LOCATION AND DISTRIBUTION OF DIURNAL ROOSTS, ROOST SITE PARAMETERS, & FORAGING PATTERNS BY BOULDER COUNTY BATS (REPORT 2001)

OVERSITE AGENCY & PEOPLE

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BULLETED HIGHLIGHTS

★ Since the seasonal closure, the imperiled species *Corynorhinus townsendii* has increased its known presence in Mallory Cave which now houses up to 40 individuals of two maternity colonies. The lowering of human disturbance at the site by the seasonal closure has lead not only to more than triple the number of *C. townsendii* using the site, but also the colonies which were only very occasionally observed at the site, now utilize this roost for most days of the summer. This site has proven imperative to the long-term survival of this species in the area.

★ Comparative temperature data shows that Mallory Cave has a lower and more stable temperature profile than does Harmon Cave and mimics published temperature and morphology characteristics known to be preferred by this species. These data further illustrate the uniqueness of Mallory Cave in the Boulder area as a roost site for *C. townsendii*.

★ Another roost site for Myotis ciliolabrum was found to occur under a rock on scree-slopes. Thus far 3 of 4 maternity sites for this species have been in scree-slopes. These data indicate that protection from human disturbance of such slopes is important to the long-term survival of this species in the area. To date, *M. ciliolabrum* has the lowest population numbers for *Myotis* spp. in the area bringing to light the possibility of human disturbance affecting reproduction in this species.

★ Foraging patterns among bat species in the assemblage show distinctive, nonoverlapping, dominant foraging areas within larger overlapping home ranges.

IMMEDIATE RECOMMENDATIONS

A. Protection of Mallory Cave from human disturbance between the months of May and October is of paramount importance. Since the seasonal closure colony size has more than tripled for the imperiled species, Townsend's big-eared bat *(Corynorhinus townsendii)*. The seasonal closure should be kept in place and immediate further study on human impacts is needed to quantify the necessity of further protective measures.

B. Further study of temperature and humidity profiles of Mallory and Harmon Caves and the movement patterns of *C. townsendii* between these sites to determine the importance of each site to this species reproductive effort and persistence in the area.

C. Study the importance of scree-slopes to the reproductive effort of the small-footed myotis (*Myotis ciliolabrum*) and the degree to which off-trail hiking is impacting these maternity sites.

Abstract

The 2002 season of research for the Boulder bat project was hampered by weather more so than in any previous year. Almost 1/3rd of the 49 net nights covering 19 water holes were negatively affected by wind and rain. Nonetheless, 119 bats were captured and five were tagged with radio transmitters. Of these, two individuals disappeared without reacquisition of their radio signal, one individual was reacquired as it foraged approximately 1.5 km from the tagging area, however exhaustive attempts at finding its roost site proved futile, and for two others, roost sites and accurate telemetry data were gathered. The first maternity site for the imperiled fringed myotis (*Myotis thysanodes*) was found in north Boulder at the southern end of Mount Sanitas. In addition, a maternity site for the small-footed myotis (*Myotis ciliolabrum*) was found under a rock in scree-slope near the climbing rock dubbed The Maiden. Thus far 3 of 4 maternity sites for this species have occurred under rocks on scree-slopes and are potentially highly susceptible to human disturbance. Temperature data from Harmon and Mallory Caves show that the latter retains a lower temperature profile and more stable environment for the imperiled Townsend's big-eared bat (*Corynorhinus townsendii*) and its protection is critical for this species survival in the area. Since the seasonal closure on this site in 2001, less human disturbance has occurred and the number of *C. townsendii* using the site has grown from 10-15 to 35-40. More study is required to determine if further protective measures at this site are warranted.

STATEMENT OF OBJECTIVES AND GOALS

The main objectives and goals of the 2001 bat research project were to **1)** add to the current locality data base (n = 22) for maternity roost sites using radio telemetry, **2)** continue to evaluate bat behaviors relative to water hole sites, **3)** gather roost temperature data using temperature-sensitive data loggers, **4)** conduct visual outflight counts at maternity roosts, **5)** map roost sites and document distance between them and water hole sites of capture, **6)** continue to document home-ranges and preferred foraging habitats per species by conducting nighttime tracking of radio-tagged individuals, **7)** monitor the status of *C. townsendii* colonies at Harmon and Mallory Caves.

METHODS

A. Capture--The study was conducted from 30 April to 26 August 2001 with the help of Krista Fish, EPOB graduate student, who acted as field assistant. All bats were captured using American-made mist nets. Trapping was conducted over water and also at a single site in Douglas fir forest. Captured bats were weighed, sexed, identified to species, and released.

B. Radio Telemetry–Five individuals of five species were tagged with 0.45 g radio transmitters *(Holohil Systems, Ltd., Canada)* and tracked with either one or two 48 channel receivers (*Wildlife Materials, Inc., Ill.*). Individuals were tracked until either the transmitter stopped transmitting, the transmitter fell from the animal, or the signal was not received over the 10-day life of the transmitter. General locations of telemetry signals were first acquired by driving to high points overlooking the search area. After the signal was attained and relative position was documented, exact locations of roost sites were located by hiking and following transmitter

signals from tagged individuals hanging in their day-roosts. In most cases, the exact crevice that housed the colony was located. To determine coordinates of tagged bats while they foraged, we used triangulation techniques from two distant landmarks, coordinating the timing of compass readings by walkie-talkie communications. If two people were not available, telemetry was conducted via a single radio point, distances between radio and transmitter were calculated using signal strength and direction calculated using signal strength and compass reading at a specific point in time. Time intervals between readings were 1 minute. Coordinates were mapped using TOPO Inc. (*San Francisco, CA*) computer software containing Front Range topographical maps. The point at which compass bearings intersect corresponds to the position of the foraging bat in space and time. Circumscribing of intersection points gives the minimum, approximate home range for that individual on that night. In order to gather roost site locality data, we used a Magellan 4000XL global positioning system to record coordinates at each roost site. We then used TOPO Inc, computer software to map the locations based upon our GPS readings. Once roosts were located, out-flight counts were made at dusk with unaided eyes until darkness, after which a MoonLight Night Vision scope (*Cabela's Inc., Ill*) was utilized.

C. Roost Temperature Recordings--Onset Computer Corporation 'Hobo' temperature-sensitive data-loggers equipped with six foot probes were placed in Mallory and Harmon Caves *(C. townsendii* maternity sites), DerZerkle (*M. thysanodes* maternity site), and the Matron *(M. lucifugus* maternity site). Loggers were placed into the DerZerkle and Matron roosts with the help of Rick Hatfield, Burton Stoner, and Lynne Sullivan. Data were downloaded from the data loggers after they were removed from the sites using BoxCar Pro version 3.5+ for Windows software, and graphical results from these sites are presented in the results section.

RESULTS

Of these, five individuals were radio-tagged (Table 3), leading to the discovery of two new roost sites (Table 4).

