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# HABITAT AFFINITIES OF BATS FROM NORTHEASTERN NEVADA

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ABSTRACT.—Bat surveys were completed in 6 habitat types in eastern Nevada between 1980 and 1994. Twelve species of bats and 578 individuals were identified from 33 trap localities in 144 trap nights. There were weak correlations between bat species richness and January maximum temperatures (0.728, $P < 0.05$) and mean annual days with 0° C or lower (–0.704, $P < 0.05$). Bat species richness exhibited no correlation with annual normal precipitation, January minimum temperatures, July minimum temperatures, and July maximum temperatures. It appears that bat species richness is highest in portions of northeastern Nevada typified by sedimentary deposits (limestone, dolomite). Igneous mountain ranges (basalt, volcanic ash) generally had moderate bat species richness, and metamorphic mountain ranges (quartzite) typically had low bat species richness. Notable range extensions include *Antrozous pallidus* (from central Nye County north to the Nevada-Idaho border, approximately 450 km), *Tadarida brasiliensis* (approximately 350 km north), and *Pipistrellus hesperus* (approximately 350 km north). Also, the presence of *Lasionycteris noctivagans*, *Lasiurus cinereus*, and *Corynorhinus townsendii* was confirmed.

*Key words: bats, Chiroptera, Nevada, habitat.*

Although the distribution of mammals of the Great Basin has been studied in some detail (Hall 1946, Durrant 1952, Brown 1971, Thompson and Mead 1982, Wells 1983, Grayson 1987), bats remain poorly known. There are very few recent records of bats from the northern Great Basin of Oregon, Idaho, and Nevada (Hall 1946, Durrant 1952, Larrison and Johnson 1981). Here we present new information on habitat affinities and distribution of 12 species of bats from eastern and northeastern Nevada. Such information may prove valuable to land managers and wildlife biologists who make decisions on how to deal with the impact of human activities on bats.

## METHODS

### Study Area

Northeastern Nevada is part of the Great Basin Division of the Intermountain Floristic Region (Holmgren 1972), an area of continental climate with fairly hot summers and cold, snowy winters. Some 30 north/south-trending fault-block mountain ranges (3000–4000 m) are separated by high-elevation (1500–2000 m) xeric basins.

Mountain ranges in northern Elko, Eureka, Humboldt, and Lander counties are mostly igneous and metamorphic fault blocks, covered with various mountain brush communities and fragmented coniferous and deciduous forests. Perennial streams produce riparian habitats in most canyons. Vertical cliffs and stands of deciduous and coniferous trees provide sites for day roosting and shelter for maternity activities. Valley floors are mostly xeric, covered with salt-tolerant shrubs (*Atriplex* spp., *Sarcobatus* spp.) and sagebrush (*Artemisia* spp.). Occasional perennial streams extend onto valley floors and are lined with narrow corridors of deciduous woodlands and mesic shrubs.

Mountain ranges in eastern Nevada (White Pine and southern Eureka and Lander counties) are predominantly limestone and dolomite fault blocks and tend to have more xeric plant communities. A large number of natural caves and vertical cliff sites provide excellent habitats for bat maternity and hibernation roosts. Natural perennial springs found near the valley/mountain fault lines often provide the only dependable water for miles around. Contiguous coniferous forests on some of the higher mountain slopes provide suitable tree roosts. Abandoned mine shafts and adits are abundant in northeastern Nevada and are critically important to some bat species, both summer and winter.

### Survey Methods

Surveys began in the summer of 1980 and extended through the fall of 1994. Capture

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methods included mist nets, hand capture, and harp trap (Kunz and Kurta 1990). Mist nets and the harp trap were used over perennial streams, small springs, beaver ponds, livestock tanks, in forest canopies, and adjacent to mine shafts, adits, and natural caves. Captured bats were identified, sexed, reproductive status recorded, aged, weighed, and then released. Some individuals were taken as voucher specimens and are temporarily held in the vertebrate collection of Great Basin College. S. Altenbach (personal communication) and M. O'Farrell (personal communication) assisted in identifications. Localities were identified on 1:100,000 scale metric topographic maps.

