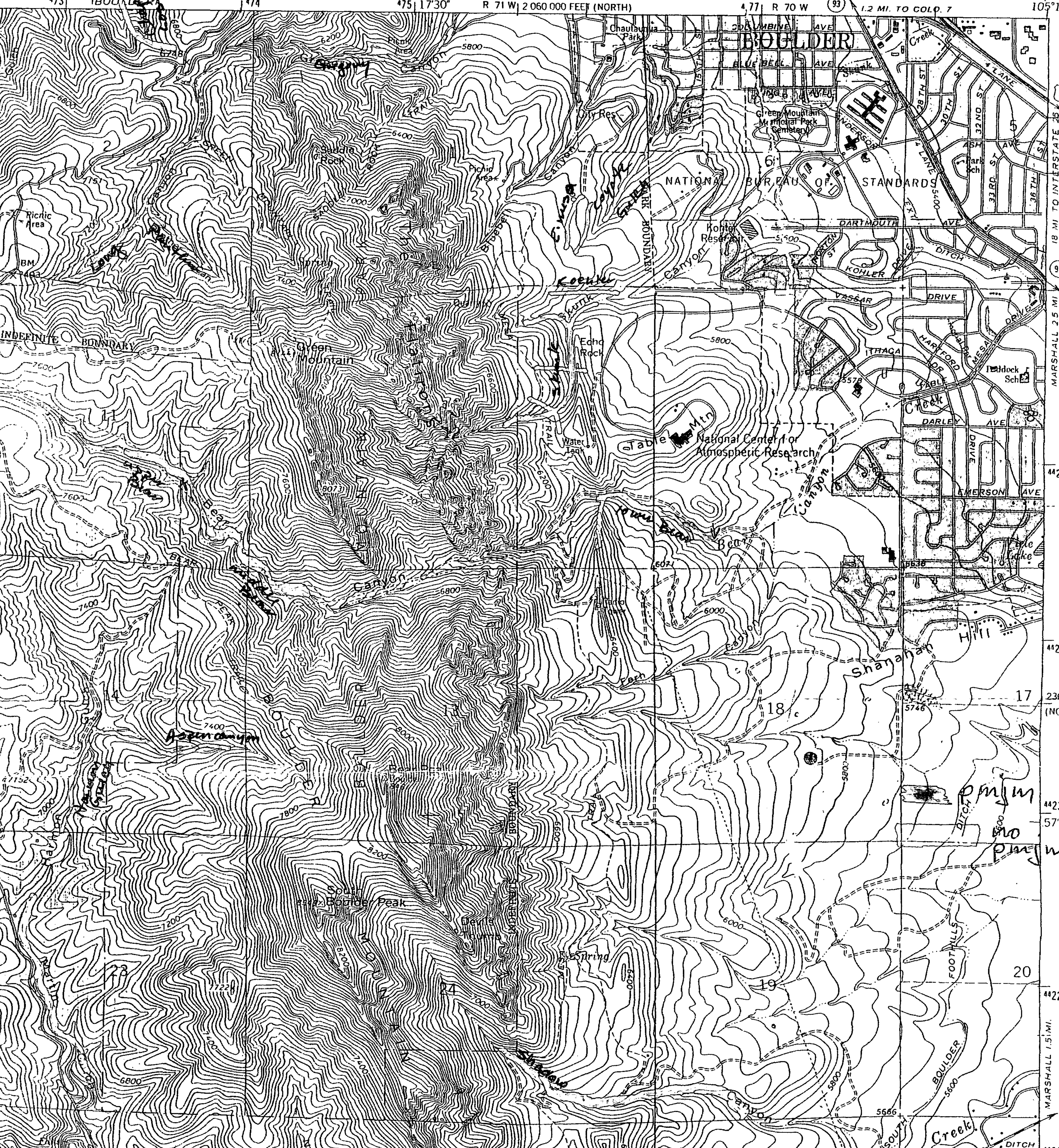


Name: ELDORADO SPRINGS
Date: 8/10/2001
Scale: 1 inch equals 1333 feet

Location: 13 472994 E 4424014 N
Caption: Aspen Upper Bear Canyons
OSMP
Summer 2001

NTY REGIONAL PLANNING COMMISSION

ELDORADO SPRINGS QUADRANGLE
COLORADO
7.5 MINUTE SERIES (TOPOGRAPHIC)



Zapus hudsonius preblei, Preble's Meadow Jumping Mouse

Aspen

Survey Field Data Compilation Form

Z. h. *preblei* found ? Yes X No O Dates of Survey ~~24~~ June – 29 June 01

Surveyor:

Organization/Company meaney & Co.