A. Capture Data: A total of 119 bats over 49 net nights was captured (Table 1). Of these, 56 were *Myotis lucifugus*, 27 were *M. evotis*, 14 were *M. ciliolabrum*, 11 were *M. thysanodes*, seven were *Eptesicus fuscus*, three were *M. volans*, and 1 was *Lasiurus cinereus*. Several individuals were recaptures from previous years. A female *M. evotis* that was tagged on 20 June 2000 at Long Canyon was recaptured at the same site on 25 July 2001 (BK284, Table 1A). At Upper Gregory Canyon, a female *M. thysanodes* was recaptured on 5 June 2001 that was banded two nights before at the Long Canyon site (BK294, Table 1E). On 17 June, a female *M. thysanodes* was recaptured at Bear Canyon Creek that had been banded in 1997, however the tag number was illegible (Table 1H). At Abbey Pond a male *M. lucifugus* was recaptured, however, the number was illegible (Table 1M). A male *M. ciliolabrum*, that was banded in 1999 (BK204) at Stockton Cabin (Shadow Canyon), was recaptured at Stockton Cabin on 28 July (Table 1U). Of the 119 bats captured only 34 were female. Males accounted for 85 captures or 71.4% of all captures. The site highest in female captures was Long Canyon which also had the highest dissolved calcium content in 2000. Out of a total of 21 captures 16 or 76.2% were female. Curiously, Bear Canyon Creek, which was predominately female visited in previous years, was predominately male visited in 2001 (36 of 40 captures, 90%, were male). A total of 12 juveniles of three species (*Myotis lucifugus*, *M. ciliolabrum*, and *M. volans*) were captured in 2001.

Nineteen water holes were trapped in 2001, eight of which were previously untested sites

Table 1.–Captures in 2001by species by site

A. *Myotis evotis* at Lower Long Canyon

Time of Capture	**Sex**	**Repro. Status**	**Weight**	**Age**	**Band #**	**Date of Capture**
2106	female	nl	4.5 g	adult	none	1 June
2113	female	nl, p	6.5	adult	none	1 June
2138	female	nl, p	5.0	adult	BK295	1 June
2138	male	ns	5.0	adult	BK296	1 June
2145	female	nl, p	5.0	adult	none	1 June
2159	female	nl, p	7.3	adult	none	1 June
2205	female	nl, p	8.5	adult	none	1 June
2228	female	nl, p	7.0	adult	none	1 June
2110	male	ns	5.1	adult	**BK284 Recap**	25 July
2112	female	nlnp	6.9	adult	none	25 July
2115	female	lactating	none	adult	**Radio-Tag #27**	25 July
2110	female	lactating	6.9	adult	none	25 July
2144	female	lactating	6.9	adult	none	25 July
2118	female	lactating	9.2	adult	none	27 July
2120	female	lactating	9.1	adult	none	27 July
2134	male	ns	5.9	adult	none	27 July
2151	female	post-l	5.3	adult	none	27 July

B. *Myotis thysanodes* at Lower Long Canyon

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2120	female	nl, p	8.9	adult	BK294	1 June
2105	female	post-lact	10.8	adult	none	27 July

C. *Myotis ciliolabrum* at Lower Long Canyon

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2145	male	ns	4.6	adult	none	1 June

D. *Myotis evotis* at Upper Gregory Canyon

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2120	female	nl, p	6.0	adult	none	5 June
2120	female	nl, p	6.2	adult	none	5 June
2134	escaped					5 June

E. *Myotis thysanodes* at Upper Gregory Canyon

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2123	female	nl, p	9.4	adult	**RECAP. BK294**	5 June

F. *Myotis ciliolabrum* at Bear Canyon Creek

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2105	male	ns	4.0	adult	none	17 June
2107	female	nl, p	none	adult	none	17 June

G. *Myotis evotis* at Bear Canyon Creek

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2058	male	ns	4.9	adult	B488	17 June
2117	male	ns	5.2	adult	none	17 June
2147	male	ns	4.5	adult	none	17 June
2212	male	ns	6.0	adult	none	17 June

H. *Myotis thysanodes* at Bear Canyon Creek

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2152	male	ns	6.9	adult	**RECAP W79(?)**	17 June

I. *Myotis lucifugus* at Bear Canyon Creek (continued on next page)

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2100	male	ns	4.9	adult	none	28 June
2103	male	ns	7.3	adult	none	28 June
2104	male	ns	6.5	adult	none	28 June
2104	male	ns	5.3	adult	none	28 June

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2104	male	ns	5.2	adult	none	28 June
2105	male	ns	4.9	adult	none	28 June
2105	male	ns	5.5	adult	none	28 June
2106	male	ns	7.2	adult	none	28 June
2106	male	ns	7.1	adult	none	28 June
2106	male	ns	6.8	adult	none	28 June
2106	male	ns	5.7	adult	none	28 June
2107	male	ns	7.0	adult	none	28 June
2112	male	ns	6.9	adult	none	28 June
2112	male	ns	7.2	adult	none	28 June
2112	male	ns	7.0	adult	none	28 June
2115	male	ns	7.5	adult	none	28 June
2115	male	ns	6.8	adult	none	28 June
2116	male	ns	6.8	adult	none	28 June
2117	male	ns	7.0	adult	none	28 June
2122	male	ns	5.3	adult	none	28 June
2123	male	ns	4.9	adult	none	28 June
2123	male	ns	7.0	adult	none	28 June
2125	male	ns	7.1	adult	none	28 June
2122	male	ns	4.0	adult	none	28 June
2245	male	ns	7.1	adult	none	28 June
2252	male	ns	71	adult	none	28 June

J. *Myotis ciliolabrum* at Bear Canyon Creek

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2105	female	nlnp	3.6	adult	none	28 June
2123	female	nlnp	3.1	adult	none	28 June
2308	male	ns	6.5	adult	none	28 June

K. *Myotis volans* at Bear Canyon Creek

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2246	female	p	4.0	adult	none	28 June
2247	male	ns	7.0	adult	none	28 June

L. *Eptesicus fuscus* at Bear Canyon Creek

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2217	male	s	11.1	adult	none	28 June

M. *Myotis lucifugus* at Abbey Pond (continued on next page)

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2104	male	ns	7.0	adult	**Radio-tagged #25**	30 June
2107	male	ns	7.5	adult	none	30 June
2109	male	ns	7.9	adult	none	30 June

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2110	male	ns	6.1	adult	**Recap.**	30 June
2111	male	ns	5.5	adult	none	30 June
2111	male	ns	6.5	adult	none	30 June

N. *Myotis ciliolabrum* at Abbey Pond

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2135	male	ns	3.1	adult	none	30 June

O. *Myotis volans* at Abbey Pond

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2057	male	ns	5.1	adult	none	30 June

P. *Eptesicus fuscus* at Abbey Pond

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2104	male	ns	15.1	adult	none	30 June
2106	male	ns	15.0	adult	none	30 June
2117	male	ns	14.1	adult	none	30 June
2145	male	ns	15.3	adult	none	30 June
2145	female	lact.	none	adult	**Radio-Tagged #21**	30 June
2236	male	ns	17.5	adult	none	30 June

Q. *Myotis lucifugus* at NIST

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2102	female	nlnp	3.1	juvenile	none	22 July
2104	male	ns	7.0	adult	none	22 July
2104	male	ns	none	adult	none	22 July

R. *Myotis ciliolabrum* at NIST

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2106	male	ns	2.1	adult	none	22 July
2107	female	nlnp	1.8	juvenile	none	22 July

S. *Myotis lucifugus* at Stockton Cabin (Shadow Canyon) (continued on next page)

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
unknown	male	ns	7.3	adult	none	28 July
unknown	male	ns	7.1	adult	none	28 July
unknown	male	ns	9.0	adult	none	28 July
unknown	female	nl	5.3	SA	none	28 July
unknown	male	ns	6.9	adult	none	28 July
unknown	male	ns	5.5	adult	none	28 July
unknown	male	ns	6.0	adult	none	28 July
unknown	female	post-l	6.5	adult	none	28 July
unknown	male	ns	5.3	adult	none	28 July
unknown	male	ns	5.2	adult	none	28 July