To describe habitat affinities, we delineated 6 general habitat types for the region: **C**–river **canyons** in igneous or metamorphic rock, above low-gradient, perennial streams lined with cottonwood (*Populus* spp.), willow (*Salix* spp.), and mesic shrubs (*Rosa* spp. and *Ribes* spp.), elevation approximately 2200 m; **S**–foothill and valley **springs**, with or without deciduous trees and a surrounding area of salt-tolerant shrubs (*Atriplex* spp., *Sarcobatus* spp.) or mountain brush (*Artemisia* spp., *Amelanchier* spp., *Sambucus* spp., *Symphoricarpos occidentalis*, *Purshia tridentata*) communities, elevation approximately 2000 m; **F**–mid- to high-elevation coniferous **forests** of juniper (*Juniperus osteosperma*), fir (*Abies concolor* and *A. lasiocarpa*), spruce (*Picea engelmannii*), and pine (*Pinus monophylla*, *P. flexilis*, and *P. longaeva*) often with cliff sites and natural caves in the proximity, elevation approximately 2300–3000 m; **D**–mid- to high-elevation **deciduous** forests of aspen (*Populus tremuloides*), cottonwood (*Populus* spp.), and mesic shrubs (*Amelanchier* spp., *Prunus* spp., *Betula occidentalis*, *Alnus tenuifolia*) often along high-gradient, perennial streams, elevation approximately 2300–2800 m; **U**–natural caves and **underground** mine shafts/adits with surrounding plant communities described in habitats C, F, S, and D; and **B–buildings** in towns and on ranches. There may also be additional important bat habitats not yet identified in this region.

## RESULTS AND DISCUSSION

A total of 578 individuals of 12 species of bats were identified from 33 trap localities in 144 trap nights from eastern and northeastern Nevada (Tables 1, 2 and Appendix 1). Three species of *Myotis*, (*M. evotis*, *M. volans*, and *M. ciliolabrum*) were the most widespread (Appendix 1) and had the highest occurrence (Tables 1, 2) of bats from eastern Nevada. *M. evotis* was one of the most abundant species of *Myotis* in eastern Nevada and occurred in all habitats except towns and around buildings. This species is most often associated with mid-elevation pinyon pine and Utah juniper woodlands (Manning and Jones 1989). We, too, found this species to be most abundant in this habitat type (localities 8, 9, and 18, Table 1). *M. evotis* depended heavily on the presence of natural springs within these woodlands as their sole source of water. *M. volans* was also found to utilize a variety of habitats in eastern Nevada, including pinyon-juniper woodlands such as those found near Old Man's Cave. Eight lactating females were examined at this site, suggesting a nearby nursery colony. Upon release, 4 individuals flew into the cave while the others flew to nearby rock outcrops. The literature suggests that this species uses cracks in cliff sites and areas beneath bark as roost sites and caves only as hibernacula (Warner and Czaplewski 1984). It is possible that *M. volans* is using caves in eastern Nevada as maternity roosts, although more data are needed to confirm this. *M. ciliolabrum* also occurred in a variety of habitats in eastern Nevada (Table 1), including river canyons with surrounding sagebrush deserts (locality 14, Appendix 1). Larrison and Johnson (1981) found this species in similar canyon and desert habitat in central Idaho.

Only 6 individuals of *M. lucifugus* were caught. This species was uncommon and more restricted in its habitat affinities. Unidentified specimens of *Myotis* were sent to Dr. Scott Altenbach and Dr. Mike O'Farrell to determine whether or not *M. californicus* is present in this region (Table 2, *Myotis* spp.). Tentative identifications suggest that *M. californicus* may be found in southern White Pine County, while *M. ciliolabrum* is more common in the remainder of the region.

