HIBERNACULA LOCATION

FOR

PREBLE'S MEADOW JUMPING MICE

ON

CITY OF BOULDER OPEN SPACE AND MOUNTAIN PARKS

16 DECEMBER 2003

INTERIM REPORT SUBMITTED BY:

Bear Canyon Consulting, LLC

3351 Sentinel Dr.
Boulder, CO 80301
(303) 449-8001

Anne K. Ruggles
Lauren S. Whittemore
Melissa Reed-Eckert
Amanda Smith

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Bear Canyon Consulting, LLC

Contact:Lauren Whittemore
email: ljschneider@webacces.net

Contact: Anne K. Ruggles
email: aruggles@igc.org

PROJECT DESCRIPTION

City of Boulder Open Space and Mountain Parks (OSMP) has done an excellent job of identifying and protecting active season habitat of Preble's meadow jumping mice (*Zapus hudsonius preblei*) along South Boulder Creek. OSMP has, through research and adaptive management, developed a management plan that enables a threatened species to flourish, the public to recreate, and agriculture to persist. However, little is known about hibernacula of jumping mice either generally or along South Boulder Creek. Since Preble's hibernate up to seven months of the year (Whitaker 1972), hibernacula requirements may prove to be a significant factor limiting distribution and persistence of populations. This project is designed to identify and describe hibernacula along South Boulder Creek so that OSMP can manage habitat used by Preble's during hibernation as well as during the active season. Additionally this information may be useful throughout the species' range for predicting occurrence, preventing habitat degradation, and in aiding habitat restoration.

PREBLE'S MEADOW JUMPING MOUSE

The Preble's meadow jumping mouse (Preble's) was listed as threatened under the Endangered Species Act on May 13, 1998 (63 FR 26517). It is a sub-species 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) though it once had a wider distribution in the tallgrass prairie across the eastern plains of Colorado and Wyoming (Fitzgerald et al. 1994).

The preferred habitat of the Preble's meadow jumping mouse consists of drainages with well-developed vegetation characterized by high plant species richness and structural diversity (Bakeman 1997, Clippinger 2002). Such areas include feeding and daybed sites consisting of grassland communities with adjacent dense riparian shrubs (Choate et al. 1991, Tester et al. 1993). The riparian corridor not only supports necessary plant communities but also serves as a route of movement (Choate et al. 1991; Tester et al. 1993).

Little is known about hibernation habitat in Colorado as there are only one definite and 14 possible hibernacula known from Colorado (USFWS 2003).

STUDY AREA

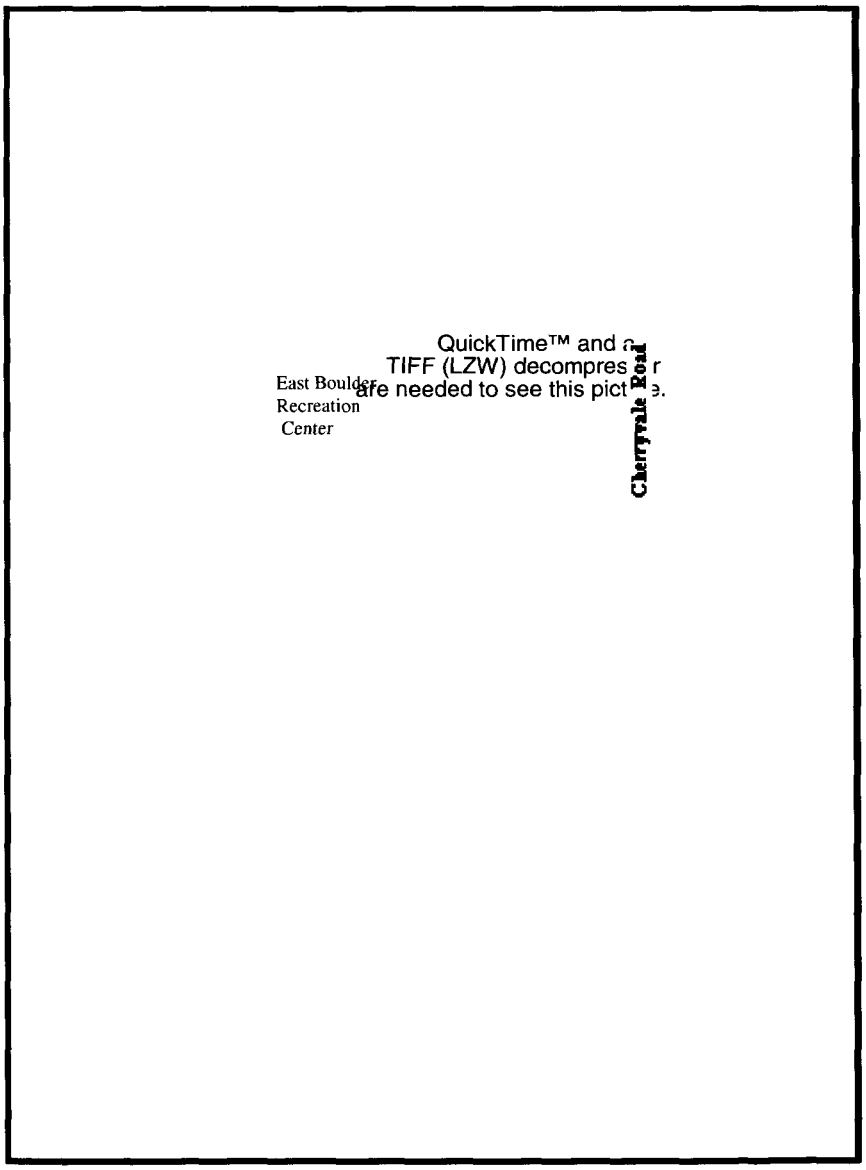
The study area is located in Boulder County, and is bounded by Baseline Road, South Boulder Road, Cherryvale Road and South Boulder Creek (Fig. 1). The study area includes the Burke and Gebhard properties which are located in the W. 1/2 of S. 3, T. 1 S., R 70 W. of the 6th Principle Meridian. The area is managed by the City of Boulder Open Space and Mountain Parks as wildlife habitat and for recreation and agricultural use. The state of Colorado recently designated a 486 ha (1,200 acre) parcel of City of Boulder open space along South Boulder Creek as a State Natural Area. The study area falls within the bounds of the State Natural Area. In the study area, South Boulder Creek forms a broad floodplain that is characterized by grasslands and wet meadows adjacent to a cottonwood and willow riparian corridor. Biking and hiking trails follow the course of the creek throughout the study area and several diversion ditches and laterals cross the area.

A large population of jumping mice occupies South Boulder Creek. Between Eldorado Springs and Baseline Road there is a mean linear density of 34.5 ± 4.1 jumping mice/km (Meaney, Ruggles, et al. 2003). Enterprise Ditch and East Boulder Ditch have higher density estimates of 116 jumping mice/ linear km and 53 jumping mice/ linear km respectively (Meaney, Ruggles, et al. 1999 and 2003).

HIBERNATION

Jumping mice are deep hibernators – they maintain a body temperature of about 5°C for periods of days to weeks (Lyman et al. 1982, Waters et al. 1965) and they remain in hibernation, in the Colorado Piedmont, for 7-8 months (Meaney et al. 2003). Most of the possible known Preble's hibernacula in Colorado are located in El Paso and Douglas Counties. One is from Rocky Flats in Boulder County. All 15 have all been found in dense shrubs, and with one exception, within 100m of a creek bed (USFWS 2003).