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
unknown	female	ns	4.5	juvenile	none	28 July
unknown	male	ns	5.1	SA	none	28 July
unknown	male	ns	6.1	SA	none	28 July
unknown	female	nlnp	6.9	SA	none	28 July
unknown	male	ns	6.1	juvenile	none	28 July
unknown	female	none	5.9	adult	none	28 July
unknown	male	ns	5.1	adult	none	28 July
unknown	male	ns	6.0	SA	none	28 July
unknown	male	ns	6.1	SA	none	28 July

T. *Myotis thysanodes* at Stockton Cabin (Shadow Canyon)

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
unknown	male	ns	7.3	adult	none	28 July
unknown	male	ns	none	adult	**Radio-Tagged #29**	28 July
unknown	male	ns	6.5	adult	none	28 July
2237	male	ns	7.2	adult	none	28 July

U. *Myotis ciliolabrum* at Stockton Cabin (Shadow Canyon) (continued on next page)

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2136	male	ns	4.0	adult	none	28 July
2145	female	nlnp	3.0	juvenile	none	28 July

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
unknown	male	ns	3.9	adult	**Recap. BK204**	28 July

V. *Myotis evotis* at Stockton Cabin (Shadow Canyon)

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2121	male	ns	5.1	adult	none	28 July
2243	male	ns	4.8	adult	none	28 July

W. *Myotis volans* at Stockton Cabin (Shadow Canyon)

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
unknown	male	ns	6.3	juvenile	none	28 July

X. *Lasiurus cinereus* at Stockton Cabin (Shadow Canyon)

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2121	male	ns	24.0	adult	none	28 July

Y. *Myotis thysanodes* at Maiden I

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2048	male	ns	5.2	adult	none	29 July
2107	male	ns	4.3	adult	none	29 July

Z. *Myotis evotis* at Maiden I

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2052	male	ns	5.0	adult	none	29 July

AA. *Myotis ciliolabrum* at Maiden I

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2054	male	ns	3.1	adult	none	29 July
2110	female	lactating	none	adult	**Radio Tagged #24**	29 July

BB. *Myotis thysanodes* at Dakota Ridge

Time of Capture	Sex	Repro. Status	Weight	Age	Band #	Date of Capture
2050	female	lactating	none	adult	**Radio Tagged #28**	31 July

and eight of the 20 yielded no captures (Table 2). For approximately 1/3rd of the net-nights, weather prevented successful attempts at gathering data. In many of these cases, high winds affected capture success which equated to a mere 2.42 bats per net per night in 2001.

B. Radio Telemetry: Six bats of five species were tagged with 0.47g LD-2 Holohil, Inc. radio tags (Table 3). On 30 June a nonscrotal male *Myotis lucifugus* and a lactating female *Eptesicus fuscus* were radio tagged at Abbey Pond. The male *M. lucifugus* disappeared and its signal was never reacquired despite daytime attempts to find the roost site and nighttime surveys with telemetry gear at Abbey Pond (Table 1M & Table 3). The signal of the female *E. fuscus* was reacquired the following morning and the individual was found roosting at Seal Rock above Bear Canyon Creek and was determined to be a member of a maternity colony of 80 bats found in 1999 (Table 1P & Table 3).

On 25 July a lactating female *Myotis evotis* was radio-tagged at Long Canyon. The signal for this individual was not reacquired until two days later when from a position above Long Canyon on Flagstaff's Summit Drive a weak signal was received as the bat foraged SSE of Long Canyon at a distance of at least 2 kilometers. Four days of searching for the roost site and several more nights of telemetry work proved futile as the signal was never heard from again.

On 31 July, a lactating female *M. ciliolabrum* was radio-tagged at the water hole Maiden I (Table 2). I followed this individual after release for about one hour as it foraged in the area, returning to its roost at about 2300h. On 1 August I tracked this individual to its roost site located in an east-facing scree field slope 0.14 kilometers above Maiden I. The roost was located on the ground under a large rock with the opening to the roost facing NNE (Table 4, see Photograph # 3). We returned that night to conduct a roost site count and track the tagged

Table 2. Field sites, locations, dates netted and net-night accrued in 2001. Total net-nights = 48. Continued on next page.

SITE	COORDINATES	DATES	NET NIGHTS
Big Blue Stem	Lat. 39° 57' 10" Long. 105° 16' 42"	30 April	one
Long Canyon	Lat. 39° 59' 38" Long. 105° 17' 40"	1 June, 25 & 27 July	three
Upper Long Canyon	Lat. 39° 57' 01" Long. 105° 18' 34"	11 June	four
Upper Gregory Canyon	Lat. 39° 59' 54" Long. 105° 18' 06"	5 June	two
S. Mesa Trailhead	Lat. 39° 56' 24" Long. 105° 15' 25"	7 June, 17 August	four
Lower Gregory Canyon	Lat. 39° 59' 53" Long. 105° 17' 31"	12 June	two
Bear Canyon Creek		17 & 28 June	four
Chapman Drive		19 June	three
3rd St. Ditch	Lat. 40° 02' 19" Long. 105° 17' 33"	21 June	one
Maiden I	Lat. 39° 57' 01" Long. 105° 16' 54"	23 June, 29 July	three
Blue Bell	Lat. 39° 59' 47" Long. 105° 16' 49"	24 & 25 June	four
Maiden II	Lat. 39° 57' 09" Long. 105° 16' 43"	27 June	one
Abbey Pond	Lat. 39° 57' 52" Long. 105° 15' 44"	30 June	two
Dakota Ridge	Lat. 40° 01' 47" Long. 105° 17' 43"	9 & 31 July	four
NIST	Lat. 39° 59' 29" Long. 105° 16' 06"	22 July	one

SITE	COORDINATES	DATES	NET NIGHTS
Stockton Cabin	Lat. 39° 56' 44" Long. 105° 17' 08"	23 & 28 July	four
Sanitas Valley Trailhead (SVTH)	Lat. 40° 01' 14" Long. 105° 17' 40"	26 August	two
Sanitas Valley Irrigation Ditch	Lat. 40° 01' 22" Long. 105° 17' 41"	21 August	two
Middle Gregory Canyon	Lat. 39° 59' 52" Long. 105° 17' 44"	25 August	one
Buckingham Park		3 August	one

Table 3.–Radio-telemetry information. NA = not applicable (continued on next page)..

SPECIES	SITE	TAG DATE	DATE ACQUIRED	DATE LOST	OUTCOME
Myotis lucifugus ♂	Abbey Pond	30 June	none: searched for 8 days	NA	never reacquired signal
Eptesicus fuscus ♀	Abbey Pond	30 June	1 July: 0700	4 July	female from previously known roost above Bear Canyon Creek, tracked bat for 2 nights
Myotis evotis ♀	Long Canyon	25 July	27 July: 2110, minimal signal SSW of site	28 July	never located roost, nor reacquired signal over 6 day/night search
Myotis ciliolabrum ♀	Maiden I	29 July	30 July: 1000	1 August	located roost site in talus slope above site, tacked bat over 3 nights

SPECIES	SITE	TAG DATE	DATE ACQUIRED	DATE LOST	OUTCOME
Myotis thysanodes ♀	Dakota Ridge	31 July	1 August: 0830	2 August	located roost SSW of site, tracked bat for 4 nights

Table 4.–Roost sites found in 2001.