Full Name(s) Anne Ruggles, Norm Cuppingen, Lauren Whitmore, Collin Ahrens, Caroline Sudbay, Christine Ruggles

Location:

Descriptive Site Name (creek, nearby road intersection, etc.) Aspen Canyon @ Harmon Gulch U.S.G.S. Quad Name Dovadospgs

County Boulder Elevation 4046ft (12133m)

Top of Trapline
13 S 0481903
442 4203
7265ft (2216m)

1/4 1/4 Section(s) NE1/4 of SE1/4 Township(s) 1N Range(s) 71W

UTM Coordinates. Zone 13 Northing 0473158 Easting 4423289

Directions to Location Flagstaff Rd. W to Bison Rd (Aspen Canyon flows into Harmon Gulch @ Bison Rd) So. Tow on Ethel Harrold Picnic Area.

Land Ownership City of Boulder Openspace Mountain Parks

Habitat:

General Habitat Description Aspen/birch/pyrola/twisted stalk, raspberry, wildflowers & bush honeysuckle, 9-bark, Alder, cow parsnip, horsetails, Bracken, violets, woodlily } Riparian

Dominant Plant Community narrow riparian corridor in N-facing canyon – uplands are Ponderosa Pine dominated

Drainage Type: Perennial Stream X Ephemeral Stream _____ Pond/Lake _____ Ditch _____

Other _____

Trapping Information:

Type of Traps Sherman Live Type of Bait Sweet Feed % Available (unsprung) 64% Number of Nights Trapped 4 Total Trapnights 1204 (A bear tore apart most of 2 lines the last night)

Weather conditions prior to and during survey lows mid-40's / highs 80's 2nd night w/ hard rain & hail Associated Animal Species (especially urban predators, rats, house mice) deer mice, rock mice in uplands, Red squirrel

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

Preble's Data:

Number of Preble's trapped or seen 1

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

1. 6m ♀ † nipples visible 19g not marked permanently
2.
3.
4.

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 _____

SUBMIT THIS FIELD DATA FORM WITH THE SURVEY REPORT

Zapus hudsonius preblei Injury/Mortality Documentation

_____ Found dead

_____ Found severely injured, euthanized

_____ Slightly injured, returned to wild

_____ Died during handling

photo - over →

Date/Time: _____

Location: _____

Weather Conditions: _____

Approximate Time Trap Set: _____

Time Trap Checked: _____

Field Technician(s) Present: _____

Information:

Species: _____

PIT TAG Number: _____

-Weight (g): _____

Total Body Length (mm): _____

Tail Length (mm): _____

Hindfoot Length (mm): N/A

Ear Length (mm): _____

Sex: _____

Reproductive Condition(s): _____

Description of Injury: _____

Details of Probable Reasons for Injury or Mortality: _____

Signature of Technician(s): Anne K. Ruggles

Zapus hudsonius preblei, Preble's Meadow Jumping Mouse

Survey Field Data Compilation Form

Long/ Panther

Z. h. preblei found? Yes X No O Dates of Survey 11 June – 15 June

Surveyor:

Organization/Company Meaney & Co.

Full Name(s) Anne Ruggles, Norm Clippinger, Lauren Whitemore, Collin Ahrens, Amy Schwantz

Location:

Descriptive Site Name (creek, nearby road intersection, etc.) Long Canyon U.S.G.S. Quad Name El Dorado Springs County Boulder Elevation 6861 ft. (2091 m)

1/4 1/4 Section(s) NW 1/4 of SE 1/4 Township(s) 1S Range(s) 71W

UTM Coordinates. Zone 13 Northing 0473455 Easting 4426454

Directions to Location W on Baseline to Flagstaff Rd. West to trailhead for Long canyon

Land Ownership City of Boulder Open Space Mountain Parks

Habitat:

General Habitat Description montane Riparian

Dominant Plant Community Alder - Birch - Beaked Hazelnut / violets, false solomon seal, shooting star, cow parsnip, Phacelia / Raspberry, Rose, snowberry

Drainage Type: Perennial Stream X (2-3ft across) Ephemeral Stream _____ Pond/Lake _____ Ditch _____

Other _____

Trapping Information:

Type of Traps Sherman / live Type of Bait sweet home feed % Available (unsprung) 95% Number of Nights Trapped 4 Total Trapnights 1017

Weather conditions prior to and during survey First 2 nights Rainy, windy & cool (40°) then seasonable Associated Animal Species (especially urban predators, rats, house mice) no exotics. Also captured: Peromyscus maniculatus & neotoma mexicana

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

see attached

Preble's Data:

Number of Preble's trapped or seen 1

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

1. at creek's edge / ♀ / 20g / no evidence of reproduction / not marked permanently

2.