The 3 high-elevation, tree-roosting species (*L. noctivagans*, *E. fuscus*, and *L. cinereus*) were found in order of decreasing occurrence (Table 1). These species were found repeatedly in several mountain ranges of eastern Nevada that have a combination of coniferous and/or deciduous trees (aspen, cottonwood, white fir, subalpine fir, and Engelmann spruce) for

TABLE 1. Occurrence of bat species by locality (see Appendix 1). Habitat affinities (C–river canyons, S–springs, F–high-elevation coniferous forests, D–mid-elevation deciduous forests, U–underground caves and mines, B–buildings) for each species and relative frequencies for each species examined.

| Bat species | Localities (Appendix 1) | Habitat affinities |
|---|---|---|
| *Myotis ciliolabrum* | 2, 6, 8, 9, 10, 11, 12,14, 17, 20, 25, 26, 29, 32, 33 | C, S, F, D, U, B |
| *Myotis evotis* | 1, 3, 4, 6, 8, 9, 11, 12, 15–19, 21, 22, 25, 32, 33 | C, S, F, D, U |
| *Myotis lucifugus* | 5, 12, 15–17 | C, F, D, U |
| *Myotis volans* | 1, 2, 6, 7, 9–12, 15, 17–19, 24, 25, 27, 32 | C, S, F, D, U |
| *Lasiurus cinereus* | 10, 17, 20 | S, F, D |
| *Lasionycteris noctivagans* | 10–12, 17, 23, 28, 29, 32 | C, S, F, D, B |
| *Eptesicus fuscus* | 10, 12, 17, 23, 26, 29, 32 | C, S, F, D, U, B |
| *Pipistrellus hesperus* | 10, 29 | S, B |
| *Corynorhinus townsendii* | 5, 9, 10, 13–15, 24–27, 30, 32 | C, S, U |
| *Antrozous pallidus* | 10, 14, 15, 25 | C, S, U |
| *Tadarida brasiliensis* | 10, 29, 31, 32 | S, U, B |

roosting and open water in the form of beaver ponds, stock tanks, and perennial streams for foraging and drinking sites. In the mountains of the West, these 3 species are known to commonly forage together in similar habitats along with 2–4 species of *Myotis* (Kunz 1982). In eastern Nevada high-elevation deciduous and coniferous forests are limited to watered drainages and north-facing slopes in the larger mountain ranges. This suggests that these species are uncommon when compared to populations in the northern Rocky Mountains and may be negatively impacted by deterioration, fragmentation, and/or total removal of forest habitats by hard-rock mining, livestock grazing, and logging.

Foothills covered with pinyon pine and Utah juniper, caves, and river canyons with high cliffs provided habitats for 2 lower-elevation breeding species, *Corynorhinus townsendii* and *A. pallidus*. *C. townsendii* had 4 times the frequency of occurrence as *A. pallidus* and appeared to be more evenly distributed across the region (Table 1). *C. townsendii* and *A. pallidus* depend heavily on cliff sites, natural caves, and mine shafts/adits for maternity, hibernation, and day roosts in eastern Nevada. They are found to utilize similar situations in other arid regions of the West, such as California, Montana, Washington, and Utah (Kunz and Martin 1982). Hermanson and O'Shea (1983) rarely found *A. pallidus* using caves, but rather found them depending heavily on crevices and cliff sites for maternity roosts, day roosts, and hibernacula. We found this species using caves (localities 15, 25), cliff sites (14), and valley springs (10) in eastern Nevada.

A large, historic colony of *T. brasiliensis* was found occupied in July 1994. Vandalism may have caused this population to roost elsewhere in 1992 and 1993. Outside of Las Vegas and Reno, this colony is the largest known concentration of mammals in Nevada. Based on visual techniques suggested by Kunz and Kurta (1990), we estimate the population at between 54,000 and 82,000 animals.

*P. hesperus* was found in low numbers in this region. Two individuals were caught 320 km apart, and no meaningful habitat patterns were identified for this species.

Species found in and around abandoned mine shafts and adits included *C. townsendii*, *M. ciliolabrum*, and *M. volans*. *C. townsendii* was found using mines during both winter and summer. *Myotis* species were found only in summer. Pat Brown (personal communication) recently documented a maternity colony of *Antrozous pallidus* in an abandoned mine shaft in northern Lander County as well.