SPECIES	COLONY TYPE	# INDIVIDUALS	ROOST TYPE
Myotis ciliolabrum	maternity	3-4	talus slope
Myotis thysanodes	maternity	12-15	rock crevice

individual. The first bat left the roost at 2030. The lactating female was the third and last individual to leave the roost at left the site at 2031. Upon exiting the roost she foraged briefly and visited the Maiden I water hole approximately 35 seconds after emerging from the roost. The farthest distance we were able to pick up her signal was 1.3 km from the roost in a SSE direction (Figure 1). She moved out of range within 5 minutes after emergence. We hiked downslope in the direction from which we last received her signal, but we were unable to reacquire the signal that night. Because the signal was relatively strong when it disappeared, it is possible that the radio tag fell from the bat at that moment.

On 31 July, a lactating *Myotis thysanodes* was radio-tagged at the Dakota Ridge water hole, Sanitas Valley. Its roost site was found the next day and was located SSW, 0.87km from the Dakota Ridge water hole on a SE aspect rock face (Table 4, see Photograph #4). We visited the roost on the evening of 1 August to conduct a colony count and to track the tagged individual. Rain and wind prevented us from gathering any data on that night. We returned on the night of 2 August, and located the approximate location, within 3 m, of the roost site's opening on the rock face. The tagged individual left the site at 2031 and traveled 0.8 km SSW towards Settler's Park and appeared to forage for about 10 minutes along the "saddle" area SSW of the Red Rocks irrigation ditch. It then returned to the area surrounding its roost site and headed north up Sanitas Valley to approximately 1.3 km away (Figure 2) and foraged for approximately 15 minutes before moving out of range for about 30 minutes. It then returned briefly to the top of Sanitas Valley before disappearing out of range once again. We left the area at 2345 never again reacquiring the telemetry signal.

Figure 1 shows general overlap in home range areas in bats that emerge from roosts in a

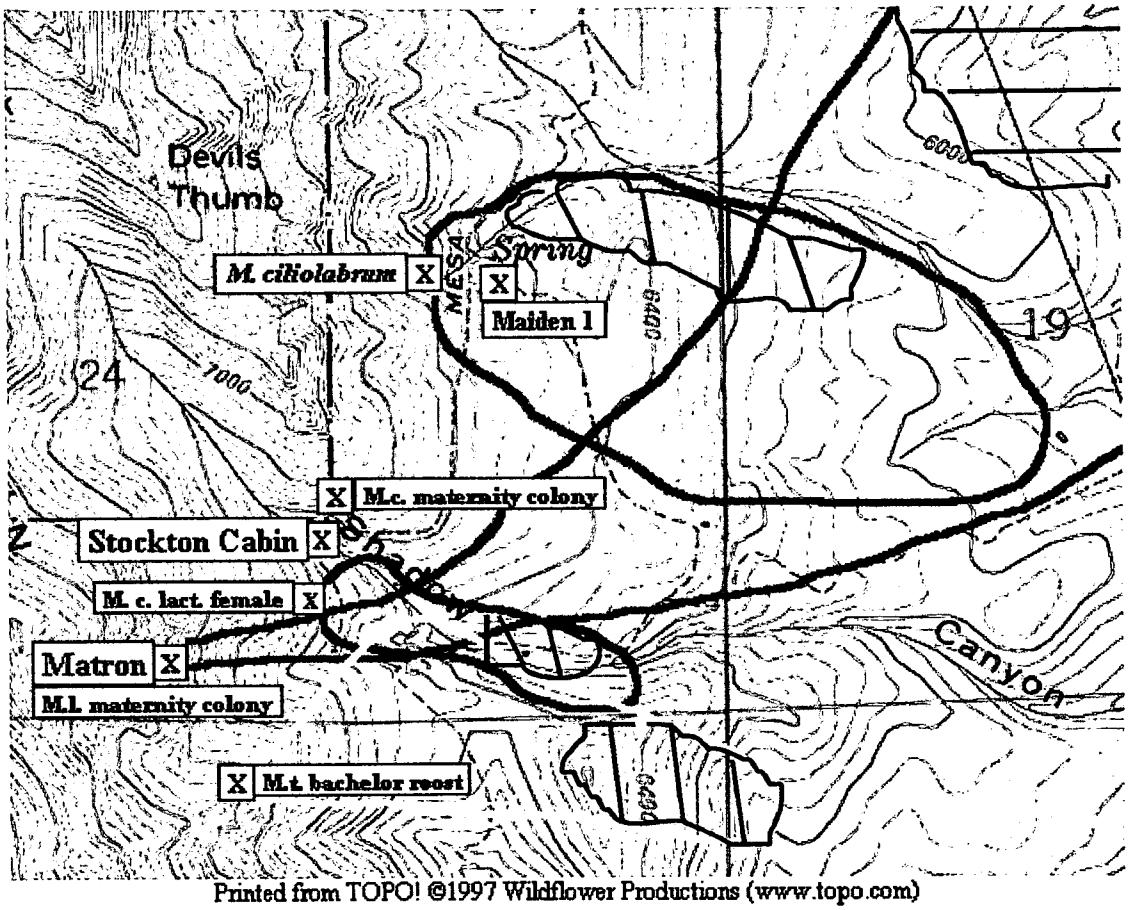

Figure 1. Minimum home ranges for bats tracked in the Shadow Canyon area. Red line demarcates minimum home range for a lactating female *M. ciliolabrum* tracked in 2001 from her roost site above a water hole dubbed Maiden I. Black-hatched areas indicate where each species spent majority of time during sampling period.