Figure 1. Study Area.



Hibernation is an important and critical period for Preble's (Wunder and Harrington 1996; Meaney et al. 2003). On South Boulder Creek total active time, from date of first animal trapped in spring to date of last animal trapped in fall, was 150 days in 1999 (Meaney et al. 2003). This is 12 days less than the average reported for two years by Muchlinski (1988). By remaining in hibernacula for seven months Preble's avoid predation and injury and escape the period when forage and cover are least abundant. Thus hibernacula requirements may be a significant limiting factor in the distribution and persistence of Preble's populations.

Pre-hibernation fattening occurs in the two to three weeks prior to hibernation (Wunder and Harrington 1996). Adults appear to enter hibernation prior to young of the year and males precede females (Quimby 1951, Muchlinski 1988; Meaney et al. 2003), presumably because females must recover from having borne and nursed offspring.

Young born in early litters have higher over-winter survival than late litters (Muchlinski 1988). Early litter individuals generally attain adult weights by late September and have been reported to enter hibernation by mid-September, whereas late-litter juveniles were the last to enter hibernation – late September to mid-October (Muchlinski 1988).

In work carried out along East Boulder Ditch in 1998 and 1999 Meaney, Ruggles, et al. (2003) found that adults appeared to enter hibernation from mid-August to early September, with males entering first, followed by females. By the third week in August both male and female adults were reaching weights that would enable them to enter hibernation. Sub-adults born late in the year (August) require additional time to gain the weight necessary to enter hibernation, and were still active through September and into mid-October (Meaney, Ruggles, et al. 2003). Clearly, litters born the third week in August (two of these were documented) would have a difficult time attaining sufficient weight for successful hibernation.[1]

Muchlinski (1980) found that *Z. h. preblei* kept in a laboratory under short day length and cold temperatures, short day length and warm temperatures, or decreasing photoperiod alone, and attaining at least 25g, subsequently entered hibernation. Meaney

[1] Though data from 2003 indicate that late litter individuals can attain hibernation weight.

et al (2003) found that males weighing > 27g were seldom recaptured and thus could be presumed to have entered hibernation. Likewise females weighing > 25g were seldom recaptured and were also presumed to have entered hibernation. In work completed on Rocky Flats, a radio-collared male weighed 27g when last captured and 2 days later entered hibernation (T. Ryon, personal communication).

During one year of investigation, emergence along South Boulder Creek occurred in late May (Meaney et al 2003). Muchlinski (1988) found that emergence was tied to soil temperatures at 20-, 50-, and 100-cm depths.

Most hibernation sites are located underground (Whitaker 1972; Krutzsch 1954) thus soil characteristics including composition, texture, depth, permeability, and moisture are likely to influence the ability of an animal to burrow and survive hibernation (Fitzgerald et al. 1994). Soil porosity and permeability directly influence potential subsurface water content and resultant mortality due to exposure (Davidson, et al. 1997). Early researchers identified wet soils as a liability to hibernating jumping mice (Sheldon 1934). Soil structural stability is an indirect measure of the potential for collapse of hibernacula due to soil disaggregation by water and fissuring resulting from shrinking and swelling of the soil (Burke et al. 1986). Slope and slope curvature influence hydrology and sediment sorting in soil (Hall et al. 1991) which in turn will effect digging (Fitzgerald et al. 1994) and hibernation success. In western jumping mice *(Zapus princeps)* chamber temperatures of hibernacula at greater depths were found to be higher than shallower hibernacula (Cranford et al. 1978). Slope aspect and consequent insolation influences soil temperature and hibernation timing in the western jumping mouse (Cranford et al. 1978).

METHODS

CAPTURING, MARKING, AND MONITORING

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 for trapping. Polyester batting (for nesting material) 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. From mid-August through mid-November ≈ 600m of South Boulder Creek north of

the bridge at the East Boulder Recreation Center and ≈ 375m along East Boulder Ditch, were trapped continuously. Traps were set at 5m intervals and were run until two weeks passed without any Preble's captures (Muchlinski 1988, Meaney et al. 2003) and traplines were adjusted or moved as necessary to maximize captures. The total number of traps set varied through the trapping period (Table 1).

Table 1. Number of Traps and Trap nights in the South Boulder Creek Study Area.

DATES	# NIGHTS	# TRAPS	# TRAP NIGHTS
5 August - 17 September	26	285	7410
22 September - 1 October	8	175	1400
2 - 4 October	3	150	450
5 - 19 October	10	125	1250
20 - 24 October	3	100	300
27 October – 21 November	15	80	1200

Captured Preble's were sexed, aged, and weighed to the nearest 0.1g to determine if hibernation was imminent. All other species were noted, marked with a non-permanent marker, and released. Female jumping mice that weighed at least 25 g and males that weighed at least 27 g were permanently marked with a Passive Integrated Transponder (PIT tag) (Schooly et al. 1993; Elbin and Burger 1994), collared, and released. Mice under those weights were marked with a non-permanent marker and released.

Animals meeting target weights were fitted with radio collars (Holohil systems BD-2C 0.80g transmitters that transmit for 21 days) without the use of anesthesia (Figure 2). Handling time averaged about five minutes from insertion of the PIT tag to completion of collaring. Animals were held in plastic boxes with dry grass bedding, food, and water until activity appeared normal at which time they were released at their capture site. Following release animals were located three times per week to estimate the date of hibernaculum entrance. Animal locations were triangulated during peak activity times (1900-2400 hrs).A set of three simkultaneous bearings were taken and entered, I the field, into Locate II. Once a mouse's position remained unchanged for 3 monitoring periods (minimum of 6 days), the animal was assumed to be hibernating, the hibernaculum was

located using modified telemetry equipment[2], and the location marked with a semi-permanent marker and a GPS unit.

Figure 2. Holding Preble's Meadow Jumping Mouse for Collaring.

[2] Using modified equipment the presumed hibernation site was carefully searched for a slipped collar. On two occasions a collar was located. If no collar was found, and the signal attenuated sharply when the Yaggi antenna was not pointed toward the ground, location of a hibernaculum was assumed.

HIBERNACULA CHARACTERISTICS

1. Vegetation

Microhabitat characteristics at each potential hibernaculum and at the last active location for each hibernating mouse were collected. Sites were assigned to one of 35 plant community types (Appendix A) following Meaney et al (2002). Vegetative characteristics within a 10 m diameter circle centered on the hibernaculum or on the telemetry location of the last active site were collected. Visual estimates of percent canopy cover of trees, shrubs, grasses, and forbs were made to the nearest 10% and plant species richness was assigned to one of three categories. (Appendix B).

2. Distance moved/distance from creek and trail

Of fourteen potential and one confirmed hibernacula in Colorado all were within 100m of the mainstem stream (USFWS 2003). We calculated distance from hibernacula to South Boulder Creek as well as the distance between each hibernaculum and the mouse's last active site and, the distance between the hibernaculum and the nearest trail.

3. Abiotic Site Characteristics

A detailed geologic map was prepared by Bob Crifasi, OSMP Water Resources Administrator, and 1.0 cm soil samples were taken at each hibernaculum site. Soil texture, classification, and geologic Unit were described for each sample. Aspect and slope were measured with a Brunton™ compass and height above the stream was determined. Throughout the hibernation season soil moisture and temperature will be measured at 10 cm intervals from the surface to 90 cm below the surface near each hibernaculum and at each last active site. Measurements will be made once a month, and 1 day and 5 days following a precipitation event.