Climatological data from Elko in the northeastern part of the state, Ely in the east central, and Las Vegas in the south were compared to

TABLE 2. Number of bats examined, percent frequency by species, and number of specimens collected and preserved from eastern Nevada (1980–1994).

| Bat species | Number of bats examined | % frequency | Specimens collected |
|---|---|---|---|
| *Myotis ciliolabrum* | 73 | 13.0 | 2 |
| *Myotis evotis* | 112 | 19.0 | 3 |
| *Myotis lucifugus* | 6 | 0.4 | 1 |
| *Myotis volans* | 186 | 32.0 | 3 |
| *Myotis* spp. | 16 | 3.0 | 2 |
| *Lasiurus cinereus* | 3 | 0.1 | 1 |
| *Lasionycteris noctivagans* | 39 | 7.0 | 4 |
| *Eptesicus fuscus* | 52 | 10.0 | 2 |
| *Pipistrellus hesperus* | 2 | 0.1 | 0 |
| *Corynorhinus townsendii* | 69 | 12.0 | 1 |
| *Antrozous pallidus* | 15 | 3.0 | 1 |
| *Tadarida brasiliensis*[a] | 5 | 0.4 | 2 |
| TOTAL | 578 | 100.0 | 22 |

[a]Roost cavern not included in calculations.

bat species richness from each of these regions (Hall 1946, Durrant 1952). Pearson's $\Re$ and Spearman's Rho tests were used to test for correlations. Bat species richness exhibited no correlation with the following climatological data: annual normal precipitation, January minimum temperatures, July minimum temperatures, and July maximum temperatures. There were weak correlations between bat species richness and January maximum temperatures (Pearson's $\Re$, 0.728, $P < 0.05$) and mean annual days with 0° C or lower (Pearson's $\Re$, –0.704, $P < 0.05$).

Bat records were pooled by mountain ranges with similar rock types—sedimentary, igneous, or metamorphic. Bat species richness was highest in portions of northeastern Nevada typified by sedimentary rock (limestone, dolomite). Igneous mountain ranges (basalt, volcanic ash) generally had moderate bat species richness, and metamorphic mountain ranges (quartzite) typically had low bat species richness.

Several bat localities from eastern Nevada represent notable range extensions. Four localities (10, 14, 15 and 25, Appendix 1) for *A. pallidus* extend its range from central Nye County (Hall 1946) north to the Nevada and Idaho border, approximately 450 km. Two specimens of *T. brasiliensis* at Swallow Canyon (locality 10, Appendix 1), the recent confirmation of a large roost colony, and the two specimens from Elko (locality 29, Appendix 1) represent the first records of this species for Elko and White Pine counties (Hall 1946) and extend its range approximately 350 km north. The capture of single specimens of *P. hesperus* at Swallow Canyon (locality 10, Appendix 1) and in Elko (locality 29, Appendix 1) also suggest a northern range extension and, based on spring and late-summer capture dates, may represent migrating individuals.

Although certain bat species have long been suspected of occurring in this region (Hall 1946, Durrant 1952, Kunz 1982, Kunz and Martin 1982), the localities listed in Appendix 1 represent the first range confirmations for *L. noctivagans*, *L. cinereus*, and *C. townsendii* in eastern and northeastern Nevada.

On examination of contributing abiotic factors such as geological features, precipitation, and average temperatures, one can see patterns in eastern Nevada's bat fauna beginning to emerge. The greatest diversity of bat species from eastern Nevada was recorded in east central Nevada. The lower maximum January temperatures and more annual days below 0° C in east central Nevada contradicted the correlations in our data and suggested that factors other than climate were contributing to zoogeographical patterns. East central Nevada's mountain ranges are primarily sedimentary in nature and provide abundant caves, cliff sites, and high-elevation forests for roosting and hibernation. In northeastern Nevada most of the mountain ranges are igneous or metamorphic in structure, thus reducing the number of potential roost sites for bats. Climatic factors undoubtedly play a large role in defining bat distribution. However, the density of suitable roost sites may prove to be an even greater influence on bat distribution where roost site availability becomes a limiting factor. Inasmuch as most bat species probably do not migrate more than 1500 km from maternity roosts to hibernacula (Hill and Smith 1992), an abundance of suitable hibernation roosts would probably provide any given bat fauna the best chance of survival in an area where severe winters are commonplace.