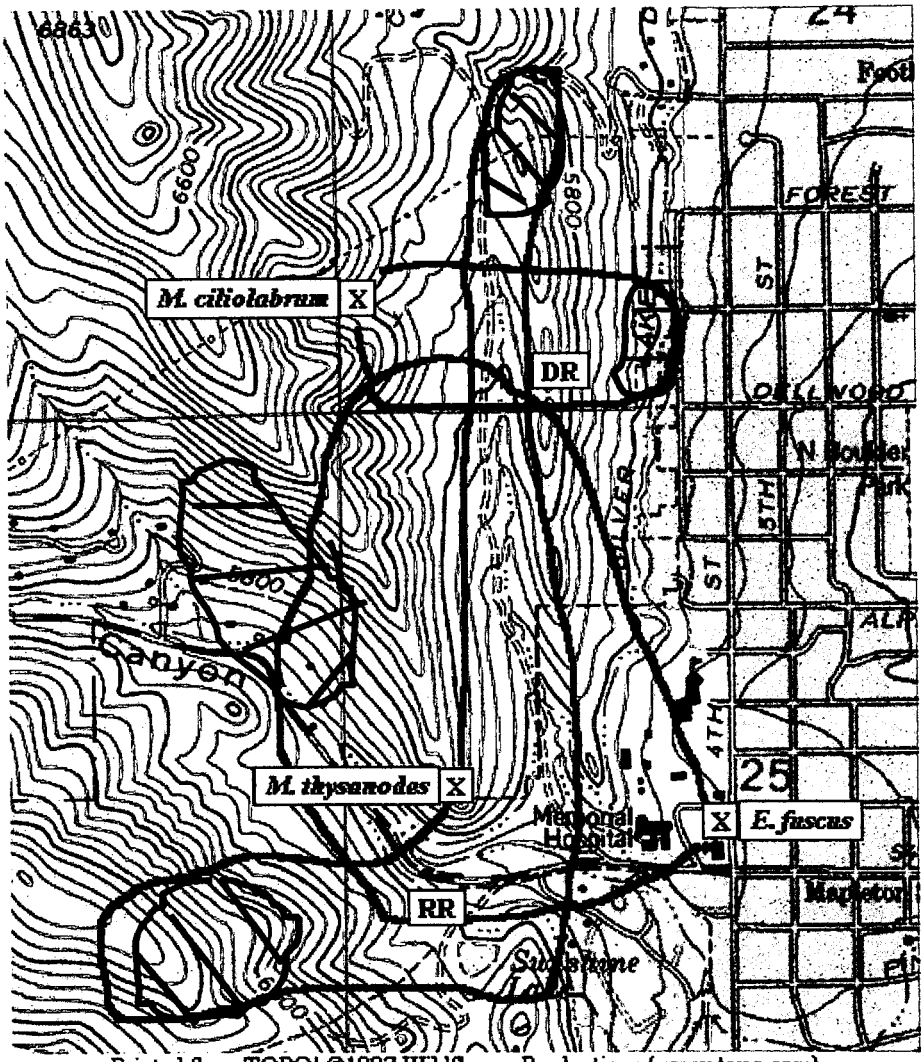

Figure 2. Minimum home ranges for several species living in the Sanitas Valley area. Red line indicates movements of a lactating female *Myotis thysanodes* radio-tagged in 2001.

given area. However, although ranges do overlap, where individuals spent the majority of their time foraging during the observation periods appear to be discrete from each other. The two female *M. ciliolabrum* spent most of the time closest to their roost sites on these occasions. On other occasions, however, females have moved much farther from the roost when foraging. Whether or not their young have themselves become volant may determine distance traveled during foraging by lactating. If a female's young is not yet volant the adult would predictably remain close to the roost. In 2001, the youngster of the lactating adult *M. ciliolabrum* tagged at Maiden was likely volant at this late date (29 July), as her foraging took her out of the 1 km range of our telemetry unit. Most of the foraging time for *M. ciliolabrum* was in edge habitat between Douglas fir or ponderosa pine and clearings, or along cliff faces. These foraging patterns are consistent with data gathered in 1996 on a light-tagged *M. ciliolabrum* captured at Gregory Canyon that spent the following few hours foraging along the edge of Douglas fir forest and a clearing near the trail.

The male *M. thysanodes* radio tagged in Shadow Canyon spent most of it time when in range foraging in the mixed coniferous forest to the SE of its roost site (Figure 1). The lactating female from the Matron maternity colony had the farthest documented range thus far. It spent most of its time foraging in open ponderosa pine habitat near South Shanahan Pond over three nights. On one night I watched the individual foraging around the pond before complete darkness for close to 45 minutes before it headed NNE out of range of our telemetry gear despite our efforts to follow it (Fig. 1).

Figure 2 shows minimum home range data for three species living in the Mount Sanitas area. The lactating *M. ciliolabrum* whose roost was located on Mount Sanitas in 1999 spent

most of its time foraging over three nights along 3rd Street near a parking lot where street lights attracted insects. The *E. fuscus* female captured 0.5 km from its roost located in the church at the corner of 4th and Mapleton Drive in 2001 in the Red Rocks area, spent most of its time out of range of our telemetry units in the direction of Boulder Canyon, probably foraging along Boulder Creek (Figure 2). In other areas this species was observed foraging 20-30 m above the ground in ponderosa pine habitat.

In 2001, a lactating female *M. thysanodes* was radio-tagged at the Dakota Ridge water hole. Figure 2 shows its minimum home range. This individual spent most of its time during the observation period, foraging in two areas. Immediately after leaving its roost it flew to the "saddle" area near Settler's Park where it foraged for approximately 15 minutes. It then spent significant time foraging in Sanitas Valley, mostly at the top of the valley in and out of range of our telemetry unit.

C. Roost Temperature Data: Table 5 shows temperature data gathered from roost sites thus far in this study. Four colonies were monitored in 2001. For *Corynorhinus townsendii*, the maternity colonies in Mallory Cave experienced a lower mean temperature ($\bar{x}$ = 15.2° C) and smaller temperature range (11.4-17.9° C) than did Harmon Cave ($\bar{x}$ = 21.8° C; range = 9.5-25.9° C). Temperatures for the *M. thysanodes* maternity site on DerZerkle averaged 22.9° C and for *M. lucifugus* on the Matron averaged 26.5° C (Table 5). Inside roost temperature for *M. thysanodes* tended to exceed external roost temperatures (Fig. 3), whereas inside roost temperature for the *M. lucifugus* maternity colony tended to always be less than external temperatures (Fig. 4). For *E. fuscus*, average temperatures were higher in maternity roosts than in a bachelor roost (Table 5).

Table 5.–Temperature (°C) means and ranges for four maternity colonies measured in 2001 and four measured in 2000.

SPECIES	ROOST SITE	COLONY TYPE	COLONY SIZE	MEAN TEMP. (°C)	TEMP. RANGE
*Corynorhinus townsendii**	Mallory Cave	Maternity (two)	a. 6-10 b. 20-25	15.2	11.4-17.9
*Corynorhinus townsendii**	Harmon Cave	Maternity	25	21.8	9.5-25.9
*Myotis thysanodes**	DerZerkle	Maternity	46	22.9	12.9-36.5
*Myotis lucifugus**	Matron	Maternity	120	26.5	11.8-27.4
Eptesicus fuscus	Seal Rock	Maternity	82	30.8	27.7-31.6
Eptesicus fuscus	House	Maternity	235	45.4	34.8-37.2
Eptesicus fuscus	Amphitheater	Maternity	80	29.0	20.2-31.8
Eptesicus fuscus	Harmon Cave	Bachelor	35	25.1	23.2-25.5

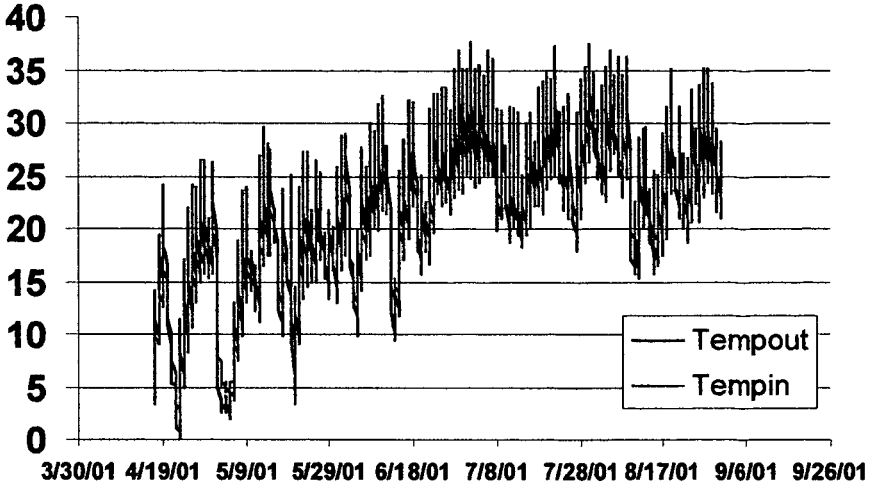

Figure 3. Temperature profiles for *Myotis lucifugus* inside and outside of maternity roost at the Matron. See text for explanation.