RESULTS

Captures

Between August 5 and November 21, 2003 – two weeks after the last capture of a Preble's – we captured 1,874 animals over 12,010 trap nights (Table 2 & 3). Almost 80% of captures were deer mice *(Peromyscus maniculatus)* – a significant increase over deer

Table 2. Total Capture By Species – South Boulder Creek-N and East Boulder Ditch, Colorado, 5 August – 17 September 2003 and 1998, 1999, 2000.

Species	Total 2003	Species Proportion of Total 2003	1998 % Total	1999 % Total	2000 % Total
Microtus ochrogaster Prairie Vole	58 (35)[3]	0.069	0.064	0.102	0.003
Microtus pennsylvanicus Meadow Vole	22 (16)	0.028	0.203	0.330	0.045
Microtus spp. vole species	3	0.002	0.053	0.031	0.003
Mus musculus House Mouse	79 (37)	0.086	0.012	0.002	0.003
Neotoma mexicana Mexican woodrat	3	0.002	0.005	0.005	0.000
Peromyscus maniculatus Deer Mouse	544 (510)	0.785	0.345	0.389	0.489
Rattus norvigecus Norway Rat	3 (1)	0.003	0.00	0.001	0.000
Zapus hudsonius preblei Preble's Meadow Jumping Mouse	24 (8)	0.024 (0.094)[4]	0.316	0.139	0.435
Total captures	**1343**	**339**	**566**	**313**	
# trap nights	**7415**	**2660**	**4010**	**2000**	
Capture rate	**18.1%[5]**	**12.7%**	**14.1%**	**15.6%**	
Closed	**203**	**51**	**120**	**63**	
Mortalities	**12 (1)[6]**	**29 (1)**	**17 (2)**	**15 (2)**	

[3] Values in ( ) parentheses indicate recaptures
[4] pmjm capture rate 5 Aug-12 Nov 2003
[5] Total captures/trap nights (tn)
[6] mortalities 7 deer mice, 2 prairie voles, 1 meadow vole, 1 house mouse, 1 Preble's
∴ mortalities/trap night = 0.16%; mortalities/total captures = 0.9%.
[3] fleas and bot fly larvae found on < 5 deer mice and on no other animals

mouse captures in the same area in 1998, 1999, and 2000. House mouse *(Mus musculus)* captures also increased dramatically – 1.2% of captures ion 1998, 0.2% in 1999, 0.3% in 2000, and 8.6% of captures in 2003. Preble's comprised 9.4% of the capture in 2003, a decline from 31% in 1998, 13.9% in 1999, and 43.5% of capture in 2000. The total capture rate in 2003 was 15.6%. There were 31 mortalities of which 4 were Preble's – three trap mortalities and one animal taken by predators (Table 3).

Table 3. Captures and mortalities on South Boulder Creek and East Boulder Ditch, 5 August – 21 November 2003.

Total captures	1874
Trap nights	12,010
Total capture rate	15.6%
Total Preble's captures	177
% total captures = Preble's	9.44%
Preble's capture rate (pmjm/tn)	0.014
Total mortalities	31 (3 meadow voles, 5 prairie voles, 1 unknown voles, 1 house mouse, 5 deer mice, 4 Preble's – 1 was predation, 3 were trap mortalities).
Preble's mortalities/all captures:	0.001
All mortalities/all captures	0.016
Preble's mortalities/trap nights	0.0002
All mortalities/trap nights	0.002

Because there were so few Preble's captures in August and early September and West Nile Virus was rampant in the Front Range we sent 10 small mammals to the Division of Wildlife for testing for West Nile Virus. The results were all negative (Attachment A).

One hundred seventy seven captures were of Preble's. From August through mid-September most captures were of adults. After that date most captures were of young of the year (Figure 3). Meaney et al. (2003) developed a trend line that identifies animals as either adult or late season young-of-the-year (YOA) based on weight and date; weights above the trend line are adults or YOA born in late June or early July and weights below the trend line are young of the year born in August or September. We used this trend line to assign an age to all of our 2003 captures and compared the age of animals collared to all captures. Total captures of Preble's, with similar trapping effort at the same site, were skewed in 2003 compared to past trapping efforts (Table 4). Most captures in 2003 occurred after mid-September.

Figure 3. Adult and Late Born Young of the Year Preble's Meadow Jumping Mice, South Boulder Creek and East Boulder Ditch, 5 August – 21 November 2003. YOA are below the trend line and adults are above the trend line.

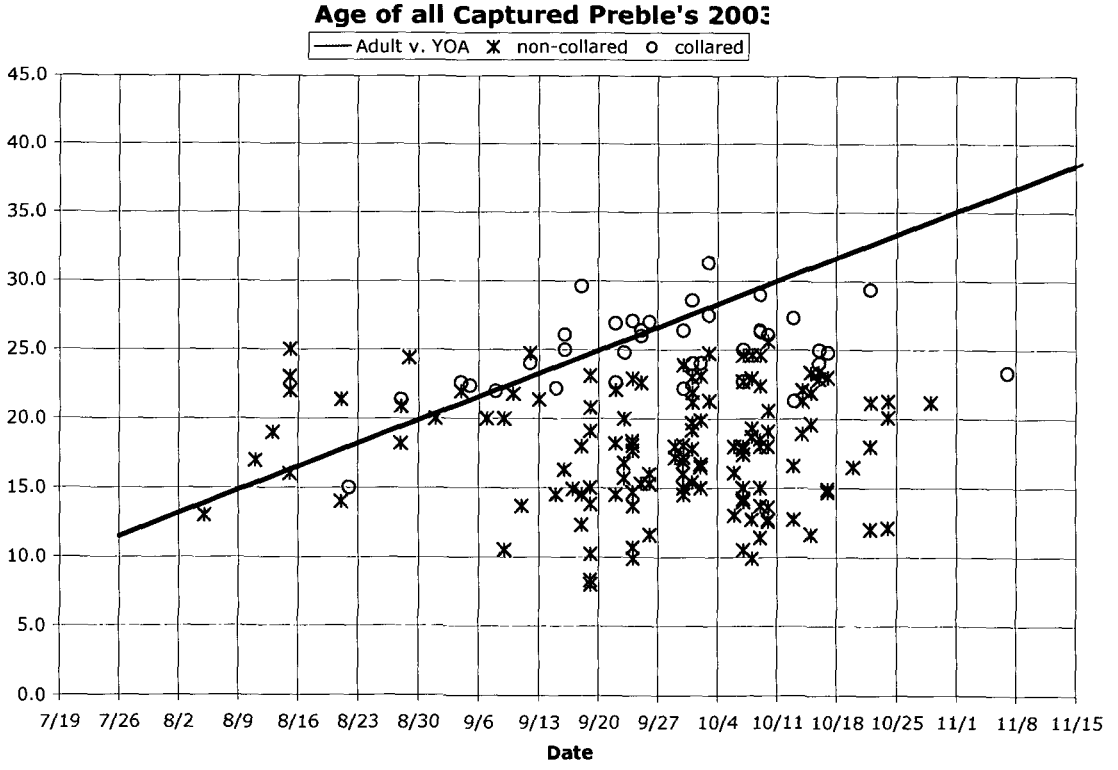


Table 4. Preble's Meadow Jumping Mouse Captures by Trapping Period, South Boulder Creek and East Boulder Ditch 1998, 1999, 2003.