3.

4.

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 _____

(SUBMIT THIS FIELD DATA FORM WITH THE SURVEY REPORT)

Zapus hudsonius preblei Injury/Mortality Documentation

_____ Found dead

_____ Found severely injured, euthanized

_____ Slightly injured, returned to wild

_____ Died during handling

NA

Date/Time: _____

Location: _____

Weather Conditions: _____

Approximate Time Trap Set: _____

Time Trap Checked: _____

Field Technician(s) Present: _____

Information:

Species: _____

PIT TAG Number: _____

-Weight (g): _____

Total Body Length (mm): _____

Tail Length (mm): _____

Hindfoot Length (mm): _____

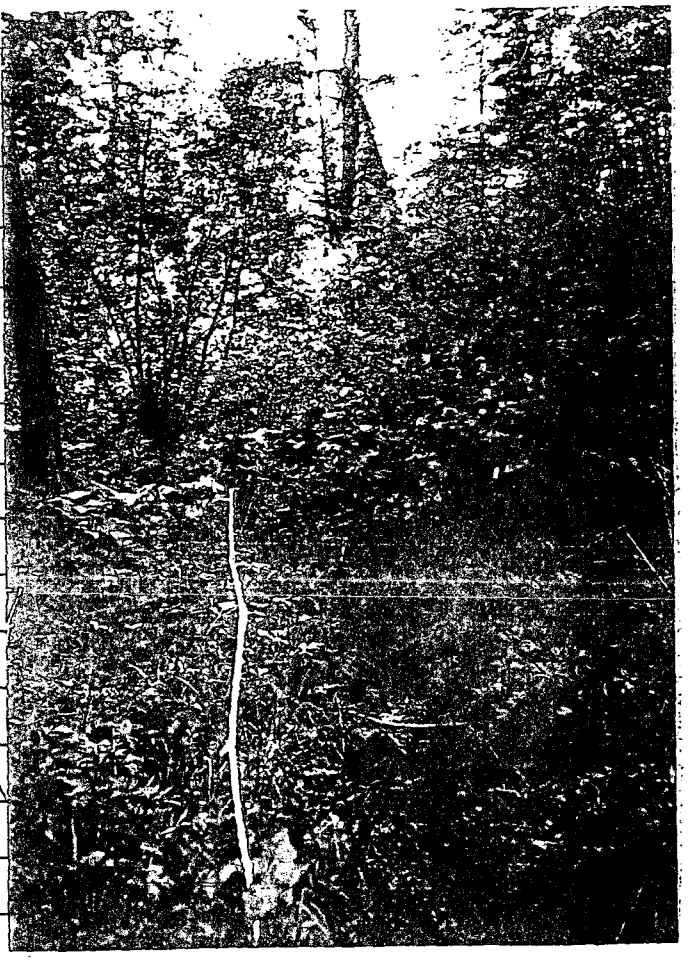
Ear Length (mm): _____

Sex: _____

Reproductive Condition(s): _____

Description of Injury: _____

Details of Probable Reasons for Injury or Mortality: _____

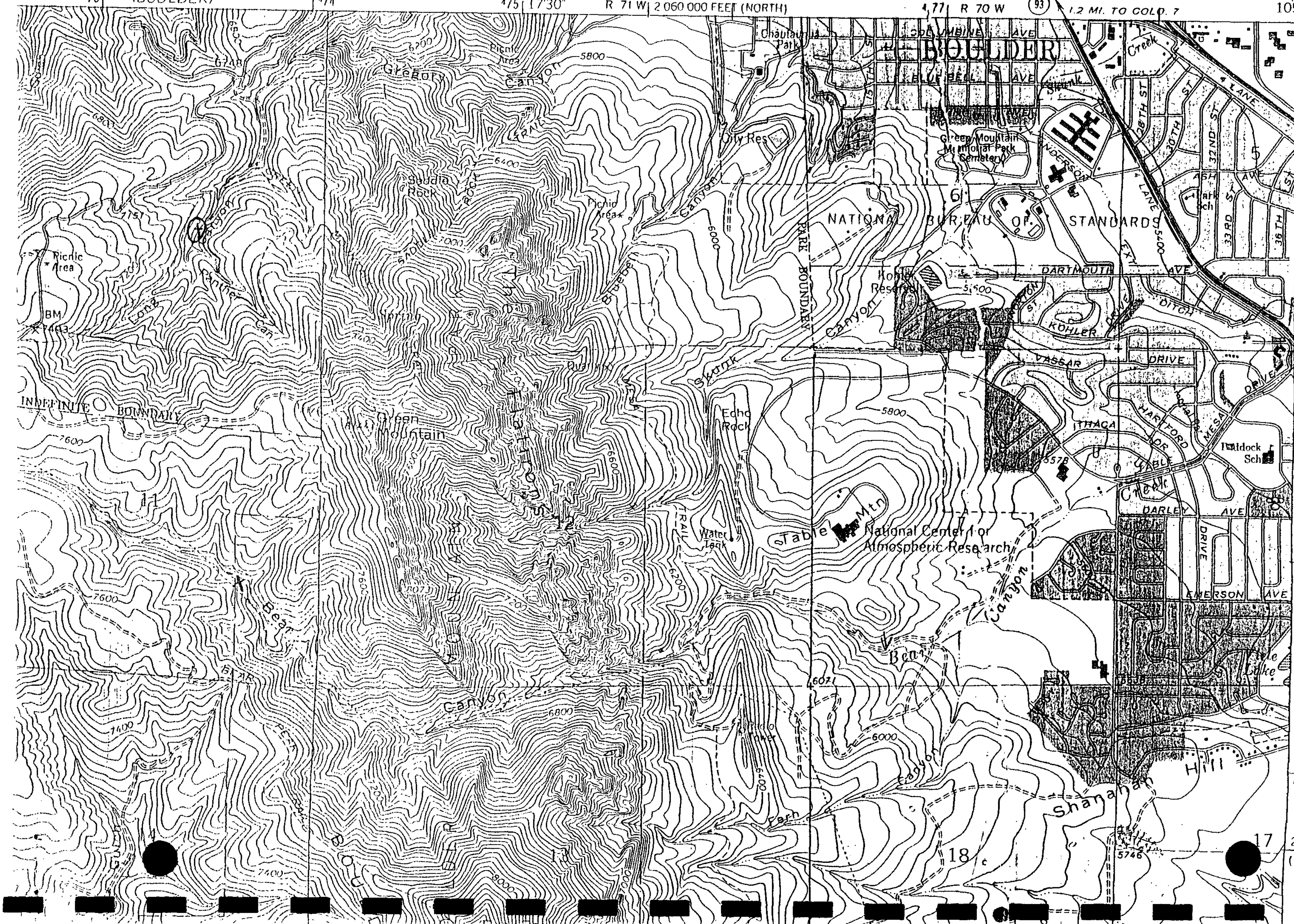


Trap location

Signature of Technician(s): Anne K. Ruggles

INTY REGIONAL PLANNING COMMISSION

ELDORADO SPRINGS QUADRANGLE
COLORADO
7.5 MINUTE SERIES (TOPOGRAPHIC)



Zapus hudsonius preblei, Preble's Meadow Jumping Mouse

Survey Field Data Compilation Form

Bear

Z. h. preblei found ? Yes X No O Dates of Survey 16-20 July 01

Surveyor:

Organization/Company meaney & Co.

Full Name(s) Anne Ruggles, Norm Clippinger, Lauren Whitmore, Collin Ahrens, Christine Ruggles

Location:

Descriptive Site Name (creek, nearby road intersection, etc.) upper Bear Canyon U.S.G.S. Quad Name El Dorado Springs County Boulder Elevation 7290

1/4 1/4 Section(s) SE 1/4 of SW 1/4 Township(s) 1S Range(s) 71W

UTM Coordinates. Zone 13 Northing 473789 Easting 4429634

Directions to Location Boulder mtn. Parks - on trail system. start @ Intersection of Bear Canyon & Green mtn. - West Ridge - Go Downstream

Land Ownership Open Space Mtn. Parks of Boulder

Habitat:

General Habitat Description Riparian - mtn.