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## APPENDIX 1
## BAT SURVEY LOCALITIES AND ANIMALS EXAMINED

1. Stump Creek, 8.2 mi S and 7.6 mi W of Northfork, Independence Mountains, Elko Co., Nevada. T40N, R53E, SW1/4 sec 12. 2325 m. 17 July 1980, *Myotis evotis* (1), *M. volans* (2).

2. Sheep Creek, 8.5 mi S and 7.8 mi W of Northfork, Independence Mountains, Elko Co., Nevada. T40N, R53E, NW1/4 sec 13. 2320 m. 6–7 August 1980, *Myotis volans* (1 lactating female), *M. ciliolabrum* (1 male).

3. Jim Creek, 10.4 mi S and 7.2 mi W of Northfork, Independence Mountains, Elko Co., Nevada. T40N, R53E, NE1/4 sec 25. 2155 m. 15 July 1981, *Myotis evotis* (2 nonscrotal males).

4. Jarbidge River, 5.5 mi S and 1.2 mi E of Jarbidge, Jarbidge Mountains, Elko Co., Nevada. T45N, R58E, SE1/4 sec 10. 2460 m. 26 July 1981, *Myotis evotis* (1).

5. Northfork of the Humboldt River, 12.4 mi S and 2.5 mi E of Northfork, Elko Co., Nevada. T39N, R55E, center sec 3. 1850 m. 7 Sept. 1981, *Corynorhinus townsendii* (1); 30 August 1989, *Myotis lucifugus* (1).

6. Mouth of Cave Creek, Ruby Lake National Wildlife Refuge, east slope of the Ruby Mountains, Elko Co., Nevada. T27N, R57E, SW1/4 sec 24. 1850 m. 25 July 1986, *Myotis volans* (2), *M. evotis* (1); 15 June 1987, *Myotis evotis* (1), *M. ciliolabrum* (1).

7. Ferguson Springs, 1/4 mi W of Ferguson Station on St. Hwy 93, Elko Co., Nevada. T30N, R69E, NE1/4 sec 33. 1875 m. 17 Sept. 1989, *Myotis volans* (1).

8. Arizona Springs, southeast end of the East Humboldt Range, Elko Co., Nevada. T33N, R61E, SW1/4 sec 20. 2050 m. 21 June 1991, *Myotis evotis* (9 males, 18 lactating females), *M. ciliolabrum* (3 males).

9. Sidehill Spring, 6.4 mi S and 11.8 mi W of Wendover, Goshute Mountains, Elko Co., Nevada. T32N, R68E, SW1/4 sec 14. 2255 m. 7 June 1991, *Myotis evotis* (6 males, 2 lactating females), *M. volans* (4 males, 2 lactating females), *M. ciliolabrum* (1), *Corynorhinus townsendii*, 1 male.

10. Swallow Canyon, spring site at the mouth of the canyon, Snake Range, White Pine Co., Nevada. T11N, R68E, sec 5. 2100 m. 21 August 1991, *Myotis ciliolabrum* (1), *Lasionycteris noctivagans* (1 male, 2 females), *Lasiurus cinerius* (1 male), *Tadarida brasiliensis* (2 males), *Antrozous pallidus* (1 lactating female); 30 August 1991, *Myotis volans* (1 male), *Lasionycteris noctivagans* (19 males), *Pipistrellus hesperus* (1 male), *Eptesicus fuscus* (2 males), *Corynorhinus townsendii* (1 male); 22 August 1994, *Myotis*