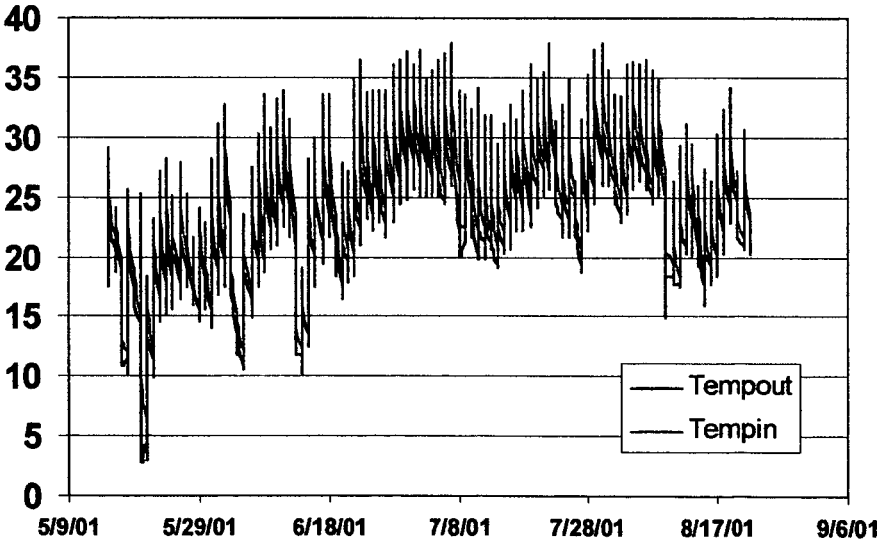

Figure 4. Temperature profiles for *Myotis thysanodes* inside and outside of maternity roost at DerZerkle. See text for explanation.

D. Cave Roost Monitoring of Mallory & Harmon Caves: Because Mallory and Harmon Caves house maternity colonies of Townsend's big-eared bats (*Corynorhinus townsendii*), special attention was paid to monitoring these sites for bat colony persistence and human disturbance (Table 6). Harmon Cave was entered twice throughout the summer to check for roosting *C. townsendii*. On 28 May 2001, a single individual was present and roosting in the small chamber known to house a maternity colony *C. townsendii*. The individual was roosting on the upper wall on the SSE side. It was in torpor and did not arouse at my entry. The second entry occurred on 26 August and again a single individual was present roosting in the same general location as observed on 28 May. It appears likely that this was the same individual of unknown sex and age. Guano accumulation on the floor of the chamber was consistent with use of a small group of individuals and appeared to represent more than one would expect from a single individual throughout the summer. Little human disturbance was noticed at Harmon Cave, although people had visited as observed through footprints at the cave opening.

Mallory Cave was monitored more extensively than Harmon Cave in 2001 because 1) it was the first year of a mandatory seasonal closure at Mallory to protect roosting bats, and 2) Mallory is a high-impact site because no entrance gate is present on the cave to protect the bats. On 28 May I entered the cave and found no bats present. On 10 May I entered the site with Ranger Lynne Sullivan and found a colony of 5-6 *C. townsendii* roosting in the NE corner of the cave approximately 1 meter from ground level. On 19 May I reentered Mallory Cave and found 8-10 adult *C. townsendii* clustered together, but at this time they were roosting on the ceiling approximately 4 meters above ground. On 10 June I visited Mallory Cave and found two distinct colonies of *C. townsendii*. The colony of 8-10 individuals that had been present since May

Table 6.–Dates and tasks of cave & crevice work.

SITE	DATE	TASK
Mallory Cave	28 April	placement of data logger
Harmon Cave	28 April	placement of data logger
Matron	20 January	placement of data logger
DerZerkle	10 May	placement of data logger
Mallory Cave	10 May	changed signs, censused bats
DerZerkle	12 May	changed signs
Mallory Cave	12 May	censused for bats
Mallory Cave	19 May	erected protective fencing
Mallory Cave	10 June	censused for bats
Mallory Cave	26 August	censused for bats
Harmon Cave	26 August	censused for bats, removed data logger
DeZerkle	1 October	removed data logger (B. Stoner)
Mallory Cave	15 October	removed data logger (L. Sullivan)

utilized the same north-end of the cave throughout the summer, however, another colony numbering approximately 20-25 individuals was found roosting in a cluster on the S-end of the cave, hanging from the ceiling approximately 5 meters above the ground. On 26 August, a single colony of 10-15 individuals, females and young, were observed in Mallory Cave roosting at the north end. Entry time was 1055h and the bats were alert and squeaked as Lynne Sullivan and I entered the cave briefly. A visit by Lynne Sullivan on 15 October indicated that the bats had left the cave for the season.

DISCUSSION

For 2001, capture success was less than in previous years, however, all indications are that the lower capture numbers were a direct effect of inclement weather, rather than reduced numbers in population sizes. More than 1/3rd of our netting attempts were dramatically affected by wind and/or rain. Radio telemetry data led to the finding of two new maternity roosts, one for *M. thysanodes*, which is the first such site found in the Mount Sanitas area in north Boulder. It was predicted in 2000 that such a colony existed because of a capture of a post-lactating female along the Red Rocks irrigation ditch. The second maternity site found in 2001 was for *M. ciliolabrum* which documents yet another such site for this species occurring under a rock on a scree-slope. The discovery of several such maternity sites for this species encourages further study of the use of scree-slopes by bats and the probability of human disturbance due to off-trail hiking in the area. In addition, *M. ciliolabrum* comprises < 5% of all captures for *Myotis* spp in the assemblage. The reason for such low population numbers for this species is unknown, but the possibility that human disturbance at maternity sites cannot be ruled out.

Telemetry data on foraging patterns among species in the assemblage indicates that although home ranges do overlap, the majority of time spent foraging occurs in different and non-overlapping areas. Tagging several individuals of the same species would likely give insight into whether or not colonies forage in the same areas together. Data thus far indicate little interspecific overlap in foraging areas on any given night.

Data on roost temperatures give insight into specific microclimate requirements. However, data collection is subject to probe placement in terms of depth into the rock crevice. Data gathered from two rock crevice roosts for *M. lucifugus* and *M. thysanodes* show distinctive strategies for temperature regulation and roost temperature profiles. For *M. lucifugus*, roost site temperatures were consistently lower than outside ambient temperature, whereas for *M. thysanodes*, roost site temperatures were consistently higher inside the roost. In fact, *M. thysanodes* appears to tolerate much higher roost site temperatures (Table 5). More data from different roosts will be required to understand if these are species-specific roost site factors.

Data on temperatures from Mallory and Harmon Caves show that Mallory has a lower and more stable roost site temperature profile throughout the summer. In fact, the temperature readings and cave morphology of Mallory are consistent with data collected on site preferences for *C. townsendii* in other regions of the U.S. The increased usage of Mallory Cave by approximately 35-40 *C. townsendii* shows the importance of this roost site for this species and that to a certain extent the seasonal closure was effective. However, several visitations by us and others working for the CBOSMP showed that people entered the site while ignoring the seasonal closure. The colonies of *C. townsendii* now using Mallory Cave are highly susceptible to human disturbance and outright human destruction if intended. We plan a much more rigorous analysis

of the site in terms of human impacts and the usage patterns by the maternity colonies of *C. townsendii* in 2002.