YEAR	1 AUGUST – 16 SEPTEMBER	17 SEPTEMBER-NO FURTHER CAPTURES
1998	31 (35% of total)	58 (65% of total) last capture = 14 October
1999	40 (63% of total)	23 (37% of total) last capture = 15 October
2003	33 (19% of total)	144 (81% of total) last capture = 7 November Captures after 15 October = 16

COLLARED ANIMALS

We collared 11 animals – 6 males and 5 females. The first was collared 12 September though she slipped that collar and was re-collared 1 October when she had re-attained the weight we used for determining readiness for hibernation. The last animal collared was a late young of the year female collared on 7 November. Two collars were slipped, one animal died in a trap, and two animals were predated. Six animals were tracked to possible hibernation sites (Table 5). Five of these animals moved more than 100m from their last active site to their hibernaculum (range 105m to 233m). The sixth animal remained on EBD. Her hibernation site is a grass nest on the surface in the same area in which she was active. This animal may have a hibernaculum in the ground under the grass nest. Sheldon (1934) described a similar situation.

HIBERNACULA CHARACTERISTICS

1. Vegetation (Table 6).

Active season habitat for five of the six hibernating animals was along East Boulder Ditch. This is an area characterized by little or no tree or shrub canopy and dense, lush grammanoids and forbs. Graminoid and forb species richness in the active season habitat was 4-5 and 4-7 species respectively. There was very little large litter present. Along the ditch there is a low wet site where there is an ≈ 30m diameter area of dense *Salix exigua* with a lush understory of *Symphicarpos sp.* and Graminoids. Collared mice were frequently located in this area and seven day nests were identified here (Figure 2). The sixth animal spent the active season in an abandoned channel of South Boulder Creek.

This is a low area with wet soils, dominated by *Populus deltoids*, mixed shrubs, and mixed herbs.

TABLE 5. Last Location before Hibernation Move and Location of Hibernation Site.

COLLAR FREQUENCY	PIT TAG #	LAST LOCATION DATE & WEIGHT	UTMs	HIBERNATION SITE AND DATE	UTMs	DISTANCE MOVED
241 male	4451183E26	EBD-willows 3 Oct; 27.5g	0481770/ 4427329	SBC 6 Oct	0481669/ 4427377	110m[1] 48m to ck[2] 40m to paved[3] 20m to dirt tr.[3]
041 female	4439363271	EBD 28 9 Oct; 29.0g	0481750/ 4427272	SBC 10 Oct	0481648/ 4427340	145m 11m to ck 6m to dirt tr.
080 male	444F325137	EBD 13 9 Oct; 26.4g	0481720/ 4427218	SBC 10 Oct.	0481651/ 4427476	233m 15m to ck 10m to dirt tr.
161 female	4453194E41	EBD 21 20 Oct; 24.0g	0481738/ 4427241	EBD-grass nest 22 Oct.	0481739/ 4427238	8m 18m to EBD[4] 102m to SBC 55m to paved
690 female	44530B2F13	SBC–N of bridge 24 Oct; 30.2g	0481473/ 4426761	SBC–S of bridge 28 Oct.	0481491/ 4426646	105m 3m to ck. 1m to social tr
061 female	NA	EBD 9 7 Nov; 23.3g	0481703/ 4427199	SBC 12 Nov.	0481683/ 4427301	110m 45m to ck 9m to dirt tr.

[1] Distance moved is the straight-line distance from the last known active site to the hibernation site.
[2]This is the straight-line distance from the hibernation site to the mainstem South Boulder Creek.
[3] This is the straight-line distance to the dirt, paved, or social trail, whichever is closest.
[4]This is the straight-line distance to East Boulder Ditch, the functional equivalent of a tributary to South Boulder Creek.

Four of the six hibernation sites are in a riparian area dominated by tree canopy with a shrub and herbaceous understory (Table 6).A fifth animal is in an opening dominated by mesic to xeric herbs in the same tree-dominated riparian site. Species richness in these areas was lower than in the active season habitat, however because of the presence of trees, shrubs, and herbaceous species, structural diversity was much higher. There was also a component of large litter present in the hibernation habitat that was missing in the active season habitat. The sixth animal did not leave the active season habitat.

Table 6. Vegetation at Hibernation and Last-Active Sites.

A. Hibernation Sites

Collar Frequency	# Tree Species	% Tree Canopy Cover	# Shrub Species	% Shrub Canopy Cover	# Gramanoid Species	% Gramanoid Canopy Cover	# Forb Species	% Forb Canopy Cover	% Woody Debris	Community Type[1]
241	2-3	30	0-2	10	2-3	50	1-3	10	50	29
041	0-1	50	0	0	2-3	80	0	0	10	25
080	2-3	10	0-2	30	2-3	50	4-7	30	40	25/26
161	0	0	3-5	20	4-5	90	4-7	40	10	3
690	2-3	50	0	0	4-5	60	0	0	0	27
061	0	0	3-5	10	4-5	90	4-7	20	10	4

[1] See Appendix A

B. Active Season Sites.

Collar Frequency	# Tree Species	% Tree Canopy Cover	# Shrub Species	% Shrub Canopy Cover	# Gramanoid Species	% Gramanoid Canopy Cover	# Forb Species	% Forb Canopy Cover	% Woody Debris	Community Type[1]
241	1	<10	0-2	50	4-5	90	1-3	10	0	3
041	2	<10	0	0	4-5	90	4-7	30	0	4
080	0	0	0	0	4-5	70	4-7	50	0	3
161	0	0	2	<10	4-5	80	4-7	20	0	3
690	4-5	50	3-5	30	2-3	70	4-7	10	20	28
061	0	0	0	0	4-5	60	4-7	40	0	3

[1] See Appendix A

Figure 4. Grass Day Nest.

Six day nests were found in October and examined. All were ≈ 12.5 – 17.5 cm (5-7 inches) in diameter and sat in a shallow depression. Five were at the base of willow stems. Entrances holes of ≈ 2.5 cm inch were located on the bottom of the each nest. In each there was a center chamber of ≈ 5 – 7.5 cm (2-3 inches) in diameter and all were lined with milkweed *(Aesclepias sp.)* silk. The grass nest that appears to be a hibernaculum is similar to these nests.

2. Distance from Creek and Trails (Table 5).

Hibernacula are located an average of 35 m from the mainstem South Boulder Creek (range is 3 m to 102 m). The study site is crossed by two trails, one paved and one dirt, that more or less parallel the creek. Recreation use is high, 29.1± 8.3 people/hr., and 6 ± 3.6 dogs/hr. (Meaney et al. 2002). Preble's regularly cross both trails (Meaney et al. 2002). Hibernacula are an average of 20 m from a trail (range 1 m to 55m).

3. Abiotic Site Characteristics

All active-season sites were located on relatively level, low-lying sites. However, five of six hibernation sites were located on slight slopes (Table 6) with an east to south aspect.

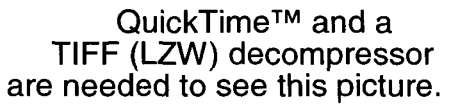
Table 7. Slope and Aspect at Last-Active and Hibernation Sites.

	LAST ACTIVE SITE			HIBERNACULUM	
FREQUENCY	SLOPE	ASPECT		SLOPE[1]	ASPECT
241	≈ level	N/A		10% 6° from level	E
041	≈ level	N/A		5% 3° from level	SE
080	≈ level	N/A		22% 13° from level	SE
161	≈ level	N/A		≈ level	N/A
690	≈ level	N/A		22% 13° from level	E
061	≈ level	N/A		14% 8° from level	SW

[1] Slope was measured over a distance of 1 m at each site (hibernaculum and last active).