Dominant Plant Community Birch, Aspen, Rose, snowberry, willow, choke cherry, nine bark, lovage, Jamesea, violet, twisted stalk, maple, raspberry, graminoid

Drainage Type: Perennial Stream X Ephemeral Stream _____ Pond/Lake _____ Ditch _____

Other _____

Trapping Information:

Type of Traps Sherman Live Type of Bait Sweet feed % Available (unsprung) 97% Number of Nights Trapped 4 Total Trapnights 1120

Weather conditions prior to and during survey to 90's during day / 50's @ night / rain one night

Associated Animal Species (especially urban predators, rats, house mice) deer mice, rock mice

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

Preble's Data:

Number of Preble's trapped or seen 5

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

1. ~10m ♀ pregnant 21g, 23g, 24g, 26g not marked permanently
2. ~10m ♀ pregnant 22g, 27g, 28g "
3. ~10m ♂ disembedded testes 19g "
4. ~10m ♂ " 22g "

Evidence of disease, predation or injury NO

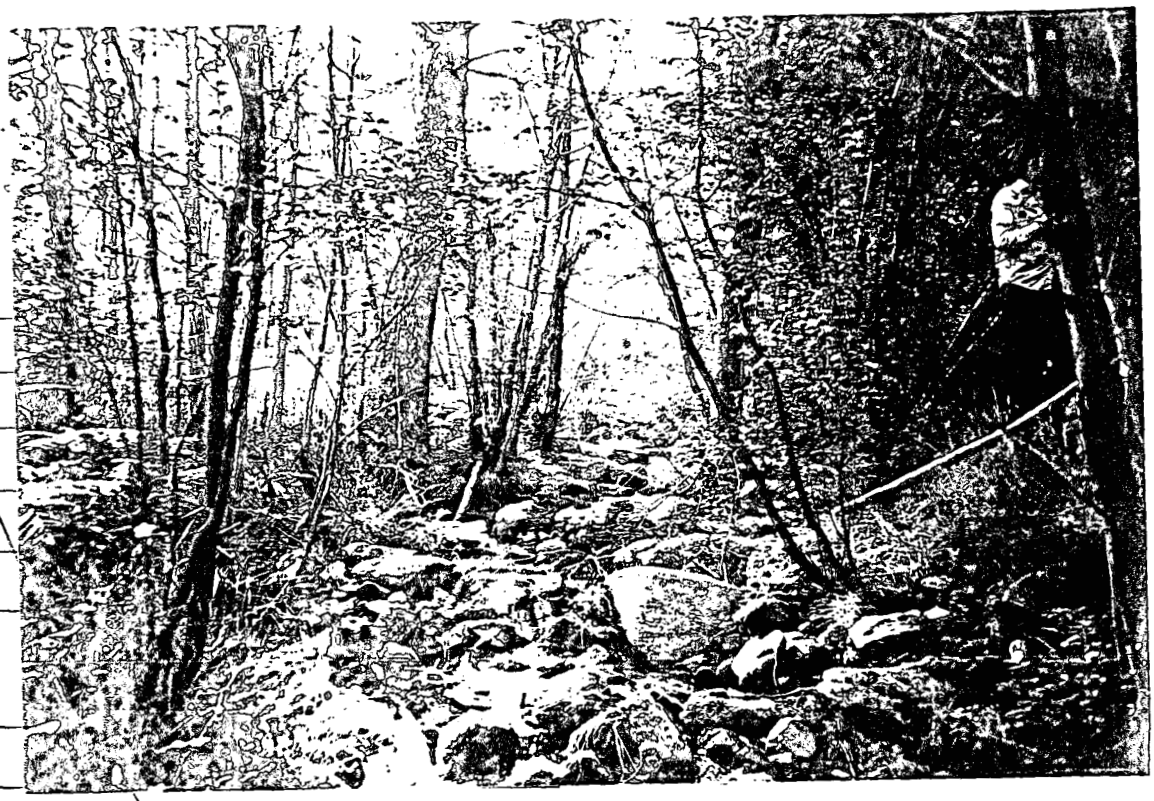
(Submit injury/mortality form if appropriate)

Genetic Material Obtained? Yes X No _____ Forwarded to hair samples taken - held

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

SUBMIT THIS FIELD DATA FORM WITH THE SURVEY REPORT

Zapus hudsonius preblei Injury/Mortality Documentation



_____ Found dead

_____ Found severely injured.

_____ Slightly injured, returne

_____ Died during handling

Date/Time: _____

Location: _____

Weather Conditions: _____

Approximate Time Trap Set: _____

Time Trap Checked: _____

Field Technician(s) Present: _____

Information:

Species: _____

PIT TAG Number: _____

-Weight (g): _____

Total Body Length (mm): _____

Tail Length (mm): _____

Hindfoot Length (mm): _____

Ear Length (mm): _____

Sex: _____

Reproductive Condition(s): _____

Description of Injury: _____

Details of Probable Reasons for Injury or Mortality: _____

Signature of Technician(s): Anne K. Ruggles

NTY REGIONAL PLANNING COMMISSION

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