Harmon Cave is already a well-protected site due to its gating in 1996. *C. townsendii* continue to use this site even though Mallory Cave apparently is preferred. Harmon provides a safe-house for some of the bats that apparently utilizing both sites throughout the summer. This is usual for *C. townsendii* which is known to switch roosts throughout the summer. Only a single individual of Townsend' bat was observed in Harmon Cave on two visits, however, the amount of guano present at summer's end suggest higher use that just one individual. A study to determine the extent to which humans are visiting Harmon Cave is important because even though entry into the cave is afforded by the gate, people standing just outside the gate can are close enough to the colony that disturbances such as yelling into the cave could be significant and disturbing to the colony.

ACKNOWLEDGMENTS

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Naturalist/Ranger, Burton Stoner, Naturalist Ranger Rick Hatfield, and Access Fund's Kath Pyke who risked danger to place temperature data loggers in rock crevices and survey roosts in some very difficult climbing situations. We greatly appreciate Wildlife Biologist Cary Richardson for her support conducting field work and with public education. I would like to thank the many volunteers who have produced very important data on activity of bats at water holes and at roost sites along the Front Range.

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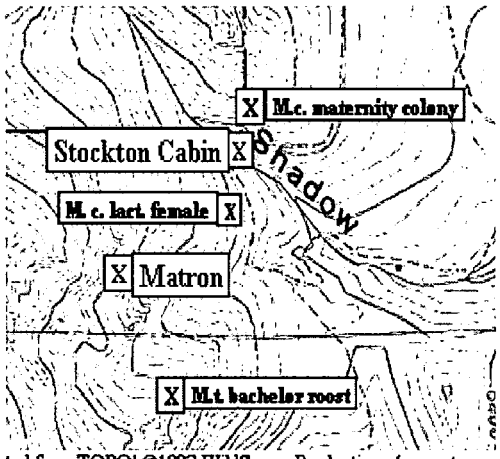
APPENDIX I

Photographic gallery of representative roost sites thus far documented in the City of Boulder Open Space and Mountain Parks. All photographs were taken by Rick Adams with the exception of Mallory Cave, Harmon Cave, and Der Zerkle that were provided by Burton Stoner of the CBOSMP. This gallery is to act as representative collection of the various roost sites occupied by bat species living in the area and is not meant to represent an exhaustive gallery of all roost sites thus far documented.

Content

1. Scree-field maternity roost site of *M. ciliolabrum*. Colony size = 2-3 individuals. Location: Directly north of Stockton Cabin in adjacent scree-field Lat. 39° 56' 40", Long. 105° 17' 10"

Map of roost sites pictured



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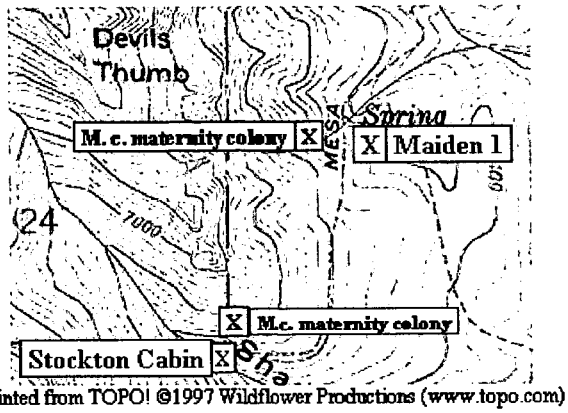
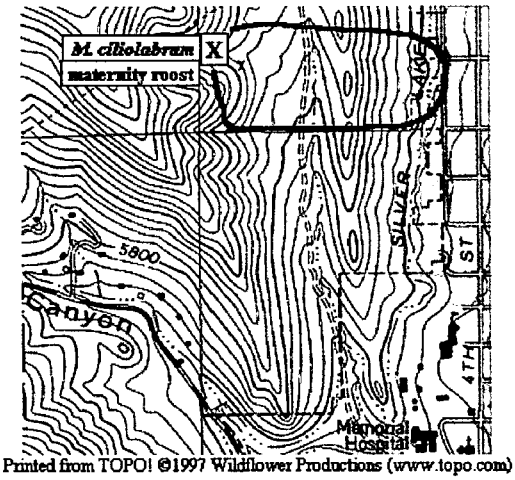
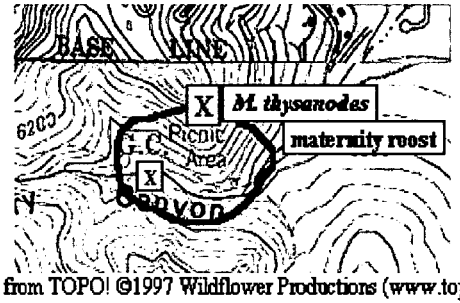
2. Scree-field maternity roost of *M. ciliolabrum*. Colony size = two individuals, mother and offspring. Location: Scree field SW of Stockton Cabin. Lat. 39° 56' 40" Long: 105° 17' 10"



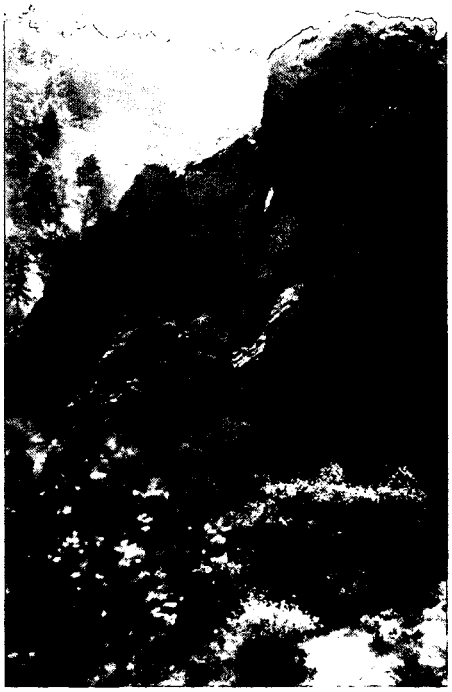
3. Scree-field maternity site for *M. ciliolabrum*. Colony size = 3-4 individuals, likely two females with two offspring. Lactating female captured at Maiden 1 waterhole. Location: Scree-field just below the Maiden climbing rock and just west of Mesa trail. Lat. 39° 57' 01", Long. 105° 17' 00"

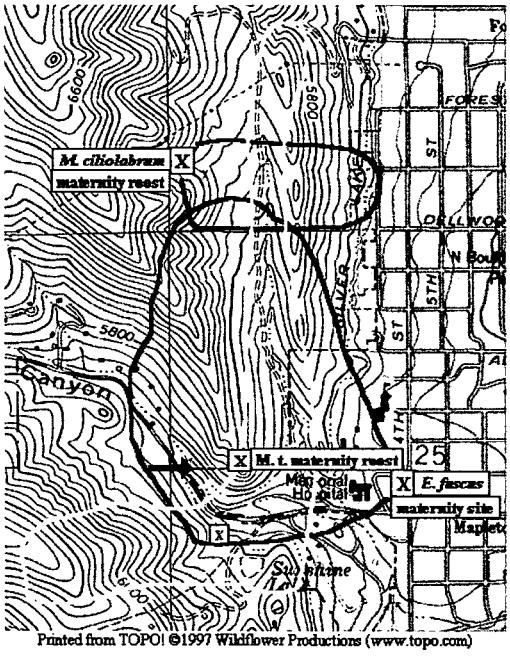


4. Rock crevice maternity roost site and home range for *M. ciliolabrum* on Mount Sanitas. Colony size is 3-4 individuals. Location: Approx. 1.6 km (1 mi.) from base of Sanitas mountain trail head and west of the trail at commonly used overlook. Crevice is < 1 m from ground level. Lat: 40° 01' 52", Long. 105° 18' 00"