The soils (Figure 3) in the study area are predominantly Piney Creek alluvium that extends laterally approximately 1 kilometer. It consists of reworked gravel that is locally overlain by 0.3 to 1.0 m of noncalcareous sand and silt (Crifasi, Attachment B, 2003). The Piney Creek alluvium forms a terrace 1.2 to 6 meters above the modern stream and, on the east side of the stream, is flanked by Broadway alluvium (Crifasi 2003). The Broadway alluvium is 6-12 meters above the modern stream surface, has an overall thickness of 0 to 7.6 m and consists of humic, clayey, silt and sand in the upper 20 to 91 cm (Crifasi 2003).

Figure 5. Geologic Map of the Study Area (Crifasi 2003).



The soil at all hibernacula ranges from medium to fine grained silty to clayey sand. A small amount of humic material is present in each sample. The texture of the samples is summarized in Table 8 using U.S. Department of Agriculture Soil Conservation Service nomenclature (Deitrich, and others, 1982)(Crifasi 2003).

Table 8. Soil Texture and Geologic Setting of PMJM Hiberncacula and Last-Active Sites. (See Crifasi, Attachment B).

A. Hibernacula

FREQUENCY	SOIL TEXTURAL CLASSIFICATION	GEOLOGIC UNIT
241	Loam	Piney Creek alluvium
041	Sandy loam	Holocene alluvium
080	Sandy loam	Holocene alluvium
161	Loamy sand	Broadway alluvium
690	Silty loam	Holocene alluvium
061	Silty clay loam	Piney Creek alluvium

DISCUSSION

Preble's is a deep hibernator, entering hibernation in September or October and emerging the following May. Adults are the first cohort to enter hibernation (Meaney et al. 2003) because they accumulate sufficient fat stores earlier than do YOA (Wunder and Harrington 1996). Young-of-the-year enter hibernation in late September, October (Meaney et al. 2003), and November (this paper). Preble's does not store food for use in winter, surviving on fat stores accumulated prior to hibernation (Whitaker 1963) thus one critical factor for overwinter survival is the ability to acquire sufficient fat (Wunder and Harrington 1996). This requires high quality habitat from August through October that provides sufficient food to enable an animal to attain hibernation weight within a period of two weeks (Cranford 1978; Wunder and Harrington 1996; Meaney et al. 2003). Wunder and Harrington (1996) found that when an animal had attained > 5g of fat (± 20% body fat) that it was ready to enter into hibernation. For adults this occurs at ≈ 25g (Muchlinski 1988; Wunder and Harrington 1996) though for YOA this can occur at lower weights (Wunder and Harrington 1996).

Generally it is critical to the success of hibernators to find a hibernaculum where the temperature is not likely to drop below 0° C (Marchand 1987). This is particularly

important for small mammals, like Preble's, that cannot fully compensate for the loss of heat through their proportionately large body surface by increasing surface insulation (Lyman et al. 1982). One method of reducing the surface area of exposure is to curl the body and retract the extremities, something that has been reported for jumping mice (Sheldon 1934) and that we have seen on finding a torpid Preble's in a trap. It has been found that curling reduces the surface area of an animal's body by one third and this results in an equal reduction in heat loss (Marchand 1987). Animals can further reduce heat loss by increasing insulation but there are upper limits to how much insulation can be added before the animal's ability to move is compromised.

PMJM differ from most small mammals that hibernate because most species become quite obese, nearly doubling in mass (Boyer and Barnes 1999), and many also store food. PMJM does neither. PMJM gains only $\approx 20\%$ body fat in preparation for hibernation (Wunder and Harrington 1996), stores no food (Whitaker 1972), and is limited by its small size in how dense a winter coat it can grow. Thus the choice of hibernation habitat becomes critical, as the hibernaculum must provide insulation, maintain a temperature above freezing (Marchand 1987), and remain dry in spring when snow melts (Sheldon 1934, 1938; Halfpenny 1989).

Location of burrows of semi-fossorial vertebrates has been found todepend, in part, on the physical properties of the soil relative to the species considered (Kinlaw 1999). Ability of the animal to excavate a burrow and of the burrow to withstand collapse are important aspects of site selection (Reynolds and Wakkinen 1987; Reichmann and Smith 1990; Kinlaw 1999).

Clearly, the survival of Preble's through hibernation is dependent on attaining sufficient lipid stores but the selection of a hibernation site is also important as it increases insulation of the mouse from the harsh winter environment. Successful hibernation sites should: be easy for the animal to dig in; have sufficient clay to retain the burrow structure; provide insulation; and remain dry through the winter and early spring.[7]

[7] Soil temperature and moisture will be monitored through the hibernation period and this information will be incorporated into the current work. Known hibernation sites will be excavated after emergence to locate a hibernation chamber and thus to know what specific soils and what depth the animals selected for hibernacula.

There is only one year's information on over-winter survival of Preble's at this site. Survival through the winter of 1998-1999 was 54.1 ± 18.8% while active season survival was 16.2 ± 9.6% (Meaney et al. 2003) highlighting the significance of hibernation for Preble's. Hibernation allows this animal to avoid harsh winter conditions, predation, and injury for up to 7 months of the year, but survival is dependent on acquiring adequate lipid stores *and* selecting an appropriate hibernation site.

Too few hibernacula were located this season to make broad inferences about hibernation habitat selection by Preble's but some similarities were found among the six sites identified.

- Most collared animals moved > 100m from their last active sites to hibernation sites;
- Hibernation sites were located in areas with higher tree species richness and more tree canopy than active season sites, lower grammanoid species richness than active season sites, lower forb canopy cover than active season sites, and more woody debris than active season sites;
- Hibernation sites had silty, clay loam soils;
- Hibernation sites were located from 1– 48 m from the mainstem creek. The sixth site is located 105m from the creek but is 3m from East Boulder Ditch;
- Five hibernation sites are located on benches above the creek. The sixth site is above East Boulder Ditch on a bench above South Boulder Creek.
- Three of the sites are located under dense grasses, three sites are located under woody debris.

This information has already been used by OSMP to help determine which Russian Olive trees could be removed this year from the Burke 1 and Gebhard Open Space Properties in an ongoing program to eradicate Russian Olive trees (Attachment C).

RECOMMENDATIONS

The minimum number of animals needed to make statistical inferences about hibernation habitat selection is 30, we have located 6 hibernacula. This project needs to

be continued to collect over-winter survival of collared animals, excavate known hibernation sites, and to collar and track more animals to hibernation. With sufficient sites we can evaluate variability and significant variability of the site characteristics by calculation of standard deviation for: plant community composition; soil texture, temperature, and moisture; and slope and aspect of hibernation vs. last active sites.

The equipment has been purchased; The Colorado Chapter of the Wildlife Society has awarded a $1000 grant to Bear Canyon Consulting to refurbish collars for this project (Attachment D); and the techniques for identification of hibernation-ready animals, collaring, and telemetry have been fine-tuned. We are actively seeking funding to continue this project next spring (emergence trapping and hibernacula excavation) and next fall (trapping, collaring, and telemetry).

ACKNOWLEDGEMENTS

We would like to thank Bob Crifasi, Water Resources Administrator for OSMP for his help in obtaining funding and his expertise in geomorphology. We also thank Eric Butler, Director GIS section for providing orthophotos and maps for our fieldwork and Carey Richardson, former OSMP Wildlife Biologist for help in developing the project. We thank the State of Colorado for funding through the State of Colorado Species Conservation Trust Fund Grant. We thank Dr. Carron Meaney, Dr. Dave Armstrong, Dr. Tanya Shank, and Rob Schorr for discussions about hibernation and population dynamics of Prebles in Colorado. And we thank our volunteers, without whom much of this work would not have been possible: Fred Ruggles, Sean Ruggles, Nan Hampton, Kat Demarra, Don Whittemore, Harrison Whittemore, Dan Fernandez, Don Hampton, Thalia Camena, Gary Emerson, Joyce Robertson, Alison Michael, Leslie Elwood, Erin Robertson, Shannon Solo, and Lisa Ceski.

Appendix A.

TABLE OF COMMUNITY CLASSIFICATIONS

I. Little or No Tree or Shrub Canopy

1. *Bromus inermis/* sometimes with othr grasses or sedges
2. *Typha larifolia* sometimes with grasses or sedges
3. Mixed herbs: wetland type (*Carex sp., Juncus sp., Poa spp., Equisetum arvense, Mentha arvense,* etc.)
4. Mixed herbs: mesic type (*Cirsium sp., Lepidium sp., Bromus inermis, Poa spp.*)
5. Litter/mixed herbs
6. Soil/mixed herbs
7. *Calamovilfa longifolia/* mixed herbs/ litter

II. Shrub dominated – Little or no Tree Canopy

8. Symphoricarpos occidentalis/ often with high litter and some grasses and/or herbs
9. Mixed shrubs/Graminoids (*Scirpus sp., Juncus sp., Poa spp.*)
10. Mixed shrubs/ mixed herbs
11. *Padus americana/ Symphoricarpos occidentalis/ Poa spp.*

III. Tree Canopy Only – Little or No Understory

12. *Salix exigua/* soil or litter
13. *Salix fragilis/* soil or litter
14. *Salix sp./* soil or litter

IV. Tree Canopy with Shrub and/or Herbaceous Understory

15. *Salix sp./* shrubs / litter
16. *Salix sp./* shrubs / mixed wetland herbs
17. *Salix sp./ Salix sp./* litter or soil
18. *Salix sp./ Salix sp./ Carex sp.*
19. *Salix sp./ Salix sp./* mixed herbs (with grasses)

20. *Salix fragilis/* mixed herbs

21. *Salix exigua/ Salix exigua/* litter
22. *Salix exigua/* shrubs/ mixed herbs
23. *Salix exigu/* wetland Graminoids (*Carex spp., Juncus sp., Scirpus sp., Poa sp.*)

24. *Alnus incana/* mixed shrubs/ mixed herbs
25. *Alnus incana/* mixed herbs

26. *Populus deltoides* and *P. angustifolia/* mixed shrubs/ Graminoids
27. *Populus deltoids/* Graminoids/ litter
28. *Populus deltoids/* mixed shrubs/ mixed herbs
29. *Populus deltoids/ Padus virginiana/ Bromus inermis*
30. *Populus deltoids/* mixed herbs
31. *Populus angustifolia/* mixed shrubs/ mixed herb

32. *Quercus gambelii/ Symphoricarpos/* litter

33. *Pinus ponderosa/* Graminoids
34. *Pinus ponderosa/* mixed shrubs/ mixed herbs

35. *Eleagnus angustifolia/* mixed herbs

Shrubs usually include one or more:

	COMMON NAME
Symphoricarpos occidentalis	Snowberry
Rosa Sp.	Rose
Padus virginiana	Choke cherry
Prunus americana	Wild plum
Ribes sp.	Currant, gooseberry
Amorpha fruticosa	Lead plant
Salix exigua	Coyote willow
Salix amygdalides	Peach leaf willow
Rhus trilobaata	Skunkbrush

Mixed herbs are usually wetland or mesic combinations and *include forbs and Graminoids.*

Graminoids include one or more:

	COMMON NAME
Bromus inermis	Smooth brome
Poa spp.	Bluegrass
Dactylis glomerata	Orchard grass
Calamovilfa longifolia	Sandreed
Bromus pumpeliana	
Equisetum arvense	Horsetails
Buchloe dactyloides	Buffalo grass

APPENDIX B
PREBLE'S MEADOW JUMPING MOUSE
PLANT SPECIES AND COVER DATA FORM

Site:_____ **Date:**_____ **Observer**_____

UTMs:_____

	Structural Variables	Dominant Species
Tree Component	% Canopy cover: 0 10 20 30 40 50 60 70 80 90 100 Richness = n species 0 or 1 2 or 3 4 or 5 more than 5	
Shrub Component	% Canopy cover: 0 10 20 30 40 50 60 70 80 90 100 Richness = n species 0 to 2 3 to 5 6 to 8	
Herbaceous component I	**Grasses** – % Canopy cover: 0 10 20 30 40 50 60 70 80 90 100 Richness = n species 0 or 1 2 or 3 4 or 5 more than 5	
Herbaceous component II	**Forbs** – % Canopy cover: 0 10 20 30 40 50 60 70 80 90 100 Richness = n species 1 to 3 4 to 7 >7	

Community type: _____

% Litter: _____ **% Bare Ground**_____

ATTACHMENT A

August 16, 2003

TO:
Anne Ruggles
Bear Canyon Consulting, LLC
850 37th Street
Boulder, CO 80303

Anne,

We have completed the necropsies on the ten small mammals that you submitted for necropsy in September. Gross necropsies were performed and tissues collected for West Nile testing. At necropsy, the rodents were found to be in good to fair body condition. Eight of the ten rodents had either blood noted from the nares, pulmonary hemorrhage or both noted. No other gross lesions were noted in these carcasses.

All ten of the rodents tested negative for West Nile Virus via RT-PCR. This test detects viral antigen. Due to the condition of the tissues after thawing, we did not pursue any histology on these animals.

With the presence of pulmonary hemorrhage, rodenticide poisoning, plague, tularemia, capture stress or pneumonia (Mycoplasma) are possible rule outs as cause of death in these individuals.

Thank you for including the DOW-Wildlife Health Laboratory in this project. Let me know if we can be of further assistance.

Sincerely,

Laurie A. Baeten, DVM
Wildlife Health Laboratory Supervisor
317 W. Prospect Road
Fort Collins, CO 80526
970-416-1516

City of Boulder Open Space & Mountain Parks

P.O. Box 791, Boulder, CO 80306; 303-441-3440
www.ci.boulder.co.us/openspace/

Memorandum

Date: November 24, 2003
To: Anne Ruggles, Bear Canyon Consulting
From: Robert R. Crifasi, Water Resources Administrator
Subject: Geomorphology and Geology of the Burke 1 and Gebhard Open Space Properties with a Special Reference to Hibernacula Sites for the Preble's Meadow Jumping Mouse

The surficial geology of the City of Boulder Open Space and Mountain Park's Burke and Gebhard properties was examined as part of an effort to identify the characteristics of hibernacula for the federally threatened Preble's Meadow Jumping Mouse (PMJM). Fieldwork for this effort was completed in November and December 2003. These properties are located in the W. 1/2 of S. 3, T. 1 S., R 70 W. of the 6th Principle Meridian.

Background Information and Previous Mapping

A surficial geologic map of the Louisville quadrangle (Malde, 1955) depicts the alluvium near South Boulder Creek within the study area to be predominantly Piney Creek alluvium. Malde describes the alluvium as reworked gravel locally overlain by 0.3 to 1.0 meter of noncalcareous sand and silt. Malde also depicts a small portion on the east margin of the site as "undifferentiated bedrock." The lateral extent of the alluvium is approximately 1 kilometer.