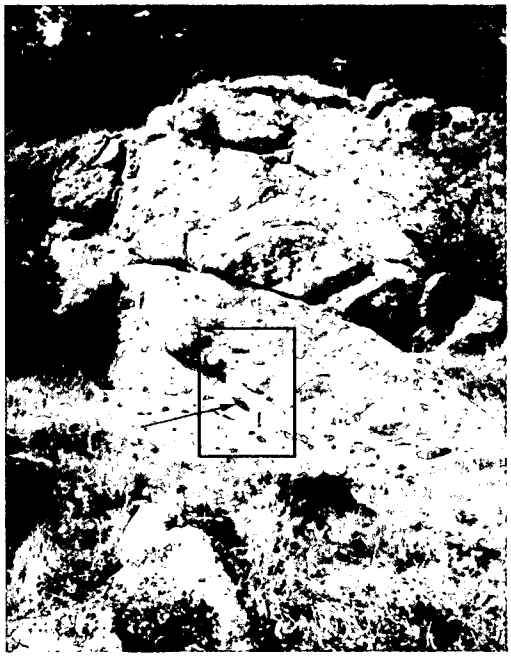
5. Rock Crevice maternity roost and minimal home range for *M. thysanodes* (arrow indicates roosting bat). Colony size is eight individuals, females and young. Location is West and approximately 60 m (200 ft) above Gregory Canyon parking area. Lat. 39° 59' 57", Long. 105° 18' 00"



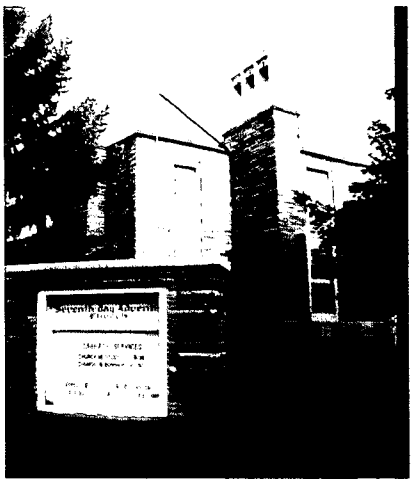


6. Rock crevice maternity roost and minimum home range (yellow) for *M. thysanodes*. Colony size is 10-15 individuals. Location: Southern-most rock outcrop on west side of Sanitas Valley, approximately 0.4 m (1/4 mile) from Sanitas Valley trailhead at Mapleton Dr. Lat. 40° 01' 19", Long. 105° 17' 53"

7 & 8. Rock crevice roosts for a maternity colonies of *Myotis thysanodes*. Left, DerZerkle. Colony size = 47 individuals. East aspect. Right, Second Flat Iron. East aspect. Climbers Kath Pike and Burton Stoner could not find exact location of roost. Colony size = 12-14 individuals. Location: Lat. 39° 59' 57", Long. 105° 17' 35"

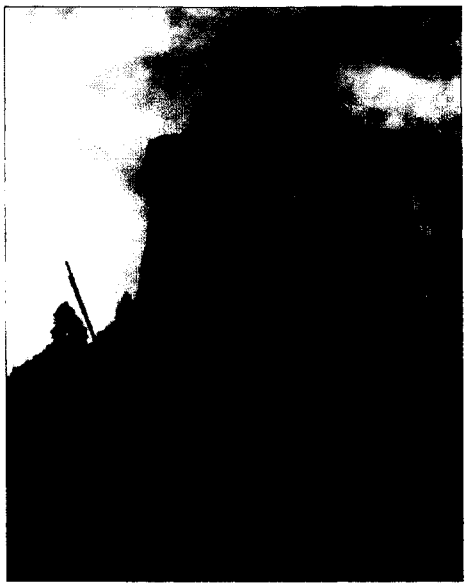


9 & 10. Rock crevice maternity roost site for *Myotis evotis*. Left photo of entire outcrop, right photo, closeup of crevice boxed in left. Colony size is unknown. Location: Rock outcrop overlooking Boulder Canyon, east aspect, Lat. 40° 00' 37", Long. 105° 18' 59"

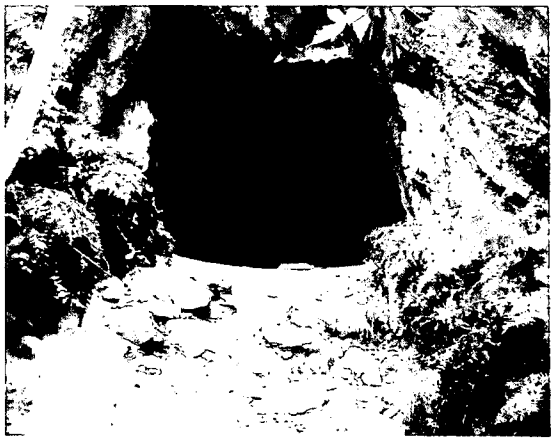


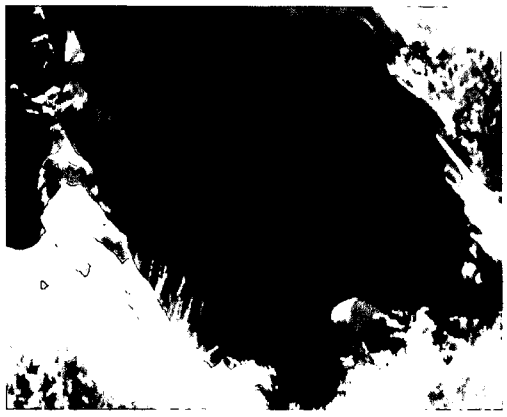
11. Human-made structure used as a roost site by maternity colony of *Eptesicus fuscus*. Colony size is 22-24 females and juveniles. Location: Seventh Day Adventist Church on the corner of 4th and Mapleton, Lat. 40° 01' 17", Long. 105° 17' 29"

12. Rock crevice roost of *E. fuscus* maternity roost. Colony size = 70 females and juveniles. Location: NNW corner of Gregory Canyon Amphitheater, Lat. 39° 59' 42", Long. 105° 17' 40" Another rock crevice roost for *E. fuscus* (not pictures) is located NNW of Harmon cave. Colony size = 80 females and juveniles. Lat. 39° 58' 06", Long. 105° 17' 28"



13. Rock crevice roost for maternity colony of *Myotis lucifugus*. Left: Matron climbing rock showing roost site location. Right: Exit hole for roost site. Colony size = 120 females and juveniles. Location: SSE face of Matron climbing rock. Lat. 39° 56' 36", Long. 105° 17' 22"





14 & 15. Two maternity sites for Townsend's big-eared bat (*Corynorhinus townsendii*). Left: Mallory Cave housed two distinctive colonies of individuals after seasonal closure in 2000. Right: Harmon Cave pictured here in 1995 before gating. Arrows indicate position of *Eptesicus fuscus* bachelor roost (upper left) and position of small entry into back-chamber where *C. townsendii* roosts in a colony up to 20 individuals.