Trimble (1975), working in the Niwot Quadrangle to the immediate north of the study site, describes the Piney Creek Alluvium as a dark gray humic silt and sand that contains cobble size (6 cm) clasts composed of rounded Precambrian crystalline rocks. Trimble notes little or no alteration of the pebbles and cobbles in the Piney Creek Alluvium. He also notes that the upper part of the Piney Creek alluvium may contain a weak brown soil and writes that the Piney Creek alluvium generally has a thickness of 0 to 6 meters and forms a terrace 1.2 to 6 meters above the modern stream. There is occasionally some Post-Piney Creek Alluvium present within the mapped extent of Piney Creek Alluvium. Carbon-14 dating of the Piney Creek Alluvium indicates an age of about 2800 years before present (Scott, 1963).

A discrepancy in geologic interpretation is evident at the join line for the Trimble (1975) and Malde (1955) maps. Trimble indicates that the Broadway alluvium flanks the Piney

Creek alluvium east of South Boulder Creek, whereas Malde does not indicate the presence of Broadway alluvium on the other side of the map join line. Field work conducted for this study did not locate any "undifferentiated bedrock" as mapped by Malde (1955), but did locate a low terrace corresponding to the Broadway alluvium mapped by Trimble (1975).

Trimble (1975) describes the Broadway Alluvium as being composed of yellowish orange to reddish brown humic clayey silt and sand in its upper 20 to 91 cm and the lower part of the Broadway Alluvium as a cobbly pebble gravel composed of Precambrian crystalline rocks. Its overall thickness is approximately 0 to 7.6 meters and is typically located 6 to 12 meters above the modern stream surface. The Broadway alluvium is the lowest Pleistocene aged valley fill terraced alluvium present in the region (Scott, 1960) and has been dated to about 30,000 years before present (Pierce, and others, 1976).

In the southeast portion of the study area, Malde (1955) mapped a terrace higher than the Broadway alluvium. The position of this terrace and condition of the alluvium suggests it is an extension of the Louviers alluvium as mapped by Trimble (1975) north of the study area. Trimble describes the Louviers alluvium as a reddish-brown pebbly to bouldery alluvium stained by iron and magnesium oxides that forms a terrace 6 to 12 meters above the modern stream. The Louviers alluvium is a valley fill alluvium dated to the Late Pleistocene (Illinoian age, Bull Lake Glaciation), or about 140,000 years old (Pierce, and others, 1976).

Site Specific Geology

The existing published geologic maps showing the study site are of too course a scale to be useful in identifying detailed characteristics of the study area, let alone individual PMJM hibernacula locations. For this reason, a more detailed geologic map was prepared of the study area (figure 1). This fieldwork indicated the presence of five alluvial units within the study area. These include the previously discussed Piney Creek, Broadway and Louviers alluviums along with a Holocene alluvium and alluvial deposits within the modern incised channel of South Boulder Creek. A small amount of upper Cretaceous aged Pierre Shale was also identified in the southeast portion of the study area. In addition, the location of anthropogenically modified materials was mapped.

The Piney Creek, Broadway and Louviers alluvium present in the study area fit the description of these units given by Malde (1955) and Trimble (1975). Within the Piney Creek alluvium significant microtopography related to the stream processes that deposited it is observed. Point bar and other gravel deposits, abandoned oxbow, levee, and over bank deposits are present and are observed both on the ground and with aerial photographs.

A Holocene alluvial surface is also present approximately 0.5 to 1.5 meter above the modern channel and 0.5 to 1.0 meter below the Piney Creek alluvium. The Holocene alluvium is composed of silt and sand that contains cobble and small boulder clasts

composed of rounded Precambrian crystalline rocks. Little or no alteration of the cobbles and boulders is evident in the Holocene alluvium. A substantial amount of the riparian tree vegetation is located within the area mapped as Holocene alluvium. Within the Holocene alluvium significant microtopography related to the stream processes that deposited it is observed. As with the Piney Creek alluvium, point bar and other gravel deposits, abandoned oxbow, levee, and over bank deposits are present and are observed both on the ground and with aerial photographs.

Recent erosional downcutting along with channel straightening activities has established a new channel grade for South Boulder Creek below the topographical elevation of the Holocene alluvium. Because this incised channel represents a geomorphic surface that is new and distinct from the Holocene surface, it was included as mapped unit.

Various anthropogenically modified materials are also present and were mapped as a single unit. The anthropogenically modified materials include artificial fill that has a provenance related to irrigation ditch and headgate excavation and cleaning or stream channelization activities. The area along the irrigation ditches that was mapped as anthropogenically modified includes both the ditch and ditch banks. In addition, a substantial amount of fill appears to have been imported into the extreme southwest part of the study area to construct flood levies for a small tributary channel (Viele Channel) to South Boulder Creek. Minor amounts of disturbed soil associated with field irrigation laterals and two recreation trails that cross through the study site were not recorded.

Soil Conditions Specific to Hibernacula Sites

Soil samples were collected at five PMJM hibernacula sites using a 1.0 cm diameter soil auger. Care was taken to offset the auger hole from the actual hibernaculum chamber so as not to disturb any PMJM that were present. A possible sixth hibernacula site (No. 161) was located, that appeared to lie solely within vegetation. Because a hibernacula may be present underneath the vegetation a soil sample was collected as well. The soil at all hibernacula locations ranges from medium to fine grained silty to clayey sand. A small amount of humic material is present within each sample. The texture of the samples is summarized in table 1 using U.S. Department of Agriculture Soil Conservation Service nomenclature (Deitrich, and others, 1982).

Table 1. Soil texture and geologic setting of PMJM hiberncacula sites.

Hibernacula Site Number	Soil Textural Classification	Geologic Unit
061	Silty clay loam	Piney Creek alluvium
690	Silty loam	Holocene alluvium
080	Sandy loam	Holocene alluvium
041	Sandy loam	Holocene alluvium
241	Loam	Piney Creek alluvium
161	Loamy sand	Broadway alluvium

Interpretation of Geomorphic and Soil Conditions for Hibernacula sites.

Each observed hibernacula site is located within a well-drained loamy or loamy sand soil. In other words, most particles present in the samples are less than 2 millimeters in diameter. The sediment texture along with the morphology of the deposits in which they were collected suggest that these soils may have been deposited as overbank, abandoned oxbow, or possibly back levee deposits. The material within all of the hibernacula sites is much too fine grained for it to be from the cobble to boulder dominated point bar or other stream bar deposits that are commonly observed within the South Boulder Creek alluvial deposits. However, one hibernacula site (No. 080) is located at or near the edge of a deposit of artificial fill although it is not certain if the hibernacula itself is located within artificial fill.

Although too few hibernacula sites were identified to draw broad conclusions for all Preble's, the mice for which hibernacula were located clearly show a preference for fine-grained soils that are well drained. The small amount of clay that is present within these soils likely provides some structural support for the hibernacula chamber.

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ATTACHMENT C

RUSSIAN OLIVE REMOVAL AND PREBLE'S HIBERNACULA

Date: October 30, 2003
To: Bryan Pritchett
From: Anne Ruggles, Sr. Wildlife Ecologist, Bear Canyon Consulting, LLC
Subject: Compatibility of Russian Olive Removal and Hibernacula Sites for the Preble's Meadow Jumping Mouse on the Gebhard Open Space Properties

Attached are my recommendations with respect to removal of Russian Olive trees this fall and winter on the Gebhard Open Space Properties. I would be willing to walk the area with OSMP folks and point out what I'm looking for. Generally, Russian Olives near occupied ditches or creeks, located where they are likely to be above saturated soils in late winter/early spring, and that have evidence of digging in the soil nearby should be left intact until mid-June when *zapus* have emerged from hibernation. Figures 1,2 and 3 demonstrate what I am looking for.

Let me know if I can be of any further help.

Anne

Bear Canyon
Consulting, LLC

Anne Ruggles
Senior Wildlife Ecologist
aruggles@igc.org
303-938-0490

RUSSIAN OLIVE REMOVAL AND PMJM HIBERNACULA

1. New Dry Creek Carrier Ditch: (from the bridge that crosses the ditch just north of the trail underpass at South Boulder Road east to Cherryvale Road). Russian Olives away from the ditch are probably unimportant as *zapus* hibernation habitat. However, Russian Olives along the ditch *may* be used. These are growing either on the bank–primarily the south bank–or at the very edge of the channel. The banks consist of soft easily excavated dirt and have burrow entrances (see Fig.1 and 2). These *may* be vole, deer mice, or *zapus* burrows. Removing the trees by pulling them out of the ground would very likely disrupt the integrity of these bank burrows. Removal by this method would not likely disrupt *zapus* if done after mid-June. Mid-June is based on past spring trapping along South Boulder Creek that had females emerging from hibernation into the 2nd week of June.

Fig. 1. Small mammal burrows on south bank of New Dry Creek Carrier Ditch above Russian Olives. I have flagged the start of a run of young Russian Olives along this bank.

Fig. 2. Small mammal burrows in ditch banks.

2. New Dry Creek Carrier Ditch: On the north side of the ditch at the east end (almost to the cross fence that crosses the ditch) there are some old Russian Olives in the channel. These do not seem to be associated with any small mammal burrows and are too close to the channel to provide hibernation habitat that would be above saturated soil in the spring. These could probably be pulled without harming *zapus.*

3. Wet Meadow: Russian Olives can safely be pulled from the wet meadow–this gets standing water in late winter/early spring from snow and rain. The saturated soil is very likely not ideal hibernation habitat.

4. Enterprise Ditch: (From its out-take from South Boulder Creek east to the concrete bridge that crosses the ditch–ie. the section that has cottonwoods growing along it). Any Russian Olives between the fence on the south side of the Ditch and the lateral ditch on the north side should be left in place until mid-June as there are small mammal burrows all along the ditch.

5. Enterprise Ditch: (From the concrete ditch east to the gauging stations near Cherryvale Rd). These Russian Olives can be removed.

6. Trail: (from South Boulder Rd. north to the raised pipeline). This is a low-lying area and like the wet meadow has standing water in the late winter/early spring. Any Russian Olives here can be removed.

7. Trail: (from the raised pipeline north to the cattle shed in the wet meadow to the east). The Russian Olives along here can be removed except for the one that is flagged with pink flagging. This one is in a high area and has soft, worked dirt like we have found at some of the hibernacula we have identified this fall. (Fig.3).

Fig. 3. Soft, worked dirt at the base of a Russian Olive on the west side of the trail between the raised pipeline (southwest) and the cattle shed (northeast).

8. South Boulder Creek: (from the cattle shed on the east side of the trail south to South Boulder Road). Russian Olives along the west side of the creek can probably be removed. The west side is fairly low-lying and thus the soils are saturated in late winter/early spring. On the east side, from the shed south to the drop dam, these trees are high enough that the soil probably does not become saturated in late winter/early spring. I also found soft soil that had been worked and some with small mammal burrows nearby.

9. Corner of Cherryvale and South Boulder Road: Any Russian Olives here are probably not associated with hibernation habitat.

10. Trail underpass at South Boulder Road: The Russian Olives near the underpass are probably not associated with hibernation habitat.

ATTACHMENT D.

PROPOSAL SUBMITTED TO COLORADO CHAPTER OF THE WILDLIFE SOCIETY

27 October 2003

HIBERNACULUM LOCATION AND DESCRIPTION FOR PREBLES MEADOW JUMPING MICE (*ZAPUS HUDSONIUS PREBLEI*) ON CITY OF BOULDER OPEN SPACE AND MOUNTAIN PARKS

Submitted by:

Bear Canyon Consulting, LLC

3351 Sentinel Drive
Boulder, CO 80301
(303) 449-8001

Contact:
Anne K. Ruggles, member CCTWS
email: aruggles@igc.org

Lauren Whittemore, member CCTWS
email: mailto:BearCanyonCo@earthlink.net

HIBERNACULUM LOCATION AND DESCRIPTION FOR PREBLE'S MEADOW JUMPING MICE ON CITY OF BOULDER OPEN SPACE AND MOUNTAIN PARKS (OSMP)

PURPOSE: This project is designed to identify and describe hibernacula and hibernation habitat of the threatened (USFWS 1998) Preble's meadow jumping mouse (Preble's) along South Boulder Creek so that OSMP and other local and state agencies can manage Preble's hibernation habitat as well as active season habitat. Previous work at this site has shown that the over-winter survival rate for Preble's (54.1 ± 18.8%) is significantly higher than is the summer survival rate (16.2 ± 9.6%) suggesting that hibernation may be essential to the persistence of Preble's populations in the wild (Meaney et al. 2003).

PROJECT OBJECTIVES: We are continuing a project begun in 2003. The objectives are to locate and describe 30 Preble's hibernacula along South Boulder Creek. During the Preble's active season of 2003, six animals were tracked to hibernacula (Ruggles et al 2003, in prep). Unusually low capture numbers resulted in using only 10 of 30 purchased collars. Unused radio collars will be refurbished with new batteries and used during a second season in 2004.

STUDY AREA: The study area is in the City of Boulder along South Boulder Creek. The area is managed by the City of Boulder OSMP as wildlife habitat and for recreation and agricultural use. This is a well-characterized population of Preble's (Meaney et al. 2002, 2003) with mean linear density per stream and ditch kilometer of 40.0 ± 4.4 (Meaney et al 2003).

METHODS: We are using a mark-recapture protocol in which we carefully track individual weights beginning in September. When an animal reaches the target weight indicating imminent hibernation–25g for females and 26g for males (Muchlinski 1988)–it is fitted with a radio collar. Thereafter animals are tracked three nights per week using triangulation techniques until they have been located at the same site for three sequential tracking sessions. Sites are then searched to determine whether the mouse is hibernating or if the collar was slipped. If no collar is found the site is marked and revisited and excavated the following June after animals have emerged.

BENEFITS TO WILDLIFE IN COLORADO: This is a species that hibernates, in the Front Range of Colorado, from September through May. Little is known about hibernation habitat (Clippinger 2002). Fewer than a dozen hibernation sites are known from

Colorado; all but one are located in El Paso and Douglas Counties. Hibernacula location and habitat description will aid OSMP, Boulder County, and neighboring counties in their efforts to develop Habitat Conservation Plans for Preble's under § 10 of the Endangered Species Act.

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BUDGET FOR CCTWS GRANT:

Refurbish 20 radio collars @ $50/each	$1,000.00

OTHER FUNDING: City of Boulder Open Space and Mountain Parks is currently finalizing a federal Endangered Species § 6 grant that will fund development of a habitat conservation plan for PMJM on city lands. OSMP has expressed a strong commitment to continuing the hibernacula work. We are submitting a proposal to OSMP to fund personnel time for a second year of this study. We are also pursuing a second-year grant from our original state funding source. City of Boulder Open Space and Mountain Parks will provide in-kind services.

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